WP Management - Deliverable 1.2
Minutes of REAMIT Project Meetings

Improving Resources Efficiency of Agribusiness supply chains by Minimizing waste using Internet of Things sensors (REAMIT)

The REAMIT Project

Approved minutes of the REAMIT Kick-Off meeting held on 16 May 2019

RP[1] 19/01

Present

Name	Institution	Name	Institution
Ram Ramanathan (RR)	**Chair**, BED	Davinder S Bola (DB)	Levstone
Tahmina Ajmal (TA)	BED	Usha Ramanathan (UR)	NTU
Charmaine Guyo (CG)	BED	LuukRijnbende(LR)	Whysor
Katarzyna Pelc (KP)	BED	Gerard Corkery(GC)	IT Tralee
Gaël MAUGIS (GM)	IMAGES & RÉSEAUX	Fabien Tencé(FT)	SenX
Fionnuala Murphy (FM)	UCD	Daniel Kelly (DK)	Ulster University
Ali Assaf (AA)	UoN	Bryan Gardiner (BG)	Ulster University
Simon Levstone (SL)	Levstone	Adrienne Gentil (AG)	Pole-valorial

Also attended for providing support from BED:
Samuel Van Ransbeeck
Ioana Stoica
Winifred Udende
Claudia Zugno

Welcome and Introduction

RM19.01.01 RR welcomed the attendees to the kick-off meeting, which started with refreshments. During this time, RR received signed PA from partners (except from Dunbia NI, who did not attend the meeting) and also distributed hard copy of letters informing all the partners about the approval of the project (except to Whysor as Luuk arrived late and to Dunbia NI).

RM19.01.02 RR introduced the project. This was then followed by short five-minute session by each partner introducing themselves, their organisation, what do they bring to the consortium, activities already started and immediate activities for the next 6 months. Presentations were made by RR, UR, DK, SL, FT, AA, GM, GC and FM. LR presented this information after the finance presentation by CG due to late arrival. Slides by these partners have been made available to all partners in REAMIT website.

Feedback and inputs based on the Project seminar in Lille

RM 19.02.01 RR presented some important information discussed at the Approved Project Seminar in Lille on 11-12 April 2019. The notes have already been circulated to all partners.There was a query about whether the deadline will be delayed as the project effectively started in April not in January. RR explained that JS considers the project to have started in January and hence we had to follow the standard reporting procedures. Thus the first reporting period is January-June 2019.

[1] RP refers to REAMIT Paper number. RM refers to REAMIT Minute number.

RM 19.02.02 There was a question about submitting claims for the first reporting period as it was not compulsory for partners to claim for the first period (except for French partners who need to claim for all periods). RR subsequently clarified this with the JS that partners need not submit their financial claim for the first period but have to submit their progress report. Thus, all partners are requested to submit their progress report by the end of July for the first reporting period (January – June 2019). Those partners wishing to submit their financial claims should complete the audit by their FLC and submit this information to BED by the second week of August 2019.

Action: All partners to submit progress report and those wishing to submit financial claims to complete FLC on time.

RM 19.02.03 There were queries about appointing FLC but this varies depending on the country. RR suggested that Programme Manual Version 9 should be consulted. CG also explained the process of FLC in her presentation subsequently.

Action: All partners to appoint FLC ASAP as per the procedure in their country.

RM 19.02.04 RR explained that REAMIT online interface in eMS at the implementation stage is distinct from the interface at the application stage. This means that all partners who wish to use the eMS for project management (submitting reports etc.) should be freshly registered. RR also noted that individuals managing REAMIT in some partner organisations are different at the implementation stage compared to the application stage. Hence, he asked all partners to send their registered email to him so that he can provide the read/write access or read only access depending on the need.

Action: All partners to send registered email address to RR for getting access in eMS.

RM 19.02.05RR asked all partners to send their bank details to BED (in a suggested template) as JS will send the claims only to BED, who will send funds to individual partners. Partners, in turn, will pay their sub-partners.

Action: All partners to send their bank details to BED in the suggested template.

Personnel Recruitment in all partner institutions

RM 19.03 Recruitment of project personnel in partner organisations was then discussed. It was noted that BED will recruit a project manager and a big data hub research coordinator, NTU will recruit a communication manager, ITT will recruit a research assistant, and UCD will recruit a PhD student and a Postdoctoral researcher. These and other partners have been asked to complete the recruitments as soon as practicable. RR informed that there is limited opportunity to move funds within selected budget heads (up to 20%).

Action: Partners to complete recruitment as per their requirements.

Finance training

RM 19.04.01 CG provided some details of financial issues, including appointment of FLC and data entry in eMS. More details are available in separate slides.

RM 19.04.02 Progress reports and financial claims have to be submitted every six months (January-June and July-December). The activities should be reported within three months after the end of the period. Thus the reporting deadline for January-June period is 30th September, and the reporting deadline for July-December period is the 31st March of the next year.

RM 19.04.03 DB asked for a template of eliciting quotes for FLC. RR will send it after getting from CG.

Action: RR to send the template for eliciting FLC quotes to all UK partners

A networking lunch was organised for facilitating interaction and networking among partners.

IoT Technology Demonstration

RM 19.05 The afternoon session started with the demonstration of IoT sensors by the GATEWAY Electronic Company (Gatewaycando.com) (represented by Keith Rogers and Tom Wright). They brought some sensors and routers and highlighted their capabilities. Some modern sensors are solar powered enhancing their utility in remote locations. They are distributors of sensors from a number of sensor manufacturers. RR has asked partners for their opinion in engaging them for providing sensors for pilot tests.

REAMIT Operational Matters

RM 19.06.01 Since the second technology demonstration could not take place, RR then discussed the constitution of REAMIT Steering committee (RSC) and REAMIT Advisory Committee (RAC).

RM 19.06.02 It was decided that RSC will have the following members (Table 1). These members have to attend the RSC meeting. In extra ordinary circumstances when a member is not able to attend a RSC meeting, another member (well-informed about REAMIT) from the same institution can be deputed.

Table 1: Composition of REAMIT Steering Committee (RSC)

PP1	BED	Ram Ramanathan (Chair)
PP2	I&R	Gael Maugis
PP3	UCD	Fionnuala Murphy
PP4	UoN	Gerald Thouand
PP5	Levstone	Simon McGraw
PP6	NTU	Usha Ramanathan
PP7	Whysor	Luuk Rijnbende
PP9	ITT	Gerard Corkery
PP10	SenX	Herve Rennou
PP11	UU	Daniel Kelly until Joan Condell returns from maternity leave
PP12	DNI	Colin Potts

RM 19.06.02 REAMIT Advisory Committee will consist of all associated partners as per the Table 2 below. Associated partners should be invited by the members to which they are associated to.

Table 2: Composition of REAMIT Advisory Committee (RAC)

Associated Partner	Invitation Responsibility
GIQS	BED
Oost NL	BED
Radboud Universiteit	BED
Terre d'essais	I&R
JEAN ROUTHIAU	UoN
Société Des Transports Européens Frigorifiques (STEF)	UoN
Biosearch NI	UU
Cottagequinn Farms LLP	DNI

RM 19.06.03 RR mentioned that, based on the responses received from Doodle poll, the first meeting of the RSC, Work Package meetings and RAC meeting (hereafter called as RSC+WP+RAC meeting) will be held in Luton from 11 am on Sep. 11th Wednesday until 4 pm on Sep. 12th Thursday. This meeting requires attendance by all partners, sub-partners and associated partners. Sub-partners and associated partners should be invited by their corresponding project partners. It is normally expected that travel and subsistence of one person from each associated partner should be reimbursed by the corresponding project partner.

Action: Partners to send invitations to their sub-partners and associated partners to attend the next RSC+WP+RAC meeting and to all subsequent meetings.

RM 19.06.04 The following dates were agreed for the remaining six-monthly RSC+WP+RAC meetings. Partners were requested to block these dates.

- 15 and 16 January 2020 (to be hosted by I&R)
- 08 and 09 July 2020 (to be hosted by UCD)
- 20 and 21 January 2021 (to be hosted by Whysor)
- 07 and 08 July 2021 (to be hosted by Ulster)
- 19 and 20 January 2022 (to be hosted by NTU)
- 23 and 24 March 2022 (to be hosted by BED)

All are Wednesdays and Thursdays in third week of January or second week of July to enable to submit the progress reports of the previous period (January-June or July-December) on time (except for the last meeting).

19.06.05 All partners should submit a progress report for the preceding period one week before the RSC+WP+RAC meetings to all project partners and the associated partners. The exceptions are the first and last meetings. For the first meeting, all partners should send progress report in the second week of June 2019 and those wishing to submit financial claims should complete FLC and send this information to BED by the second week of August 2019.

Action: All partners to submit progress report (mandatory) and submit financial claims if needed.

RM 19.06.06 The following is the suggested structure of the RSC+WP+RAC meetings:

- The REAMIT Advisory Committee (RAC) meeting, comprising all associated partners and project partners, will be held in the morning of the first day (11 am – 1 pm). The associated

partners will assess the progress on the basis of progress report and provide guidance and suggestions to project partners at the RAC meeting.

- REAMIT Work Package (WP) meetings, chaired by WP leads and participated by all partners and sub partners, will be held during 2 – 6pm.
- The REAMIT Steering Committee (RSC) meeting, with all project partners, will be held during 9 am – 1 pm on the second day. REAMIT progress reports will be finalised at the end of the RSC meetings. The risk log will also have to be updated using the standard template provided by the JS.
- If needed, special meetings can be held in the afternoon of the second day. For the first RSC+WP+RAC meeting, a workshop on sensors and big data will be organised in the afternoon of 12th September. This will discuss a white paper prepared by technology partners (lead by Levstone and Ulster) but may also have some technology demonstrations by potential external companies willing to supply sensors for pilot tests.
- All partners are expected to complete financial audit of the expense claims by the First Level Controllers immediately after the RSC+WP+RAC meeting and confirm completion by their FLC to BED at least six weeks (i.e., by the second week of August or by the second week of February) prior to the reporting deadline.
- BED will compile the actual project progress report and the financials, arrange audit by FLC in early September and will submit all documents to the JS two weeks ahead of the reporting deadline (i.e., by the second week of September or by the second week of March).
- The timelines are different for the first period. Please see RM 19.06.05.

RM 19.06.07 The WP Long Term requires that a REAMIT Network event is conducted every year for the next three years. The following times were suggested. Exact dates will be decided by the hosting partner.

- January 2020 (to be hosted by NTU)
- October – December 2020 (to be hosted by I&R/Valorial)
- October – December 2021 (to be hosted by UCD)

RM 19.06.08 REAMIT Pilot tests are the most important activities in the first year of the project. An open challenge call has to be organised. As the lead of WPT1 Pilot Tests, I&R is preparing the details of the call. All partners are requested to provide their inputs and help maximise the recruitment of end-users using this call.

Action: GM to prepare the open challenge call, and all partners to contribute to it.

RM 19.06.09 The following is the approximate timeline for pilot tests.

a. UU will conduct the first pilot test with DNI. Installation of sensors to be completed during Sep.-Dec. 2019.
b. UU and DNI will jointly report preparations of this pilot at the RSC+WP+RAC meeting in September 2019.
c. More tests are required. End-user has to be recruited using open challenge call. The following is a tentative schedule;
    - January 2020 (France – STEF?)
    - April 2020 (Ireland – end-user to be recruited)
    - July 2020 (Netherlands – Whysor to help in recruiting the end user)
    - Oct. 2020 (Germany – Whysor to help in recruiting the end user)

- More can be tried depending on interest of end-users

RM 19.06.10Since there is some overlap in the expertise available in our technology partners (Whysor, Levstone, SenX and ITT), their roles and responsibilities for the pilot tests (WPT1) and big data analytics (WPT2) should be clarified. This will be discussed at the Sensors & Big Data workshop on 12th September. These partners are requested to discuss among themselves about allocation of responsibility and submit a joint document at the workshop.

Action:Whysor, Levstone, SenX and ITT to submit a joint document on their responsibilities for all work packages.

REAMIT in Social Media

RM 19.07.01 UR presented some details of REAMIT in social media. She introduced REAMIT website (www.nweurope.eu/reamit) and asked partners for suggestions in improving the website. She also introduced REAMIT's Twitter handle (@reamit4nwe), hashtag (#reamit4nwe), the Facebook page (https://www.facebook.com/Reamit4nwe/) and a Gmail (reamit4nwe@gmail.com). She requested all REAMIT related communications to include the Gmail so that the gmail account can act as a repository. She informed that photos take at the KO meeting will be uploaded in the Facebook page. RR asked for permission from partners for uploading the photos, and everyone agreed to it. All partners were requested to visit the Facebook page regularly and use the hashtag while tweeting REAMIT related matters. Suggestions for improvement were also solicited.

Action: All partners to keep visiting REAMIT webpage, Facebook page, Twitter handle regularly, and use the hashtag while tweeting. Also send suggestions for improvement.

RM 19.07.02 GM queried about using an exclusive website URL for REAMIT (e.g., www.reamit.com or www.reamit.eu). Most partners supported the idea as it would give more credibility for the project. At the minimum, we could purchase the domain and redirect the URL to the existing website (www.nweurope.eu/reamit), but the website could also be used for project purposes (e.g., secured login for confidential sharing of data among partners). RR highlighted that JS does not encourage building a new website and will not be paying for the associated expenses. It was felt that buying a domain would be cheap. GM has been asked about purchasing a suitable URL.

Action: GM to explore purchasing a URL for REAMIT.

RM 19.07.03 UR asked all partners to keep sending small videos on the project to her regularly. She has budget to prepare a summary video of the project at the end. RR pointed out at this stage that videos should not be uploaded in REAMIT website. Instead, they can be uploaded in external sites such as YouTube and a link can be included in REAMIT website.

RM 19.07.04 UR said that poster will have to be prepared and kept in the premises of each partner. She asked for suitable pictures from partner organisations. TA suggested that pictures on food would attract more end-users.

Project Management issues

RM 19.08.01 Development of a Project Handbook was discussed. All project related information and documentation (including this notes of the KO meeting) will be securely maintained in a University computer by the Project Manager. Partners have been requested to provide more suggestions for best practices for project management. Key control register was discussed.

RM 19.08.02 Risk register on key project risks & mitigation actions for each were discussed. RR pointed out that the REAMIT application outlined three risks (Risk 1: Technological risk linked to adapting sensor and big data technologies, Risk 2: Lack of companies participating in tests, and Risk 3: Lack of roll-out potential). It was agreed that these risks are relevant at this stage of the project. Other risks were elicited. The following additional risks were discussed by partners.

- Assignment of risk-ownership among partners
- Effectiveness of sensors in providing genuine new information
- Maintaining confidentiality of the sensor data on food quality from end-users. This requires that we install our own sensors to have direct access to the data. If external sensors are used, the data will first go to their platform before reaching the partners, which may breach the confidentiality of the data.
- Risk of not using the correct sensor for a given application. To minise this risk, it is important to identify right sensors for a given purpose. For example, a sensor that works well with fish and a different kind of sensor may work well with fruits. DK suggested that a position paper or white paper on appropriate sensors for specific applications should first be developed. SL supported the idea and they jointly accepted to lead the development of the white paper. RR suggested it could be the first tangible output from the REAMIT project, and requested that the white paper be prepared ahead of the workshop on Sensors & Big Data in September 2019.

Action: DK, BG and SL to jointly lead the preparation of the white paper on sensors for discussion at the sensors workshop in Sep19. All partners to send their inputs to SL and DK.

- Though we strive to reroute food before it becomes bad, there is risk involved as the food might become waste during rerouting. RR mentioned that the risk is likely to be low as the REAMIT project does not take ownership of the food and provides decision support only to the owners. Owners will be taking appropriate decisions on their food.
- Partners were asked to think about more risks and suggest them in the next meeting.

Action: Partners to give their opinions on more risks to help develop a risk log.

Any other business

RM 19.09RR asked partners for any other business that they wish to raise. There was no other business. RR reminded Levstone to start working on the second Big Data platform that would collect data on food demand points (local convenience stores, food charities, etc.) along REAMIT corridors to enable these businesses to self-enrol.

Action: Levstone to start the second Big Data platform for self-enrolling.

Date for next RSC+WP+RAC Meeting

10.30 am on September 11 until 4 pm on September 12, 2019, Putteridge Bury Campus, University of Bedfordshire, Luton, UK.

The Kick-Off meeting ended with thanks from the Chair.

RP 19/02 Matters Arising and Actions

Date	Minute/ Item	Action	Responsi-bility	Update
		Action identified, including referral to other committees	***Member of staff with lead responsibility***	***Confirmation of completion or reasons for non-completion***
16/05/ 2019	RM 19.02.02	All partners to submit their progress report by the end of July for the first reporting period (January – June 2019). Those partners wishing to submit their financial claims should complete the audit by their FLC and submit this information to BED by the second week of August 2019.	All partners	Complete
16/05/ 2019	RM 19.02.03	All partners to appoint FLC	All partners	Ongoing
16/05/ 2019	RM 19.02.04	All partners to send registered email address to RR for getting access in eMS	All partners	Complete
16/05/ 2019	RM 19.02.05	All partners to send bank details to RR.	All partners	Complete
16/05/ 2019	RM 19.03	Partners to complete recruitment	RR, UR, FM, GC	Ongoing
16/05/ 2019	RM 19.04.02	RR to send the template for eliciting FLC quotes to all UK partners	RR	Complete
16/05/ 2019	RM 19.06.03	Partners to send invitations to their sub-partners and associated partners to attend the next RSC+WP+RAC meeting and to all subsequent meetings.	All partners	Complete
16/05/ 2019	RM 19.06.05	All partners should send progress report to RR in the second week of June 2019 and those wishing to submit financial claims should complete FLC and send this information to BED by the second week of August 2019.	All partners	Complete

16/05/2019	RM 19.06.08	GM to prepare the open challenge call, and all partners to contribute to it.	GM and all partners	Ongoing
16/05/2019	RM 19.06.10	Whysor, Levstone, SenX and ITT to submit a joint document on their responsibilities for all work packages	LR, SL, DB, FT and GC	Ongoing
16/05/2019	RM 19.07.01	All partners to keep visiting REAMIT webpage, Facebook page, Twitter handle regularly, and use the hashtag while tweeting. Also send suggestions for improvement	All partners	Ongoing
16/05/2019	RM 19.07.02	GM to explore purchasing a URL for REAMIT	GM	Ongoing
16/05/2019	RM 19.08.02	DK, BG and SL to jointly lead the preparation of the white paper on sensors for discussion at the sensors workshop in Sep19. All partners to send their inputs to SL and DK	DK, BG, SL and All partners	Complete
16/05/2019	RM 19.09	Levstone to start the second Big Data platform for self-enrolling.	SL and DB	Ongoing

The REAMIT Project

Minutes of the REAMIT RAC & RSC meeting
held on 11-12 September 2019, Luton (Putteridge Bury), UK

Present

Name	Institution	Name	Institution
Ram Ramanathan (RR)	Chair, BED	Davinder S Bola (DB)	Levstone
Tahmina Ajmal (TA)	BED	Usha Ramanathan (UR)	NTU
Katarzyna Pelc (KP)	BED (only second day)	Luuk Rijnbende (LR)	Whysor
Gaël MAUGIS (GM)	IMAGES & RÉSEAUX	Gerard Corkery (GC)	IT Tralee
Sasha Bennett (SB)	NTU	Fabien Tencé (FT)	SenX
Yanqing Duan (YD)	BED (only for second day)	Daniel Kelly (DK)	Ulster University
Régis DEL FRATE (RF)	Pole-valorial	Simon McGraw (SM)	Levstone
Bryan Gardiner (BG)	Ulster University	FransHarren (FH)	Radboud University (only for the first day)
Shane Ward (SW)	UCD	JolineBrouwer (JB)	Oost NL (via Skype, only for the RAC meeting on the first day)
Gerald Thouand (GT)	UoN		

Apologies: Colin Potts (Dunbia Northern Ireland)

Also attended for providing support from BED:

- Samuel Van Ransbeeck (SR)
- Ioana Stoica (IS)
- Winifred Udende (WU)
- Claudia Zugno (CZ)

Welcome and Introduction

RM 19.10 RR welcomed the attendees for the 2-day long series of meetings. Progress report, agenda, and minutes from previous meeting have been distributed. All attendees introduced themselves very briefly.

REAMIT Advisory Committee (RAC) meeting

RM 19.11.01 The RAC meeting was attended by two RAC members – FH and JB.

RM 19.11.02 RR began the RAC meeting with a description of progress so far. A part of project recruitments has been completed. Social media accounts have been created. The first REAMIT Networking Symposium will be held in Nottingham on 09th January 2020. Since Oost NL sent their feedback ahead of the meeting, RR included the comments in a slide. Oost NL had suggested about strengthening the open call document to highlight the motivation for food transporters to participate in the project and creating an infographic about the end users experience. JB added more comments – revising the Open Call- so the end user can understand the benefits they would receive. JB advised she will come back with some communication to highlight the benefits to the end users.

Action: JB to send more materials on communication to help strengthen the open call.

RM 19.11.03 FH advised that he has contacts of businesses that would like to try these sensors in their trucks. Also, to contact insurance companies – big risk of loss for them with food waste.FH said that financial costs could be risky. RR suggested that all activities have to be evidenced clearly and be concise.

Action: FH to suggest Dutch businesses that would try sensors in their trucks.

RR thanked both the RAC members for their comments and promised that these comments will be considered in planning future project activities. He then closed the RAC meeting.

REAMIT Work Package (WP) meetings

RM 19.12.01RR started the WP meetings with some additional discussion on project progress. The first pilot studies are due to start in September with UU and Dunbia NI. Another UK pilot test is likely in the next few months. RR mentioned that the most recent IPCC report had some useful data that could be used to develop the framework for measuring the impact of REAMIT technologies on food waste. There are data in the report on carbon potentials of meat and plant based diet, which could be used to estimate the savings in carbon emissions by saving certain quantities of meat or plant food.

WP T1 Pilot Tests meeting (Chair: GM)

RM 19.12.01 GM mentioned that the open call document has been published in REAMIT website in all the four languages and requested all partners to use the document and invite potential end users for pilot tests. He purchased the website domain (www.reamit.eu) for the project. He and GT presented the current activities in France at the University of Nantes, using Raman Spectroscopy technology to monitor food quality. The first pilot in France is being carried out by UoNin co-operation with STEF and Jean Routhiau on chicken. GT expected that installation of their kit (Raman) and measurement will be done around May-June 2020. Since Raman sensors provide more volume of data than traditional sensors, he needed full support from technology partners on transmission of the data in real time to the BIG DATA platform. RR requested technology partners to discuss these issues with GT regularly to avoid any last minute issues.

Action: GT and technology partners (Whysor, SenX, IT Tralee and BED) to work together on linking Raman spectroscopy sensors to the cloud to ensure success of the first French pilot test.

TA asked GM and GT if they will continue to only use chicken for this study. GM advised that they have started with chicken and then move on to beef and seafood. GT explained that they wanted to use this technology in trucks, use samples of these meats for the study.

SM suggested that they are willing to allow University of Nantes to use their sensors in their trucks to provide assistance in collecting the data. RR also made a suggestion try other sensors from other suppliers in France.

RM 19.12.02 GM mentioned that another pilot test is being planned in France with UCPT, who are interested in participating using vegetables. The challenge is to be able to identify and be notified when the threshold temperature is reached. GM says if they are able to transmit the information real time that would be beneficial. RR requested technology partners to support this pilot test too.

Action: SM and technology partners (Whysor, SenX, IT Tralee and BED) to work together on linking traditional sensors to the cloud to ensure success of the French pilot test.

RM 19.12.03 DKdescribed the progress on the first REAMIT pilot test being carried out with partner Dunbia. He informed that they are currently researching into VOC (Volatile organic compound) gas to detect changes in food quality. Also looking into if packaging affects food quality. They will usepackaged meat vs unpacked meat and compare the two. Then, analyse the data to detect any differences. They still need to sort logistics and also to source the actual sensor to be used. Using electronic noses are useful in detecting the freshness of the food according to scent but the technology needs some manual intervention.

RR mentioned that, while the focus on VoC sensors is good and is the strength of the Ulster team, all pilot tests should have common minimum requirement in that traditional sensors (temperature/humidity/etc.) and GPSare fitted and linked to the cloud so that we can monitor a measure of food quality remotely and continuously.

Action: All partners to ensure that pilot tests have the common minimum requirement.

DK discussed the sensor's requirements and the cost of other sensors.Progress has been slow but he was confident on making more progress in the next month. RR mentioned that technology partners would like to be involved in the design of this pilot, and can make a visit to Ulster if needed.

Action: DK to make more progress on the pilot test by meeting with Dunbia ASAP and inform RR and other partners a potential date for visiting the pilot test site.

RM 19.12.04 LR presented the progress of pilot tests in the Netherlands and Germany. He mentioned about starting a German pilot test soon. They will keep looking for a potential participant for Dutch pilot studies. RR expressed willingness to be involved in designing the German pilot (as also all other pilot tests).

Action: LR to provide more information about German pilot test (including details of the participating company) and a time line soon.

RM 19.12.05 SW presented progress on starting the Irish pilot test. He said the Irish pilot will use the Cyberbarsystem. This enables you to track and trace the process of the food from the farm to the consumer's kitchen. Place a QR code unto the food item, tamper proof. The label is embedded in the

product, so not a part of the packaging. Using a QR reader you can scan the food item to trace the origin of the food.He expected that the Irish pilot will start inspring/summer 2020. RR advised that all partners willwork with UCD to support them with this new venture.

Concerns raised: TA argued that she did not find the concept of imprinting barcodes on edible food comfortable from a personal perspective, however SW stated many inventions were initially considered unethical but have now become the norm e.g. bottled water.

WP T2: Big data Analytics (Chair: BED)

RM 19.12.05 RR introduced the progress in WP T2 but highlighted that there was not much scope so far to make a good progress as WP T2 activities are contingent up on the progress of WP T1. However, there were some activities conducted as part of this work package such as purchase of the Big Data server in BED and the mini IoT platform by Levstone. DB discussed their mobile framework-mini pilot test running/IoT platform. They will be working on database with raw data, they have created a passkey to get data into the cloud. They are currently considering various approaches to data analytics. RR pointed out that one of their activities, of developing a web-interface with self-enrol facility for enrolment of potential suppliers and consumers of food produce (Activity T2.5.3 in the application form) could be started without waiting for any previous activities in WP T1. This is a database based on Google maps.

Action: BED to procure the Big Data Server. SM and DB to develop a database using Google maps to detect where trucks are moving.

A suggestion was made that it would be better to carry out the analysis at the source and what you are sending is just the results of the data. This would reduce the size of the data. This may be tested when possible.

WP T3: Business models (Chair: Ulster)

RM 19.12.06 The discussion on activities on WP T3 has been postponed until next RSC meeting as there is no activity is scheduled for the previous reporting period.

WP LT Long Term (Chair: BED)

RM 19.12.07 RR discussed rolling out REAMIT Technologies to be used in other companies and to roll this out to other industries such as pharmaceutical industries. He reminded partners that the first REAMIT networking Symposium has been finalised in Nottingham for 09 January 2020. He requested active participation of all partners for the first symposium by showcasing their products and making presentations, not only on their involvement in REAMIT but also on all other related activities that are being carried out by them. He also requested all partners to provide maximum publicity to the event in their networks and ask several of their contacts to attend the event. They can organise stalls, technology demonstrations, special tracks and workshops, for example. RR requested partners to send details of their participation including stalls, demonstrations, tracks and workshops to UR to help prepare an impressive promotional material that would help attract more audience to the symposium.

RR also reminded about the other two REAMIT symposiums scheduled in France (IR and Valorial) in Oct-Dec 2020 and in Ireland (UCD) in Oct – Dec 2021.

Action: All partners to send details of their presentations, stalls, demonstrations, tracks and workshops to UR to help prepare impressive promotional materials. They need not be fully linkedto REAMIT and can be on related activities too.

RM 19.12.08 RR reminded partners about another activity (LT.2.1) in WP LT, which is the development of an agreed framework for measuring the impact of REAMIT technologies on food waste. He reminded that the data from IPCC could be used to supplement the data from WRAP's Fusion Project report for the purpose.

Action: RR, KP, YD and TA to produce the framework for measuring the impact of REAMIT technologies on food waste.

WP M Project Management (Chair: BED)

RM 19.12.06 RR announced that newProject manager Katarzyna Pelc (KP), known as Kate, would be joining from 01 October 2019. She was expected to meet the partners on the second day. KP has started developing a project handbook, which would be madeavailable on the REAMIT website. He requested all partners to give suggestions on best practices in managing the project handbook, internal management systems and risk-log.

Action: All partners to suggest best practices in Project management, handbook, internal management systems and the risk log.

WP C Communication (Chair: NTU)

RM 19.12.07 UR introduced the new Communication Manager, SB. She presented a draft version of the communication strategy and requested support from all partners to update the strategy.

UR discussed the social media strategy:

- Social media posting- at least once a week, mainly Fridays- Likes and comments on social media are needed to expand the audience
- Discussed the new design for the roll up.
- Newsletter, videos, flyers will be made in preparation for our event in January 2020.

Partners pointed out that images cannot be uploaded on the Interreg website due to the file size limitation of 10MB. SB suggested uploading them onto the various social media platforms, linking these sites to the website.RR further requested all partners to follow REAMIT (@reamit4nwe) in Twitter and join the Facebook group (https://www.facebook.com/Reamit4nwe/). The REAMIT roll-up was kept at a central place in the venue and RR informed all partners that a similar roll-up should be kept prominently at the premises of all partners.

Actions: (i) All partners to send their inputs to REAMIT Communication Strategy document; (ii) All partners to follow REAMIT (@reamit4nwe) in Twitter and join the Facebook group; (iii) All partners to produce a REAMIT roll-up and keep it prominently in their premises.

RM 19.12.08 SB pointed out that it is a requirement that all partners feature REAMIT project in their organisational websites so as to raise more awareness across NWE. She also requested all partners to send any posts they would want to promote on the REAMIT social media pages. She further

requested partners to send suitable images (without infringing any copyright) for use in REAMIT website; the current photo representsjust freshness but we need more variety of pictures, including trucks that implement REAMIT sensors, Raman spectra, and more that represent technology.

Actions: (i) All partners feature REAMIT project in their organisational websites; (ii) All partners to send any posts they would want to promote on the REAMIT social media pages;(iii) Partners to send suitable images (without infringing any copyright) for use in REAMIT website.

RM 19.12.09 UR discussed target groups for the project, including policy makers and local councils. As the organiser of the first REAMIT Networking Symposium, she extended a warm welcome to all partners to attend the symposium in Nottingham on 09 January 2020 and requested full support to get participants from all over Europe.

Actions: All partners to support UR in successfully organising the first REAMIT Networking Symposium in Nottingham on 09 January 2019.

REAMIT Steering Committee (RSC) meeting

RM 19.13.01 Since RAC meeting and WP meetings concluded earlier than scheduled, it was felt that a part of the RSC meeting could be discussed depending on the availability of time.

RM 19.13.02 The minutes of kick-off meeting was circulated. RR went through the draft minutes from last meeting for confirmation. The following changes were highlighted by partners:

- GT raised a query on RM 19.06.02 because he may not be able to attend all the RSC meetings. RR highlighted the information in the same paragraph that in extra ordinary circumstances when a member is not able to attend a RSC meeting, another member (well-informed about REAMIT) from the same institution can be deputed.
- Some partners queried about RM 19.06.10 as it has not been possible for partners to discuss the allocation of responsibility. It was decided to discuss this in detail after the Sensor & Big Data workshop on the next day.

With these queries, the minutes of the Kick-off meeting have been confirmed as accurate by the RSC.

RM 19.13.03 RR discussed the action log to follow the actions assigned to partners. Some actions had not yet been completed as highlighted below.

RM 19.13.04 The action, RM 19.02.03 - All partners to appoint FLC, had not been completed as Levstone and NTU had not yet appointed their FLC. They needed further information about potential auditors to approach. RR promised to send relevant details to the two partners.

Action: Levstone and NTU to appoint FLC soon and RR to send relevant details to the two partners.

RM 19.13.05 The action, RM 19.03 - Partners to complete recruitment, had not yet been completed. RR urged all partners to complete recruitment in a timely manner.

Action: Partners to complete recruitment of project personnel.

Actions RM 19.06.10 and RM 19.09 were discussed earlier in the WP or RAC meeting on the day. All other actions were considered complete though some are ongoing activities.

RM 19.13.06 RR went back to the feedback from the RAC so far, commented that Oost NL had some very valid points and their comments should be carefully considered. BED will work on revising the open challenge call document but all partners were requested to contribute.

Action: BED team will revise the open-challenge call in line with the feedback of RAC and all partners should also contribute.

RM 19.13.07 SM suggested that a strategy of disseminating information to end users should be developed in order to create more awareness. UR highlighted that it would be part of the Communication Strategy.

RM 19.13.08 GT suggested that it would be good idea if a survey is held with prospective end-users about the potential barriers in joining as an end-user in REAMIT. This survey would help understand the expectations from end-users and hence help revise the open challenge call and target correct end-user. A lengthy discussion took place and it was concludedthat a short survey of 10 question could be distributed to attendees of the symposium. This could also be tested by partners in different countries. Since the time was running out, it was decided to discuss this further on the next day.

~Close of meeting~

Day 2 – 12 September 2019

RM 19.13.09 RR welcomed the partners for the second day of the meeting. RR introduced KP to all partners as the new REAMIT project manager. He asked KP to talk about risks.

RM 19.03.10KP highlighted the need to be aware of risks and to make advanced preparations anticipating them. She presented the Risk log, highlighting the 3 main risks:

1. Lack of roll out potential
2. Lack of company's participating in tests
3. Technological risk linked to adapting sensor and big data technologies.

She then presented the following additional potential risks at this stage of the project:

4. Effectiveness of sensor in providing genuine information;
5. Maintaining confidentiality of the sensor data on the quality of food;
6. Risk of not using the correct sensor for a given application.

Partners discussed these risks in detail. RR highlighted that there is progress in identifying levels of risks for end users through carrying out the pilot tests, but we need to explore further. GC suggested once we have collected the data we will be able to have proof of concept.

RM 19.03.11 GC queried about the volume of food that needed to be monitored to have an idea of the impact of food waste. Need to focus not just on transportation, but also on waste of food. There will be moments when these two goals conflict and necessarily need to prioritise one or other – yet important to focus on both. RR agreed on need to focus on both waste of food and transportation – ideal case would be to find a company that does both food and transport.

SM reiterated that these pilot tests are the prototypes, so distributing the tests along the timeline of the project, will reduce the risks.SM suggestedthat the end users need to be carefully managed - customer relationship to understand the customer's journey and get feedback.

RM 19.03.12 The idea of a mini-survey discussed in the previous evening (RM 19.13.08) was further discussed.RRwondered whether it would be meaningful to send the 10 question survey to potential end-users available to all partners as this could sometimes discourage potential end-users. It was felt that this would be a risky move. GM suggested that first we need to identify 5 end users who are meaningful, and find out their expectations. RF suggested it might be difficult as this project is completely new to clients. DB suggested to list Top 3 things the end users would want addressed in the survey. TA felt there might be some restrictions with this survey, adding that it might be too soon as there aren't any tangible cases and for the first pilot to go ahead.

RM 19.03.11 GM suggested that it would help if all partners leading pilot testing produced the ongoing report from their pilot test to update all partners. The LP (BED) could develop a template to be used by all pilot leaders. Template would be sent to all pilot leaders ASAP. Partners would need to send out this report filled in to all PPs to share information with them regularly and at next REAMIT meeting we would discuss it:

1. Aim of the pilot
2. Calendar of the pilot
3. challenges during the pilot
4. recovery plan from challenges

GM further suggested that LP develops a Power Point template to be filled in by all leaders of pilot tests. Power point slide produced for all pilots would then be used to exchange information with all partners about pilots they are carrying out. The flow of information on the PP graph could be this:

Sensors -> Data -> Cloud ->Data -> Data analysis -> Data Bank ->Yes ->Alert (Decision support system) ->No

SM suggested GM and other partners in France who have the experience with the end users, to ensure this first piece of communication is approved by them before sending it off.

Action: BED to develop a template on the architecture of pilot tests for partners to follow uniformly.

RR reminded partners about the next RSC meeting: in France 15- 16 January 202. These dates have been decided at the kick-off meeting. The RSC meeting after this would be held in UCD on 8th and 9th of July 2020.

RM 19.03.12 RR reminded partners about project report and financial claims (after getting approval from their FLC) for the preceding period, and financial forecast for the next period. This should be submitted in eMS every 6 months. In order to provide sufficient time for the LP to submit the overall project report, financial claimsand financial forecasts, allpartners need to submit their details within six weeks of the end of the preceding period. This will help ensure that the LP submits the details on time and get paid. For the current period ending December 2019, all partners were requested to submit their progress report, financial claims and forecast by 15th February 2020. This will help LP to organise FLC approval and submit well before the end of March 2020.

RR officially closedthe RSC meeting.

Sensors & Big Data workshop

RM 19.14.01 The workshop started with two technology demonstrations.

RM 19.14.02 The first demonstration was made by Peter Marchant from Review Display Systems Ltd. and Šimon Chudoba from IQRF Alliance. They specialise in developing specialised and generalised sensors.An example of sensors installed in an airport in Prague was given, whereby the installation period took only six hours as opposed to six months.The sensors were installed in hospital freezers where medicines were kept in order to ensure that the right temperature was maintained. The sensors measured things like CO2, temperature etc. results were uploaded unto the cloud devices through a gateway at regular intervals. The presentation elicited interest from several partners, who engaged in further discussions with IQRF. RR requested interested partners to engage with the IQRF team on further activities and keep all partners updated.

RM 19.14.03The second demonstration was made by SR on an aquaculture project being carried out by BED with partners in Brazil. Sensors made by a British Company called Seneye were installed into ponds to detect their PH value, light, temperature etc. The data getsuploaded on the cloud devices which could be assessed using an app. SR showed the measurements on a real time. The presentationwas requested by RR to show the ability to upload real time information on the cloudthat will facilitate further real-time analytics.

RM 19.15.01 Draft of a white paper titled “Review of Potential Sensor Technology for Continuous Monitoring of Food Quality in Transport” has been prepared by Partners in Ulster University with further inputs from Levstone and ITT. This was discussed at the workshop. It was highlighted that the white paper should be improved further with inputs from all the partners, and should form the basis for selection of sensors for pilot tests. When the paper is sufficiently improved with practical insights from pilot tests, it should be submitted to a suitable journal. RR requested all partners to add more information to the document.

Action: All partners to contribute to the sensors white paper with insights form their previous experience and experience of conducting pilot tests.

RM 19.15.02The role of technology partners (SenX, Whysor, ITT, BED and Levstone) was further discussed. Whysor expressed interest in being involved mainly with connecting sensors to the cloud but not much in the analytics stage. Other partners have expertise in conducting business analytics, though Levstone has expertise to contribute to more REAMIT activities (e.g., the second database on locating nearest demand points and the Smartphone APP). It was decided that the data collected from sensors would be made available to SenX, ITT, BED and Levstone to conduct independent analysis and the sharing the results. This is because the same data can provide multiple insights depending on how it is analysed. The partners can then decide about how to prepare a joint report collating all these results.

RM 19.15.03 DK has raised a question regarding authoring scientific publications based on the REAMIT project. It was agreed that names of all persons who have contributed to a specific task(s) leading to the scientific publication would be mentioned as authors of this publication.

RR closed the Sensors and Big Data workshop although technical discussions were continued by members on the schema for pilot tests. A template for pilot tests resulted from these discussions as shown in the Box below.

Box: Technical Details of Pilot Tests

- First pilot test will be carried out by Ulster with Dunbiaas the end-user. DK and Colin Potts in Dunbiawill lead this pilot. Data collection will continue throughout the pilot test, until March 2020. Minimum amount of data collection to conduct data analysis will be achieved by January 2020.
- VOC sensors, temperature and humidity sensors will be purchased with support from Levstone and Whysor. These sensors will be connected to cloud to collect data.

A Schema of Activities of first pilot test:

- Dunbia will fix the sensors. Levstone and Whysorwill get quotes for sensors.
- These sensors will be attached to black boxes and put in trucks (Ulster will decide this operation)
- Ulster, IT, Bed, Dunbia and SenX will do data analysis.
- WARPIO software will be used by SenX. But data needs cleansing before analysis. Data from cloud will be downloaded to use in csv form.
- Progress will be updated by Dunbia.

Main conversation

- RR: All pilot tests to run until end of the project
- DK: it is difficult to overrun after 3 months; as pallets will finish their life or change, so it is difficult.
- DB: We will discuss and continue to work beyond 6/7 runs.
- FT: Data will be generated only after five runs.
- RR: Need to have more pilot tests
- **Second pilot** test will be in Germany by Whysor (LR)
- Third pilot test will be in June 2020 in France by UoN (GT) with Raman Spectrography
- Another French pilot test by I&R (GM) by 16 Jan 2020
- Ulster will be conducting another pilot test for testing 3D Fluorescence spectrometers

Proposed plans:

- VOC sensor will be used by DK.
- Whysor will also help to source sensors along with DB for VOC and Co2 sensors.
- Quotes for Temp and Humidity sensors will be obtained by LR and DB for two different sets of sensors.
- Daniel will buy both the types and send them to DB and LR respectively. DBand LR will fix the sensors in box and send back to DK.
- Same boxes (that house sensors and fitted on to pallets) will be used for all pilots.
- Email quotes for sensors will be obtained by DB and LR. This will be evidence for Interreg.

Conversation

- KP: Procurement policy is to be checked to verify simple way to get quotes
- RR: Quotes for all sensors including light VOC, Co2, GPS, temp, humidity will be obtained
- KP: How will achievement of REAMIT objectives be evidenced? (by photos)
- Provide decision support – threshold should be put for temperature. All pilot test will feed into this to provide support and evidence.
- DK and GC: Temperature can be monitored. VOC can do more.

REAMIT targets:

- At least 5 solutions will be tested and prototyped.

Matters Arising and Actions

Date	**Minute/ Item**	**Action**	**Responsi-bility**	**Update**
		Action identified, including referral to other committees	***Partner(s) with lead responsibility***	***Confirmation of completion or reasons for non-completion***
11/09 /2019	RM 19.11.02	JB to send more materials on communication to help strengthen the open call.	Oost NL (JB)	Complete
	RM 19.11.03	FH to suggest Dutch businesses that would try sensors in their trucks	FH	FH to be contacted by Whysor
	RM 19.12.01	GT and technology partners (Whysor, SenX, IT Tralee and BED) to work together on linking Raman spectroscopy sensors to the cloud to ensure success of the first French pilot test.	GT and technology partners (Whysor, SenX, IT Tralee and BED)	Complete
	RM 19.12.02	SM and technology partners (Whysor, SenX, IT Tralee and BED) to work together on linking traditional sensors to the cloud to ensure success of the French pilot test	SM and technology partners (Whysor, SenX, IT Tralee and BED)	Not needed
	RM 19.12.03	All partners to ensure that pilot tests have the common minimum requirementthat traditional sensors (temperature/humidity/etc.) and GPS are fitted and linked to the cloud so that we can monitor a measure of food quality remotely and continuously.	All partners	UoN does not need GPS as it is lab tested Accepted
		DK to make more progress on the pilot test by meeting with Dunbia ASAP and inform RR and other partners a potential date for visiting the pilot test site	DK, Dunbia	Complete
	RM 19.12.04	LR to provide more information about German pilot test (including details of the participating company) and a time line soon	LR	Complete

	RM 19.12.05	BED to procure the Big Data Server.	BED	Ongoing BED is waiting for senior research fellow to join BED.
		SM and DB to develop a database using Google maps to detect where trucks are moving.	Levstone	Ongoing SM to send BED information
	RM 19.12.07	All partners to send details of their presentations, stalls, demonstrations, tracks and workshops to UR to help prepare impressive promotional materials.	All partners	Ongoing
	RM 19.12.08	RR, KP, YD and TA to produce the framework for measuring the impact of REAMIT technologies on food waste	RR, KP, YD and TA (BED)	Complete
	RM 19.12.06	All partners to suggest best practices in Project management, handbook, internal management systems and the risk log,	All partners	Complete
	RM 19.12.07	All partners to send their inputs to REAMIT Communication Strategy document.	All partners	Complete
		All partners to follow REAMIT (@reamit4nwe) in Twitter and join the Facebook group.	All partners	Complete
		All partners to produce a REAMIT roll-up and keep it prominently in their premises.	All partners	Complete
		All partners feature REAMIT project in their organisational websites.	All partners	Ongoing NTU to send a template to PPs
		All partners to send any posts they would want to promote on the REAMIT social media pages.	All partners	Complete
		Partners to send suitable images (without infringing any copyright) for use in REAMIT website.	All partners	Complete
		All partners to support UR in successfully organising the first REAMIT Networking Symposium in Nottingham on 09 January	All partners	Complete

		2019.		
	RM 19.13.04	Levstone and NTU to appoint FLC son and RR will suggest to send relevant details to the two partners.	Levstone and NTU	Complete
	RM 19.13.05	Partners to complete recruitment of project personnel.	Relevant partners	Ongoing
	RM 19.13.06	BED team will revise the open-challenge call in line with the feedback of RAC and all partners should also contribute	BED	Ongoing I&R – French version Whysor – German and Dutch version
12/09 /2019	RM 19.13.11	BED team will revise the open-challenge call in line with the feedback of RAC and all partners should also contribute.	BED	Complete
	RM 19.15.01	All partners to contribute to the sensors white paper with insights form their previous experience and experience of conducting pilot tests	All partners	Complete

The REAMIT Project
Minutes of the REAMIT RAC & RSC meeting
held on 15-16 January 2020, Rennes, France

Present:

Name	Institution	Name	Institution
Ram Ramanathan (RR)	Chair on Day 2 – BED	Ali Assaf (AA)	University of Nantes
Katarzyna Pelc (KP)	Chair on Day 1 – BED	Gerald Thouand (GT)	University of Nantes
Gérard Le Bihan (GLB)	I&R Day 1 only	Emilie Grange (EG)	University of Nantes
Darin Beach (DB)	I&R	Gerard Corkery (GC)	IT Tralee (Attended the meeting on Day 1 afternoon via video link)
Sasha Bennett (SB)	NTU	Pratheepan Yogarajah (PY)	Ulster University
Usha Ramanathan (UR)	NTU	William Duffy (WD)	Ulster University
Régis DEL FRATE (RF)	Valorial	Shane Ward (SW)	UCD
Blandine Fortin	Valorial	Imke Hermens (IH)	Whysor
Simon McGraw (SM)	Levstone	Fabien Tencé (FT)	SenX

Apologies:
Tahmina Ajmal (BED)
Gael Maugis (I&R)
Yanqing Duan (BED)

Welcome and Introduction

KP opened the meeting and welcomed the attendees for the 2-day long series of REAMIT project meetings. GLB also welcomed the attendees in the premises of I&R. KP invited all attendees to introduce themselves and went through key points of the agenda. Agenda and minutes from previous RSC meeting were distributed in the seminar pack.

REAMIT Advisory Committee (RAC) meeting

RM 20.01.01 KP presented feedback received from Joline Brouwer (JB) from East NL Development Agency (REAMIT Associated Partner associated to BED) on the draft REAMIT progress report for the period July-December 2019. Since JB sent her input ahead of the RAC meeting, KP included the comments in a slide. In summary, East NL Development Agency were pleased with REAMIT project progress so far. She commended the Communication part of the progress report, especially REAMIT's growing presence in social media (website, twitter, etc.). She was curious to see how deliverable 'Publication of the Open Call' document turned out based on suggestions provided at the second RAC meeting (11-12 Sept-2019) to include a section on 'benefits for food producer and food transporter companies from participation in REAMIT pilot tests' and asked for an update on the pilot tests. REAMIT partners thanked JB for her continuous support.

Action: BED to send updated Open Challenge Call document (which includes a section on benefits for food producer and food transporter companies from participation in REAMIT pilot tests and infographics) to JB at East NL Development Agency.

Action: BED to send an update on REAMIT pilot Tests to JB at East NL Development Agency though the details will be included in the next progress report.

RM 20.01.02 KP asked if other REAMIT partners who have Associated Partners have received feedback from their Associated Partners. Partners confirmed they have not yet sent the second draft REAMIT progress report to the Associated Partners. RR requested partners to provide the progress report to their Associated Partners every six months, as soon as the report is ready, in time for advice and feedback ahead of each RAC meeting.

Action: REAMIT partners (I&R and UoN) to send to Associated Partners second REAMIT progress report for feedback.

Associated Partner	Partner responsible for sending progress report and obtaining feedback and suggestions
GIQS	BED
Oost NL (East NL Development Agency)	BED
Radboud University	BED
Terre d'essais	I&R
JEAN ROUTHIAU	UoN
Biosearch NI LTD	UU
Cottagequinn Farms LLP	Dunbia

KP continued the RAC meeting and presented slides summarising REAMIT progress based on the draft second REAMIT progress report.

WP Project management
RM 20.02.01 Four staff members have been recruited and three more will be recruited in the coming months; all REAMIT partners have appointed their First Level Controllers; first REAMIT report and payment claim were submitted to Joint Secretariat of Interreg NWE Programme in Sept-2019; six bilateral meetings took place among REAMIT project partners; cooperation among partners have been intensified i.e. first RAC meeting (Sept-2019 hosted by BED, UK) was attended by nine project partners.

WP Long Term
RM 20.02.02 REAMIT was promoted at 'NWE making an Impact' event (4-5 Dec-2019, Tourcoing, France). REAMIT stand at that event was prepared jointly by several partners. BED has developed a first draft of a framework for measuring the impact of REAMIT technologies on reducing food waste. REAMIT partners, under the leadership of NTU, have jointly organised REAMIT first Symposium (Jan-2020 Nottingham, UK) which sets the premise for future REAMIT Symposia.

WP Communication
RM 20.02.03 NTU has advanced the REAMIT Communication Strategy; updated REAMIT's website; developed REAMIT promotional materials (brochure, two videos, banner, newsletter); and enhanced REAMIT's presence in social media.

KP requested that all partners inform BED and NTU about their activities promoting REAMIT (e.g. participation in exhibitions, conferences, etc.) so that NTU communicates about these activities on REAMIT website and on REAMIT social media platforms.

KP confirmed that every REAMIT partner needs to have a REAMIT roll-up. This is a compulsory publicity requirement of the funder and non-compliance may be penalised by cutting the partner's budget (following on-the-spot audit by the funder or EU Commission's auditors). Partners wanted a template

for preparing the roll-up. NTU will send the template but it was highlighted that the main picture should be changed to reflect the activities of each partner.

Action: Each REAMIT partner to develop a REAMIT roll up by end of June 2020.
Action: NTU to send all partners a template for a roll-up.

RM 20.02.04 KP suggested that each REAMIT partner makes five communication actions each semester to promote REAMIT. These can be e.g. mentioning REAMIT in their organisational newsletter, talking about the project in seminars or discussions they are involved in, uploading REAMIT pictures in social media, making REAMIT related tweets, posting REAMIT related news in LinkedIn or Facebook.

Action: UOB to remind partners to take five actions each semester to promote REAMIT.

Action: Each partner to report on their five communication actions at the next RSC meeting and in the next progress report.

Action: NTU to make the hashtag #REAMIT4NWE more actively promoted.

WPT1 Adapting and pilot testing sensor technologies in agri-food supply chains

RM 20.02.05 KP confirmed that BED has developed the Open Challenge Call document based on input from East NL Development Agency. It now includes a section on 'Benefits for food producer and food transporter companies from participation in REAMIT pilot tests'. This new section currently is available in English only. KP asked partners for help with translating it to French, German and Dutch. Whysor has offered to translate it to German and Dutch, and I&R have offered to translate it to French. All partners are requested to read the new version of the document available at REAMIT website and provide feedback on the new section on 'benefits for food producer and food transporter from participation in REAMIT pilot tests'. The new, updated version of the Open Challenge Call document will be made available on the REAMIT website in four languages.

Action: Whysor to translate the newly added section on 'Benefits for food producer and food transporter companies from participation in REAMIT pilot tests' in the Open Challenge Call document to German and Dutch, and I&R to translate it to French.

RM 20.02.06 KP confirmed that based on suggestions from East NL Development Agency, BED has also developed a table summarising benefits for food producer and food transporter companies from participation in REAMIT pilot tests. This table will be presented as infographics and uploaded on REAMIT website. BED will send a copy to partners and all partners are requested to provide feedback on the infographics. Whysor and I&R have been requested to translate the infographics in the other three languages.

Action: BED to send the infographics to partners for comments.

Action: All partners to send their feedback on infographics to BED and NTU.

Action: Whysor to translate the infographics to Dutch and German; and I&R to translate the infographics to French.

Action: NTU to upload the infographics in all the four languages to REAMIT website.

RM 20.02.07 KP discussed a template for pilot tests and requested all REAMIT pilot test leads to use it when presenting pilot tests at REAMIT project meetings in the future.

Action: All pilot test leads are requested to use pilot test template to report update on the pilot test at the next REAMIT meeting.

WPT2 Big Data integration and application to reduce food waste
RM 20.02.08 KP confirmed that BED was finalising the recruitment process of a Research Fellow responsible for Big Data Hub management and coordination at BED (interviews on 28 Jan-2020); BED developed specification of equipment to build the Big Data Hub at BED; Whysor has built a platform for REAMIT at reamit.whysor.com; a separate database to identify potential food consumption points in REAMIT corridors is being done by Levstone with self-enrol function; a Smart Phone APP is being developed by Levstone.

KP informed that more detailed updates on progress of WPT1, WPT2 and WPT3 will be presented by leads of these WPs over the next two days. KP closed the RAC meeting.

Lunch break

Gerard Corkery (GC) from IT Tralee joined via video conference at 13:30 PM.

REAMIT Work Packages meetings

KP opened REAMIT Work Packages meetings and asked each lead of the WP to chair the meeting.

WPT1 Adapting and pilot testing sensor technologies in agri-food supply chains

RM 20.03.01 KP invited GLB to chair a discussion on WPT1 in the absence of GM. After a brief introduction to WPT1, GLB invited WW to present the first pilot test in UK.

Pilot test in UK with Dunbia (Lead: Ulster University)

RM 20.03.02 WD reported an update from the Pilot Tests carried out by Ulster University and Dunbia. WD said that cattle that are stressed produce dark cutter beef, which is usually turned down by consumers, as they are not visually appealing. In consequence, retailers end up with a lot of wasted meat. WD confirmed that UU was considering using another sensor i.e. Bolar sensor. It would measure PH and temperature of the animal and would sit inside the cow's second chamber of stomach. This sensor would indicate that the cow was stressed or hungry. WD said there were ethical problems related to putting sensors inside a cow's stomach. Vets are concerned with fitting sensors inside cows, they are aware the cows can regurgitate the sensors, and the sensors are quite expensive. There will be a meeting with UU and Dunbia to figure out if these sensors are appropriate. WD said there were several questions raised at the REAMIT Symposium (9th January 2020, Nottingham, UK) related to this new idea. One of them concerned why Dunbia don't mince dark cutter meat, rather than sell it as full cut. This and other relevant points will be discussed by Joan Condell (UU) and Colin Potts (Dunbia) at the upcoming meeting with Dunbia.

GT advised this was a very interesting concept and asked if there was any publication on the sensors proposed by UU. WD advised these were industrial sensors and more information about these sensors would be gathered by UU in the near future.

RR briefed partners about his visit to Dunbia (3 Dec-2019, Dungannon, UK). During the visit, Colin Potts mentioned that there was minimum or no meat wastage during meat transportation in Dunbia trucks. This is because meat was vacuum packed and reached destinations within a few hours. All Dunbia trucks are temperature controlled and as per Colin, usually there is no problem with Dunbia trucks during meat transportation.

RR confirmed that working with Dunbia and installing sensors in trucks transporting fresh meat was acceptable to REAMIT as the REAMIT project application included farms in its definition of supply chains.

RR also mentioned to the participants that he asked Colin Potts (CP) for the following details based on the decisions during his visit to Dungannon in December 2019.

- In line with the primary theme of REAMIT (on tracking temperature etc. in trucks in which meat is transported), CP will arrange to provide data from data loggers from the trucks used to transport meat. They will be monitored by the REAMIT Big Data Analytics team for any quality issues.
- CP will send some professional photographs on Dunbia for use in REAMIT flyers, website, brochures.
- CP will arrange for a visit by REAMIT team to their packing facility in Coddington.

Action: CP (Dunbia) to provide data from data loggers from the trucks used to transport meat.

Action: CP (Dunbia) to send some professional photographs on Dunbia for use in REAMIT flyers/website/brochures.

Action: CP (Dunbia) to arrange for a visit by REAMIT team to their packing facility in Coddington.

RM 20.03.03 RR said that while UU needed to refocus the pilot test with Dunbia, he has requested Joan Condell, the lead in Ulster University, to search for a new suitable business in the UK to carry out REAMIT pilot test where sensors could be installed in a truck transporting fresh food. RR highlighted that REAMIT's activities were not limited to just five pilot tests; while a minimum of 5 were promised, we should aim to carry out additional tests in order to increase the reach of the project and bring more reduction in food waste. RR confirmed that NTU has offered to carry out another pilot test in England.

Action: UU to start looking for another pilot test, NTU to provide more details of the new pilot test in England.

RM 20.03.04 SM asked whether it was possible to install one of Levstone's sensors into Dunbia's trucks to have comparable data, and see the differences in how both sensors will capture the data. RR asked WD check it.

Action: WD to check if Levstone can install their sensor in Dunbia trucks to assess quality of data collected.

RM 20.03.05 WD described the pilot test with Dunbia in more detail. He said that the objective of the pilot test was to detect the production of the dark cutter beef and possibly, to check mineral deficiency. UU will be buying more Bolar sensors from their supplier; the risk is related mainly to the possibility that the cow regurgitates the sensor. WD said that once the data was collected, UU would retract the sensor from the cow and install it into another cow, rather than buying multiple sensors.

WD said that data on cows' behaviour can be obtained in real time, data will be uploaded directly to the cloud, which they have full access to (Smaxtec sensor provider and cloud server). Data will most

likely be received in CSV/ excel format. UU will analyse the data. RR suggested sharing data with other tech partners to review the data. SM suggested that the router could be directed to another IP address. An example could be redirected to Levstone's server, they can communicate to the farmer the real time data and any triggers that need to be communicated.

RR asked what other preventions were available in case sensor data points to the possibility of dark cutter meat. WD said they would most likely just hold off from slaughter. There are others preventative measures but UU will develop further ideas of prevention of dark cutter meat.

Action: UU to try to make data from sensors available to REAMIT's analytics partners.

Pilot test in Germany and the NL (Lead: Whysor)

RM 20.03.06 KP invited Whysor to present progress on the second and third pilot test in Germany and in the NL.

IH confirmed that Whysor would carry out pilot tests with two companies: a German company Weyers GmbH that is selling vegetables; and a Dutch company Picnic, which in 2019 was the fastest growing company in the Netherlands specialising in delivering fruits and vegetables to private households for a small delivery cost.

IH said that Weyers GmbH stored vegetables in warehouses and transported them from warehouses to supermarkets. Sensors would be fit in trucks. Farmers can provide data such as photos of fresh fruits. Sensors will collect data on smell and appearance of fruit. Sensors (spectroscopy) will also monitor VOC, carbon dioxide and pressure. Data from sensors will be sent to a gateway. This system uses GPS sensors but does not work so well when a vehicle is moving so we will need to find a new sensor that works better in transit. In future, data collected in cloud will be sent to Big Data Hub at BED for analysis. Whysor has produced a cloud server called whysor.reamit.com for this purpose.

GT asked how Whysor would measure and evaluate the quality of the food at the end of the process. RR advised there were multiple ways e.g. we could use Raman Spectroscopy and detect the significant variations to detect changes in food quality, or we could monitor variations in traditional measurements such as temperature and humidity as a proxy for food quality indicators. He also sought support from REAMIT partners to work on this to develop it further.

GC (via video conference) asked whether the data would be in easily-obtainable format. RR confirmed raw data would be made available from REAMIT sites to Big Data hub at UOB, but we will need someone to carry out data cleansing. RR advised to wait until we see the type of data collected from sensors as then we will know the amount of data cleaning required. RR asked GC when the new Researcher would be appointed at ITT. GC confirmed he/she would start the new role at the end of Feb-2020. RR advised BED would also appoint a Research Fellow (in March 2020) to manage Big Data Hub and data analytics.

RR and SM discussed with IH how customers would upload photos of fruits/vegetables and how this would be analysed. IH confirmed there would be a mobile application to upload such images. RR advised this could be developed further.

IH said confidentiality agreement would need to be signed between Whysor and German and Dutch companies. She asked BED for help with designing a template.

Action: BED to develop a template of Confidentiality Agreement to be used by partners who need to sign it with the end user company participating in the pilot test.

RR reminded that all partners should be aware of the cost of buying sensors. Partners should provide sensors to end users rather than expect that end users will purchase the sensors. BED, NTU, UoN and UCD have budget allocated for purchasing sensors. All other partners should set a part of their budget for purchasing and maintenance of sensors.

Action: All partners to inform BED about the size of their budget available for purchasing sensors.

IH then provided more details of the Dutch pilot test. Picnic is an online supermarket, which delivered fresh foods to homes. Fresh products were kept cool in separate containers. Temperature sensors monitor temperature of groceries inside each cool box; each truck is fitted with GPS sensors. Data collected from sensors (temperature, GPS location) will be combined with weather data and uploaded into cloud. All data will be transferred to UOB's Big Data hub and to Picnic's data hub. Start date of the Dutch pilot is yet to be determined as there is no final agreement with Picnic yet. RR requested IH to provide starting dates of German and Dutch pilot tests. He proposed to visit the two pilot test sites at a mutually convenient time.

Action: IH to provide starting dates of German and Dutch pilot tests, and also to propose some dates for RR's visit.

IH then demonstrated the online cloud server developed by Whysor (Reamit.whysor.com). It shows the measurements of weather data and other various measurements. RR commented that we would be able to obtain the timeseries data from this cloud server. IH advised it was a valuable system to show customers the history of the product before it was delivered to their homes. This would build trust of customers and offered them information to better understand the journey of their food.

KP asked IH what happened when the system sent alerts to end user. IH confirmed Whysor would need to develop this aspect further with Picnic.

GC confirmed the Freshbox project did similar testing to the Dutch pilot with Picnic. GC forwarded a link with information which maybe of relevance for Whysor: http://fresh-box.info/.

RR requested GC to check whether a new Irish pilot test would be possible with the Freshbox idea. GC would check and confirm this soon.

Action: GC to check whether a new Irish pilot test would be possible with the Freshbox idea.

Pilot test in France (Lead: University of Nantes)

RM 20.03.07 AA confirmed UoN has been using Raman spectrum and Raman spectroscopy in their tests. They have created a database based on analysis of two meat samples. UoN has two solutions for database. The first solution will have computer built inside the truck, where you can obtain results from the Raman Spectrum. In the second solution, data will be sent wireless to the cloud. Results of comparison will be sent to a driver. UoN will collaborate with UU and Levstone to develop smartphone application.

Pilot test will start in January 2020 and end in July 2020. UoN expect to receive new traditional sensors in mid Jan-2020 from IQRF to supplement their Raman sensors. They will have chemical information of the samples and microbiological information; and will have a wider spectrum of data with these

new sensors. Contactless probe will be used to obtain the data of the food. The objective of the pilot is to test meat quality using Raman-Spec. RR suggested we should get Whysor involved in collecting the sensor data into cloud.

Action: UoN to collaborate with Whysor to develop the cloud system for Pilot Test carried out by UoN.

AA said that the challenge is using portable device (spectrometer) to detect data while moving – showing Raman spectrum of chicken also using Raman spec to analyse the packaging of the chicken. This can detect the intensity. UoN will use ocean optics spectrometer. Maximum intensity of the laser will provide the maximum details of the packaging. In order to avoid overlap in data, they have to develop algorithms.

RR suggested that partners ask for support in pilot tests, should they need help. There will be a researcher at BED dedicated specifically to data analytics in REAMIT and since we have more pilot tests running, this will give confidence to end users.

Action: Whysor, UU and UoN to provide photos representing their pilot tests. Photos should be sent to NTU and BED and will be used in REAMIT promotional materials developed by NTU.

Pilot test in Ireland (Lead: UCD)

RM 20.03.08 SW confirmed UCD was responsible for Cyberbar demonstrations. SW said his lab was working on imprinting QR codes onto chicken fillets. This process eliminates the necessity of relying on the information on the packaging. Cyberbar can be read on iPhone, creates traceability of the chicken meat, without needing the original packaging information. Things like the expiry date would be imprinted on the chicken meat, without having to refer to the packaging. UCD experimented with organic broccoli (which was niche market) to remove the plastic, hence decreasing waste. UCD will start demo towards end of the year. UCD are also working with a large food processor in Ireland on demonstration of the pilot. RR reminded that all pilot tests, including the Irish one, will have traditional sensors (temperature, humidity, vibrations, lighting, etc.) and GPS, in addition to any specialist system (e.g., Cyberbar for the Irish pilot and Raman for the French pilot). SW agreed and promised that Cyberbar will be complimented with other sensors including temperature sensor.

PY, new staff member at UU, asked whether there would be a visible barcode imprinted on the chicken meat. Different forms of symbology can be embedded in the food, not necessarily QR code. DB suggested if we promote the idea of traceability, people would be more likely to buy food. Otherwise, some will think it is unethical to imprint chicken meat with a traceability system. Depending on the market, some people will be happy with the environmental impact. UCD also discussed imprinting chicken meat without damaging the meat.

Break for coffee.

The Second Pilot test in France (Lead: I&R)

RM 20.03.09 DB explained that due to last minute absence notice of GM (due to important family matters) he was not able to provide details on the second pilot test in France where I&R were a lead. Instead, DB offered to show a video which was recently developed by I&R. The video focused on food waste reduction form farm to supermarket where GT and DB talked about the theme of REAMIT. It is in French and it is available on YouTube:

https://www.youtube.com/watch?v=p0Y2KB_iosI. RR welcomed this video and asked NTU to upload a link onto the REAMIT website.

Action: NTU to upload the link to the YouTube video developed by I&R onto the REAMIT website.

Pilot test using 3D Flurorescence Spectrometers

RM 20.03.10 RR highlighted the need to run another pilot test using 3D Flurorescence Spectrometers. This was included in the application form as FreshDetect, who were a partner in the successful application but later pulled out as they became insolvent, promised a pilot test using this new technology. Since UU has kindly offered to do these tests in place of Freshdetect, the funds of FreshDetect have been transferred to UU. Hence, he requested UU to ensure that this pilot test will be completed on time. RR also mentioned that BED has an expert on the technology. The expert, Tahmina Ajmal (TA), is already in the REAMIT team.

Action: UU to update partners about progress in 3D fluorescence pilot test at 4th RSC meeting (July 2020). WD agrees to work with TA at BED to develop this.

WPT2: Big data integration and application to reduce food wastage (Chair BED – RR)

RM 20.04.01 RR explained that activities in WP T2 have not yet been started in a big way as they are depended on running of pilot tests. Nevertheless, preliminary activities to ensure big data integration have already been started. For example, BED has scheduled interviews to select a Research Fellow who will manage procurement and maintenance of the Big Data Hub. He also asked Levstone on the progress of the second database that has food consumption points (e.g., supermarkets, convenience stores, food charities and other similar actors) on REAMIT corridors. He also wanted this database to have self-enrolment facility so that interested food consumption actors can enrol themselves. This database will be used to decide optimal rerouting of trucks to nearby consumption points in case of potential loss of quality. The optimal rerouting will be done using sophisticated vehicle routing algorithms built into the database.

RR said it was important to enable food stores and food banks to enrol in the database. Levstone has already taken steps to collect the data of who can use REAMIT food and identified possible demand points.

SM confirmed that customers with tight security (data privacy) on food rerouted from REAMIT truck would be treated separately. Levstone has facility to register their interests in getting the food from rerouted truck. End user will facilitate rerouting of the food. Supply point is the one with facility to receive the food.

RM 20.04.02 RR asked Levstone to update progress on the second self-enrolling database and their efforts on data security in REAMIT.

UR asked what data security was. SM said that data security and governance was different in every country. RR requested SM to help create a general data governance system for REAMIT.

Action: Levstone to update progress on the second self-enrolling database and their efforts on data security in REAMIT. Also to help create a general data governance system for REAMIT.

SM confirmed there is an overlap of WP1 and WP2. Truck driver can take a photo at the beginning and at the end of transportation to show the evidence. Collection of millions of data will be compared with the drivers' photo of the goods – this will add value.

RR confirmed BED was recruiting Research Fellow to manage Big Data and perform data analytics. BED held interviews for Research Fellow post on 28th Jan-2020. Research Fellow recruited at BED will be involved in designing confidentiality agreement for data security; and will do data cleansing.

There were further discussions about collecting and storing sensor data. It was suggested that Levstone (SM) can check with Whysor (Marcel and Luuk) on collection of data. Whysor has already produced a cloud server (Reamit.whysor.com). RR further confirmed that Big Data hub will get the redirected data.

RM 20.04.03 RR requested SM for an update on the 3rd activity under WPT2 - smart phone app being developed by SM (Levstone). SM would provide a detailed description soon.

Action: Levstone to update progress on preparation of the Smartphone App.

RR said that WP2 started only from Jan. 2020 and in the next 6 months we will have more activities to report.

RM 20.04.04 SM showed the members an interesting new sensor called Pebble – Blue maestro. It costs £40 with 5-year battery to collect data (on temperature, humidity, du point and pressure). It is standalone sensor. It can be put in a truck. This device can be linked to a smartphone inside a truck (e.g., the smartphone used by the Driver or a dedicated smartphone fixed in the truck by the REAMIT team). The phone not only would provide GPS data but will also collect the sensor data and to the cloud. This will enable faster downloading of the data, and rerouting is possible. This is very low-cost solution. Another significant advantage of this Pebble sensors is that the interface is public (unlike several commercial sensors that require the data be routed to a dedicated server of the sensor manufacturer), enabling easy coding for linking to the Smartphone application. RR requested SM to check with the leads of all pilot tests and with Whysor (who will install sensors and connect them to cloud for all pilot tests) about the appropriateness of using Pebble.

Action: SM to provide detailed technical description of Pebble and discuss about using it in pilot tests with pilot test leads and Whysor.

UR asked who would decide on rerouting. RR and SM said only the owner of the truck would decide the rerouting.

Levstone made an additional presentation on the next day to follow this up (see RM 20.08.10).

WPT3 Business development of REAMIT (Lead – UU)

RM 20.05.01 KP invited UU to chair this WP meeting. SW (UCD) confirmed that UCD has conducted research into the state of the art in terms of life cycle assessment and food waste. The REAMIT Sensor Review Report, when it is ready, would be analysed to identify the methods of measurement of relevant parameters for the LCA study. It was concluded that WPT3 activities will start later in the year.

RM 20.05.02 There was a discussion on the reliability of data from sensors. Several streams of data are of importance in REAMIT – including data on food consumption points, self-enrolling food

consumption data, data on temperature, humidity, etc. – may be affected by data reliability. For example, if battery life of a sensor is much lower than promised life from the manufacturer, this will affect reliability. RR requested technological partners to provide a robust scheme for testing the sensors.

Action: All technology partners to test the reliability of their systems before installation in REAMIT.

Day 2 – 16th January 2020

RR welcomed the partners for the second day of the meeting.

REAMIT Video made by SB

RM 20.06 RR asked partners if they agreed to be recorded by SB who would make a short REAMIT video with input from all partners. Partners were asked for a 45 seconds input focusing on:

1. "At the University of.....we work on ...
2. This is consistent with our role in REAMIT...
3. We are excited for working in the project because...

All partners agreed to be filmed by SB.

Action: NTU to develop REAMIT video based on partners' input.

RR invited UR to lead WP Communication meeting.

WP Communication meeting

RM 20.07.01 UR summarised the work done under WP Communication.

SB played REAMIT video which is being produced by an external consultant. She asked partners for comments and suggestions for improvements. Main comment from the partners concerned the need to improve presentation of partners' geographical locations in the video.

Action: SB to improve the video based on the comments by REAMIT partners.

SB confirmed that tweeting about REAMIT should be systematic, as Twitter is an important communication channel in business nowadays. Tweeting is about building your e-reputation. Partners exchanged about tweeting. They asked whether when they tweet, they push information as individuals or as organisations. They concluded that they should tweet only professional things/messages to be regarded as organisational tweets.

Action: All partners to make at least five communication actions about REAMIT each semester, among this at least one tweet.

Action: All partners to include REAMIT logo in their organisation's website, email signature, etc.

UR briefed partners about the need to improve REAMIT Communication Strategy document based on input from Madara Rancane, REAMIT officer at Joint Secretariat of Interreg NEW Programme. UR asked partners for input regarding communication objectives and target audiences. SM suggested that

REAMIT would be able to identify communication target audiences as soon as we have something to tell them e.g. that REAMIT pilot works. That is why we need a working pilot.

UR and SB briefed partners about REAMIT first Symposium (9th Jan-2020, Nottingham, UK).

RM 20.07.02 Ideas for the second REAMIT Symposium were discussed such as e.g. providing speed-dating function or arranging designated time-slots for bilateral talks. They should help increase attendance at the symposium i.e. avoid a situation where people sign up for the Symposium, but do not turn up.

Action: All partners to send their ideas for the second REAMIT symposium to the organisers (I&R and Valorial), NTU and BED.

RR closed the WP meetings, noting that WP LT has been discussed immediately after the RAC meeting (see minute RM 20.02.02) and WP M was discussed in RM 20.02.01 with more discussions as part of the RSC meeting on risk log (RM 20.08.07).

WP Project Management meeting

RM 20.08.01 KP confirmed that REAMIT Project Management Handbook has been advanced to include sections on: Responsibilities of the lead partner and project partners; Legal agreements; REAMIT Committees; Monitoring of the REAMIT project; Reporting and reimbursement process, REAMIT project financial management and REAMIT project evaluation. Moreover, it includes two annexes: Minutes of REAMIT Steering Committee and Risk Log. Project Management Handbook contains also lessons learnt and feedback from Madara Rancane (REAMIT officer at Interreg NWE Programme Joint Secretariat) from each project reporting exercise, and answers to questions raised by partners during REAMIT project implementation. Partners are encouraged to review the Handbook, provide their feedback and ideas for improvements.

RM 20.08.02 KP confirmed that BED has received feedback from Madara Rancane regarding REAMIT Risk Log. REAMIT Risk Log needs to be developed further and submit to Interreg NEW Join Secretariat with the second project report. KP run a dedicated session on REAMIT risks during RSC meeting.

RM 20.08.03 KP confirmed that minutes and list of actions from the first RSC meeting were circulated to partners in October 2019 and were included in the seminar pack. RR run a session dedicated to the minutes and actions during RSC meeting.

WP Long Term meeting

REAMIT Measurement Framework

RM 20.09 RR presented the draft REAMIT measurement framework. He highlighted that computing avoided carbon emissions requires data from previous studies. He drew up on the FUSIONS project report by WRAP in which it was reported that emissions of 3090 kg of CO2 can be prevented per tonne of food waste if the food is redistributed to people from manufacture / retail. This coefficient could be used in REAMIT once we know the quantity being redistributed.

However, he also highlighted more recent studies, which seemed to suggest the avoided CO2 emissions will be different for different kinds of food with plant based food resulting in lower values while meat based food producing higher levels of emissions. Accordingly, he presented data from recent studies that showed this difference using quantitative data. Using these quantitative data, he

then arrived at revised values of avoided CO2 emissions. This has highlighted that if a tone of beef is prevented from becoming waste and redistributed, then the avoided carbon emissions could be as high as 22002 kg of CO2. The values are much lower for plant-based food. For example, for tomato grown in the Netherlands, the value is just 1517 kg of CO2 per tonne of tomato redistributed.

RR further highlighted more research need to be done in this area, and requested partners to send their feedback.

Action: All partners to send their feedback on the REAMIT Measurement Framework.

KP closed the meetings for the day.

REAMIT Steering Committee (RSC) meeting

RR opened RSC.

RM 20.10.01 RR asked if partners had comments to the draft minutes from RSC meeting (Sept-2019, Luton, UK). Partners had no comments and draft minutes of that meeting have been accepted as accurate reflection of the first RSC meeting.

RM 20.10.02 KP confirmed that REAMIT first report was submitted to Joint Secretariat in Sep-2019. KP presented feedback from Madara Rancane (REAMIT officer at Interreg NWE Programme Secretariat) on first REAMIT project activity and finance report (January – June 2019) and payment claim. The following comments were sent to BED in Dec-2019 by REAMIT officer at Interreg NWE programme:

- Communication in eMS must be in English.
- All partners need to provide sufficient level of information when reporting every cost item: name of the person; type of cost (e.g. travel), kind of ticket purchased (plane, train, etc.), activity the cost is related to, location of the activity, date of the activity.
- Staff cost should be distributed across WPs in every reporting period.
- Staff time sheet template should be used for staff working part time on REAMIT.
- All partners need to report in eMS.
- Target groups that each partner has reached should be reported in eEMS, e.g. Agri-businesses, transport companies, food companies, local authorities, etc. For more information about REAMIT target groups please consult REAMIT Application Form.
- Every partner needs to identify their target groups and communicate directly to their target groups at least five times during REAMIT project lifetime. **Action: Every partner to identify their target groups and communicate directly to their target groups at least five times during REAMIT project lifetime.**

Action: BED to send timesheet template to all partners.

Action: All partners to observe the requirements above (RM 20.08.03) while submitting their progress reports and financial reports.

RM 20.10.03 KP briefed partners about timeline for second reporting round. KP presented key points and calendar for second REAMIT project activity and finance report (July – December 2019). BED received all partner activity reports in Dec-2019. Regarding partners finance reports, partners need to finish all work on their reports, including first level control audit, by 16 Feb-2020. This means all partners must submit their partner's activity and finance report as well as payment claim and spending forecast for the next 6 months, early enough for their auditor to complete audit by 16 Feb-2020. To

do this, it is advisable that partners agree with their auditor in advance the timing of the audit so that the audit is completed by 16-Feb 2020.

Action: All partners to observe the deadlines in RM 20.12.01 for their progress reporting.

RM 20.10.04 SW asked whether partners can put the claim altogether in June 2020. KP advised that most probably no as we needed to report volume of spending now, by end of March-2020. If REAMIT underspends, there is a chance of having a cut of the corresponding REAMIT partners' budget.

RM 20.10.05 SW mentioned that they were unable to host the next RSC meeting in UCD as originally planned as per the minute RM 19.06.04. He requested that this meeting could be swapped with another meeting. IH responded and offered to host the next RSC meeting in the Netherlands. Accordingly, it was decided that the 4th RSC meeting will be organised by Whysor in the NL on 8-9 July 2020 and 5th RSC meeting will be organised by UCD in Dublin on 20-21 January 2021.

Deviations from Work Plan

RM 20.10.06 RR confirmed the partnership is making good progress in project implementation and there are no major delays yet on the project level. RR asked partners to report any deviations on the partner level.

UoN confirmed the sensor equipment they have purchased was delivered only now, in Jan-2020. However, they expect to get data from pilot tests by May/June 2020. RR confirmed that this does not create a delay for REAMIT.

RR requested more details from three pilot tests where the leads are: UCD, I&R and UU (regarding 3D fluorescence). This information should be sent to BED before RSC meeting in July 2020.

Action: By mid-April UCD, I&R and UU are requested to send to BED information about progress in the pilot tests they lead.

RR suggested that with regards to the Pilot Test in France under the leadership of I&R, REAMIT partnership is banking on I&R's (and Valorial's) business links and hope for more than one pilot test in France. They could use the pilot tests pioneered by Whysor as an example.

Several REAMIT partners advised that some companies are very concerned about their company's name being mentioned in REAMIT materials. They claim this is deteriorating for their reputation and gives an advantage to their competitor companies who tend to believe they have problems. RR mentioned that associating with REAMIT could also be viewed positively, as these companies are willing to encourage innovation and as green champions.

SM confirmed we needed proof of concept to attract more companies to participate in pilot tests. In order to have proof of concept we need to start at least one pilot test. It seems to be a catch 22 situation and REAMIT's inescapable dilemma. SM confirmed that REAMIT couldn't seem like trying to create a new problem for businesses to solve. Rather, REAMIT tries to help solve problems that companies have. Hopefully, in the next 6 months we will make a progress and will be able to leverage more end users to participate in pilot tests.

REAMIT risk log

RM 20.10.07 KP reminded partners about REAMIT risks reported in REAMIT Risk Log. Risk Log is a compulsory document required by the funder and it needs to be reviewed by the partnership systematically. Currently the Risk Log contains eight risks: three risks have been identified in REAMIT Application Form and five risks have been added following second RSC meeting (Sept-2020, Luton). KP invited all partners to brainstorm if they considered other risks for REAMIT.

SM pointed out that short life of a battery inside a sensor fit in a truck is a risk. Failure of a sensor battery due to cool conditions inside the truck can be a risk too.

SM suggested that to mitigate this risk we need to consider batteries with longer life, such as e.g. 5000 hours, install more than one sensor in a truck and clarify all uncertainties with sensor manufacturers in the moment we purchase sensors. If battery life is not what the manufacturer says, our efforts to collect data may fail and we will have no data if a sensor has failed. Consequently, we will have no information about what is happening inside the truck. Moreover, conditions inside the truck maybe be impossible for a sensor to handle. For example, in a cool truck, a battery may be affected as it may not handle cool temperature well.

KP asked how to mitigate this risk. SM confirmed that to mitigate this risk, we need to install multiple sensors in a truck (they are cheap and we can afford them) to obtain data from multiple sensors. This will allow us to do combined reading of sensors' data.

SM confirmed that another way to mitigate this risk is to ensure a battery sends a warning signal when it goes down. When purchasing sensors, we need to make sure that the manufacturer of the sensor provides a function informing us when sensor battery is going down.

KP asked about ownership of this risk. RR confirmed that whoever is the lead of a Pilot Test is the owner of this risk since they are the first one to get notified.

KP asked partners if they foresee other risks but no other risks have been identified.

KP asked partners to reflect on four risks which were added to the REAMIT Risk Log following the second RSC (September-2019, Luton, UK).

Additional Risk No 1: effectiveness of sensors in providing genuine new information
Partners commented that if a sensor does not offer new genuine information, it will not be used in REAMIT pilot tests. Only these sensors will be used in REAMIT Pilot Tests, which provide genuine, new information. Moreover, reading from a sensor must be correct and for this reason correct calibration of the sensor must be done at the start. Otherwise, the risk is that sensors don't provide correct data, thus the analysis of this data will be wrong.

Additional risk No 2: Maintaining confidentiality of the sensor data on food quality from end-users
To mitigate this risk, all pilot test leads need to write an agreement with the end user company. The agreement must cover data governance issues. A Research Fellow employed by BED (expected to join the REAMIT team in March 2020) will also have a function of data controller who checks quality of data collected from sensors, and ensures that storing and analysis of data complies with EU and GDPR requirements.

Additional risk No 3: Risk of not using the correct sensor for a given application
Though it is difficult to expect complete knowledge of all available sensors to be able to choose the best one for a given application, RR requested all partners to documents their knowledge on sensors in the Sensor Review paper. He highlighted that the practical experience of REAMIT partners would

be a great contribution to knowledge. He requested partners to send their responses to the table of best sensors for a given combination of chillness of food (frozen, chilled, ambient, etc.), kind of perishable product (fruits such as strawberry, meat, fish, etc.) and specific part of the supply chain (truck, warehouse, etc.). This can help prepare a successful research article for publication in reputed journals.

Action: All partners to contribute to the Sensors Review continuously, specifically for the table of best sensors for a given combination of chillness of food, kind of perishable product and specific part of the supply chain.

Additional risk No 4: Though we strive to reroute food before it becomes bad, there is risk involved as the food might become waste during rerouting.

Partners confirmed that this is the last stage of food transportation process, and that it is out of their control if a truck driver takes too much time to take a decision or not. Therefore, partners agreed that this risk should be deleted from REAMIT Risk Log, though REAMIT will try best to link owners and food demand points as early as possible

Additional risk No 5: Receiving store does not accept the food
Partners suggested that a closer store might not accept the food in the lorry. For example, Auchan will not accept and sell food from Intermarche, if such food is on the way and in risk of becoming waste. SM said that the REAMIT APP needs to have a function, which links food owners with food consumers. Also, ultimately end users of REAMIT will use REAMIT to improve food quality rather than to reroute waste. GT said that STEF are asking food certificate at two moments (1) before food is on the move and (2) when food arrives at a destination. In this way they control freshness of food during the journey. RR highlighted that, similar to Additional Risk 4, this risk is also beyond the control of the REAMIT consortium. REAMIT will try to link owners and food demand points but the negotiations between the two is not under the project's control.

Action: Bed to update REAMIT Risk Log.

Conference call with GM

RM 20.10.08 GM has joined the discussion through the conference call. He confirmed that the FLC process at I&R took as long as one month. In order to submit I&R report to LP on 16 Feb-2020, I&R would need to initiate FLC process of I&R now i.e. in mid-January.

REAMIT elevator Pitch

RM 20.10.09 KP presented the additions to the Open Challenge Call document based on the comments of the first RAC meeting. The additions included 'Benefits for food producer and food transporter companies from participation it REAMIT pilot tests'. KP explained that the text on benefits would be accompanied by infographics i.e. a powerful tool to communicate with end users of REAMIT technologies. KP invited partners to comment about the proposed benefits. Partners suggested that a short video could be developed based on the proposed text on the benefits.

Action: NTU to consider preparing a short video highlighting the benefits to food producer and food transporter companies.

SM suggested that the list of benefits could be presented also as an elevator pitch, and that this can be developed over the period of time. SM said that in the REAMIT website we need to have all these

elements to effectively communicate about benefits from participation in REAMIT pilot Tests: newsletter, posters, videos and infographics.

KP suggested that the infographics would present four categories of benefits: financial (SM said that this must not be the focus of REAMIT), technological, image building, and access to wide network.

SM suggested that cost of fitting sensors might not attract businesses to accept REAMIT technologies. However, it can help indirectly.

KP invited partners to brainstorm about ideas for REAMIT elevator pitch. The following ideas emerged from the brainstorming session:

UR: REAMIT will create a new norm for using sensors to reduce food waste.
GT: REAMIT creates a point of care analysis. We diagnose quality of food before it reaches the consumer.
AA: We certify your food quality, point of freshness, food health.
RR: We will reduce your insurance costs. We will complete full certificate of food quality.
DB: YUKA supply chain. CO2 foot print of supply chain.

DB explained that YUKA is an independent mobile phone application that allows people to scan the bar code on a product and get a "score" on the healthiness of this product with recommendations on "healthier" products to buy instead. YUKA website https://yuka.io/ is currently available only in French. The idea was that REAMIT could be used to inspire a YUKA-like application that would be able to scan a bar code and indicate how "CO2" friendly was the logistic path it took to get to the consumer. Products that benefit from REAMIT's optimized logistics thanks to early warning on possible degradation would obviously receive a higher score on the application. This is an idea to inspire thought among REAMIT partners and the ecosystem interested in the project.

Presentation by Levstone

RM 20.10.10 RR has invited SM to make a presentation about Levstone's activities in REAMIT. This is a follow-up of WPT2 discussion in RM 20.04.02.

SM said that GPS is about recording history i.e. telling you where you have been. However, you also need to know where somebody is going. REAMIT technology installed in a truck will inform you where the truck is going. Also, if a truck / sensor inside a truck stops communicating, you will get an alert about it.

Partners asked SM whether we could do tracking without a mobile phone.

SM said that normally you would need to have a permanent power supply in a truck to recharge your phone if its battery is low. He suggested that we could create a solution that uses a battery, rather than power from the truck. This solution would have a local buffer – if there is no communication with the sensors, it can store data. SM confirmed we needed a concept for saving data. The cost would be EUR 150. SM confirmed that Levstone tested such solution recently: they put it in a box, tested it and run power to 0, and lost all the configuration. Levstone realised that to remotely reconfigure the sensor, was not a secure solution. Top security solution is when you set it up again locally. Solar power can supply energy too. The devise needs to have low voltage detection so that it shuts in time to save data. Then it starts up again once it has been recharged. SM confirmed that currently he experimented

with GSM mobile data network. Another idea is to try the LORA network which is cheaper and less energy consuming. SM confirmed that after 40 hours of testing they put a devise into sleeping mode as it could be switched off manually. Then they recharged it manually. Regardless of sampling frequency of the sensor (every minute or every hour), still the life of its battery is 40 hours.

SM said that for REAMIT project it was a big advantage to have a phone as you could take pictures as well.

DB suggested that it was important that REAMIT had data management plan.

RR confirmed developing data management plan would be a task for the Research Fellow at BED employed to manage Big Data Hub.

Action: BED to coordinate development of data management plan for REAMIT.

Lunch break

Updates on Sensor Review

RM 20.11 While the paper on Sensor Review has been discussed at length during the session on REAMIT risk log (Additional Risk 3 in RM 20.10.07), RR invited further discussions from partners. He presented a table listing given combinations of chillness of food, kind of perishable product and specific part of the supply chain, and requested partners to use their practical experience to complete the table.

RR further informed partners that an abstract of sensor review has been submitted for presentation at the 2020 Conference of the European Operations Management Association in Warwick, UK, in June 2020.

RR requested all partners to complete their activities for the video. The meeting then closed with thanks from Chair.

Matters Arising and Actions

Date	Minute/ Item	Action	Responsi-bility	Update
		Action identified, including referral to other committees	***Partner(s) with lead responsibility***	***Confirmation of completion or reasons for non-completion***
15/01	RM 20.01.01	**BED to send updated Open Challenge Call document (which includes a section on benefits for food producer and food transporter companies from participation in REAMIT pilot tests and infographics) to JB at East NL Development Agency.**	BED	Completed
15/01	RM 20.01.01	**BED to send an update on REAMIT pilot Tests to JB at East NL Development Agency though the details will be included in the next progress report.**	BED	Completed
15/01	RM 20.02.03	**REAMIT partners (I&R and UoN) to send to Associated Partners second REAMIT progress report for feedback.**	I&R UoN	Outstanding. GM to send out report to associated partners.
15/01	RM 20.02.03	**Each REAMIT partner to develop a REAMIT roll up by end of June 2020.**	Each partner	Completed UCD ongoing
15/01	RM 20.02.03	**NTU to send all partners a template for a roll-up.**	NTU	Completed
15/01	RM 20.02.04	**BED to remind partners to take five actions each semester to promote REAMIT.**	BED	Completed
15/01	RM 20.02.04	**Each partner to report on their five communication actions at the next RSC meeting and in the next progress report.**	Each partner	Completed
15/01	RM 20.02.04	**NTU to make the hashtag #REAMIT4NWE more actively promoted.**	NTU	Completed
15/01	RM 20.02.05	**Whysor to translate the text added to Open Challenge Call document to German and Dutch; I&R to translate it to French.**	Whysor I&R	Completed

15/01	RM 20.02.06	**BED to send the infographics to partners for comments.**	BED	Completed
15/01	RM 20.02.06	**All partners to send their feedback on infographics to BED and NTU.**	All partners	Completed
15/01	RM 20.02.06	**NTU to develop infographics on benefits for food producer and food transporter companies from participation in REAMIT pilot tests.**	NTU	Completed
15/01	RM 20.02.06	**Whysor to translate the infographics to Dutch and German; and I&R to translate the infographics to French.**	Whysor I&R	Completed
15/01	RM 20.02.06	**NTU to upload the infographics in all the four languages to REAMIT website.**	NTU	Completed
15/01	RM 20.02.07	**All pilot test leads to use pilot test template to report update on the pilot test at the next REAMIT meeting.**	Pilot test leads	Completed
15/01	RM 20.03.02	**Dunbia to provide data from data loggers from the trucks used to transport meat.**	Dunbia	NA
15/01	RM 20.03.02	**Dunbia to send some professional photographs on Dunbia for use in REAMIT flyers/website/brochures.**	Dunbia	NA
15/01	RM 20.03.02	**Dunbia to arrange for a visit by REAMIT team to their packing facility in Coddington.**	Dunbia	NA
15/01	RM 20.03.03	**UU to start looking for another pilot test, NTU to provide more details of the new pilot test in England.**	UU	Completed NTU – ongoing
15/01	RM 20.03.04	**UU to check if Levstone can install their sensor in Dunbia trucks to assess quality of data collected.**	UU	Ongoing
15/01	RM 20.03.05	**UU to try to make data from sensors available to REAMIT's analytics partners.**	UU	Ongoing
15/01	RM 20.03.06	**BED to develop a template of Confidentiality Agreement ready to be used by partners who need to sign it with the end user company participating in the pilot test.**	BED	Ongoing

15/01	RM 20.03.06	**All partners to inform BED about the size of their budget available for purchasing sensors.**	BED	Ongoing
15/01	RM 20.03.06	**Whysor to provide starting dates of German and Dutch pilot tests, and also to propose some dates for RR's visit.**	Whysor	Completed
15/01	RM 20.03.06	**ITT to check whether a new Irish pilot test would be possible with the Freshbox idea.**	ITT	Ongoing (Freshbox similar to Picnic)
15/01	RM 20.03.07	**UoN to collaborate with Whysor to develop the cloud system for Pilot Test carried out by UoN.**	UoN and Whysor	Ongoing
15/01	RM 20.03.07	**Whysor, UU and UoN to provide photos representing their pilot tests. Photos should be sent to NTU and BED and will be used in REAMIT promotional materials developed by NTU.**	Whysor UU UoN	Ongoing. NTU will visit pilot test sites to make videos.
15/01	RM 20.03.08	**NTU to upload the video developed by I&R on the REAMIT website.**	NTU	Completed
15/01	RM 20.03.10	**UU to update partners about progress in 3D fluorescence pilot test at 4th RSC meeting (July 2020). WD agrees to work with TA at BED to develop this.**	UU	Completed
15/01	RM 20.04.02	**Levstone to update progress on the second self-enrolling database and their efforts on data security in REAMIT. Also to help create a general data governance system for REAMIT.**	Levstone	Ongoing
15/01	RM 20.04.03	**Levstone to update progress on preparation of the Smartphone App.**	Levstone	Completed
15/01	RM 20.04.04	**Levstone to provide detailed technical description of Pebble and discuss about using it in pilot tests with pilot test leads and Whysor.**	Levstone	Ongoing

15/01	RM 20.05.02	**All technology partners to test the reliability of their systems before installation in REAMIT.**	BED	Ongoing
16/01	RM 20.06	**NTU to develop new REAMIT video based on partners' input.**	NTU	Completed
16/01	RM 20.07.01	**NTU to improve the REAMIT video based on the comments by REAMIT partners.**	NTU	Completed
16/01	RM 20.07.01	**All partners to make at least five communication actions about REAMIT each semester, among this at least one twit.**	All partners	Ongoing
16/01	RM 20.07.01	**All partners to include REAMIT logo in their organisation's website, email signature, etc.**	All partners	Completed
16/01	RM 20.07.02	**All partners to send their ideas for the second REAMIT symposium to the organisers (I&R and Valorial), NTU and BED.**	All partners	Completed
16/01	RM 20.09	**All partners to send their feedback on the REAMIT Measurement Framework.**		Ongoing
16/01	RM 20.10.02	**BED to send timesheet template to all partners.**	BED	Completed
16/01	RM 20.10.02	**Every partner to identify their target groups and communicate directly to their target groups at least five times during REAMIT project lifetime**	Each partner	Ongoing
16/01	RM 20.10.02	**All partners to observe the reporting requirements listed in RSC meeting (RM 20.11.02) while submitting their progress reports and financial reports.**	All partners	Ongoing
16/01	RM 20.10.06	**By mid-April UCD, I&R and UU are requested to send to BED information about progress in the pilot tests they lead.**	UCD I&R UU	Completed
16/01	RM 20.10.03	**All partners to observe the deadlines in RM 20.12.01 for their progress reporting.**	All partners	Completed
16/01	RM 20.10.07	**All partners to contribute to the Sensors Review continuously, specifically for the table of best sensors for a given combination**	All partners	Ongoing

		of chillness of food, kind of perishable product and specific part of the supply chain.		
16/01	RM 20.10.07	**BED to update REAMIT Risk Log.**	BED	Completed
16/01	RM 20.10.09	**NTU to consider preparing a short video highlighting the benefits to food producer and food transporter companies.**	NTU	Completed
16/01	RM 20.10.10	**BED to coordinate development of data management plan for REAMIT.**	BED	Ongoing

Approved minutes from REAMIT Advisory Committee, Work Packages and Steering Committee meetings, 8-9 July 2020 (Zoom online meeting room)

Present:

Name	Institution	Name	Institution
Ram Ramanathan (RR)	BED	Ali Assaf (AA)	UoN
Katarzyna Pelc (KP)	BED	Pat Doody (PD)	ITT
Lohithaksha Maniraj Maiyar (LM)	BED	Gerard Corkery (GC)	ITT
Tahmina Ajmal (TA)	BED	Joan Condell (JC)	UU
Yanqing Duan (YD)	BED	William Duffy (WD)	UU
Shantanu Banerjee (ShB)	BED	Pratheepan Yogarajah (PY)	UU
Gael Maugis (GM)	I&R	Bryan Gardiner (BG)	UU
Usha Ramanathan (UR)	NTU	Daniel Kelly (DK)	UU
Sasha Bennett (SB)	NTU	Fabien Tencé (FT)	SenX
Simon McGraw (SM)	Levstone	Imke Hermens (IH)	Whysor
Blandine Fortin (BF)	Valorial	Luuk Rijnbende (LR)	Whysor
Saptarishi Chakravarty (SC)	UCD	Marcel Steegh (MS)	Whysor
Fionnuala Murphy (FM)	UCD	Mark Logan (ML)	WD Meats
Shane Ward (SW)	UCD	Joline Brouwer (JB)	Oost NL
Frank Gorte (FG)	Picnic		

Apologies:
Gerald Thouand, UoN
Fionnuala Murphy, UCD (Day 2)
Shane Ward, UCD
Oliver Breuer, QIQS
Annemarie Vilsteren, Oost NL

Welcome to REAMIT meetings (Chair: BED)

20.12.01 RR opened the meeting and welcomed all attendees (partners, sub-partners and associated partners) to a 2-day round of REAMIT project online meetings hosted by Whysor. RR thanked everyone for their efforts in the implementation of the REAMIT project so far.

RR said there were 5 REAMIT pilot tests running (or in the pipeline), there were more funds to be allocated to new pilot tests and all partners were requested to help bring in more pilot tests.

RR reminded that the agenda and minutes from previous RSC meeting were distributed to attendees via email.

20.12.02 RR welcomed new staff to the REAMIT project team:

- Shantanu Banerjee, Visiting Lecturer/Consultant, BED
- Lohithaksha M Maiyar, Research Fellow, BED
- Saptarishi Chakravarthy, Master Student, UCD

20.12.03 SB asked everyone to pose for a group photograph. All attendees turned on their cameras and SB took photos of the REAMIT team meeting online.

RR handed over to KP.

20.12.04 KP welcomed the attendees and summarised the agenda for Day1. She confirmed that an updated agenda would be sent for the second day. It would be updated based on progress of Day 1 meetings. KP asked if there were any questions or issues before the meetings started.

20.12.05 UR requested that everyone participated actively in sharing the screen shots and communicating about REAMIT meetings in social media.

RR reminded that, while communicating through social media, we should keep names of companies / institutions confidential while sharing the content of REAMIT online meetings.

REAMIT Advisory Committee (RAC) meeting (Chair: BED)

KP welcomed attendees to RAC meeting. JB confirmed her presence at the RAC meeting. KP thanked JB for her input on the draft REAMIT progress report for the period January-June 2020. This would be discussed in RM 20.23.01 below.

KP summarised the progress made so far of the REAMIT project in the following order: WP T1, WP T2, WP T3, WP M, WP LT and WP C.

<u>WP T1 Adapting and pilot testing sensor technologies in agri-food supply chains</u>

KP summarised the progress made so far in the implementation of WP T1.

WPT1 Deliverable 1.1 Publication of open call
20.13 The open call was published on the REAMIT website in four languages: English, French, Dutch and German. However, most companies recruited for pilot tests come from partners' own networks. Only I&R and Valorial confirmed they planned to recruit companies for pilot tests through the open call – ADRO Ouest (Egg consortium) and BbaMV (dairy products). Infographics on benefits from participation in REAMIT pilot tests was prepared and uploaded in the open call section of the REAMIT website. The open call deadline on the REAMIT website was extended until December 2020.

Deliverable 1.2 Companies recruited from across agri-business supply chain (min 5 companies) for pilot tests
20.14 The following five companies have been recruited for REAMIT pilot tests in 5 countries:

- Picnic (NL)
- Routhiau (FR)
- WD Meats (UK)
- WEYERS GMBH (DE)
- Manor Farm (IE)

WPT1 Deliverable 2.2 Test Roadmap
20.15 Partners at I&R have drafted Test Roadmap based on inputs from all pilot test leads, and have updated it systematically based on updates from pilot test leads. Test Roadmap contains the following information on each pilot test:

- Aim of the pilot test
- Partner companies involved

- REAMIT partners involved
- Technologies employed
- Role of technology partners
- Protocol for the pilot test
- Implementation calendar

In addition, I&R have developed a document 'Pilot Impact Assessment' summarising the impact of COVID-19 on each pilot test. 'Pilot Impact Assessment' is not a REAMIT deliverable though.

WPT1 Deliverable 3.1 Working prototypes using sensor technology (5 REAMIT Pilot Tests)
20.16.01 KP summarised the scenario for each of the 5 pilot tests and confirmed that prototypes using sensor technology are being developed for each of the pilot test:

- Working prototype for pilot test run by Whysor with Picnic in the NL
- Working prototype for pilot test run by UoN with Routhiau in France
- Working prototype for pilot test run by UU with WD Meats in the UK
- Working prototype for pilot test run by Whysor with Weyers GMBH in Germany
- Working prototype for pilot test run by UCD with Manor Farm in Ireland

20.16.02 RR confirmed that UU initially started the pilot test with Dunbia. However, due to company's own internal issues, after a period of 3-4 months, the company have decided to exit the REAMIT project. Luckily, the partners at UU were able to recruit for REAMIT pilot tests an equally big company called WD Meats.

20.16.03 KP confirmed there were several new pilot tests in the pipeline:

- UoN contacted Adria (France) to complement the Raman measurements by an interesting application called "Sym Previus" necessary for the validation of results.
- I&R and Valorial initiated talks with ADRO Ouest (France)
- I&R and Valorial made a proposal to BbaMV consortium (France) to design a pilot test focusing on egg powder. I&R and Valorial are now waiting for BbaMV consortium's response.
- Whysor contacted Meyer/QSL (NL)
- NTU contacted Tesco (UK)
- UU and BED contacted Metro (Germany)

<u>WP T2 Big Data integration to reduce food waste (Deliverable 4.1 – 8.2)</u>

20.17 LM summarised progress made under different deliverables in WP T2. There was progress in deliverables 4.1, 5.1, and 7.1. BED, Whysor and Levstone have contributed to the progress of this work package so far. Detailed progress would be presented in the dedicated WP T2 session.

<u>WP T3 Business development of REAMIT technologies</u>

20.18 FM confirmed there was progress in the implementation of this WP at UCD. During WP T3 meeting there would be detailed presentation from FM on conducting life cycle assessment for understanding the impact of REAMIT technology in Irish market or in the European market. Even though FM was present during Day 1 meetings, due to technical problems, the audience could not hear her. RR suggested to move on with the rest of the meetings to avoid causing delays.

<u>WP Management</u>
20.19 KP confirmed the following information related to this WP:

- BED updated Project Handbook (available on REAMIT website), developed and circulated minutes from RAC/RWP/RSC meetings (15-16 January 2020, Rennes, France), undertook

intermediate work package coordination, updated REAMIT risk log, developed and submitted to JS second REAMIT report and payment claim, prepared third REAMIT report, assisted partners with improving quality of reporting in eMS.

- Mrs Una Bruhann was appointed as a new REAMIT officer at JS of Interreg NWE Programme.
- 1 full time staff was recruited at BED in March 2020 (research Fellow – Dr. Lohithaksha M Maiyar), recruitment of a full time research assistant has been put on hold at ITT (a person has been selected but his start date has been postponed due to Covid-19), UCD has been in the process of appointing a post-doctoral researcher but the process has been put on hold due to COVID-19, new part time staff has joined the REAMIT team at Ulster University – Dr. Ruth Price would join REAMIT as clinical trials manager (she has previous experience in food research and will be assisting in coordinating future trials), James Dooley – Professor of Microbiology also has joined UU REAMIT team as part-time staff. His experience in microbiology will be invaluable in assisting in pilot tests with WD Meats.
- BED submitted second REAMIT report and payment claim to JS on 30/03/2020; In February 2020 Dunbia and Cotttagequinn Farms informed BED that they would exit REAMIT; WD Meats joined REAMIT as sub-partner of UU; bi-weekly online meetings have been organised for fixed term staff in REAMIT (KP and LM from BED, WD from UU and SB from NTU).

<u>WP Long Term</u>

20.20 KP summarised progress under WP LT:

- NTU with assistance of BED, Valorial, Levstone, SenX, UCD, UU, developed and delivered REAMIT first Symposium in Nottingham, UK.
- Second REAMIT Symposium is being developed jointly by I&R and Valorial. The plan for the second symposium will be discussed on Day 2.
- BED has developed the first draft of the framework measuring the impact of benefits of technology on food waste.
- Two research proposals have been submitted inspired by REAMIT. BED submitted one proposal to UKRI. The proposal was developed in collaboration with NTU, UU, Levstone and WD Meats and proposed to study how technology was supporting fresh food supply chains in the UK in the light of COVID-19. BED submitted another large European proposal as project partner. That proposal was led by UCD and was unsuccessful.

<u>WP Communication</u>

20.21 KP confirmed that:

- Deliverables under WP Communication are advanced and follow progress made in other work packages. The only deliverable that has not been delivered yet is 'Policy briefings'.
- BED with support from REAMIT partners has submitted two applications for REAMIT stand at two exhibitions – CABS Research exhibition 2020 (March 2020, Nottingham, UK) and ICT 2020 Leading the Digital Age (December 2020, Cologne, Germany). However, due to COVID-19 the CABS exhibition has been cancelled and the ICT2020 exhibition has been postponed till 2021.
- REAMIT project partners were invited to present the REAMIT project at 11 external and internal events as specified in the progress report. These include:

1. PI, Ram Ramanathan, delivered an invited research seminar on REAMIT at Cass Business School, London, UK, on 05/02/2020.
2. PI, Ram Ramanathan, delivered a plenary lecture at the 3rd International Industrial Engineering and Operation Research (http://ieconferences.com/) Conference, Istanbul, Turkey, on 25/06/2020 on the topic, "Improving Operations and Sustainability of Agribusiness Supply Chains using Internet of Things sensors and Big Data Analytics." (Presented online).

3. PI, Ram Ramanathan, presented a paper titled "A review of sensors for reducing waste in food logistics and supply chains", at the 27th EurOMA Conference, on 26/06/2020 – 01/07/2020, Warwick, UK. (Presented online at the publication workshop of the conference). The authorship was Ramakrishnan Ramanathan, Daniel Kelly, Bryan Gardiner, Gerard Corkery, Tahmina Ajmal, William Duffy and Joan Condell.
4. Usha Ramanathan, NTU, presented REAMIT at UNIDAVI, Brazil: 'Importance of technology in food supply chains to reduce waste'.
5. PM, Katarzyna Pelc, signed to represent REAMIT at Interreg NWE project 'Food Heroes Final Conference' on 18/03/2020, Brussels. However, the meeting was cancelled due to Covid-19.
6. PM, Katarzyna Pelc, presented 'Introduction to REAMIT' to BMRI staff and research students, Business and Management Research Institute Day, on 13/01/2020, University of Bedfordshire, Luton, UK.
7. PM, Katarzyna Pelc, presented 'Introduction to REAMIT' to BED master students in Logistics, Global Supply Chain and Logistics Management class, University of Bedfordshire, Luton, UK, on 25/01/2020.
8. KP was invited to present REAMIT at 'Waste dinner' event on 16/03/2020 organised by MSc class students in Food Policy at the City University of London, London, UK. However, this event was cancelled due to COVID-19.
9. PI, Ram Ramanathan, was invited to 'Total Food Conference' on 14-17/04/2020 in Nottingham, UK. However, the meeting was cancelled due to COVID-19.
10. PI, Ram Ramanathan was invited to present REAMIT at 'Smart Food Matters' on 24-25/06/2020, London. However, the meeting was postponed due to COVID-19.
11. SenX participated in a conference SMARTAGRI in France: http://smartagri.bzh where SenX was present in the demo area.

KP confirmed that two associated partners of BED have sent feedback on draft REAMIT progress report: Radbound Universityand Oost NL.

20.22.01 Feedback from Radbound University, The Netherlands: BED need to explain better why the project applies for a 12-month extension if the project is delayed by 6 months; BED needs to avoid delaying payment by LP to project partners due to unclear administrative procedures.

20.22.02 RR addressed comments from the Radbound University. He extended thanks to all partners for understanding the delays in payment and felt there was no reason for such delays to occur in the future. He promised to work towards improving internal systems at BED to avoid delays in the future. RR further explained that 12-month extension would be needed for the REAMIT project to account for further delays due to the pandemic as at the time of the RSC meeting lockdown was still in vogue.

20.23.01 Feedback from East Netherlands Development Agency (Oost NL):

- JB asked what the actual delay of REAMIT was.
- JB noted that BED already established good contact with Picnic.
- Oost NL could help involve other companies in the NL to collaborate with REAMIT (e.g. organisations from other Interreg projects e.g. Blockchain project (however, there might be problems due to COVID-19 and companies may resist such collaborations at the moment).
- JB asked if REAMIT set the limit on maximum number of pilot tests.

20.23.02 RR confirmed it would be best to have as many pilot tests as possible. The idea is to minimise food waste and carbon footprint at a larger scale. The REAMIT project still has funds to support more pilot tests. Once the systems are established and can prove that food wastage can be reduced, more companies will be attracted.

20.23.03 KP asked if other partners received any feedback from their Associated Partners on the third REAMIT progress report. Partners confirmed that they had no feedback.

Associated Partner	**Invitation responsibility -- Response**
GIQS	BED -- Unavailable for meeting
Oost NL	BED -- Given
Radbound University	BED -- Given
Jean Routhiau	UoN – No feedback yet
Societe Des Transports EuropeensFrigorifiques (STEF)	UoN and I&R – No feedback yet
Bio search	UU – No feedback at this stage

RR asked partners to send draft third REAMIT progress report to their associated partners who have not yet sent their feedback yet and ask for feedback. RR thanked associated partners for their feedback and suggestions and closed RAC meeting.

Action: UoN and I&R to send third REAMIT report to their associated partners and ask for feedback.

REAMIT Work package meetings (Chair: each WP lead)

<u>WP T1 Adapting and pilot testing sensor technologies in agri-food supply chains.</u>

KP handed over to GM to lead WP T1 meeting.

20.24.01 GM confirmed that Deliverables 1.1, 2.1 and 2.2 have been completed. GM is still working on deliverable 1.2 (Recruitment of companies). Minimum five companies need to be recruited from agri-business supply chains for REAMIT pilot tests and these companies will be described in a document 'Companies recruited for pilot tests in REAMIT'.

GM confirmed that the following deliverables need to be submitted by June 2021:

Deliverable 3.1: Working prototypes using sensor technology
20.25 GM asked whether the REAMIT project would really develop new prototypes. He confirmed that this deliverable would be described in a document titled: 'Working prototypes using sensor technology' and containing the following information:

- Overview of sensors and scanning technologies
- Matrix of food used for analysis in REAMIT pilot tests (meat, fish, fruits, vegetables, etc.)
- Overview of the environment in which food is stored/transported: cold, hot, static, moving
- Conclusions

Deliverable 3.2 User manual for each pilot
20.26 This deliverable would be accompanied by 'User manual' for each pilot test. The user manual will contain the following information:

1. Introduction to the pilot test
2. Description of the pilot test
    - Aim of the pilot test
    - Partners involved in the pilot test
    - Companies involved in the pilot test
    - Technologies deployed in the pilot test
    - Step by step implementation of the pilot test
3. Conclusions from the pilot test: what has been achieved

Deliverable 3.3 Report on the pilot test and development of the sensor prototypes.
20.27 The 'Report on the pilot test and development of the sensor prototypes' will cover the following information:

- Introduction
- Results obtained from the pilot tests
- Good practise examples and lessons learned from the pilot tests
- Recommendations
- Conclusions

GM handed over to KP who invited all pilot test leads to present the pilot test they were responsible for including the companies involved in the pilot test.

<u>Pilot test 1, pilot test lead Whysor with Picnic, the Netherlands</u>

20.28.01 IH and MS from Whysor presented the progress in the implementation of the pilot test with Picnic. They briefly introduced Picnic and the needs of Picnic, which would be addressed by this pilot test. These needs include: i) monitoring the temperature inside food boxes; and ii) measuring shock detection and how roughly food boxes inside the Picnic truck are handled.

20.28.02 IH confirmed that a sensor called EMS from Elsys was selected for deployment in the pilot test with Picnic. This sensor measures temperature, shock detection and humidity. Picnic collects data related to types of food in each food box and customer's complaints related to each food box. This data will be transported to REAMIT cloud, and from the cloud it will be downloaded to the Big Data hub at BED.

20.28.03 MS confirmed that the pilot test with Picnic had been further defined. Whysor asked BED to order 20 EMS sensors and batteries. These sensors will be installed in food boxes inside the Picnic truck. Whysor needs 2-3 weeks for configuration of sensors. Expected start date of the pilot test (with 20 new sensors) is August 2020.

The new sensor is a mini sensor. It also has a battery, which constitutes the biggest part of the sensor. It can be easily hidden and fixed in the food box. This sensor can measure humidity, temperature, acceleration and position. The combination of the last two parameters (acceleration and position) shall help determine how the food box is treated. 20 sensors are connected and data from these sensors is transmitted using KPN LoRaWAN (which has coverage in the entire Netherlands) to the online Whysor cloud. From there, data can be later transferred to a server at BED. It is important to decide whether it is wise to set alerts now. Or otherwise, it needs to be decided when alerts will be sent. This can be done with the help of a functionality called complex event processor available in the Whysor cloud to generate alerts based on temperature thresholds or acceleration thresholds. These alerts are meant to generate new information for the pilot test partner – Picnic.

20.28.04 Frank Gorte (FG) from Picnic confirmed that during the pilot test they bootstrapped this. Ultimately the runners (delivery men and women) are carrying their own runner device. Ideally, the alerts will go through the Picnic backed system to the runner's device. Separate systems will need to be created to bootstrap it. The amount of sensors will not be that big to completely develop these backed systems. The same applies for the data cloud. Full integration of the data should not be the main objective yet, some amount of integration should be made with the data warehouse of Picnic. It should be easy to separate the data into tables for analysis.

20.28.05 MS confirmed that Picnic can use the REAMIT website and use it as an export system for sensor data. There should be some addition to the existing architecture on how the data with Picnic can be used or exported.

20.28.06 MS asked FG how Picnic can provide their data to REAMIT for analysis.
FG said that Picnic measures as much as possible throughout the supply chain and cannot share GPS or address of data. Picnic can share data which contains information about products, volume, weight, density, type of product (liquid or a lattice which has air inside), fill-up rate of the toads, amount of icepacks added (jellified ice-packs provide cooling), time stamp throughout the change, time of pick-up of food in the warehouse, last pick-up done, time when the load leaves the centre and enters the truck. Although it is unreliable data point as it is not measured but entered. Temperature setting inside the truck, time when the truck arrives at a hub, time when the truck leaves the hub, time when the truck arrives at customer's address. This can be augmented with weather data.

MS: Since the distance is 1-2 hours of travel, weather data from the hub should be sufficient to estimate weather data of the truck location.

FG: The distances may be shorter or longer. Weather data is also available in the Picnic data warehouse.

20.28.07 RR thanked MS for presenting the pilot test with Picnic. RR asked what Picnic expected from the REAMIT project and how REAMIT project could help satisfy the needs of Picnic.

MS responded that Picnic's ultimate objective was to deliver fresh products to the customer's house in a way, which was cost efficient and environmentally friendly. Temperature control was a key parameter to achieve this objective. In a typical supermarket you can find products stored in a cool system at 4 degrees C. Often, products in supermarkets are stored in a cool system also at 8 degrees C. Picnic is able to deliver groceries to customers' houses using a closed, chilled box. Many of the products which are stored in ambient environment in a supermarket, are stored in chilled environment in Picnic, and these products are transported to customer's door-steps in temperature of 4 degrees C, or lower. Ideally, Picnic aims to achieve a situation where the only time when there is a chance of food quality degradation, is the time when food is in between the customer's front door and their refrigerator, as during this time the product is not kept in chilled environment.

MS added that other risk areas for Picnic are when a lid of the food-box is not completely closed, or when the amount of ice-pack required to keep the amount of cooling required in the lorry is underestimated (NB Picnic is aware that using ice packs in its lorries has an impact on the environment).

RR asked whether Picnic was able to deliver food to longer distance customers.

FG said that Picnic operates e-trucks and the key parameter was the battery inside each truck. The battery makes it possible for a truck to drive at 50 km/h. With 4, 5 or 6 ice-packs inside a truck, food-boxes are kept cool for hours. Adding weight to a lorry is not very useful. The system has the potential to scale up and operate longer delivery routes. However, the key in this system is the optimal number of ice-packs rather than longer routes.

FG rank shared his experience how Picnic has operated during lockdown due to COVID-19. FG has been involved in company's scale-up and hyper-growth due to arranging deliveries to substantially increased number of customers and orders. Most of customers in pre-pandemic time had their orders finalised just before 10 PM on a day before delivery. However, during the pandemic peak period, many

customers ordered food much in advance. So, the whole forecasting algorithm developed in Picnic was useless. Many new customers registered in Picnic, they downloaded the Picnic APP and used it to order food. A future plan of establishing a fulfilment centre was anticipated and a new fulfilment centre has been opened recently to cope with increased orders. Now the situation is back to normal and hopefully it will remain this way.

20.28.08 MS explained that it is important to sort out what combination of position and acceleration should be used in order to translate it to shock detection. MS confirmed that BED would purchase 20 sensors and batteries to be used in Picnic pilot test.

KP explained that purchase of 20 sensors for Picnic has been put on hold at BED due to a series of questions raised by finance and procurement teams at BED. They included questions of ownership, warranty and insurance of equipment during transit from Sweden to the NL and from the NL to UK.

KP asked MS and FG how delay in delivering sensors would affect the pilot test with Picnic.

MS and FG confirmed that summer time was ideal for data collection because they would get data for different environmental conditions (sun, humidity, rain, etc.) unlike during other seasons, to see the product decay characteristics. The testing could also be done in winter, except that Picnic would be using smaller amounts of ice-packs per load in winter and that the day time available for measuring the parameters would be more in summer than in winter. The difference between outside temperature and inside temperature was more substantial in summer and more number of data points for say 4-weeks period is possible in summer. MS will need some time for endurance tests with summer and expect to start in July-August or probably August if there is delay in the sensors delivery. It is good to resolve ownership issues first given the cost of each sensor is approximately £45 (bulk buy at least 100) or £62 per sensor. Whysor wants have this resolved as soon as possible to start testing and implementation.

RR confirmed that BED would resolve this within the next weeks.

Action: BED will resolve purchase of sensors for pilot test with Picnic within 2-3 weeks.

20.28.09 RR asked whether Picnic could be approached at a later stage for data to create case studies. FG said yes and confirmed there were a number of things that still needed to be determined in the pilot test with Picnic: i) at what point alerts will be sent and to whom (based on the analysis of shock detection / acceleration); ii) personalised cooling profile per food-box needs to be developed (based on the analysis of outside weather conditions combined with data on temperature inside food-box during transport).

20.28.10 MS confirmed roles and responsibilities of Picnic, Whysor and BED in the pilot test with Picnic:

Roles and responsibilities of Picnic:

- Installing sensors inside food boxes
- Administration/collection of information from all sensors in all food boxes
- Administration/combination of other information and data from the Picnic system on each food box (location, type of food in each food- box, complaints linked to each food box)

Roles and responsibilities of Whysor:

- Configuration, registration and endurance test of the sensors
- Delivery of sensors to Picnic
- Maintenance of the sensors inside Picnic’s trucks

- Online storage and visualisation of data from Picnic at reamit.whysor.com
- Transferring data to Big Data hub at BED

Roles and responsibilities of BED:
- Purchase of 20 sensors and batteries
- Development of Big Data hub

20.28.11 RR confirmed that data analysis will be conducted by SenX, ITTralee, Levstone and BED independently based on their own understanding. LM at BED could be involved in cleansing the data and providing the data in a common structured format.

MS confirmed that Whysor preferred to do their own cleansing of raw data.

RR agreed and confirmed that all four technology partners would have their own ways of cleansing and analysing data. BED could perform any common data handling activities that would remove any repeated functions at individual partner level. The specific roles of each partner could be agreed upon at a later stage.

20.28.12 MS confirmed the following challenges with the pilot test with Picnic that need to be considered:
- The importance of privacy of consumers (GPS data sharing concerns)
- Delay in purchasing sensors at BED
- The impact of COVID-19: lockdown and work from home restrictions have had impact on the pilot test with Picnic but partners hope to be able to move on with the pilot test soon and recover the time 'lost'

20.28.13 FG made a presentation about Picnic and the company's business model. Contrary to a traditional supermarket, Picnic draws inspiration from the milk-man last mile delivery to deliver products to the customer's doorsteps via a last mile radar delivery system. Picnic has 7 fulfilment centres and more than 60 hubs spread across two countries. The delivery cost reduction from reduced food wastage (they don't have to maintain excessive inventory) offsets the additional costs involved in the last mile deliveries.

Q&A session about Picnic and the pilot test with Picnic

Q1: How does Picnic keep their prices competitive compared with supermarket prices?
FG: By focusing on efficient operations throughout the supply chain.

Q2: Does Picnic keep track of environmental impact?
FG: Picnic has not specifically considered environmental impact study but certainly the current set-up is environmentally friendly because of less food waste and less transport involved. Picnic's electric trucks also contribute to Picnic's position as environmentally friendly company.

Q3: Does Picnic have physical fulfilment centres or is it a virtual centre where Picnic gets all information (demand for food ie food orders and supply of food from food producers/suppliers).
FG: It is a physical building of 8000 square metres. It is an industrial supermarket.

Q4: Do all fulfilment centres have the same products?
FG: More or less except for some local differences based on local food preferences.

Q5: How does Picnic handle traffic?

FG: On a typical day, the traffic is known and predictable. So it is not much of an influence because Picnic also learns from previous deliveries how long it takes to deliver the products to achieve a second-precise delivery accuracy.

Q6: Would the 20 sensors provided by BED be placed in one truck or in multiple trucks?
FG: Picnic plans to place the sensors inside one truck.

Q7: Does Picnic face any competition in the area?
FG: Picnic has a good business model unlike traditional supermarkets with which Picnic is able to capture decent market share.

Actions for the pilot test with Picnic:

1. **BED to finalise purchase of 20 EMS sensors from Elsys and 20 batteries.**
2. **Whysor to do configuration of sensors.**
3. **Whysor to install 20 sensors in the Picnic's truck.**
4. **Whysor to connect 20 sensors and arrange for transmission of data from sensors using KPN LoRaWAN (which has coverage in the entire Netherlands) to the online Whysor cloud.**
5. **Whysor, BED, Levstone to arrange for data to be transferred from Whysor cloud to Big Data server at BED.**
6. **Whysor and BED to decide whether it is wise to set alerts now (with the help of a functionality called complex event processor available in the Whysor cloud to generate alerts based on temperature thresholds or acceleration thresholds. These alerts are meant to generate new information for the pilot test partner – Picnic.**
7. **Whysor, BED and Picnic to develop a system to generate alerts for Picnic.**
8. **Whysor and BED (with assistance from ITT and SenX) to integrate data obtained from sensors with data in warehouse of Picnic.**
9. **BED (with assistance from Whysor, ITT and SenX) to separate the data into tables for analysis.**

<u>Pilot test 2, pilot test lead Whysor with Weyers GMBH, Germany</u>

20.29 MS presented the pilot test with Weyers GMBH. Weyers GMBH is fresh fruits and vegetables transporting company, which transports these goods from where they grow, through warehouses to supermarkets. The company is based in several countries including Germany and the Netherlands. Weyers GMBH were provided with VOC and GPS sensors (from REAMIT) in January 2020 by Whysor. These sensors would be built into their trucks from where the data will be received and transported to the reamit.whysor cloud. The sensors will also measure VOC, CO2, temperature, pressure and Lux. Data will also be collected on weather conditions and employees' inputs. The connection to the cloud is through a gateway. The situation with this pilot test in July 2020 is the same as it was in January 2020. The communication from their side is very poor now due to COVID-19 and Whysor finds it challenging to continue the pilot test with this company.

MS confirmed that it was difficult to re-establish good communication with Weyers, following COVID-19 crisis. MS recently got an update from Weyers that Whysor's contact person at Weyers was back at work only last week (end of June 2020). MS planned to approach Weyers to discuss whether they were still interested in continuation of REAMIT pilot test.

RR confirmed that it was not unexpected to see such outcome given the current crisis situation due to COVID-19. We would hope that Weyers GMBH came back to us after they stabilised. RR asked whether REAMIT has already provided some sensors to Weyers GMBH.

MS confirmed that REAMIT has provided sensors and gateways to Weyers which have been installed in their storage room. Whysor planned to also install them in Weyers trucks.

Actions for the pilot test with Weyers

1. **Whysor to re-establish contact with Weyers to check if they are still interested in REAMIT project.**
2. **Whysor to install VOC and GPS sensors provided by REAMIT (January 2020, by Whysor) in Weyers trucks.**
3. **Whysor and BED to arrange for receipt of data from sensors and transport of data to the reamit.whysor cloud.**
4. **Whysor to arrange collection of data from sensors on VOC, Co2, temperature, pressure, Lux, weather conditions and employees' inputs.**
5. **Whysor to arrange the connection to the cloud through a gateway.**

Break for 30 minutes

Pilot test 3, pilot test lead Ulster University with WD Meats, UK (Clostridium bacteria)

20.30.01 Mark Logan (ML) from WD Meats made a presentation of the company. WD Meats is a family owned company established in 1979; it slaughters 1300 cattle per week, employs over 460 employees, and is a market leader in Northern Ireland. It produces beef (dry aging/maturation processed, fresh and frozen mince, fresh and frozen dice, stir-fry beef, stamp beef, portion controlled products controlled by weight and size, packed steaks, thermoformed steaks) and delivers it to supermarkets.

ML confirmed that two important issues would need to be addressed in WD Meats, which contribute to biggest food waste:

- detection of clostridium bacteria
- monitoring of meat quality in dry aging chamber

ML confirmed that REAMIT pilot tests would focus on addressing these two challenges of WD Meats.

In the Clostridium bacteria pilot test, WD Meats are looking for a solution where testing of meat can be done in a laboratory, say for 48 hours, to determine the amount of clostridium bacteria in meat, and based on it to predict spoilage and quality of meat and consequently determine ways to isolate the affected meat.

Q&A for pilot test with WD Meats

Q1. How long do you think the trials will last?
ML: Dry aging trial may take a few weeks. Clostridium trial may take a little bit longer because it will need identification of the right technology.

JC: The sensors for dry aging was planned to arrive from Mathias, unfortunately it has not arrived yet. So UU is currently on the search for alternatives.

RR reminded that the ultimate goal of all REAMIT pilot tests should be reducing food waste and emissions of CO2 as per the goals of the REAMIT project.

ML and JC reassured that by effectively conducting both pilot tests, reduction of food waste can be as much as 100,000 tons of meat per year.

Actions: JC and WD to identify an alternative sensor and sensor supplier to the one promised by Mathias from Freshdetect.

JC further mentioned that WD Meats leases out the transport to a company called Blairs. UU are planning to work with data from Blairs to monitor quality of food during transportation.

RR confirmed that he supported this idea as something that could be addressed later or separately from the pilot tests with WD Meats.

Action: JC to pursue with WD Meats and transport company Blairs for a transport pilot.

WD from UU presented the progress in the implementation of Clostridium pilot test with WD Meats:

20.30.02 Clostridium bacteria develops in meat inside plastic packaging. This bacteria makes the package to bulge. Bacteria produces gases, including CO2, and creates anaerobic condition inside the package. Meat infected by clostridium bacteria is not harmful because bacteria does not produce any toxic gases. However, technically this meat is inedible because of its taste and smell, which significantly contributes to food waste. Many countries have the same problem. It is suspected that clostridium bacteria comes from soil. The hides of animals, as they are brought into the abattoir, are washed, and animals generally do not like this procedure and it makes them stressed. Avoiding washing the hides of animals may reduce stress and translate into better quality of meat, which may potentially reduce the amount of bacteria in the meat. It may be then possible to prioritise the meat to be sent out first to supermarkets, or to be removed immediately. Prof. James Dooley, a microbiology specialist, has been recently approached by UU and invited to join the REAMIT team. He would work on microbiology experimentation – Polymerase Chain reaction or DNA extraction. Also, UU is currently working on identifying the right sensor, which can be installed properly and send alerts about clostridium bacteria. However, UU team are still unsure what data should be collected by this sensor.

Q&A about the pilot test focused on Clostridium bacteria

Q1: What volume of meat is affected by Clostridium bacteria?
WD: It is volume of meat which is worth a few hundreds of thousand pounds per year (for WD Meat).

Q2: What happens with meat when it is affected by Clostridium bacteria? Is it still eatable and sold or becomes waste?
WD: It depends on how long the meat is kept inside the vacuum sealed packaging. It can be eaten immediately, but most likely it becomes inedible because of its smell and taste.

Q3: At which moment the company realises the meat is affected: when the meat is still within the company, transported or on the supermarket shelf?
WD: It could be any of them. It depends on how long the meat sits in the company and in what temperature it is stored. This bacteria only grows inside the vacuum packaging. So it is not possible to know that it was there when the meat was kept outside of the package, unless it was tested. The higher the temperature when the meat is inside the vacuum packaging, the quicker and greater is the growth of bacteria. Some bacteria will be detected in the factory and some will be detected in the retail stores.

Q4: How long will the packaged meat stay inside the company before it is distributed? Is it hours or days?
WD: Not 100% sure. It maybe a few days.

JC: It is less than a week, and most probably it will go out on the same day or the next day.

Q5: Will the sensor be able to detect bacteria through the foil?
WD: At the moment, we are not sure. Realistically, the meat may be tested even before packaging, while it is still on the conveyor belts. It may be possible to find some way to wash something off the meat while the meat is on conveyor belts. Once the meat has been packaged, the sample cannot be taken because it will disturb the vacuum and the meat will get spoiled in such case. It is best to test for bacteria in a common area (such as conveyor belts), where all the meat is going through.

Q6: Is the testing conducted as part of food safety requirements to maintain meat quality levels, before the meat is packaged? This could help narrow down your search for the right sensor and data to be collected from meat samples.
WD: WD Meats perform tests for food safety inside the plant by acid spraying procedures that kill the bacteria. The problem is the frequency of fogging of the meat since it damages the working area and machines, and the plant cannot run while the acid is being sprayed.

Q7: You mentioned that there would be an alert generated through the sensors. What kind of alert would you be looking for?
WD: The alert could be made when meat is beginning to expire due to bacteria. The alert could be made before fogging to take necessary action for fogging. Secondly, the alert can be used to prioritise or redirect the meat to the nearest supermarket/restaurant before it goes to waste.

Q8: Does all meat need to be packaged?
WD: Not sure. Vacuum makes the bacteria expire faster than other methods.

20.30.03 WD summarised the status with this pilot test and confirmed that UU was waiting to get on the site and start off with PCR (PCR stands for Polymerase Chain Reaction i.e. a method used in this case to take samples of meat DNA for detailed analysis). There are commercial kits available for detecting this bacteria specifically with PCR. The lab at UU can be used for doing this faster than doing it in the company. But, his would not be a long-term solution. The idea is to first find out the method to detect the bacteria and then determine the sensing equipment that could help detect without the laboratory testing.

20.30.04 WD confirmed roles in pilot test with WD Meats: UU's role is to select the right sensor and find ways to detect the bacteria. WD Meats' role is to provide the permission to run the tests on the company's site.

20.30.05 WD confirmed there were several challenges related to this pilot test. First, other people have already been able to detect the bacteria using PCR or DNA extraction, but not through ambient ways. Second, COVID-19 has had an impact on the progress of activities within the pilot test, mainly since UU's team was not able to access the company's site for several months. As soon as WD Meats reopens, UU team will enter the company's sites to assess the sites and determine where to install the sensors.

Actions for the pilot test with WD Meats (Clostridium bacteria)

1. **As soon as it is possible (due to COVID-19 lockdown restrictions) UU to access the sites of WD Meats to determine where to install the sensors.**
2. **UU to carry out PCR analysis on meat samples from WD Meats in the laboratory of UU (this will be a temporary solution to determine the method to detect the bacteria.**
3. **UU to identify an alternative sensor and sensor supplier to the one promised by Mathias from Freshdetect.**

4. **UU to determine the right sensing equipment that can help detect Clostridium bacteria without the laboratory testing i.e. in ambient environment on the sites of WD Meats while the meat is still on the conveyor belts.**
5. **UU to use the sensing equipment to detect Clostridium bacteria on the sites of WD Meats.**
6. **UU to pursue with WD Meats and transport company Blairs for a transport pilot.**

Pilot test 3, pilot test lead Ulster University with WD Meats, UK (Dry aging chamber)

20.31.01 WD introduced a dry aging chamber pilot test with WD Meats. Meat would be hanging in the dry aging room for about three weeks. The air extraction and the cooling fans are generally on one side of the room, which creates a gradient of different temperatures, oxygen levels and humidity across the room, leading to meat spoilage. To solve this problem, the pilot test would install temperature and humidity sensors across different points in the room. UU has approached a company called Tsenso, and Tsenso has offered to send out its sensors to UU to be used in this pilot test. However, due to internal problems within Tsenso, the sensors have not yet been delivered and UU has started to look for alternative options. UU plans to use LoraWAN connectivity for transferring data from sensors to the cloud. Once this has been set up and the analytics done, UU intends to approach to solve the problem by generating alerts indicating the meat which is spoiling fastest in the dry aging chamber, or provide solutions to reconfigure the dry aging chamber to sustain consistent temperature and humidity gradients. Whysor has sent to UU an EMS sensor that shall be tested for this pilot test. UU will work with Levstone and Whysor in order to install this sensor in a dry aging chamber and to transmit data from this sensor to the cloud.

20.31.02 WD confirmed the status of this pilot test implementation: UU is currently waiting for WD Meats to open its sites to UU so that UU team can install sensors within the company's sites.

20.31.03 WD confirmed roles in the implementation of this pilot test: UU installs the sensors and WD Meats allows UU to use the chambers.

20.31.04 WD confirmed the following challenges with the implementation of this pilot test:
- Due to COVID-19, WD Meats remained inaccessible for UU team as the company was locked down for outsiders
- Procurement process at UU has been frozen for several months

20.31.05 RR suggested that UU team work with Whysor and Levstone on choosing sensors and fitting them inside WD Meats sites. This is to ensure uniformity and consistency in these tasks across all pilot tests.

Action: UU team will work with Whysor and Levstone on choosing sensors and fitting them in the sites of WD Meats. This is to ensure uniformity and consistency in these tasks across all pilot tests.

Q&A

Q1: Is the focus of this pilot test driven by the needs of WD Meats? Does this mean that other (similar) companies face similar problems?
WD: Yes, the focus of this pilot test is driven by the needs of WD Meats. Many similar companies face similar problems, especially with clostridium bacteria. As for the dry aging chamber, it all depends on how these chambers are configured with temperature and humidity levels.

Actions for the pilot test with WD Meats (Dry aging chamber)

1. **Once WD Meats opens up again, UU to access the sites of WD Meats to assess where to install sensors in a dry aging chamber.**
2. **UU to work with Whysor and Levstone on choosing the right sensors suitable for fitting inside WD Meats's dry aging chamber.**
3. **UU to purchase sensors suggested by Whysor.**
4. **WD Meats to facilitate installation of sensors by UU.**
5. **UU to install sensors in dry aging chamber.**
6. **Whysor and Levstone to ensure uniformity and consistency in connecting sensors to cloud across all pilot tests.**

Pilot test 4, pilot test lead UU (3D Fluorescence sensor), UK

20.32.01 WD said that 3D Fluorescence sensor is usually used in medical environment. It is too bulky and not suitable for certain scenarios, and it is also very expensive technology. If used in analysing quality of meat, 3D Fluorescence sensors can detect the total amount of bacteria on meat.

WD confirmed that UU discussed with Matthias Heiden procuring sensors for 3D fluorescence pilot test, even though UU does not yet have a pilot test lined up with any specific company.

RR suggested going ahead with this pilot test.

20.32.02 TA suggested another German company for procuring hand-held device as a second option. Chelsea (company) do not have experience with sensors used in food context. TA was concerned about dealing with a bankrupt company when procuring sensors from Matthias Heiden. WD suggested that the sensors they provide can be used for producing a proof of concept. Ulster will need to decide in the next few months which technology they will go with. FreshDectect, Flurotech or the German tech company TA mentioned or Chelsea Technology. Once this has been done, we can take this pilot test forward.

20.32.03 RR said that by the next RAC/RWP/RSC meeting, we hope to have good progress with this pilot test. He confirmed that in the next few months the project would need to make some progress in the implementation of 3D Fluorescence pilot test, either by choosing one sensor supplier from among several companies (FreshDetect, Flurotech, the German tech-company and Chelsea Technology – the last three companies have been suggested by TA) or by listing pros and cons of each approach. If the companies are interested to commercialise their technology by acquiring patents etc., we would need to think about it deeper.

Actions for the 3D Fluorescence pilot test

1. **UU to action procurement of two 3D Fluorescence sensors from Matthias Heiden from FreshDetect.**
2. **In parallel, UU to explore other possibilities of procuring 3D Fluorescence sensors from the following companies: Chelsea Technology (German company suggested by TA), Flurotech (company in the UK suggested by TA) and German tech company (suggested by TA).**
3. **UU to develop a document listing pros and cons of 3D Fluorescence sensors offered by each of the companies: FreshDetect, Chelsea Technology, Flurotech and German technology company.**
4. **UU to investigate whether the company selected to provide 3D Fluorescence sensors for pilot test with WD Meats is keen to commercialise their technology by acquiring patents. If yes, UU to develop a list of steps necessary in the process of patent acquisition.**

Pilot test 5, pilot test lead University of Nantes (Raman Spectroscopy), France

20.33 Ali Assaf (AA) from the University of Nantes confirmed that Raman spectroscopy is an optical method to detect chemical composition of product samples, in this case food product samples. The sensors will be integrated in a food truck and will provide data on the quality of food during transportation. This data will be further used for analytics.

In the Raman Spectroscopy pilot test run by UoN, the Raman sensor along with classical sensors (measuring temperature and humidity) will be used. The first pilot was scheduled to start in March 2020 with Routhiau (fresh food producer company in France). However, due to COVID-19 this pilot test has been put on hold. Also, due to COVID-19 and transportation delays in France, UoN has only recently received some elements of the spectrometer equipment. In this pilot test UoN works with chicken samples from Routhiau. The applied technology considers bacterial count to validate measurements. The pilot test is planned to reassume in September 2020. The overall delay is estimated as 6 months.

Actions for the pilot test at UoN with Raman Spectroscopy

1. **UoN to complete purchase of all elements of Raman spectrometer.**
2. **UoN to start the first round of measurements with Routhiu to test Raman set-up.**
3. **Whysor and SenX, to support UoN with transmission of data from Raman sensor to REAMIT cloud.**
4. **UoN to agree with Whysor frequency of data transmission from sensor to REAMIT cloud.**
5. **BED and Whysor to help UoN with data transmission from sensor to cloud.**

<u>Pilot test 6, pilot test lead UCD (Cyber bar), Ireland</u>

20.34.01 Saptarishi Chakravarty (SC) from UCD made a presentation about his master's thesis work, which focuses on Cyber bar technology.

20.34.02 Shane Ward (SW) from UCD confirmed that COVID-19 caused major problems and delayed the implementation of the Cyber bar pilot test. Due to COVID-19, there has been very strict protocol at UCD, which restricts staff from UCD from participation in any field work during the pandemic. The situation will be reviewed in September. COVID-19 has also delayed hiring a post-doctoral scholar at UCD who would work on REAMIT, but hopefully the new staff member will be in place by the time the Cyber bar pilot test is up and running.

Action: UCD to send LP an update of the situation with developing cyberbar pilot test.

20.35 KP thanked all partners and companies for presenting the progress with the implementation of REAMIT pilot tests. She asked partners for information about status of pilot tests in the pipeline.

AA from UoN and GM from I&R updated partners about new pilot tests in France:

- Some end users in France (i.e. Cooperative BbaMV which deals with milk and dairy products) are interested in participating in REAMIT pilot test. However, due to pandemic there has been very little interaction with them recently. UoN has sent a proposal to BbaMV and awaiting for their reply and final decision after COVID-19.
- Egg producer company in France (IGRECA) has been approached and invited to participate in REAMIT pilot tests. Also, sea-food producer company is interested in participating in REAMIT pilot tests if Raman sensors can produce good results.
- A company called Adria is interested in collaborating with REAMIT as they are willing to incorporate Raman technology in their prediction model. However, ADRIA refused to be part of a pilot test due effects of COVID-19. However, one partner from the consortium is willing

to test one batch of sample with Raman spectroscopy, and if they find the results positive, they are ready to engage in a full pilot.
- French partners have experienced difficulties in recruiting new companies to participate in REAMIT pilot tests, given companies hit by COVID-19 prioritise their daily business nowadays, not research.

Actions

1. **UoN and I&R to confirm whether BbaMV (milk and diary products consortium) will participate in developing a new pilot test in REAMIT.**
2. **UoN and I&R to confirm whether IGRECA (egg producer in France) will participate in developing a new pilot test in REAMIT.**
3. **UoN to confirm whether sea-food producer company will participate in developing a new pilot test in REAMIT using Raman spectroscopy.**
4. **UoN to confirm whether one partner from Adria consortium will test one batch of sample with Raman spectroscopy (and if they find the results positive, whether they will engage in a full pilot).**

RR asked:

- Whysor whether there was an update from Meyer QLS. IH responded that Whysor's contact person in this company has been made redundant due to COVID-19 issues and Whysor received no updates since then.
- RR asked NTU whether there was any update about Tesco. UR responded that due to COVID-19 NTU's contact person in Tesco conveyed that their operations would be delayed. NTU will keep trying to bring new pilots from other companies such as Pespsi and few other smaller consortia from their networks and other projects, once the COVID-19 situation become less severe.

RR updated partners that another attempt to approach METRO through Tsenso has not gone through because Tsenso was out of contact due to COVID-19 and this affected the contacts with METRO.

Actions:

1. **Whysor to approach Meyer QLS to find out if Meyer QLS will participate in the REAMIT pilot test.**
2. **NTU to approach Tesco to find out if Tesco will participate in the REAMIT pilot test.**
3. **NTU to approach Pepsi to find out if Pepsi will participate in the REAMIT pilot test.**
4. **NTU to approach smaller consortia in NTU's networks and projects to find out if they will participate in REAMIT pilot tests.**
5. **BED to approach METRO through Tsenso to find out if METRO will participate in REAMIT pilot test.**

RR acknowledged difficulties that pilot test leads and companies were facing and suggested that a gentle regular interaction would be sufficient to ensure the pilot companies remembered about the REAMIT project and came back to us when they had sufficient time and resources. RR confirmed it was not advisable to push the companies too much. RR confirmed that JS was also informed about difficulties faced by the REAMIT project and its partners in the implementation of WP T1.

20.36 GM from I&R presented a document which is being developed by I&R (based on inputs from all pilot test leads) on the impact of COVID-19 on REAMIT pilot tests.

RR thanked everyone for actively participating in all pilots despite very difficult times during the pandemic.

WP T2: Big Data integration and application to reduce food wastage (Chair BED)

20.37 Dr Pat Doody, Director of IMaR, at IT Tralee made a presentation about ITT. He introduced IMaR and its structure, as well as different projects at Intelligent Mechatronics and RFID (IMaR) group. He confirmed that the recruitment of a research assistant from India was being finalised. The candidate was selected but was awaiting completion of VISA process. ITT is exited to perform analysis for REAMIT as soon as there is data available from pilot tests.

Q&A
RR confirmed that BED would be interested in working with ITT on aquaculture projects. Since IMaR also had expertise in sensors and RFID, RR asked whether IMaR would support BED in selecting sensors.

PD answered that ITT was an expert in this field, right from high frequency to active tags. ITT could offer support in selecting the right kind of technology for the right scenario.

Action: BED to work with ITT for suitable collaboration opportunities in aquaculture, outside of REAMIT.

RR thanked participants for active participation in Day 1 meetings. He confirmed that an updated agenda for Day 2 meetings would be sent to all attendees later that day.

End of Day 1

Day 2, 9th of July 2020

RR welcomed attendees to the second day of RAC/RWP/RSC meetings. He confirmed that the second day of REAMIT meetings would run according to the updated agenda circulated by KP in the evening of the previous day.

RR handed over to LM who presented progress in the implementation of WP T2 as per deliverables.

WP T2 Big Data integration and application to reduce food waste

WPT2 Deliverable 4.1 Creation and launch of interface for each of the 5 pilot tests for collecting data from sensors and sending it to cloud for use in a transnational Big Data infrastructure (by July 2021)

LM presented the progress of this deliverable in each pilot test:

Two pilot tests led by Whysor with Weyers (Germany) and Picnic (The NL)

20.38.01 Whysor has developed a REAMIT project dashboard which is being currently used to receive data from sensors installed in the German pilot test with Weyers GMBH. The Dutch pilot test with Picnic has slowly begun to reassume after COVID-19 and sensors are yet to be installed. The sensors have been installed on the site but not inside trucks. Whysor hopes to have sensors installed in trucks too and to receive data from truck, as soon as COVID-19 situation and lock-down have relaxed.

LM confirmed that REAMIT cloud currently receives data on temperature, humidity and VOC. The REAMIT team will need to prepare a scenario enabling the REAMIT cloud to receive and manage other types of data received from all REAMIT pilot tests. Even though it maybe early at this stage to have

such discussion, nevertheless it is good to start planning this kind of scenario to obtain new inputs, ideas and clarifications in due course.

Pilot test led by the University of Nantes (with Routhiau), France
20.38.02 Whysor and SenX have supported UoN with sending data to REAMIT cloud. However, due to COVID-19 no data has been collected yet.

Pilot tests led by Ulster University (with WD Meats), UK
20.38.03 Whysor are preparing a list of potential LoRa enabled sensors, which can track temperature and humidity and will be used in the WD Meats dry-aging pilot test. Prof. James Dooley, microbiology expert at UU, has agreed to help find a suitable sensor for the Clostridium pilot test. Hence, discussions about data sharing and transporting to cloud is yet in preliminary stages and not seriously thought through at this point.

No further updates from other pilot tests have been provided regarding sending data to cloud.

Action: REAMIT sub-team (BED, Whysor, SenX, Levstone, ITT) to develop a scenario enabling the REAMIT cloud to receive and manage other types of data received from all pilot tests (not only data on temperature, humidity and VOC).

20.38.04 Levstone has implemented and added Google variant encoding to Levstone's platform – Warp 10 to help efficiently transfer data to the cloud. They have added a caching mechanism (accelerator) and other developments to their technology to help transfer small and large data in timely manner or with minimum delay.

Action: Levstone to work with Whysor in using Levstone's new platform for REAMIT.

WPT2 Deliverable 5.1 Big data platform with capability to collect and store sensors data from all REAMIT corridors (January 2020 -July 2021)

20.39 LM confirmed that based on inputs from Whysor, ITT, Levstone and SenX, BED has developed specifications of equipment for Big Data hub and software platform at BED. BED is in the process of purchasing integrated physical equipment (three quotations have been requested and the specifications have been finalised based on best price offer, in stock options, convenient deliveries and supplier location). In the recent days (on 28 June 2020) BED received approval from the IT department at BED and has also requested quotations for software licensing (for Windows server SQL 2019 and Windows server standard 2019).

Actions for WP T2:

1. **BED to finalise purchase of equipment to build the Big Data hub at BED.**
2. **BED to finalise purchase of software necessary for the Big Data hub at BED.**
3. **BED (with the help of ICT at BED) to prepare a room at BED (Luton campus) where the Big Data hub will be mounted.**
4. **With the help of equipment supplier, BED to finalise building up of the Big Data hub, including installation of software.**

WPT2 Deliverable 7.1 Launch of smartphone App for linking food owners, truck drivers and warehouses (January 2020 -July 2021)

20.40 LM confirmed that three sensors have been tested for logging data to the cloud by Levstone. The data is in raw form with minimum manipulation with no alerts and feedback to the Mobile App.

The next phase will be to perform data collection and management. A web progressive app for visualisation and data presentation is being developed. The work for data presentation to user clients self-enrolment. The App is ready for further testing on multi group users for a pilot and will need some fine tuning to suit the user requirement.

Actions for WP T2 Deliverable 'Launch of smartphone APP'

1. **BED, Levstone and Whysor to collect data from sensors, including developing step-by-step written procedure for collecting data from each REAMIT pilot test and sensor.**
2. **BED, Levstone and Whysor to develop guidance on managing data collected from REAMIT sensors.**
3. **Levstone to develop a web progressive APP for visualisation and data presentation.**
4. **Levstone, BED, Whysor, SenX and ITT to propose how data will be presented to end-user clients.**
5. **Levstone to propose self-enrolment APP for end-user clients.**

Several questions were raised by REAMIT partners:

Q1. What is the data size we expect to have from each pilot test?
A response to this question was provided by partners while answering question on data types.

Q2. When data will be collected?
Data may start being collected from early August 2020.

Q3. What type of data will be collected?
RR confirmed that data will be collected on temperature, humidity, VOC, lighting and shock type. At this moment, pictures or videos are not expected (but they are not excluded). Pilot tests involving Raman spectroscopy may have pictures. One option is to do processing of spectral data before sending it to cloud and the second option is to deal with it later (this should be discussed at a later stage).
RR confirmed he was in touch with technology partners for edge processing which may be also considered to save bandwidth. As of now we can predict relatively simple data for the first few pilots.

AA confirmed that data from Raman pilot test will be excel or .txt of 1 KB/spectrum. Data will have no pictures or videos. The total size of the data will be around few KB. The data base will have bigger sizes but automatic data sent will be small.

Action: UoN to send some examples of spectral data (completed)

Q4. Will vehicle route data be also transmitted?
RR answered that yes; this data will also be transmitted. It will also depend on confidentiality agreements as highlighted by Picnic.

Q5. Is the common cloud platform going to be Whysor?
RR: Given the fact that Whysor will be installing all the sensors in all the pilot tests, it should be the one. RR confirmed he was not sure about the capacity of Whysor's cloud to host REAMIT data.

IH confirmed that Luke would send information regarding the above questions.

Action: Luke from Whysor to send responses to the questions on data collected in cloud (i.e. Is the common cloud platform going to be Whysor? Will vehicle route data be also transmitted? What is the capacity of Whysor cloud to store data?

Action: At the end of each pilot test, each pilot test lead will fill out a form to provide information how WP T1 is connected to WPT2. Each pilot test lead will send a completed form to BED.

Action: BED and technical partners will develop a template for how WP T1 is connected to WP T2.

LM invited SM from Levstone to make presentation on the progress with implementation of WP T2.

20.41.01 SM confirmed there were three solutions of sensor architecture for REAMIT:

- External power (plug socket) – organised with gateway and sensors plugged in
- Standalone (battery) – a sensor within a box
- Sensor + mobile phone – a tiny sensor with a battery that will last for 4-5 years. It can be used with a mobile phone and will not need a router. It is a powerful option for transportation, and it is very easy because it uses the driver's phone.

The two sensors Blue Maestro Pebble and Blue Maestro Temple Disc have been tested. Temple Disc is available in Amazon retail website for about GBP 50. They have an open published interfacing protocol for communication.

The Temple disc provides pressure, temperature, dew point and humidity readings. The sensor can be accessed from 10 – 20 meters away without an obstacle and 7-8 metres with an obstacle in between. The mobile app can control the starting and stopping of sensor scanning by manually entering distance information and by selecting the required sensor. The two advantages of using the phone are the ability to access meta data (information about type of truck, type of food, temperature, pressure association with the food) and the battery life. If the sensors are put in a box, there will be loss of the accuracy of the temperature and humidity. Levstone aims to move towards the Temple disc approach and only extract useful metadata. SM showed a sample look of data on the cloud which can be accessed by clicking on the following links:

Test 1 (without readable time strings, not verbose):
https://54.154.197.71:8440/api/query_WISE4220_signal_log/896742137454/0/0

Test 2 (with readable time strings, verbose):
https://54.154.197.71:8440/api/query_WISE4220_signal_log/896742137454/0/1

Test 3 (24 Hours real test data)
https://54.154.197.71:8440/api/query_WISE4220_signal_log/896742137454/1575427677000/1

Test 4 (24 Hours real test data)
https://54.154.197.71:8440/api/query_WISE4220_signal_log/896742137454/1575417600000/1

The interface is working now. The next step (before the end of July) is to launch the first version of the app which gives the ability to connect the sensor and start to collect data. This approach could be used with Picnic and a comparison could be made with other sensors to see the temperature profiles etc. IoT sensors may not be very reliable and directly usable. It will be good to test them, compare them for validating which sensors are more reliable.

IoT sensor standalone device with 7 Amp battery which lasts for 41 hours – 18 hours to charge, 6 hours to settle down. The concept is good but has some disadvantages: limits flexibility in changing configuration, remote configuration control will not work through mobile internet because of too many proxies, temperature reported is too high (2^0 C) due to self heating from components, humidity values have a heavy lag of up to 5-6 hours to drop from 75% to 45% after the sensor is brought from

a cold and damp outside place to dry box. Simon highlighted the pros and cons of using Bluetooth and Wifi.

GM from I&R highlights that GPS data is sensitive to many companies which need to be considered while dealing metadata. SM says that they are only presenting different options and it is up to the stakeholder to choose which data they want to deal with.

Actions

1. **Levstone, to launch the first version of the APP, which gives the ability to connect the sensor and start collect data.**
2. **Levstone to assist Whysor in using this approach with Picnic.**
3. **Levstone and Whysor to assist other pilot test leads use this approach for other sensors in order to make comparison to see temperature profiles.**
4. **Since IoT sensors may not be very reliable and directly usable, Levstone and Whysor to test them and compare them for validation with sensors which are more reliable.**

Q&A

Q1. Are the sensors used by Whysor compatible with the smart phone app Levstone is using or do we need to involve Levstone when procuring the sensors for each pilot test?
SM: The sensor suppliers would provide their own proprietary licensed software and may not be compatible with other sensors.

RR suggests that Simon discusses this nuances and work with Whysor to make sure that sensors from all pilot tests are compatible with the mobile app.

SM says that they are having a different solution compared to Whysor's solution. The first two options they presented use a router and the data can be sent to the cloud, while in the third one it is logged to a mobile phone. These are two different architectures.

RR says that in some cases, it may be better to transmit data through the phone and then transmit it to the cloud. The solutions provided may be good to serve the needs of the pilot scenarios. However, we need to be careful and avoid a situation that different partners come up with different solutions that are not compatible with each other at the integration stage.

MS (Whysor) addressed RR's question whether Elsys sensor has the open feature of getting connected to other environments. MS confirmed that Elsys sensor connects to the cloud using LoraWan connectivity. It is not a problem for Whysor if communication between sensors and cloud is different.

SM confirmed that Levstone aimed to have some early version enrolment in September 2020 to have a second database. Many companies (to be engaged in REAMIT pilot tests) will want to see real data before they get convinced about what the project can offer.

MS confirmed that Whysor can provide data Whysor is gathering at the moment through their API, and send it to Levstone's app. Simon suggests to have a separate conversation on the server, as it hasn't yet been collectively decided effectively to see where the data is going to reside, in what format and how it is going to be shared.

RR agreed with Simon's point about not having additional layers of data transfers.

Action: LM (BED), MS (Whysor) and SM, DB (Levstone) to come together and make a decision on the best architecture to receive and send data to the cloud, data formatting and method of sharing with partners. The options to consider are to either use the server at BED or the reamit cloud set by Whysor and Levstone.

RR requested that AA (UoN) sends some data to LM (BED), MS (Whysor) and SM (Levstone) to have a first look at the data. AA confirmed he held talks with MS about sending data from UoN to the cloud.

Actions:

1. **Levstone and Whysor to ensure that all sensors used for REAMIT pilot tests are compatible with the smart phone APP from Levstone.**
2. **Levstone to propose an early version of enrolment (to have a second database). This is to ensure that REAMIT partners have something to show to new companies (to be engaged in REAMIT pilot tests) i.e. to show real data so these companies can see what REAMIT can offer.**
3. **Whysor to provide data Whysor is gathering at the moment through their API and to send it to Levstone's APP.**
4. **Levstone, BED and Whysor to decide where data from sensors will reside, in what format it will reside and how it will be shared.**
5. **UoN to send some data to LM (BED), MS (Whysor) and SM (Levstone) to have a first look at the data.**

KP asked SM about the database Levstone would be building. Who will be in the database? What will be the location? From where data will be coming from (UK or all REAMIT corridors)?

SM confirmed that Levstone's database is self-enrolment database, where an organisation can self-register and enter data such as location, places, description of food types, trucks, alternative places to deliver food, sensor data, Levstone's bluetooth app data. The organisation should be able to enrol itself and load data related to food journey. The customer should be able to access this database and data.

Q2: How Levstone will reach out to the organisations that should enrol in the data base?

SM: There will be a web front end. The organisation will be able to register through this and the organisation data should be able to be accessed by the managing website.

KP suggested that it would be a task for all the partners to alert their networks about self-enrolment in the long-run.

RR confirmed that SM would be creating the web-interface and all the partners would need to participate in bringing businesses to participate in self-enrolment procedure to get more data which in turn would help them.

SM presented the idea of Bluetooth sensor-mobile app option that can be used by our consortium partners for making journeys and recording them and making this data public in multi-country context since we have people from many countries.

RR talked about charities from food companies who have a self-enrolment interface to dispose the food as closely and early as possible. The buyers also have an option to register and express interest in the products they need. Even though this solution does not use IoT data, it may be used as a concept to develop web interface in REAMIT.

Q3. To comply with BED rules, external partners may not be able to access the server itself. Is there a way where the server can be used but not access it directly to transfer data to and fro from the server?

SM confirmed that Levstone uses a general architecture for mobile devices where all the data goes through encrypted secure sockets through a port or a gateway app, so the devices do not know where the database is, so there is no login username and password. All messages go to a port and there is a program that receives the messages and access the database. For example, there is no direct access to database, all the data comes from a port. The enrolment might be directly sent to the website, while the sensor data may be transferred in the aforementioned way.

IH suggests that LM (BED) has a deeper conversation with MS (Whysor) and SM (Levstone) on the above aspects.

LM requests SM to prepare a demonstration about the trial journey idea so that all partners can execute this and generate some data.
SM says that this might be one month away as Levstone needs to tidy up the interface they have developed for this.

Actions:

1. **Levstone to provide information about Levstone's database i.e. how organisations can self-enrol, what information organisations will be required to provide, how customers can access this database.**
2. **Levstone to prepare a demonstration about the trial journey idea so that all partners can execute this and generate some data.**

LM thanked partners for their input on WP T2 and closed this WP meeting.

<u>WP T3 Business development of REAMIT technologies (Chair UU and UCD)</u>

20.42 SW from UCD shared a presentation of Fionnuala Murphy, with her voice recorded. With focus on reducing food waste and environmental impact of food waste, the Life Cycle Assessment (LCA) task carried out by UCD team will estimate production-phase embedded emissions of fresh vegetables and meat lost from the food supply chain. For each of the REAMIT pilot tests UCD will be providing an estimation of the environmental impact. One of the preliminary works needed to achieve this is the quantification of embedded production phase GHG emissions using Cradle-to farm/processor-gate emission factor. The data requirements from each pilot for the LCA approach will consist of production data, transport methods and current and alternative disposal routes.

RR clarified that the main objective of the REAMIT project is to satisfy the requirement of the end-user, which may be different from the original plan. There could be a difference in the LCA method needed for each of the pilots.

SW agreed with this and assured to address the different situations based on the availability of the data. The post-doc that would be hired at UCD would be working on this and he/she would follow up on it as soon he/she joined the REAMIT team at UCD

SW apologised on behalf of Saptarishi Chakravarty who due to health issues followed by medical appointment at a hospital, could not attend REAMIT meetings on Day 2.

Action: UCD to assist each pilot test lead in quantification of embedded production phase GHG emissions using Cradle-to farm/processor-gate emission factor.

Action: UCD to assist each pilot test lead in obtaining data for the LCA approach i.e. production data, transport methods and current and alternative disposal routes.

20.43 SW confirmed UCD would host the next round of REAMIT meetings in Dublin, Ireland (January 2021). He added that hosting those meetings as physical meetings would be contingent upon the policies of the Irish government at that time. For example, the meetings will not be held physically if the situation was just like these days due to COVID-19. In this case, UCD will host REAMIT meetings online

WP Management (Chair: BED)

Deliverable 1.1 Project Handbook
20.44 KP confirmed Project Handbook is systematically being updated and available on the REAMIT website (password protected section). Recent updates in the Handbook include: Calendar for 3rd REAMIT report; common errors when reporting in eMS (based on feedback from JS and second REAMIT monitoring report); how to avoid errors when reporting in eMS in the future; Interreg NWE Programme's rules on public procurement below EUR 5000.

Deliverable 1.2 Minutes from RAC/RWP/RSC meetings
20.45 KP confirmed that BED drafted minutes from REAMIT meetings in January 2020 and circulate it among partners for feedback. Minutes will be reviewed during RSC meeting on Day 2.

Deliverable 1.3 Intermediate WP coordination
20.46 KP confirmed that BED supported WP leads (I&R, NTU and UU) with implementation of activities under all WPs. BED actioned Dunbia (Partner) and Cottagequinn Farms LLP (Associated Partner) exit from REAMIT (following their request communicated to BED in February 2020). BED assisted WD Meats in joining REAMIT as sub-partner of UU. BED organized and chaired bi-weekly online meetings of REAMIT sub-group (composed of staff working full time on REAMIT at BED, NTU, UU) during lock-down.

Deliverable 2.1 Risk Log
20.47 KP confirmed that REAMIT Risk Log has been revised and 7 new risks for REAMIT have been identified by BED based on partners' input. New risks include:

1. Delay in the implementation of running pilot tests
2. Delay in recruiting new companies for pilot tests
3. Exit of Dunbia and Cottagequinn Farms LLP from REAMIT
4. Loosing pilot tests and companies in the pipeline (i.e. since companies currently prioritize their daily business not research)
5. Lack of data from pilot tests to be sent to Big data hub for analytics
6. Delay in building Big data hub at BED
7. Delay in payments made by LP to PPs

New risks will be discussed during RSC meeting on Day 2. All partners are requested to jointly revise the REAMIT risk log.

Deliverable 3.1 Project reports
20.48 KP confirmed that BED, based on inputs from partners, developed and submitted to JS REAMIT 2nd progress and finance report on 30th of March 2020. In the second claim, BED on behalf of REAMIT partnership, claimed EUR 292,018.33. Due amounts were transferred by BED to PPs in June 2020. BED is aware that payments from LP to PPs were delayed this time and such delay should be avoided in the future as it causes liquidity problems, especially for the small organisations.

Action: BED to work on improving internal payment procedure so that delays can be avoided with transferring funds to partners.

20.49 KP shared with partners the following information related to personnel matters:

- Una Bruhann is a new REAMIT officer at JS of Interreg NWE Programme.
- Dr Lohithaksha M. Maiyar, started his position as Research Fellow at BED in March 2020. He is responsible for coordinating WP T2 at BED i.e. he will build the Big Data hub at BED and will carry out data analytics.
- ITT has completed recruitment process of Research Assistant in Data Analytics. However his start date has been postponed due to COVID-19.
- UCD is in the process of appointing a postdoctoral researcher to work on REAMIT. The recruitment process has been frozen due to COVID-19.
- Dr Ruth Price, a clinical trials manager at Ulster University's Coleraine campus, has joined the UU REAMIT team. She has previous experience in food research and will be assisting in coordinating future pilot tests (part-time).
- James Dooley, a Professor of Microbiology has joined the Ulster University REAMIT team, his experience in microbiology will be invaluable in assisting with the trials at WD Meats (part-time).

<u>WP Long Term (Chair: BED)</u>

Deliverable 1.2 REAMIT Networking events
20.50 KP confirmed that the first REAMIT Symposium was organised on 9th January 2020 in Nottingham, UK. NTU coordinated organisation of the Symposium and many partners were involved in developing and delivering it. The Symposium was attended by over 50 participants from Higher Education Institutions, technological and agri-food companies, policy formation and consultancy companies. The speakers were mainly from the REAMIT project. Frans Harren from QCAP project (Interreg) and Associated Partner of REAMIT was also the speakers. Several new, valuable contacts were established during the Symposium. However, they have not been explored due to COVID-19 lock-down.

KP confirmed that the second REAMIT Symposium is scheduled on 5th of November 2020 in Nantes, France. The responsible partners for this event are I&R and Valorial. More information about it will be presented in a dedicated session on Day 2.

Deliverable 2.1 The agreed framework for measuring the impact of REAMIT technologies on food waste
KP confirmed that in January 2020, BED sent out to partners the first draft of the framework. No progress has been made since.

<u>WP Communication (Chair: NTU)</u>

SB and UR presented progress in the implementation of deliverables under WP C.

Deliverable 1.1 Communication strategy

20.51 UR confirmed that a new section was added to the Communication Strategy i.e. Events attended by REAMIT partners. List of events attended by REAMIT partners was included in section 6.1. UR requested partners to send to NTU information about external events they attended (also online events) as this information will be included in the Communication Strategy.

Deliverable 2.1 Website Launch
20.52 SB confirmed that REAMIT website has been launched in 2019 with the address www.reamit.eu. It has been systematically updated and the most recent updates include:

- Under 'News & Blogs' information about REAMIT newsletters has been uploaded (most recent newsletter from June-July 2020); information related to COVID-19 and its effect on food supply chains has been added under "REAMIT Web Articles & Online Features"; s. News letter were added, the recent one being in June-July release.
- Under "EVENTS" tab information about conferences, exhibition planned/attended has been added. The Smart Food Matter conference to be held in London was postponed twice (due to COVID-19) and is expected to take place sometimes in 2021.
- 'The open challenge call' section has been changed to 'Call for participation in technology demonstrations' and deadline for recruiting companies has been prolonged until December 31st 2020.
- Recent changes (i.e. related to Dunbia's exit and WD Meats joining REAMIT) will be made shortly.
- 'Documents to share' section has been created where project internal files are stored. Partners can access this section with the password (shared with all REAMIT partners). This section contains REAMIT related presentations from RAC/RWP/RSC meetings, Communication Strategy, Project Handbook.
- Infographics has been prepared and will be displayed in the section: "BENEFITS TO STAKEHOLDERS"
- "Join REAMIT" will be a register page for actors who are interested in REAMIT project and want to participate in REAMIT activities
- Three videos have been posted in "MEDIA AND PUBLICATIONS"
- The "FUNDING OPPURTUNITIES" section has been updated with information on funding opportunities on matters related to food waste and agri-food supply chains

Action for NTU and all partners: to reflect exit of Dunbia and WD Meats joining REAMIT project in all REAMIT communication materials i.e. to remove Dunbia from REAMIT communication materials.

RR confirmed that the name and logo of Dunbia should be removed from all slides, brochures, posters and all communication materials.

Actions:

1. **NTU to remove name and logo of Dunbia from REAMIT website.**
2. **NTU to send to all partners the logo of WD Meats to be glued to REAMIT roll-ups in place of Dunbia's logo.**
3. **All partners to adjust their REAMIT roll-ups with the logo of WD Meats.**

SB confirmed that NTU, BED and UU have been discussing options for online storage space for larger REAMIT materials (documents, videos, pictures, etc.).

Action for BED: to purchase cloud storage space for REAMIT.
Q&A

20.53 SB inquired where information about the pilot tests should be published in the REAMIT website, and whether a separate tab should be created for this purpose. She asked if partners agreed to share information about all the pilot tests on the REAMIT website.

IH responded that it was a good idea to share information about pilot tests on the REAMIT website. However, it may be necessary to ask for the consent of those partners (i.e. Picnic) who preferred not to disclose the company's name in REAMIT materials.

RR supported to maintain confidentiality of private sector partners participating in REAMIT pilot tests. He suggested developing a case study for each pilot tests focusing on what it aims to achieve with respect to what the pilot tests measures, volume of food waste saved by each pilot tests (conducting initial interview and then using results from each pilot). All this information could be kept anonymous and stored under a separate tab dedicated to pilot tests on the REAMIT website.

RR suggested that the following materials can be used to showcase each REAMIT pilot test on the website:

- Pilot test architecture slide according to the template developed by BED
- The analysis made by UCD on the environmental impact of the technology solution in each pilot test

Action: BED and pilot test leads will set deadline for collecting pilot test results. Information about the first three pilot tests can go online since we have some good information about them already:

- **Pilot test in the NL with Picnic – End of September – IH and Picnic can be contacted**
- **Pilot test in France – end of September – AA will provide the required information**
- **Pilot test in the UK with WD Meats – WD will provide information as soon as possible**
- **Pilot test in Germany with Weyers – will need more time**
- **Pilot test in Ireland (Cyberbar) with Manor Farm (TBC) – wait till after September for this pilot information due to COVID-19**

Action: NTU to upload information about first 3 REAMIT pilot tests on REAMIT website

Deliverable 2.2 Social media

20.54 SB confirmed that only a few REAMIT partners were actively communicating about and promoting REAMIT in social media. Interreg NWE Joint Secretariat encouraged all organisations participating in Interreg NWE projects to actively communicate about their Interreg project in social media through their networks. It is therefore important that all partners in REAMIT increase their presence and communicate more about REAMIT in social media. For these REAMIT partners who actively promote REAMIT in social media, SB suggested to use #reamit4nwe when posting on Twitter, LinkedIn or Facebook. In this way the communication team at NTU can be notified about the communication activity.

Action: All individual partners are requested to share with SB personal or professional social media details, whichever they use to communicate about REAMIT activities. Based on partners' input, Sasha will develop a database.

Action: Sasha to publish the social media database (password protected) of REAMIT partners in the REAMIT website.

Action: All partners are requested to send updates to NTU about their efforts to communicate about REAMIT in social media.

Deliverable 3.1 Project banners, posters and flyers
20.55 SB confirmed that all REAMIT documents and promotional materials need to be updated to reflect exit of Dunbia and entry of WD Meats. A new promotional material has been developed to be installed on trucks during pilots. These are A2 size vehicle magnets in the form of magnetic posters.

Deliverable 4.1 Reports on networking events
20.56 UR confirmed that the first networking event (first REAMIT symposium) was organised by NTU with support from partners on 9th of January 2020 in Nottingham, UK. NTU have drafted a report from the first REAMIT Symposium.

Deliverable 5.1 Journal Articles
20.57 UR confirmed that NTU is developing a report on COVID-19 and its impact on food supply chains. Some elements of this report have been published in the REAMIT newsletter (contributions from Sasha, Usha and Lohit). UR asked all REAMIT partners to contribute with updates to improve the COVID-19 report, as the report aims to cover the impact of COVID-19 not only on the REAMIT project but also on the wider agri-food sector. This report will be published on the REAMIT website in the next months.

Action: Each partner to send updates to NTU on impact of COVID-19 not only on the REAMIT project but also on food supply chain (beyond REAMIT) seen and/or experienced from their own organisation's perspective.

Action for NTU: Advance the report on COVID-19 and its impact on food supply chain and publish it on the REAMIT website.

20.58 UR confirmed that REAMIT newsletters are published every 3 months.

20.59.01 UR confirmed that BED is leading the work on a sensor review paper. In order to collect data for the paper, LM (BED) and WD (UU) conducted interviews with 2 different companies. The sensor review paper is an extension work of a conference paper which was presented by RR at Euroma conference. The sensor review paper aims to collect tacit knowledge of sensors available in market.

20.59.02 UR observed that partners made their own efforts to write papers focusing on agri-food supply chains. At the end of the REAMIT project, all publications developed by REAMIT partners building on and related to the REAMIT project, will need to be quoted as REAMIT outcomes. UR suggested discussing this at the next round of REAMIT meetings in January 2021 to clarify requirements and agree on a shared approach.

20.59.03 RR supported UR's suggestion and asked all partners for regular updates and information on their progress on writing REAMIT inspired journal articles. Updates from partners will be used by NTU as input when communicating about REAMIT inspired publications developed by REAMIT partners. At the moment it seemed that mostly UK teams developed REAMIT inspired publications.

Infographics
20.60 SB presented infographics on 'Benefits from participation in REAMIT pilot tests'. She asked for feedback and ideas from partners about possible changes and improvements of infographics. The following suggestions were made on how to improve the infographics:

- the representative numbers on the infographics would be changed to icons
- the number of words in the paragraphs would be reduced and replaced by shorter phrases – in this way the infographics would be easily readable

- use of icons is important and strengthens the visibility of information communicate in the infographics
- including all circles in one page would improve reader-friendliness of infographics and
- consider using slogans to reduce a number of words
- RR confirmed a second version with small bullet points and customer satisfaction as the main bullet point. A pdf document with 12 bullet points would be the main infographic, while the reader should be able to access more information when they click on the infographic symbols through hyperlinks.
- Originally, the infographics was titled 'benefits for food producer and transportation companies from participation in REAMIT pilot tests'. Consider using the original title for the infographics.

Action: NTU to finalise the infographics and publish it on the REAMIT website.

Action: NTU to consider printing hard copies of infographics as REAMIT promotional materials.

<u>The new REAMIT video</u>
20.61.01 SB presented the new REAMIT video. She asked partners for ideas how it can be improved. The following comments were made by REAMIT partners:

- (SM from Levstone) Promote better typology of REAMIT partners, and in particular the academic institutions involved in the REAMIT project, to emphasize that there is real knowledge behind the project and the REAMIT consortium has some heavy weight players. RR agreed with SM and suggested to highlight the multi-disciplinary expertise blended in the REAMIT project.
- ShB agreed to the suggestions made by SM and suggested to reduce the speed of the video. This would made the video more comprehensive.
- IH agreed and confirmed text changed too fast in the video and the narrator should be a native English speaker.
- SM suggested that this video was perfect for Instagram, and other social media.
- YD (BED) inquired if a company was interested in joining, how could they join REAMIT pilot tests.

Action: NTU to create links for guiding interested parties to register on the REAMIT website their interest in REAMIT (pilot tests, technology, etc.)

20.61.02 RR clarified that the REAMIT project focussed on both research and commercialisation. He suggested that SB got in touch with ShB to improve REAMIT videos and infographics with ShB's help.

Action: NTU to work with ShB to improve REAMIT videos and infographics.

REAMIT Steering Committee meeting (attended by all REAMIT partners), Chair BED

To begin with, Ram congratulated JC (UU) for being promoted to Professor at Ulster University.

The following partner organisations were represented at the RSC meeting.

Partner organisation	**Representative presence**
BED	YES
I&R	YES
UCD	NO
ITT	YES

UoN	YES
Levstone	YES
NTU	YES
Whysor	YES
SenX	YES
UU	YES

KP confirmed that the following 7 items would be discussed during RSC meeting:

1. Confirmation of minutes from RSC meeting on 15-16 January 2020 in Rennes, France.
2. Advice from RAC and decisions on WPs meetings will be discussed and approved after discussion.
3. Impact of COVID-19 on REAMIT and deviations from the original plan highlighted by partners.
4. REAMIT Risk log
5. Second REAMIT activity and financial report – feedback from JS
6. Third REAMIT activity and finance report – calendar
7. Data for next RAC/RWP/RSC meetings

<u>Item 1. Confirmation of minutes from RSC meeting on 15-16 January 2020 in Rennes, France.</u>
20.62.01 KP scrolls through page by page of draft minutes from RSC in January 2020.

20.61.02 RR suggested that NTU can use ideas generated during the elevator pitch to develop the infographics. ShB suggested that the elevator pitch could also be used for the REAMIT video she created recently.
RR suggested that REAMIT infographics and videos would be very useful to present at external meetings and events attended by REAMIT partners.

20.62.03 No other comments were shared and the minutes from RSC in January 2020 were considered as accepted.

Action log discussed at RSC meeting in January 2020 was reviewed.

20.63.01 REAMIT roll-up done by I&R, Whysor, BED, NTU, UU. ITT is doing it and will attach it in their report to be submitted to eMS by September 2020. UCD have not done it and will need to be followed up. SenX added a photo in eMS, but will check and confirm. Levstone has printed a roll up but they are not sure whether they uploaded it in eMS.

20.63.02 RR clarified that the picture of a roll-up should be taken in the premises of the partner's organisation as it is important to show that a picture of a real roll-up is taken, rather than send a picture of a roll-up in pdf or other formats. UU will take a picture of their roll-up once the campus opens and they will include it in eMS report.

Action: BED to check with Una at JS whether the rolls ups have to be redesigned following Dunbia's exit and WD Meats joining REAMIT.

Action: All partners to take a picture of their roll-ups inside their office with their roll-up banner unfolded and send it to BED and NTU.

Action: All partners to send details to NTU about their 5 communicating actions made each semester, including information on what was communicated and when it was communicated, and what is important for each partner organisation to communicate about with regards to REAMIT.

20.63.03 IH confirmed that Whysor communicated 5 times in social media about REAMIT.

GC confirmed that ITT has made communications a couple of times through his personal email and shared the social media account details with SB. He also retweeted some posts as he spoke.

FT confirmed SenX communicated about REAMIT in social media. He would send precise information if necessary.

GM confirmed I&R and Valorial communicated about the second REAMIT Symposium but did not yet achieve 5 communication activities.

SM confirmed he needed help. He asked SB to help Levstone communicate effectively in social media.

KP suggested that SB arranged an online meeting on how to communicate about REAMIT through social media. The meeting would be open to all partners.

UU communicated about REAMIT through various channels. WD offered to send details to BED and NTU.

Action: NTU to arrange a brief online training on how to communicate about REAMIT through social media.

Action: NTU to finalise the infographics based on partners' input.

Action: NTU to engage partners to help translate the infographics to French, German and Dutch.

SM suggested that infographics would need to be updated systematically.
RR agreed.

20.64 KP reviewed with partners other actions in action log:

RR confirmed the action "Pilot test leads to use pilot test template to report update on the pilot test at the next REAMIT meeting" will be marked as "ongoing", not as "completed", since the work on pilot tests is ongoing.

RR said the action "To start looking for another pilot test. NTU to provide more details of the new pilot test in England" would be marked "ongoing", as this work is ongoing.
UR agreed.

WD approved that action "UU to check if Levstone can install their sensor in Dunbia trucks to assess quality of data collected" would be marked as "not applicable" and a new action would be created in relation to WD Meats and it would be marked as "ongoing".

UU approved the action "UU to try to send data from sensors to REAMIT analytics partners" would be marked as "ongoing".

BED approves that the action "BED to develop a template of Confidentiality Agreement ready to be used by partners who need to sign it with the end user company participating in the pilot test" is "ongoing". If any pilot test has any urgent requirement, BED will take it up as a priority issue.

WD confirmed the template UU used for REAMIT was generic which they have used for other projects and modified it for WD Meats.

Action: BED to prepare a confidentiality agreement template similar to the one prepared by UU for WD Meats.

20.65 No inputs given by partners on the amount of budget allocated for partners for sensors.

Ram clarified that partners should inform well in advance the pilot test lead and BED about their intention to purchase sensors. BED can purchase sensors for partners who asked for it in the Application Form, rather than reimburse the cost of sensors to the partner. Since BED needs to follow strict public procurement rules and requirements, partners who need sensors, need to communicate about it with BED as early as possible.

20.66 BED approves that Ram's visit to German and Dutch pilot tests is marked as completed (visit cancelled due to COVID-19) and will take it up as new action when BED reopens.

20.67 ITT agrees that the action "ITT to check whether a new Irish pilot test would be possible with the Freshbox idea" is "ongoing". That is because companies have stopped responding to UCD due to COVID-19. UCD is now looking into engaging with existing companies for the Cyberbar pilot test, as recruiting new companies is challenging.

Action: GC at ITT to consider possibilities of a new Irish pilot test with Freshbox technology

20.68 IH (Whysor) agreed that the action "UoN to collaborate with Whysor to develop the cloud system for Pilot Test carried out by UoN" is ongoing. AA (UoN) and MS (Whysor) have had talks to achieve this.

20.69 Whysor, UU, and UoN approved the action "Whysor, UU and UoN to provide photos representing their pilot tests. Photos to be sent to NTU and BED to be used in REAMIT promotional materials" as "ongoing".

Action: Whysor to take pictures of the pilot test with Picnic and send them to NTU.

Action: UU to take pictures of pilot test with WD Meats and send them to NTU.

Action: UoN to take pictures of Raman equipment and send them to NTU.

Action: Pilot test leads to make videos of their pilot tests and send them to NTU.

Levstone agrees that the action: "Levstone to update progress on the second self-enrolling database and their efforts on data security in REAMIT; and help create a general data governance system for REAMIT" is marked as "ongoing".

Levstone approves the action "Levstone to provide detailed technical description of Pebble and discuss about using it in pilot tests with pilot test leads and Whysor" to be marked as "ongoing". They are two weeks away from conducting final trials. Kate says there will be discussion with Lohit on these. All approved that "All technology partners to test the reliability of their systems before installation in REAMIT" is "ongoing".

Ram suggested that the action "All partners to make at least 5 communication actions about REAMIT each semester, among this at least one tweet" is duplicating with the earlier one with the same goals and this should be linked with the earlier one.

20.70 Action: BED to ask JS whether including REAMIT logo in email signature is compulsory.

BED approves that the action "All partners to send their ideas for the second REAMIT symposium to the organisers (I&R and Valorial), NTU and BED" to be marked as "completed" because of discussions going to be made in the afternoon session regarding this.

BED approves that the action "All partners to send their feedback on the REAMIT Measurement Framework" as "ongoing" given that UCD's framework is going to be dependent on progress on pilots which is currently ongoing.

BED approves that the action "Every partner to identify their target groups and communicate directly to their groups at least five times during REAMIT project lifetime" is "ongoing"

BED approves that the action "All partners to contribute to the Sensors Review continuously, specifically for the table of best sensors for a given combination of chillness of food, kind of perishable product and specific part of the supply chain" is "ongoing".

BED approves "NTU to consider preparing a short video highlighting the benefits to food producer and food transporter companies." as ongoing.
BED approves the action "BED to coordinate development of data management plan for REAMIT" is "ongoing".

Lunch break

<u>Item 2 – Advice from RAC and decisions on WPs meetings will be discussed and approved after discussion.</u>

<u>And Item 3 – Impact of COVID-19 on REAMIT and deviations from the original plan highlighted by partners.</u>

20.71.01 KP provided feedback from the REAMIT Associated Partner – East Netherlands Agency. They said it was not clear in the REAMIT report why BED asked for a 12-month project extension. KP confirmed that a request for 12-month extension of the REAMIT project was a result of two categories of risks identified in the REAMIT project due to COVID-19. Category 1 risk and category 2 risk. Category 1 risk were delays in the implementation of REAMIT pilot tests due to COVID-19, as partners and sub-partners were unable to proceed with pilot test activities (i.e. due to lock-down, partners were unable to attend premises of the companies participating in pilot tests). This caused a delay in the implementation of pilot tests of about 4-6 months. Delays in the implementation of pilot tests had negative impact on the remaining WPs, and might create additional delays of approximately 6 months. Hence, BED indicated an overall delay of the project amounting to 12 months. Consequently BED asked JS for a 12-month project extension. KP confirmed that BED requested only extension of time, not budget. Once this request was approved by JS, BED and partners would assess whether they needed extension of the budget. REAMIT partnership might then consider asking JS for financial extension of the REAMIT project.

ACTION: BED to ask JS when to expect an answer about extension of the REAMIT project.

Item 4 – REAMIT Risk log

20.72.01 KP invited partners to jointly revise the REAMIT risk log. She confirmed that the risk log was a compulsory document for the REAMIT project and needed to be revised systematically and jointly by the REAMIT partnership. Based on reports from partners (for the reporting period January – June 2020), BED has identified 7 new risks for the REAMIT project:

1. Exit of Dunbia from the REAMIT consortium: Partners at UU have been very engaged in developing the pilot test with Dunbia and have invested in this much resources. Now, with Dunbia exiting the REAMIT project, UU partners have to start these efforts from scratch (i.e. they need to find a new meat producer company and engage with them for the pilot test, understand the needs of the new company and based on it identify the focus of the new pilot test, enrol the new company in the REAMIT project as associated partner or sub-partner and develop the necessary paper work, etc.).

The following risks have been caused by COVID-19:

2. Delays in the implementation of pilot tests
3. Delays in recruiting new companies for pilot tests
4. Loosing pilot tests and companies in the pipeline
5. Lack of data to be analysed in the Big Data Hub
6. Delay in payments made by LP to PPs
7. Delay in building the Big Data Hub at BED

20.72.02 GC (ITT) suggested adding another risk 'recruitment of personnel'. In particular, COVID-19 followed by lock-down caused delays in the recruitment of new staff at ITT (i.e. visa application has been put on hold, selected candidate could not travel to Ireland, signing his contract and his start date at ITT have been postponed until after CPVID-19).

RR asked if other partners had similar difficulties with recruitment.

KP advised that UCD also experienced a delay in recruitment a full-time staff member dedicated to REAMIT.

20.72.03 SM suggested another potential risk for REAMIT i.e. that some companies were not producing or distributing sensors from suppliers which caused delays. Both Levstone and Whysor experienced this problem in the past months.

IH advised it was mainly production and delivery of sensors. SM said that some suppliers did not currently make or sell new sensors. There was no stock of sensors in the EU and some companies needed to ship equipment from USA. This has had impact on WP T1.

20.72.04 KP asked partners for input on various risks:

Risk 1 – Exit of Dunbia from REAMIT consortium
Ownership of risk – BED and UU
Impact on WP T2, WP T3, WP LT
Actions taken to minimise impact of this risk on REAMIT: UU approached WD Meats and WD Meats are now a sub-partner of UU in REAMIT project.

Risk 2 – Delays in the implementation of pilot tests

Ownership of risk – BED, UU, UoN, I&R, UCD
Impact on WP T2, WP T3, WP LT
Actions taken to minimise impact of this risk on REAMIT: partners gently approach partner companies involved in pilot tests, partners look for new pilot tests, BED asked JS for 12-month project extension.

Risk 3 – Delay in recruiting new companies for pilot tests.
RR suggested that partners still approach new companies but do not push too much.

Risk 4 – Losing pilot tests and companies in the pipeline
To address this risk and deliver what has been promised in the REAMIT AF, BED requested a 12-month project extension.

Risk 5 – Lack of data from pilot tests to be sent to Big Data Hub at BED:
Since there is no data from pilot tests, data analytics cannot be done and prototypes of technology cannot be built. Partners will continue to work towards resuming pilot tests and getting data from pilot tests.

Risk 6 – Delay in payments made by LP to PPs.
SM said that this delay at BED caused some liquidity issues for Levstone.
RR confirmed he would work with finance team at BED to reduce delays in the payment process from BED to project partners.

Risk 7 – Recruitment of staff for REAMIT
Any further delays in recruiting staff could impact capability of REAMIT data analytics partners to perform data analytics.
GC from ITT said that if there were further delays with recruiting new staff at ITT, ITT current staff would do some data analytics for REAMIT (staff currently working at IMAR at ITT), even though some budget was allocated to ITT in REAMIT project to employ new staff to do data analytics.

Risk 8 – No sensor equipment in stock
SM said that if there was no equipment in stock, SM would discuss with RR possibilities of obtaining other, suitable sensors.

<u>Item 5 – Second REAMIT activity and financial report – feedback from JS</u>

20.73 KP confirmed there were several comments from JS that REAMIT partners would need to consider to improve quality of reporting in eMS in the future:

- Some REAMIT partners need to improve reporting of costs in eMS. In particular, partners cannot bundle up cost items and need to report every cost item (every invoice and every pay slip) as an individual entry. KP confirmed that BED has contacted the partners concerned and explained them how to avoid this kind of error in future reporting rounds.
- REAMIT partners need to improve reporting on reaching out to target groups. Partners confirmed that it was difficult over the last 6 months to reach out to the listed target groups due to COVID-19 and lockdown. Partners confirmed they would keep trying contacting REAMIT target groups in the next 6 months.

<u>Item 6 – Third REAMIT activity and finance report – calendar</u>

20.74 KP confirmed that partners would need to submit to BED by 7th August 2020 their certified financial and progress reports and payment claims. Partners agreed.

Item 7 – Date for next RAC/RWP/RSC meetings

20.75 Partners agreed that the next round of RAC/RWP/RSC meetings will take place on 20-21 January 2021 in Dublin, Ireland. These meetings will be hosted by UCD.

End of REAMIT Steering Committee Meeting

KP confirmed there were two more important sessions planned for the second day of the REAMIT meetings: 'Presentation on the second REAMIT Symposium' facilitated by Valorial and a final session on 'Other points to discussed' facilitated by BED.

KP invited BF from Valorial to present the preparatory work on the second REAMIT Symposium.

Presentation on the Second REAMIT Symposium, on 5th November 2020, Nantes, France

20.76.01 BF, Innovation Project Manager at Valorial made a presentation on the planned second REAMIT Symposium. BL introduced Valorial and confirmed that its mission was to help agri-food businesses to innovate. Valorial had 360 members spread across different clusters. BF confirmed they expected 200 attendees at the REAMIT Symposium, of which 100 would be Valorial members, 30 persons would be leaders at Valorial, and 70 persons would be international guests and attendees (including REAMIT partners and actors from their networks).

BF confirmed the objectives of the Symposium were i) to disseminate information about REAMIT project and its results; and ii) to raise awareness about food waste and actions to address food waste.

BF confirmed there would be a possibility to have B2B meetings in separate rooms in the venue of the Symposium. Simultaneous translation service would be provided (French to English and vice versa).
BF shared an advanced draft agenda of the Symposium agenda, with a variety of speakers and presentations on REAMIT pilot tests.

The proposed agenda had four parts:

- introduction and a guest speaker – the French policy officer at the European Commission
- REAMIT presentations of pilot tests
- Testimonials and solutions
- B2B Meetings

BF confirmed that on the day before the Symposium (i.e. on 4th November 2020), I&R would arrange on-site visits to some local agri-food companies (exploratory mission). More details about on-site visits would be available together with finalised agenda and invitation to the Symposium, that are planned in September. BF also confirmed that at the end of the Symposium there would be opportunity for everyone to network.

20.76.02 BF confirmed that the main challenges Valorial and I&R faced with the organisation of the Symposium was attracting international guests. For this reason Valorial and I&R considered covering travel and accommodation costs of some international participants (4-5 persons). RR suggested it would be possible to accommodate this additional cost. Valorial and I&R would need to carefully consider with BED the budget necessary to cover the costs attendance of some international guests.

20.76.03 ShB suggested a panel discussion during the Symposium (UR said this might be too ambitious to achieve during a 1-day session), possibly including guests from other Interreg projects.

20.76.04 In the next days, Valorial would be sharing 'save the date' post about the Symposium, that all partners were requested to share through their social media.

20.76.05 BF confirmed that Valorial and I&R considered that second wave of COVID-19 foreseen in autumn 2020 would be a major risk for the second REAMIT Symposium. In current circumstances, Valorial and I&R needed to plan the event as normal and would re-assess the situation in September 2020.
SM mentioned Valorial and I&R should consider the possibility of turning this event into a webinar. GM advised against this as numbers of attendees would drop and Valorial and I&R would not meet their targets.

GM would rework the agenda with BF and would contact partners to share an updated agenda.

20.76.06 RR suggested that to attract more international attendees, BED could invite UK speakers and other international guests (from BED's network), if the agenda had flexibility to accommodate new speakers.

15 min coffee break

<u>European Green Deal</u>

20.77 RR presented the EU Green Deal funding. This EU funding source under Horizon 2020 would fund projects in the EU which were climate neutral. UK would still be eligible to apply as a lead partner. The call will be about transformative change. There will be a call for funding in September 2020 with the budget of about £1bn. The call will be about transformative change and new technologies which are very similar and in line with the focus of Interreg's calls. RR confirmed there were 8 principal areas, and Area 6 'From farm to fork' is relevant and close to REAMIT. Other principle areas such as ecosystem and biodiversity, increasing climate ambition also seem similar to Interreg thematic priorities. RR encouraged partners to keep an eye on this and similar funding opportunities. RR invited interested partners to get in touch with him. He presented more details about European Green Deal in his slides.

Action: RR to keep partners informed about the Green Deal funding.

<u>COVID-19 related funding opportunities</u>

20.78 RR confirmed there were 2 new funding opportunities related to COVID-19 and he encouraged partners to get in touch with him if they were interested.

<u>Articles and papers</u>

20.79.01 LM confirmed the following research papers have been written (or are in progress) by REAMIT partners:

- At EurOMA conference in April 2020 RR presented the conference paper "A review of sensors for reducing waste in food logistics and supply chains"
- WD (UU) and LM (BED) were conducting interviews to develop the white paper on sensors (in cooperation with Levstone)
- BED has been writing a paper on OR modelling: 'Wastage aware rapid response model for transport of fresh agri-food products'.
- UU has written a journal paper on sensor technology: 'Sensing technologies for maximizing quality and minimizing waste of meat", submitted to JCP, May 2020.

- UoN has written papers on Raman Spectroscopy

20.79.02 LM presented the EurOMA Conference paper. He said that the paper considers three types of sensor technologies focusing on temperature, humidity and light intensity. The paper includes a questionnaire which explores choosing different sensors for the appropriate food types and measurements. BED and UU would be interviewing sensor companies; they have also interviewed two of REAMIT technology partners – Whysor and Levstone who were asked about their preferences of sensor types and usage. LM explored scenario with Picnic as an example. He looked at the transportation journey and challenges (inspired by the grocery supply chain). BED and UU will now come up with a framework which looks at delivery times, wastage thresholds, degradation levels of food, location costs, and other variables.

RR suggested that partners approached LM to discuss further ideas for the paper outside REAMIT online meetings.

Action: Partners interested in contributing to EurOMA paper, to contact Lohit directly outside REAMIT online meetings.

Action: LM to champion preparing more research articles.

20.72.03 WD from UU presented 'Sensor technologies for maximizing quality and minimizing waste of meat' journal paper on sensors submitted to JCP, May 2020. In that paper UU looked at meat quality decreasing due to animal stress. UU suggested that better animal welfare management would result in better nutrition and reduced food waste. UU also looked at how changing temperature conditions during logistics (drop of temperature inside a fridge in a lorry) affects food quality (i.e. since changing conditions facilitate occurrence of dark cutter beef). When cattle go into market to be sold, separating them from other animals, makes them stunned and stressed, which results in the dark cutter meat.

WD suggested to tackle this by using different IOT sensors such as body temperature sensors, sensors to monitor animal movements to detect stress, 'electronic' noses sensors to find out why the meat is decreasing in quality so quickly. The paper explores a variety of sensors that would be most suitable for this type of study. UU is currently waiting for feedback to proceed with this work.

RR mentioned that this paper was initially inspired by the issue that Dunbia was facing.
SB suggested this could be further explored with WD meats.
FM and WD have agreed this will be done.

20.73 RR confirmed that the online meeting related to the Capitalisation Call from Interreg NWE Programme would take place on 5th November 2020 (which is the same date as the second REAMIT Symposium).

RR thanked everyone for attending REAMIT meetings and closed the meeting.

End of the meeting

Matters arising and actions from RAC/WP/RSC online meetings on 8-9 July 2020

Updated at RSC meeting on 21/01/2021

Date	**Minute/ Item**	**Action *identified***	**Responsibility**	**Update: *Confirmation of completion or reasons for non-completion***
200708	20.23.03	UoN and I&R to send third REAMIT progress report to their associated partners and ask for feedback.	UoN and I&R	UoN completed I&R ongoing
		WP T1 – Actions		
200708	20.28.13	**Actions for pilot test with Picnic** BED to finalise purchase of 20 EMS sensors and 20 batteries from Elsys.	BED	Completed
200708	20.28.13	Whysor to do configuration of sensors.	Whysor	Completed
200708	20.28.13	Whysor to install 20 sensors in the Picnic's truck.	Whysor	Planned for January 2021
200708	20.28.13	Whysor to connect 20 sensors and arrange for transmission of data from sensors using KPN LoRaWAN (which has coverage in the entire Netherlands) to the online Whysor cloud.	Whysor	Planned for January 2021
200708	20.28.13	Whysor, BED, Levstone to arrange for data to be transferred from Whysor cloud to Big Data server at BED.	Whysor, BED and Levstone	Planned for January 2021
200708	20.28.13	Whysor and BED to decide whether it is wise to set alerts now (with the help of a functionality called complex event processor available in the Whysor cloud to generate alerts based on temperature thresholds or acceleration thresholds. These alerts are meant to generate new information for the pilot test partner – Picnic.	Whysor and BED	Planned for Q1 2021
200708	20.28.13	Whysor, BED and Picnic to develop a system to generate alerts for Picnic.	Whysor, BED and Picnic	Ongoing
200708	20.28.13	Whysor and BED (with assistance from ITT and SenX) to integrate data obtained from sensors with data in warehouse of Picnic.	Whysor, BED, ITT and SenX	Ongoing

200708	20.28.13	BED (with assistance from Whysor, ITT and SenX) to separate the data into tables for analysis.	BED, Whysor, ITT and SenX	Ongoing
200708	20.29	**Actions for pilot test with Weyers** Whysor to re-establish contact with Weyers to check if they are still interested in REAMIT project.	Whysor	Completed
200708	20.29	Whysor to install VOC and GPS sensors provided by REAMIT in Weyers trucks.	Whysor	It was planned for December 2020, but is not completed yet due to lack of response from Weyers.
200708	20.29	Whysor and BED to arrange for receipt of data from sensors and transport of data to the reamit.whysor cloud.	Whysor and BED	Ongoing
200708	20.29	Whysor to arrange collection of data from sensors on VOC, Co2, temperature, pressure, Lux, weather conditions and employees' inputs.	Whysor	On hold now to be progressed
200708	20.29	Whysor to arrange the connection to the cloud through a gateway.	Whysor	Completed
200708	20.30.05	**Actions for pilot test with WD Meats (Clostridium bacteria)** As soon as it is possible (due to COVID-19 lockdown restrictions) UU to access the sites of WD Meats to determine where to install the sensors.	UU	UU accessed the sites of UU in August-2020 and since then WD Meats have been locked down again. Ongoing
200708	20.30.05	UU to carry out PCR analysis on meat samples from WD Meats in the laboratory of UU (this will be a temporary solution to determine the method to detect the bacteria.	UU	Ongoing
200708	20.30.05	UU to identify an alternative sensor and sensor supplier to the one promised by Mathias from Freshdetect.	UU	Ongoing
200708	20.30.05	UU to determine the right sensing equipment that can help detect Clostridium bacteria without the laboratory testing i.e. in ambient environment on	UU	Ongoing with support from MU and Sensipdx

		the sites of WD Meats while the meat is still on the conveyor belts.		
200708	20.30.05	UU to use the sensing equipment to detect Clostridium bacteria on the sites of WD Meats.	UU	Ongoing
200708	20.30.05	UU to pursue with WD Meats and transport company Blairs for a transport pilot.	UU	Ongoing
200708	20.31.05	**Actions for pilot test with WD Meats (Dry aging chamber)** Once WD Meats opens up again, UU to access the sites of WD Meats to assess where to install sensors in a dry aging chamber.	UU	Ongoing
200708	20.31.05	UU to work with Whysor and Levstone on choosing the right sensors suitable for fitting inside WD Meats's dry aging chamber.	UU, Whysor, Levstone	Complete
200708	20.31.05	UU to purchase sensors suggested by Whysor.	UU	Complete
200708	20.31.05	WD Meats to facilitate installation of sensors by UU	WD Meats	Ongoing
200708	20.31.05	UU to install sensors in dry aging chamber.	UU	Ongoing
200708	20.32.03	**Actions for the 3D Fluorescence pilot test** UU to action procurement of two 3D Fluorescence sensors from Matthias Heiden from FreshDetect.	UU	Complete
200708	20.32.03	In parallel, UU to explore other possibilities of procuring 3D Fluorescence sensors from the following companies: Chelsea Technology (German company suggested by TA), Flurotech (company in the UK suggested by TA) and German tech company (suggested by TA).	UU	Chelsea Ongoing
200708	20.32.03	UU to develop a document listing pros and cons of 3D Fluorescence sensors offered by each of the companies: FreshDetect, Chelsea Technology, Flurotech and German technology company.	UU	Ongoing
200708	20.32.03	UU to investigate whether the company selected to provide 3D Fluorescence sensors for pilot test with WD Meats is keen to commercialise their technology by acquiring patents. If yes, UU to	UU	Ongoing

		develop a list of steps necessary in the process of patent acquisition.		
200708	20.33	**Actions for the pilot test at UoN with Raman Spectroscopy** UoN to complete purchase of all elements of Raman spectrometer.	UoN	Completed
200708	20.33	UoN to start the first round of measurements with Routhiu to test Raman set-up.	UoN	Completed
200708	20.33	Whysor and SenX, to support UoN with transmission of data from Raman sensor to REAMIT cloud.	Whysor, SenX and UoN	Ongoing with input from BED
200708	20.33	UoN to agree with Whysor frequency of data transmission from sensor to REAMIT cloud	UoN and Whysor	Ongoing with input from BED (60 min)
200708	20.33	BED and Whysor to help UoN with data transmission from sensor to cloud.	BED, Whysor and UoN	Ongoing
200708	20.34.02	UCD to send LP an update of the situation with developing cyberbar pilot test.	UCD	Completed
200708	20.35	**Actions related to developing new pilot tests** UoN and I&R to confirm whether BbaMV (milk and dairy products consortium) will participate in developing a new pilot test in REAMIT.	UoN and I&R	Completed
200708	20.35	UoN and I&R to confirm whether IGRECA (egg producer in France) will participate in developing a new pilot test in REAMIT.	UoN and I&R	Completed
200708	20.35	UoN to confirm whether sea-food producer company will participate in developing a new pilot test in REAMIT using Raman spectroscopy.	UoN	Ongoing
200708	20.35	UoN to confirm whether one partner from Adria consortium will test one batch of sample with Raman spectroscopy (and if they find the results positive, whether they will engage in a full pilot).	UoN	Completed To be considered as a separate pilot on egg product
200708	20.35	Whysor to approach Meyer QLS to find out if Meyer QLS will participate in the REAMIT pilot test.	Whysor	Completed

200708	20.35	NTU to approach Tesco to find out if Tesco will participate in the REAMIT pilot test.	NTU	Completed
200708	20.35	NTU to approach Pepsi to find out if Pepsi will participate in the REAMIT pilot test.	NTU	Completed
200708	20.35	NTU to approach smaller consortia in NTU's networks and projects to find out if they will participate in REAMIT pilot tests.	NTU	Completed
200708	20.35	BED to approach METRO through Tsenso to find out if METRO will participate in REAMIT pilot test.	BED	Ongoing
200708	20.37	BED to work with ITT for suitable collaboration opportunities in aquaculture, outside of REAMIT.	BED	Ongoing
200709	20.38.03	**WP T2 – Actions** REAMIT sub-team (BED, Whysor, SenX, Levstone, ITT) to develop a scenario enabling the REAMIT cloud to receive and manage other types of data received from all pilot tests (not only data on temperature, humidity and VOC).	BED, Whysor, SenX, Levstone, ITT	Ongoing
200709	20.38.03	Levstone to work with Whysor in using Levstone's new platform for REAMIT.	Levstone	Ongoing
200709	20.39	BED to finalise purchase of equipment to build the Big Data hub at BED.	BED	Completed
200709	20.39	BED to finalise purchase of software necessary for the Big Data hub at BED.	BED	Completed
200709	20.39	BED (with the help of ICT at BED) to prepare a room at BED (Luton campus) where the Big Data hub will be mounted.	BED	Completed
200709	20.39	With the help of equipment supplier, BED to finalise building up of the Big Data hub, including installation of software.	BED	Completed
200709	20.40	BED, Levstone and Whysor to collect data from sensors, including developing step-by-step written procedure for collecting data from each REAMIT pilot test and sensor.	BED, Levstone and Whysor	Ongoing

200709	20.40	BED, Levstone and Whysor to develop guidance on managing data collected from REAMIT sensors.	BED, Levstone and Whysor	Ongoing
200709	20.40	Levstone to develop a web progressive APP for visualisation and data presentation.	Levstone	Ongoing
200709	20.40	Levstone, BED, Whysor, SenX and ITT to propose how data will be presented to end-user clients.	Levstone, BED, Whysor, SenX and ITT	Ongoing
200709	20.40	Levstone to propose self-enrolment APP for end-user clients.	Levstone	Ongoing
200709	20.40	Whysor to send responses to the questions on data collected in cloud (i.e. Is the common cloud platform going to be Whysor? Will vehicle route data be also transmitted? What is the capacity of Whysor cloud to store data?	Whysor	To be linked to BED server
200709	20.40	BED and technical partners to develop a template for how WP T1 is connected to WP T2.	BED, Whysor, Levstone.	Ongoing
200709	20.41.01	Levstone, to launch the first version of the APP, which gives the ability to connect the sensor and start collect data. Levstone to assist Whysor in using this approach with Picnic. Levstone and Whysor to assist other pilot test leads use this approach for other sensors in order to make comparison to see temperature profiles.	Levstone	Ongoing
200709	20.41.01	BED, Whysor and Levstone to come together and make a decision on the best architecture to receive and send data to the cloud, data formatting and method of sharing with partners. The options to consider are to either use the server at BED or the reamit cloud set by Whysor and Levstone.	BED, Levstone and Whysor	Ongoing
200709	20.41.01	Levstone and Whysor to ensure that all sensors used for REAMIT pilot tests are compatible with the smart phone APP from Levstone.	Levstone and Whysor	Ongoing
200709	20.41.01	Levstone to propose an early version of enrolment (to have a second database). This is to ensure that REAMIT partners have something to show to new companies (to be engaged in REAMIT pilot tests) i.e. to show real data so these companies can see what REAMIT can offer.	Levstone	Ongoing

200709	20.41.01	Whysor to provide data Whysor is gathering at the moment through their API and to send it to Levstone's APP.	Whysor	Ongoing
200709	20.41.01	Levstone, BED and Whysor to decide where data from sensors will reside, in what format it will reside and how it will be shared.	Levstone, BED and Whysor	Ongoing
200709	20.41.01	UoN to send some data to LM (BED), MS (Whysor) and SM (Levstone) to have a first look at the data.	UoN	Ongoing
200709	20.41.01	Levstone to provide information about Levstone's database i.e. how organisations can self-enrol, what information organisations will be required to provide, how customers can access this database.	Levstone	Ongoing
200709	20.41.01	Levstone to prepare a demonstration about the trial journey idea so that all partners can execute this and generate some data.	Levstone	Ongoing
200709	20.42	**WP T3 – Actions** UCD to assist each pilot test lead in quantification of embedded production phase GHG emissions using Cradle-to farm/processor-gate emission factor.	UCD	Ongoing
200709	20.42	UCD to assist each pilot test lead in obtaining data for the LCA approach i.e. production data, transport methods and current and alternative disposal routes.	UCD	Ongoing
200709	20.48	**WP Management – Actions** BED to work on improving internal payment procedure so that delays can be avoided with transferring funds to partners.	BED	Completed
200709	20.52	**WP Communication – Actions** NTU and all partners: to reflect exit of Dunbia and WD Meats joining REAMIT project in all REAMIT communication materials i.e. to remove Dunbia from REAMIT communication materials or to place WD Meats's logo on top of Dunbia's logo.	NTU and all partners	Completed
200709	20.52	NTU to remove name and logo of Dunbia from REAMIT website.	NTU	Completed

200709	20.52	NTU to send to all partners the logo of WD Meats to be glued to REAMIT roll-ups in place of Dunbia's logo.	NTU	Completed
200709	20.52	All partners to adjust their REAMIT roll-ups with the logo of WD Meats.	All partners	Completed
200709	20.53	BED and pilot test leads will set deadline for collecting pilot test results. Information about the first three pilot tests can go online since we have some good information about them already: - Pilot test in the NL with Picnic – End of September – IH and Picnic can be contacted - Pilot test in France – end of September – AA will provide the required information - Pilot test in the UK with WD Meats – WD will provide information as soon as possible - Pilot test in Germany with Weyers – will need more time - Pilot test in Ireland (Cyberbar) with Manor Farm (TBC) – wait till after September for this pilot information due to COVID-19	BED and pilot test leads	Ongoing
200709	20.53	NTU to upload information about first 3 REAMIT pilot tests on REAMIT website.	NTU	Ongoing
200709	20.54	All individual partners are requested to share with NTU (Sasha) personal or professional social media details, whichever they use to communicate about REAMIT activities. Based on partners' input, SB to develop a database.	All partners	Completed
200709	20.54	NTU to publish the social media database (password protected) of REAMIT partners in the REAMIT website.	NTU	To be uploaded by 21/01
200709	20.60	NTU to finalise the infographics and publish it on the REAMIT website.	NTU	Completed
200709	20.60	NTU to consider printing hard copies of infographics as REAMIT promotional materials.	NTU	When back at the university premises.
200709	20.61.01	NTU to create links for guiding interested parties to register on the REAMIT website their interest in REAMIT (pilot tests, technology, etc.)	NTU	Ongoing

200709	20.61.02	NTU to work with ShB to improve REAMIT videos and infographics.	NTU	NA
200709	20.63.02	**Decision taken during REAMIT Steering Committee Meeting – Actions** BED to check with Una at JS whether the rolls ups have to be redesigned following Dunbia's exit and WD Meats joining REAMIT.	BED	Completed
200709	20.63.02	All partners to take a picture of their roll-ups inside their office with their roll-up banner unfolded and send it to BED and NTU.	All partners	Ongoing
200709	20.63.03	NTU to arrange a brief online training on how to communicate about REAMIT through social media.	NTU	Completed
200709	20.63.03	NTU to engage partners to help translate the infographics to French, German and Dutch.	NTU	Completed
200709	20.64	BED to prepare a confidentiality agreement template similar to the one prepared by UU for WD Meats.	BED	Completed
200709	20.67	ITT to consider possibilities of a new Irish pilot test with Freshbox technology.	ITT	Ongoing
200709	20.69	Whysor to take pictures of the pilot test with Picnic and send them to NTU.	Whysor	Unable to visit the sites due to lockdown
200709	20.69	UU to take pictures of pilot test with WD Meats and send them to NTU.	UU	Completed
200709	20.69	UoN to take pictures of Raman equipment and send them to NTU.	UoN	Completed
200709	20.69	Pilot test leads to make videos of their pilot tests and send them to NTU.	All pilot test leads	Ongoing
200709	20.70	BED to ask JS whether including REAMIT logo in email signature is compulsory.	BED	Completed
200709	20.71.01	BED to ask JS when to expect an answer about extension of the REAMIT project.	BED	Completed

200709	20.77	RR (BED) to keep partners informed about the Green Deal funding.	RR at BED	Completed
200709	20.79.02	Partners interested in contributing to EurOMA paper, to contact Lohit directly outside REAMIT online meetings.	Interested partners	Ongoing
200709	20.79.02	LM (BED) to champion preparing more research articles.	LM at BED	Ongoing

Approved

Minutes from REAMIT Advisory Committee, Work Packages and Steering Committee meetings, 20-21 January 2021

(Zoom online meeting room hosted by UCD)

Present:

Name	Institution	Name	Institution
Ram Ramanathan (RR)	BED	Gerard Corkery (GC)	ITT
Katarzyna Pelc (KP)	BED	Gautam Samriya (GS)	ITT
Lohithaksha Maniraj Maiyar (LM)	BED	William Duffy (WD)	UU
Tahmina Ajmal (TA)	BED	Joan Condell (JC)	UU
Yanqing Duan (YD)	BED	Fabien Tencé (FT)	SenX
Gael Maugis (GM)	I&R	Imke Hermens (IH)	Whysor
Blandine Fortin (BF)	Valorial	Tom Verstraten (TV)	Whysor
Adrienne Gentil	Valorial	Annemarie Van Vilsteren (AV) RAC meeting only	East NL Development Agency
Usha Ramanathan (UR)	NTU	Alain Nouvellon (AN) WP T1 meeting only	Routhiau
Sasha Bennett (SB)	NTU	Matthew Thompson (MT)	Interreg NWE Programme JS
Simon McGraw (SM)	Levstone	Harry Hamilton (HH) RAC meeting only	Nifda
Davinder Bola	Levstone	Jaap Drenth (JD) WP T3 meeting only	Sensipdx
Ali Assaf (AA)	UoN	Eleanor Mathews (EM)	UCD
Gerald Thouand (GT)	UoN	Dimitrios Argyropoulos (DA)	UCD
Fionnuala Murphy (FM)	UCD	Nicholas Holden (NH)	UCD
Shane Ward (SW)	UCD	Gus Verhaeghe (GV) WP T1 meeting only	FlandersFood

Apologies:
Frank Goerte, Picnic

Day 1. Wednesday 20th of January 2021

09.00 – 09.10 Welcome to REAMIT meetings (Chair BED)

21.01
KP welcomed the attendees and presented an overview of the day. Special welcome was mentioned to Mathew Thompson from Interreg North West Europe Programme Joint Secretariat, the REAMIT project officer; and Annemarie Vilsteren, from East Netherlands Development Agency.
KP thanked Eleanor Mathews, UCD for hosting the meeting on behalf of UCD.
KP welcomed all and requested everyone to raise any questions they have before the meeting starts.

RR requested everyone to provide their consent to record the sessions. All agreed.
KP thanked partners for submitting their activity reports in eMS.

09.10 – 10.30 REAMIT Advisory Committee (RAC) meeting (Chair BED)

REAMIT project progress, including extension and capitalisation proposal (presentation by BED)

21.02

KP summarised the agenda for Day1; introduced Jaap Drenth, CEO, Sensipdx, The Netherlands as a speaker for second day on 'Market readiness levels and Technology readiness levels'; Alain Nouvellon, Operation Manager, Routhiau, France.

RR mentioned that Jaap (Sensipdx) is also partner from NL in the REAMIT Capitalisation proposal.

RR welcomed Harry Hamilton from Northern Ireland Food and Drinks Association, who also is part of the REAMIT Capitalisation proposal.

KP presented overview of the progress in the implementation of the REAMIT project.

WP T1 Adapting and pilot testing sensor technologies in agri-food supply chains

WPT1 D1.1 Publication of open call
The open call last date has been extended until 31 December 2021.

D1.2 Companies recruited from across agri-business supply chain (min 5 companies) for pilot tests

The following companies have been recruited for pilot tests:
- Picnic (NL)
- Routhiau (FR)
- WD Meats (UK)
- WEYERS GMBH (DE)
- Manor Farm (IE)
- Yumchop (UK)

WPT1 D2.2 Test Roadmap
I&R will update this section in first quarter of 2021.

WPT1 Deliverable 3.1 Working prototypes using sensor technology
- Whysor – Picnic (NL)
- Whysor – WEYERS GMBH (DE)
- UoN – Routhiau (FR)
- UoN – STEF (FR)
- UU – WD Meats (UK) on Clostridium Bacteria
- UU – WD Meats (UK) on Dry aging Chamber
- Ulster University 3D Fluorescence (UK)
- UCD Cyber bar (IE)

KP explained progress in each of the pilot tests. Detailed progress would be presented during WP meetings.

Pilot tests in the pipeline:

- New pilot test company in the NL (Whysor)
- Company producing frozen food (UK)
- NTU contacted at least 6 agri-food businesses in UK, including Pepsi, Starkey's fruits, Morrison's, Tesco and food charities within their business community.
- UU met with Finnebrouge, Galvia Digital and Riverwest Management to discuss new pilot tests
- ITT explored pilot possibility for developing pilot test in line with the Fresh Box initiative.

Q&A and comments
UR requested BED to liaise with some of NTU's contacts as a lead partner.
RR confirmed to offer support in this.
KP advised that Innovation and Enterprise services at BED helps to connect to SMEs in related areas. REAMIT networking events can also help establish contacts with new companies.

AV: How many pilot tests is REAMIT looking for?
RR: As many as possible. The budget may accommodate 20 pilot tests.
AV: Are you looking for any specific food sectors?
RR: Fruit, vegetables, meat and fish, however, any kind of food is welcomed at this stage. We are also looking into extending REAMIT pilot tests to liquid food in the REAMIT Capitalisation project proposal.

GM confirmed that BbaMV is no more an associated partner.

Action for BED: Remove BbaMV from the list of REAMIT Associated Partners.

WPT2 Big Data integration to reduce food waste

Deliverable 4.1 – 8.2
KP summarised the progress made under different deliverables in WPT2. The server is installed at BED campus and ready for receipt of data from pilot tests.

WP T3 Business development of REAMIT technologies

KP reported that UCD has begun developing the life cycle assessment framework.

WP Long Term

- 2nd REAMIT Symposium was organised online by Valorial and I&R on 5-6 November 2020. The event was originally planned to be conducted in Nantes, France.
- Some potential collaborators were approached for REAMIT pilot test.
- BED submitted REAMIT application to 'Real Impact interdisciplinary research Fund Award' organized by Emarald Publishing (27/11/2020).
- BED has developed the REAMIT project Capitalisation proposal. Deadline for submission to Interreg NWE Programme JS is 29/01/2021.
- PPs have approached over 30 new actors in agri-food supply chains to promote REAMIT and invited them to participate in REAMIT pilot tests.

WP Management

- New recruits:
    - Gautam Samriya has been recruited as Research Assistant at ITT for data analytics. He started a full time role on 30/11/2020.
    - UCD is still in the process of recruiting two post-doctoral researchers. They are expected to conclude the recruitment process in the first quarter of 2021.

- Completed third round of RAC, WP, RSC meeting online (8-9/07/2020).
- BED submitted 3rd REAMIT progress report and payment claim to JS on 29/09/2020.
- BED submitted 3rd payment claim to JS: EUR 270973.65.
- BED transferred due amounts to PPS on 27/11/2020.
- Dunbia and Cottagequinn Farms LLP exit from REAMIT was completed in September 2020.
- More than 40 online meetings of REAMIT partners took place in the past semester:
    - 6 monthly meetings of REAMIT staff at BED.
    - 14 bi-weekly meetings of REAMIT sub-group (BED, NTU, UU, ITT).
    - 3 monthly meetings of WPT1.
    - More than 15 bilateral meetings between partners.
- Project Handbook has been updated with minutes of meetings and calendar for 4th REAMIT progress report.
- BED updated REAMIT risk log (5 new risks).
- BED's request for REAMIT project 12-months extension with budget was confirmed by JS (More detail discussed at RSC meeting).

WP Communication

- NTU Updated REAMIT website
- SB from NTU delivered a social media training for REAMIT partners (03/12/2020).
- NTU updated REAMIT logos following Dunbia's exit and WD Meats joining REAMIT.
- 2 new videos were developed by NTU and posted on the REAMIT website.
- 2 newsletters (September, December) were developed by NTU.
- 12 internal and external presentations of REAMIT were delivered by REAMIT partners.
- UU submitted an article to Sensors MDPI Special Issue "State-of the Art Sensors Technologies in Ireland 2020".
- UoN contributed to drafting the article "Review of potential Sensor Technology for Continuous Monitoring of Food Quality in Transport" with the section on Raman Spectroscopy.
- Three journal articles are being developed by BED. They are targeted for submission in 2021. Ram and Lohit submitted co-authored paper conference paper to Euroma 2021.
- Shared point space was created and hosted by NTU.

Feedback from REAMIT Associated Partners

RR requested opinions and suggestions from AV and AN.
AV: REAMIT infographics is very good. Testimonials will also help to explain benefits which the REAMIT project and approach can offer companies in agri food supply chains. She confirmed that she would be happy to share information about the REAMIT project to reach out to new companies in The NL.

KP: What would be the best way of getting the testimonials, would videos help?

AV: It depends on how you want to use it? For example, when you want to use it within different countries, different languages must be used or just use textual descriptions in every local language.

RR explained about the REAMIT Capitalisation proposal. It is an extension of the REAMIT work almost like including a new work package by focussing on new markets, new food sector. The REAMIT Capitalisation proposal focuses on liquid food with partners from BE, LU and NL. It also looks at meat industry in greater detail.

KP asked if other partners received feedback from their Associated Partners on the third REAMIT progress report, but there was no response from partners.

10.30 – 10.45 Tea / Coffee break

10.45 – 13.00: Work Package (WP) Meetings

WP T1 Pilot Tests (Chair I&R)

1) Deliverables as per the Application Form
2) Presentation of pilot tests by pilot test leads:

21.03.01

Pilot test with Weyers, Whysor, The NL – presentation by IH, Whysor

- The aim of this pilot test is to follow the (loss of) quality of food during the complete supply chain. The pilot test covers the full supply chain, from farmer through a warehouses until the end-user at the supermarket.
- The pilot test started in January 2020, however due to the pandemic, it effectively started in September 2020. There has been little contact with the company. Whysor purchased mcf88 sensor from Italy and a GPS sensor from digital matter. Data would be collected in Whysor cloud and later on it will be sent to BED server.
- Data will be collected to measure Co2, VOC, humidity, temperature, light, pressure, complaints, combination of foods, inputs from employees.
- Sensors were already delivered to the company in December 2019. They were installed in their office in February 2020, but soon Whysor lost connection with the sensors. On 15th September 2020, Whysor visited the company. It was discovered that building at the company were made up of metal, which might have been the reason of the lost connection. Values of VOC were sometimes above maximum values.
- In November 2020, the contact person at Weyers confirmed they were ready to continue installation of sensors inside the trucks, but drivers raised issues regarding the installation of sensors inside the drivers' cabin due to harmful effect of radiation on drivers. Whysor discussed the possibility of installing the gateway inside the trailer. There has been little contact with Weyers since December 2020, and almost no response to any form of communication from the Whysor.
- IH proposed to look for other partner companies in Germany for pilot tests.
- German lockdown extended at least until 31/01/2021.
- At this point, IH confirmed they were one year behind schedule with the implementation of this pilot test.

Q&A

- RR expressed concerns that it would be a shame to lose one of our pilot partners.
- SM suggested a Bluetooth sensor could be used; but again it would need a driver's involvement in terms of help in installing on their phone.
- IH again expressed concern about losing contact with Weyers to even discuss a possible alternative solution for installation of sensors in Weyers trucks.
- RR suggested to explore another pilot test partner, while we think about what we can do with Weyers after we get another partner.
- RR said that the difficulty in reaching out to the German pilot test company (Weyers) might also be caused by the lockdown related issues.
- IH pointed out that Weyers scaled up at 50%-70% above their last year's operations. COVID-19 has increased demand for this online food supermarket.

21.03.02

Pilot test with Picnic, Whysor, The NL – presentation by IH, Whysor

- Picnic is an online supermarket in The NL.
- Frank could not join this meeting because of an urgent assignment.
- The main goal of this pilot test is to develop personalised cooling profile for each cooling box in the e-vehicle, determining how many cool packs are need for every cooling box.
- The second goal is to link customer's complaints with acceleration/shock detection inside the e-truck.
- 20 EMS sensors have been purchased to be placed in 20 cool boxes. Software update has been done by Whysor. 2 sensors were sent to Picnic. According to Frank, they have not been able to yet install the sensors because of Covid. They hope to be able to do it by end of January 2021.
- Values and data obtained are not interesting yet, because they are obtained outside weather conditions, i.e. cool weather does not affect food and does not cause food spoilage at this time of the year (January). In order to develop personalised cooling profiles of food boxes, outside temperature need to be higher. We will then be able to study food spoilage.
- Whysor will calibrate the other 18 sensors, and hopefully in 2 weeks' time they will be sent to Picnic. Whysor should be able to start installing them at Picnic trucks in March 2021.
- Dutch lock down will extend at least until 9/02/2021.
- Nest steps in this pilot test:
    - Validation of shock detection
    - Calibration of sensors
    - Installing sensors in cool boxes in Picnic trucks
    - Gathering data
    - Sending data to partners for analysis
    - Establishing cooling profile per cool-box

REAMIT Whysor dashboard, presentation by TV, Whysor

- The values of the dashboard show temperature, humidity, battery voltage, shock detection.
- The data can be displayed in the form of charts.
- Shock data can be sent to a dashboard every 5 minutes, but it will be interrupted when there is a sudden change in the reading.
- TV showed a live demonstration of data being sent by tapping the sensor.
- Values of last 7 days averaged for every hour were shown as bar charts.
- A table showing acceleration values shown for X, Y and Z axes.

Q&A
LM: Has there been any change in the dashboard in the last 6 months?
TV: Constant developments are being made based on progress of pilots.
LM asked TV to share information about the changes through email for the purpose of reports.
LM: What are your thoughts on transferring the data to BED server? Are you going to continue to host this cloud service or do you have other solutions in mind?
TV: We are quite flexible to send the data to be stored in any server in a specific format. More details about it will be provided in WPT2 meeting.
TA: What is the basic purpose of the dashboard? Is it for demonstration, for research or for pilot partners?
TV: It can be used for multiple uses. It can help you set up your own dashboard, your own visual representation of data.
TA: Will there be any plug-in for data analytics?

TV: It would be best to plan a separate meeting, based on each data analytics partners' needs. Whysor is cooperating with SenX to add more analytics functionality.
TA: How would the data analytics fit in to the current architecture of the dashboard?
TV: There are many modules which can be used for this. The data from the dashboard can communicate through APIs. There is another module for data analytics using Python. There are in-house Python developers who can be used for linking this with data analytics.
TA: Where this will be stored later? In the BED server or in Whysor cloud?
TV: It is best to store data in both places.
LM: What is the location of the sensor data?
TV: Currently it is sent from Whysor's office.

21.03.03

Pilot test with Routhiau, UoN, France – presented by AA, UoN

- Raman spectroscopy uses chemical composition of the food sample.
- This pilot test uses temperature sensors in parallel with Raman sensors.
- Pilot test has been carried out in lab on chicken samples provided by Routhiau (a food supplier company located in the region).
- All data should be sent automatically to BED server. Later, data should be available to data analytics partners.
- 4800 spectra collected so far. Currently storing this data on a temporary solution of google cloud and shared with SenX.
- Currently working on integration of Raman spectroscopy in a transport environment.
- Raman signals are sent through the probe on to the chicken samples placed in packages. The temperature sensor has been installed and is working fine.
- There are some technical problems with automatic transmission of data. There is data access but we cannot save it.
- UoN met with I&R and IQM (manufacturer of the sensor) to sort this out. Ali also asked partners for help.
- Covid impact: Currently France is in curfew from 6 AM to 6 PM. Estimated delay in the implementation of this pilot test is at least 1 year. New industrial partners are difficult to find, as COVID-19 has had negative impact on communication, travel and meetings.
- Recovery plan: To expand the Raman testing to new food categories, test the technology on food from supermarket; Integration of this technology during food transportation – in a truck from STEF, or in a rented refrigerated truck.

Q&A
RR: We have to move from lab-based testing to actual transport environment. What is the stage of real time implementation?
AA: We are working with an intermediate solution until we find an industrial partner to test our technology. For example, using a small fridge inside a small car can simulate the transportation.
TA: Is there any positive results? What sort of output do you get from the Raman probe?
AA: We get a complete spectrum, the chemical composition of the sample, the proteins, the lipids etc. in the same spectrum. Using statistical analysis, we can say how the spectrum changes with time and say whether the quality is good or bad. In the project, we need help from partners to analyse these projection models.
TA: At present, are you just storing the data. Do you scan it time wise?
AA: We have optimal probe and record the data for 1 min. This data should be sent later to analytics partners.
TA: What is the size of the data for one chunk of data?
AA: One spectrum is 1KB which is not enough obviously. We can program our spectrometer to do measurement after 5min depending on the need of the user.

TA: Is the sample stationary or movable?
AA: It is complicated to check with many types of environments, first we measure in one area per time unit. So, at present it is stationary.
TA expressed interest to work with UoN and asked to share any potential research works for collaboration.
KP: Why Routhiau was chosen as a pilot test partner?
AA: UoN contacted many industrial companies for REAMIT. We know Routhiau from the past from a small collaboration. It is also a local company, which facilitates communication.
KP: Why chicken sample was chosen?
AA: This is the most important food matrices in the food industry. The chicken is the food at most risk.
KP: What will happen once you find a new company, like STEF for example?
AA: I cannot give you more information how this can be integrated. It may be that we can give them the samples directly to test or ask them to provide one truck for testing.
KP: One of the food was in a plastic foil. If you move to a car for example, can you do the test of uncovered or covered with plastic?
AA: Some experiments prove that we will be able to do that using some statistical algorithms. We work now to test this in the same condition during transportation.
KP: Is the lab-based analysis being done on raw chicken or processed chicken like chicken cutlet, fillet, cooked chicken or ready to eat chicken?
AA: We have analysis related to both raw as well as cooked chicken.
GS: Are there any plugins to make binary classification of good sample or deteriorated sample?
AA: Raman spectra can be saved in many formats. We use .txt file to send it to others because text files are smaller in size. We use MATLAB software for analytics. Lots of software can be used. A list can be sent over.
GS: The output of Raman data is a chemical composition. Is that correct?
AA: You have lots of data pertaining to proteins, vibration of molecules, on each sample. We can see or compare chemical compositions, but we can also see the difference between the intensity and richness of spectra, depending on the chemical composition of the sample.
DB: In order to understand the challenge, you are facing regarding pushing data upstream, how or what access control data is stored on a PC, micro-processor, logical controller, something else?
AA: Data stored in PC on .txt file. We use google file to send it. We do not need any logical controller to do that. For a big spectrometer, we may need high performance computer, but for REAMIT we only use a normal PC.
DB: So, we can run a service on the background to push the data upstream?
Ali: Yes. In our computer, we also have installed a sim card with internet connection to send data etc.

21.03.04

Dry aging pilot test with WD Meats, UU – presented by WD, UU

- The aim of this pilot test is to detect weight and quality loss of meat during dry-aging process.
- Temperature and humidity sensors will be installed to map readings across chambers to find if certain areas or orientations cause worse quality of meat or weight loss. For example, the source of heat could be detected and managed, somebody opening the doors, improper placement of motor etc. All these factors contribute to changing temperature and humidity conditions in the dry aging chamber.
- The goal is to develop the alerting system that can send a warning if in certain areas of a dry aging chamber temperature and humidity conditions have changed; as well as determine some way of reconfiguring the dry aging chamber.
- Christmas is busy period for WD Meats so UU would start the pilot test in January 2021.
- Sensors being used are Ursalink UC11, temperature/humidity sensors, Gateway: Multi-tech MTCDT LoRa gateway.

- Elysys sensors were already connected to send data, any other sensors should be easy to setup with similar efforts.
- Status: Configured sensors loaned by Whysor. 5 Ursalink sensors purchased, Sensors received on 19/10/2020.
- Gateway being configured to use new sensors so they are ready when WD Meats allow to install and provide site test results.
- COVID impact: due to Covid, there have been restrictions to access WD Meats factory.
- Lockdown in NI started on 26/12/2020 and may be extended until 6/02/2021.
- UU have experienced difficulties in contacting WD Meats in the recent months.

21.03.05

Clostridium bacteria pilot test with WD Meats, UU, presented by WD, UU

- Clostridium Estertheticum is an anaerobic spoilage-causing bacteria. It is prevalent in abattoirs. It produces non-toxic gases which spoil products early.
- The bacteria can spread easily, and it only grows once meat has been packaged in foil. Currently, detection of this bacteria at WD Meats abattoir is slow.
- The pilot test aims to investigate methods of detecting the bacteria in conveyor belts or in any other part of the factory. This will help WD Meats inform the cleaning routine.
- Rationale: The bacteria causes significant amounts of wasted beef globally.
- Ulster team has been looking into PCR swabs; placement students have been trained to do DNA extraction on WD Meats site. If however they are not allowed inside the site, Mark offered to conduct the experiments and send over the swabs to UU for further investigation.
- Whysor and BED are involved in the transfer and storage of data from this pilot test.
- Visit to WD Meats by William and Prof James was completed in August 2020.
- Update: 16/11/2020: UU purchased qPCR kits; STA completed and waiting to get it signed off. 2 Fresh Detect sensors received on 13/11/2020.
- Update: 18/01/2021: Meetings held with WD Meats and Sensipdx/Maastricht University to investigate liquid based bacterial detection but is expected to be less sensitive than PCR approach. UU is waiting to hear Mark's opinion on the approach. Ongoing analysis to get the limit of detection for the bacteria.
- Next steps: Once the student is trained, detection of main infection areas will begin. Main infection areas to be further investigated. James Dooley to leverage his contacts on this issue. Follow-up with companies on potential solutions.
- Meeting arranged with SeedAir, after REAMIT second Symposium (Nantes, November 2020) to investigate further solutions for bacterial detection. Meeting arranged with WD Meats, UU, Sensipdx, Maastricht University on 19/11/2020.
- COVID Impact: Due to restrictions, visiting WD Meats facility was not possible for months.

21.03.06

3D Fluorescence pilot test at Ulster, presented by WD, UU

- Pilot idea: 3Df sensors can be used to make determinations of total bacterial count on solid products or liquids.
- Progress: UU have been conducting interviews with sensing companies to find an appropriate device.
- Testing results with FreshDetect device was presented.

Q&A

GT: What is the final goal of using the FreshDetect device? Is it for use at an abattoir or inside the truck by a driver?

WD: We don't have a pilot test in mind for now. These will not be really applicable to a final pilot test until the company is found.
RR: These pilot tests are going to be conducted inside WD Meats.
TA: WD Meats has got a system for measuring the bacterial count. Do they not cover the detection of clostridium bacteria?
WD: It is not covered. The problem is that the equipment will give the total count but will not say whether the bacteria is present. They use an acid spray on the conveyor belts, but still they find it in other places in the factory.
TA: How do they know that the bacteria is there?
WD: They do not know it. They just do a regular cleaning of the place for safe reasons.
KP to GV: There was a whole project dedicated to Clostridium bacteria in The NL (supported by FlandersFood). Can you tell us more about it?
GV: You can sense the total count of the bacteria, but it is challenging to sense a specific bacterium. Similar to how it is for Raman spectroscopy. We don't have a solution either to rapid sensing specific bacteria and would be interested to know more about it.
RR: In Belgium, clostridium bacteria problem is found predominantly in what sort of companies?
GV: In meat companies.

21.03.07

Cyberbar pilot test at UCD, presented by SW, UCD

- Aim of the pilot test: To develop a track and a trace system specifically applied to Chicken filets. UCD has been working with Ireland's largest chicken producer and food chain company.
- Cyberbar concept: To give an additional layer of protection rather than the conventional use of packaging. To avoid widespread use of plastic packaging. This can be avoided by directly etching on to the chicken fillet.
- QR codes can be loaded onto an ordinary smart phone and consequently product can be tracked right from the farm to the consumer.
- The goal is to extend this concept to vegetables and fruit: broccoli, braille, potato, melon.
- UCD has been also exploring extension of this concept to mushrooms.
- Lab based tests done to assess Cyber bar.
- Progress: No further progress since last meeting due to Covid.
- Covid Impact: November 2020 was very good with lowest number of cases in IE, but at the present the situation is not good. Ireland is in Level 5 lockdown and this will continue in 2021. Manor farm is interested in the pilot test but currently they are not able to continue the work on the pilot test.
- The process of hiring two post-doctoral researchers at UCD has been in progress.

Q&A
RR: When the pilot test is up and running, we will need to ensure that the pilot test is aligned with the nature of REAMIT pilot tests, particularly measurements of temperature, humidity etc.
SW: The Cyberbar pilot test will not only focus on Cyberbar but it will focus on gathering as much data as possible with the use of temperature sensing, geo location mapping, other data and send it back to the systems/website in place to analyse the information collected which can be downloaded using the QR code.
RR: Any other pilot tests in Ireland that will not only focus on Cyberbar but with some temperature sensors etc. will also be helpful. Any company that may not use Cyberbar but uses temperature, humidity sensing is also welcome.
SW: UCD is open and happy to take such ideas forward but COVID is impacting the contacts with pilot partners.
RR: Gerard talked about the Freshbox idea. UCD was also involved in the project. Any idea that can be adapted from Freshbox project and implemented for REAMIT would also be good.

SW: Agreed that Freshbox and REAMIT are compatible.

Action for all pilot test leads: to upload all the presentations of pilot tests in SharePoint.

Action for I&R: to update the COVID impact assessment document based on inputs received from partners in WP T1 meetings.

Action for I&R: to update pilot test roadmap.

21.03.08

Freshbox project at MTU, presentation by Gerard Corkery and Gautam Samriya, MTU

- GC announced that ITT is now officially part of Munster Technological University and will be using MTU logos instead of ITT.
- Freshbox is a separate EU project ITT was involved in a couple of years ago.
- ITT/MTU has recruited a new research assistant, Gautam Samriya, and welcomed him to present further.
- Freshbox is an active/smart container that stores/transports each type of fresh produce in ideal conditions of respiration rate.
- Monitors with an innovative Integrated Sensor Kit to check key environmental features in container and allow traceability.
- Lightweight, manufactured with technology that saves energy and made of innovative recyclable material.
- Transports fresh produce harvested at higher maturity stage.
- Motivated because of high food waste across Europe and corresponding high range of carbon emissions, high time span of storage, transportation and distribution. Normal containers do not provide ideal environment for transport. Therefore, it is designed to address: reduction of food waste, extension of product shelf life and savings of fuel and energy consumption.
- Scope: Farm to final retailer through storage and processing industries.
- Consortium: IMAR, Aitiip (Spain), PCTAD (Spain), Transfer LBC (Spain), Lafuente Tomsey (Spain), S.L., Kolla & Co (Germany).
- The Freshbox contains specific lid with integrated sensor circuit, equipped with active substances and absorbers to maintain organic quality, for example ethylene absorbers or anti-microbial organic substances.
- Implementation was conducted in four stages: Selection of fresh produce and requirements of Freshbox design, Design of the Freshbox with the integrated circuit, Lab test, Actual tests in Spain and Germany.
- Experimental design: 6 fresh produce types were selected. Fresh produce were characterized based on tolerances to different atmospheric conditions and their vulnerabilities. Selection of optimal atmospheric conditions were made. Determination of O2 and CO2 tolerances for each type of fresh produce was made. The vulnerabilities and physiological damages were studied. Determined the ideal permeability of the Freshbox for each type of fruit or vegetable using a mathematical model.
- Final container was designed with appropriate tensile strength and other mechanical properties, lids with appropriate permeability levels and was finally integrated with sensor circuit. This design differentiates the Freshbox from the conventional container.
- Advantages of using Freshbox for Broccoli, grapes and strawberries very found to be relatively higher compared to other fresh produces.
- Socio- economic impact was evaluated and were found to be higher for different fresh produce categories.

Q&A

YD: What is the cost of Freshbox?
PD: One of the issues is certainly the cost to manufacture the box. ITT was involved more from the technology perspective rather than manufacturing the box itself. It was prohibitive to do mass commercialisation. Because of the lightweight material, there was a need to strengthen certain sections of the box because there was a slight decrease in the number of products that could fit into the box as compared to the standard pattern of shrink wrapping. A couple of companies were seriously looking into it but we are not very sure about the results of commercialisation.
13.00 – 13.30 Lunch Break

13.30 – 14.30: WP T2 Big Data integration and application to reduce food wastage (Chair BED)

21.04

LM presented an overview of WP T2.

1) Deliverables as per the Application Form:

Creation and launch of interface for each of the pilot tests for collecting data from sensors and sending it to cloud for use in a transnational Big Data infrastructure (by July 2021)

- LM thanked Whysor for hosting the cloud.
- The cloud included data from the new sensor from the Dutch pilot.
- German pilot sensors need to be installed first.
- Whysor and SenX were supporting UoN in sending data to REAMIT cloud.
- Issue, UoN has to create a new structure of data, temporary solution to store data in google cloud. Data from the UoN pilot was shared to SenX to Data Analytics.
- There is no meaningful data yet for data analytics from UU.
- There is no update from other pilots yet as they are still in the discovery phase.
- LM thanked Levstone for providing multiple options to run the software and is waiting for the data from different pilots. They were also helping to set up a Big Data server for use of Warp 10 software.

User Manual on launching the interface (by July 2021)

- LM requested WD rom Ulster to connect the sensor to the cloud and send a document describing these efforts.

Action: UU to send to Lohit a document describing UU's efforts to connect sensors to the cloud.
Action: Whysor to send to Lohit a document describing Whysor's efforts to connect sensors to the cloud.
Action for all pilot test leads: To do the same as above actions, i.e. to send to BED a document describing their efforts to connect sensors to the cloud. (This can be ignored if the procedure is same as in the document sent by Whsyor)
Action: BED, based on inputs from pilot test leads, to develop an overview of approaches taken by partners to connect sensors to the cloud.
Action: BED will request for updates to the sensor connectivity document from Whysor if there are more connections of different nature from other pilots to the REAMIT cloud.
Action: Whysor to send to Lohit a brief document describing the different elements of the REAMIT dashboard and updates made from time to time.

A big data platform with capability to collect and store sensors data from all REAMIT corridors (January 2020 – July 2021)

Lohit confirmed that procurement of the server had been completed by BED. The physical server has been installed in BED campus in Luton, UK. Lohit listed the big data hub equipment and noted that storage can be expanded if needed (e.g. graphic cards for pictures can be added in the future).
Lohit noted the server has been moved to a permanent location at BED to enable external access through a demilitarized zone (DMZ) for enhanced security. This is separate to the university's connection for extra security.

Lohit noted that BED worked with Levstone, who were very helpful, and suggested a systematic phase approach with phases 1, 2 and 3. Phase 1 has been completed. Phase 2 is in progress. Phase 3 has not yet been started. In the multi-phase approach the first phase involved installation of SQL software, testing of basic connection to the server through VPN and Remote Desktop (RDP) Access was tested for internal and external users. The second phase would involve testing connection to MS SQL data base software and configuration of MS SQL software instances. The third phase would involve collecting opinions of partners and developing a common architecture to standardise the process of sending and receiving data. Having completed the first phase, and with the ongoing second phase of the setup we aim to progress exponentially with the future stages in coming few months.

Action: BED and Levstone will create and configuring SQL instance for Levstone on the REAMIT server. BED to work on provision of access to this instance for Levstone
Action: BED will create University network access, SQL instance, access to this instance and Windows server remote desktop access for MTUKerry
Action: BED will create SQL instance and access to this instance for other partners
Action: BED will conduct a meeting with all technical partners for opinion and consent for creating and providing access to a shared SQL instance on the server.
Action: BED will work with Levstone for creation of shared SQL instance and accesses to this instance for all partners
Action: BED will work with Whysor to transfer all pilot data from REAMIT Whysor cloud to REAMIT BED server once there is actual data from the pilots
Action: BED will continue liaising with Softcat on getting licensing quotes to license additional user connections to the server via Windows server remote desktop and to the MSSQL database software installed on the server.

Reports on Big Data platform performance (January 2020 – July 2022)

A web-interface with self-enrol facility for enrolment of potential suppliers and consumers of food produce (January 2020 – July 2022)

- The work on these deliverables has not started yet, as Big Data hub is waiting for data.
- RR noted that Levstone is leading this facility.

SM made an overview presentation from Levstone's perspective – the aim was to discuss whether they can use a low cost sensor and a mobile phone as a router. One of the things needed is metadata on temperature to exclude irrelevant temp data. Simon demonstrated how the mobile app would be used and how it will be linked with the sensor data. Simon is working on getting this app ready for REAMIT pilot tests, specifically looking at 'How to add metadata' and the visualization. They have been working on security and new technologies for making web and mobile apps on a single codebase. Ram noted that this app will be really useful for Dutch and German pilot tests and the UoN.

SB asked SM if it is ok to feature this in the next REAMIT newsletter. Simon agreed and offered to provide clearer images.

User manuals for the Big Data platform and the web-interface (January 2020 – July 2022)

Action: BED and Whysor to update the document in previous action with pilot specific or generalised data transfer procedure from REAMIT cloud to REAMIT Big data hub. (Whysor will need to contribute with data conversion or pre-processing and SQL script creation procedures, BED will contribute to description of SQL instance architecture to receive the data from REAMIT cloud and, store and view the data on the REAMIT Big data hub).

Launch of smartphone APP for linking food owners, truck drivers and warehouses (January 2020 – July 2021)

- Levstone tested three kinds of sensors for updating into the cloud.
- Levstone has a new type of sensor but the timeline is not clear on this so this is not currently a priority. LM described the key features of the sensor. Levstone will confirm whether this will be used going forward
- SM's above presentation relates to this deliverable. Deliverable 7.1 and Deliverable 5.3 are connected in that sense.
- DB made a demo of the mobile app showing the capacity of including the data from the REAMIT sensors.

Action: BED will organise a meeting to discuss next steps for implementation of mobile App on pilot test data
Action: Whysor will convert UoN sample data to blob format
Action: Whysor and BED will work together to deposit UoN data to REAMIT Big data hub
Action: After the data from either the UoN pilot or the Picnic synthetic data is ready, Levstone will have a look over the data and see if they can be used for the App.
Action: Whysor Levstone and BED will start testing the App on synthetic data from Picnic pilot

An additional deliverable: launch of second database of potential buyers (food charities, convenience stores, etc.) in REAMIT corridors – the route where trucks would travel.

This database will be developed by Levstone.

User manual for the use of the APP (January 2020 – July 2021)

Deployment of the integrated IoT/Big Data analytics/Decision support technology (January 2019 – July 2022)

A user manual for the integrated IoT/Big Data/analytics/Decision support technology (January 2019 – July 2022)

'Development of a Smartphone APP for REAMIT and a second database of potential buyers (food charities, convenience stores, etc.) in REAMIT corridors', presentation by Levstone.

Q&A

1. Do we need a pilot specific architecture or a generic one to receive and send data?

TV suggests organising a follow up meeting to discuss the technical details. TV would like to get a picture of the data format and how often values are sent from partners.

2. LM asked about time frame of data collection for making big data. As this could take a year to collect from all partners.
3. TV said 2-3TB should be more than enough for sensor data from them but need to know from other partners.

LM reminded all pilot leads to send him the template as soon as new pilots are developed.

14.30 – 15.00: WP Project Management (Chair BED)

21.05

KP confirmed that Matthew Thompson was the new REAMIT officer at the JS; and Gautam Samriya was the new Research Assistant at ITT.

KP reported about the progress in the implementation of the project:

- RAC/WP/RSC meetings took place online in July 2020
- BED submitted 3rd REAMIT project progress report and payment claim to JS.
- BED transferred due amounts to PPs
- Dunbia exiting REAMIT was completed in September 2020. WD Meats have joined REAMIT as a sub partner of UU.
- 40 online meetings of REAMIT partners took place in the past semester.

Deliverables as per the Application Form:

Project Handbook (by February 2019)

Project Handbook (PH) has been updated regularly with minutes from online meetings, reporting calendar, appreciation emails received from external organisations. PH is available in SharePoint.

Minutes of meetings of RSC, RAC and WP meetings (min 6, by January 2022)

They are included in the REAMIT Handbook.

Intermediate WP coordination (by January 2022)

LP assists all WP leads with WP coordination. LP attends meetings of all WPs. Minutes from all meetings are included in the REAMIT Handbook.

Annual risk reviews (2, by January 2022)

5 new risks have been identified in REAMIT in the past semester. They have been discussed at RSC meeting and added to REAMIT Risk Log.

Project reports (7, by July 2022)

Based on inputs from PPs, LP developed and submitted (March 2021) to JS REAMIT 4th report.

KP reported about other REAMIT related work

- BED submitted to JS application for REAMIT project 12-months extension. LP received positive answer from JS on 29/11/2020 granting REAMIT 12-months extension including budget extension.
- RR has been working on the REAMIT Capitalisation proposal.

KP stressed that each partner needs to reach out to REAMIT target groups (specified in the AF). These are organisations at national/regional/local level, who should be informed about the REAMIT project. Information about each partner reaching out to its target groups needs to be included in the partner's progress report in eMS.

15.00 – 15.15 Tea/Coffee Break

21.06

15.15 – 16.00: Life Cycle Assessment for REAMIT technologies (Chair UCD)

- FM presented the first sketch of the LCA for the RAMIT project. She presented the broad overview of the approach; she noted that the background of LCA included the environmental impact of food waste along the agri-food chain. Essentially, the embedded GHG emission will be calculated along the supply chain. FM showed a recent publication on Embedded Emissions in Avoidable Food Waste. In REAMIT, the LCA will look at each pilot test in depth, specifically what food is the focus in each pilot test.
- Each stage in the food supply chain will be taken into consideration in LCA ('on the farm' stage, food processing stage, storage of food stage. We will need to know details about emission levels and forms, volume of food entering the supply chain, volume of food transported, information about the vehicle in which food is transported, load of the vehicle, fuel consumption of the vehicle.
- In REAMIT, data is needed to determine at what point in food supply chain, food becomes waste. We need to consider the impact of implementing the different sensors.
- This is a two-stage approach looking at the baseline scenario and potential environmental impact of implementing REAMIT.

REAMIT Pilots – Data needed for LCA
France – Chicken and Shrimp – sensors to be deployed in transport.
UK – Beef – Sensor to be deployed in food factory (processing).
Netherlands – Groceries – Sensors to be deployed in transport.

KP suggested taking the pilot test with Picnic for a simulation exercise. IH from Whysor agreed to provide input.

- 20 food cool boxes are loaded in the Picnic lorry, one box is designed for a particular customer.
- 20 sensors are installed inside 20 cool boxes but may not be in the same truck.
- FM asked who will identify degradation.
- Detection is noticed by the customer. Boxes are packed in large warehouses and sent from a large warehouse to a smaller warehouse and then loaded to a truck. IH confirmed that customers pick what is in boxes and only chilled products are kept in cool boxes.
- FM suggested getting data on each product in the cool box or an average on the whole box.
- IH to ask Frank whether they can get this individual product data or determine an average per box.
- FM stated the next step would be to determine the energy consumption (electric vehicle, fridge/freezer etc.) in Picnic.
- IH noted that ice packs are used in each cool box: Do we need to determine how many ice packs are used per trip of Picnic truck?
- FM highlighted the need to have for each sensor information on the battery used (lifetime and voltage of a battery), and manufacturing details of the sensors.
- 'Big Data' platform relates to the overall project (not pilot specific) – energy required to maintain the data centre is the main detail needed.
- Ram asked if there is a need for the embedded energy on creation of the server. FM agreed this needs to be determined.
- Ram and Lohit will work on this but may not have the embedded energy used to produce the server but will try to get this info.
- FM will need details relating to the amount of wasted food per track. This information will need to be obtained from Picnic.

Action: Imke to ask Frank whether he can provide data on individual products in a cool box transported by a Picnic truck, or otherwise whether he can determine composition of a cool box on average.

Action: Imke, Fionnuala and Frank will meet to discuss conducting LCA with Picnic. FM will contact IH to organise this meeting.

Action: Imke to collect from Picnic details relating to the amount of wasted food per track.

Action: Ram and Lohit will work on determining the embedded energy needed for creation of the Big Data hub server at BED.

Q&A
UR: do you calculate retail store shelf life and energy consumption i.e. quantity of food waste in warehouse or retail store or consumption place?
FM noted that this has to be determined in terms of REAMIT but embedded emission is to look at the entire chain where food becomes wasted.
FM: we intend to do a LCA study of a pilots which are likely to have data soon. This will help the other pilots. Once the postdoc is in place, FM intends to meet with individual pilots thereafter.
NS: Will it be a comparative LCA between a base life scenario and one of the pilots to assess the impact?
FM: yes, this is correct.

RR: WP T3 should get a kick start in the coming months in relation to the other deliverables.
WD noted that talks are ongoing in relation to holding monthly meetings to progress this work package.

16.00 – 16.15: WP Long Term

21.07

KP presented WP Long Term and highlighted the deliverables including networking events.

RR presented an overview of the REAMIT Capitalisation project, which extends REAMIT's reach and impact by looking at liquid fresh products (milk, milk products, smoothies, sauces). RR received support from one dairy farm, one company, small SME in the NL which specialise in sensor technology for liquids, two business support organisations (NI Food and Drink organisation, AgriFood from the NL). RR is hopeful there will be more pilot tests with these companies. New tech companies coming on board (Maastricht and Belgium companies, which are commercialising cool boxes with sensors). RR confirmed he was happy to be expanding to Belgium. Levstone would be taking the lead for a custom-made package for REAMIT including a website which will link to REAMIT with a registration ID. Overall, RR was very positive with this capitalisation proposal.

16.30 – 17.30: WP Communication

21.08

SB presented a summary of work done under this work package.

An online training on social media was delivered by SB. She confirmed the importance of social media, including creating brand awareness, to understand your target audience and to monitor your interaction. REAMIT uses Twitter, LinkedIn, Facebook, YouTube and Instagram. A hashtag #reamit4nwe was created at the beginning of the project and is continuously used on posts.

SM asked how to separate FB business page and personal page. SB noted this was possible in the 'Manage Page' tab. UR asked if it is possible to have multiple users at the same time. On twitter this is not possible but with Facebook and LinkedIn, this is possible.

Facebook
SB noted the ads function on Facebook which targets your desired audience for a fee. Additionally, SB highlighted the insights function for monitoring the engagement with the Facebook page.

Twitter
SB noted the use of hashtags is important because of the limited characters per tweet. Images are good to grab the attention of other twitter users. SB explained the '@' username handle, when used this sends notification to the user with that handle. SB demonstrated how to post a tweet. SB explained how to find out popular hashtags. Ram noted that it is possible to search popular hashtags by typing # followed by a word of interest (e.g. #Tech) into the search bar or within a tweet and suggestions will pop up. SB went through the 'Notifications' page.

Q&A
SM asked how to connect using the Hashtag. SB demonstrated the search function using the Hashtag, how to 'follow' a page on Twitter.
SM asked what size image should be included. SB confirmed that resolution should be as low as possible but it will tell you when the image is too big.

LinkedIn
KP asked how to upload images to LinkedIn, in what format? SB noted that you can upload a document or save it as a jpeg and upload as an image.

Day 2: Thursday 21st of January 2021

9.00 – 10.00: WP Communication (Chair NTU)

UR and SB gave the update on WP Communication. UR stated the communication programme is running well and praised SB for her work so far.

UR highlighted the updates in the past semester:

- SharePoint was created for secure file storage so that all files can be in once place. UR asked all to request access and each person must be added before they can use it. She suggested all to save it as a bookmark for easy access. Through this share point site partners can share their weekly updates for the REAMIT site. UR reminded all to send email to alert new uploads to SharePoint.
- SB gave two sessions on social media training and is happy to deliver more if needed.
- There is a communication strategy document which includes goals such as attending events outside REAMIT to network. This document is available on SharePoint.
- UR demonstrated the website and reminded all to submit any suggestions and updates. She requested all partners to inform her on any presentations they may have given so that they can include in the newsletter/on website.
- UR asked all to upload photos onto the SharePoint to include in the REAMIT newsletter.

- UR noted an example in which KP linked a news story about reducing food waste which had been uploaded onto Sharepoint. UR encouraged others to upload stories like this from published stories such as local/national newspapers.
- UR noted that they are creating a storyboard to be completed by February. UR showed the various folders on Sharepoint for the stories.

Action: NTU to finalise a storyboard.

REAMIT Video Strategy 2021

- UR asked all to send SB information for the videos. SB listed the different videos included in the strategy, the first is in collaboration with UU which will be completed by the end of January. The video will include WD from UU talking about the pilot test with various animations. SB noted depending on the travel restrictions she intends to travel to partner to film or partners could submit their own videos. SB went through the other videos and their due dates and noted that she will be in touch with the various pilot leads. SB would like all videos to be started as soon as possible. Last video is a video on REAMIT highlights to 2021.
- RR noted that as more pilot tests are on board, more videos would be there. Each video should be a snapshot of each pilot study. RR encouraged all to think about what data is needed and information that can be supplied and send on to SB and UR.
- UR noted that SB is creating posters. SB noted that they are creating a poster for WD meats.
- UR asked if others have ideas for dissemination of information about REAMT.

SB described the updates from the last 6 months which included the REAMIT Symposium posts, upcoming events and new video. SB noted that the symposium was a great success with 167 people registered, 46 posts using the hashtags and 64 retweets on Twitter.

SB gave a brief report on the networking events they have attended for networking. SB noted that there has been quite a few events where REAMIT members have spoken at. UR emphasised the importance of partner to inform her and SB when speaking about REAMIT at an event.

SB talked about the promotional materials which have been created in the past year such as banners, posters, brochures/flyers, newsletters. Two new videos for new potential end users and another highlighted pilot tests and new Infographics.

SB reminded all about the proposal for REAMIT Pilot Tests on the website i.e. a section for each pilot test with a short description and a video. SB noted that this has been stated but still needs more information. The aim is to be completed in Feb 2021. SB played a general animated REAMIT video as an example but noted that human involvement would be desired as this is more interaction.

Action: NTU to create and populate a section on the REAMIT website dedicated to pilot tests.

RR highlighted the need to update the logo for ITT which has now changed to MTU on the website. GC confirmed this and mentioned that Pat should have sent the new branding. SB confirmed that she has received it and showed the new banner which includes this logo. Kate asks about the banners which have already been printed. UR noted that the logo can be printed as a sticker to be stuck on top of the old logo.

SB touched on the social media training and asked partners for feedback and whether they would like another one. SM found it very helpful. IH stated the material was not necessary for her. RR noted the other social media application could be helpful as the focus had been on Twitter previously. GC suggested shorter sessions which target each application. SB stressed the overall aim of social media

to share REAMIT work and engage a wider audience. GS noted that the session on Twitter was very comprehensive. SB offered one-to-one sessions to all partners.

Action: NTU to deliver one-to-one sessions on social media to partners, upon request.

REAMIT Newsletters

- SB encouraged all to share information to include in the next newsletter.
- SB shared the urls for each social media website and the dedicated hashtag and encouraged all to share these widely and use while posting.
- UR asked if a weekly reminder to submit info would be helpful please let her know. IH noted that the pilots are moving slow so there would not be much input each newsletter. SM noted that the technology updates would make great additions to the newsletters such as the Whysor dashboard and Levstone mobile app.
- KP mentioned that some updates from SenX, UoN, UCD on the LCA framework, UU updates and NTU case studies and storytelling would be great as input for next newsletters.

10.00 – 10.30: Update from Valorial, 2nd REAMIT Symposium

21.09

Blandine Fortin (BF) noted the key figures such as 97 participants excluding Valorial staff, 39 completed questionnaires and 72 B2B meetings. She explained the Net Promoter Score (NPT) which is the participant satisfaction. The NPT was 42 which is really good and shows participants were very satisfied. BF showed the main event statistics such as nationality/origin and occupation of participants. BF went into detail of the REAMIT presentation and round table meeting satisfaction scores. The event organisation, content and communication was described in detail. BF showed photos of the event including the REAMIT presentations.

RR noted that he valued the face-to-face event in the afternoon and made very useful contacts at this.

KP gave feedback and noted the challenges related to the sudden lockdown and the move to online. KP liked the EU Commission presence, B2B meeting, and noted that the facilitation/translation interpretation was excellent. On the other hand, KP stated that REAMIT was not exposed enough and was not linked to the other presentations. Therefore, going forward KP would like REAMIT to be at the centre and have real impact. KP noted that it was a lost opportunity to recruit pilot companies in France as no companies have been identified for pilot tests in France. The three strands of REAMIT; Sensors, Big Data Analytics and Business Strategy needs to be highlighted at the next symposium in the context of Agri-Food. Further to this, KP suggested that the outside speakers would discuss their work in the perspective of REAMIT in the same format. This would require a briefing beforehand.
RR agreed with points made by KP and noted that the agenda was not sent in sufficient time.
GM gave input regarding the challenges with organising the event and the changes in the initial agenda.

FM said, as for December 2021 REAMIT Symposium hosted by UCD, we hope to have a face-to-face meeting and will take the recommendation into consideration i.e. REAMIT at the centre, use the pilots as an example and inviting industry.

RR noted that the LP would like to be involved in the organisation of the 3rd Symposium hosted by UCD.

10.30 – 10.45 Tea/Coffee break

REAMIT Steering Committee (RSC) meeting. This meeting will be attended by all REAMIT partners (Chair BED)

21.10

KP welcomed all to the REAMIT Steering Committee meeting and gave an overview of the agenda.

1) **The minutes of 3rd RSC meeting (8-9 July-2020) will be confirmed and partners will be asked to report their activities as per the minutes. For the list of actions please refer to the draft Minutes of the third RSC meeting (8-9 July 2020) attached to this agenda.**

RR reminded all that the minutes from July and action log are very long and requested all partners to have them reviewed in advance. KP brought up the minutes on the screen. RR requested if anyone proposes any changes to the minutes.

KP brought up the Action Log for partners to raise any important issues on the actions. She logged the updates on the action log as the partners noted their status whether they are completed or ongoing. See action log for updates

Impact of COVID19 on partners:
KP stated generally that all partners are delayed due to COVID19. RR gave partners an opportunity to highlight anything specific however everything was discussed in the presentations yesterday.

2) **The advices from RAC meeting and the decisions of the WP meetings will be discussed and approved after discussion.**

3) **Revision of REAMIT risk log.**

KP stated 5 new risks have been identified in REAMIT. They are classified as covid19 related or other risks.

Risks related to Covid19:

1. WD Meats severely hit by the pandemic, in consequence, communication with WD Meats has been frozen and pilot work postponed until early 2021. UU unable to access premises of WD Meats.
2. UCD have not been able to recruit new staff which delayed Cyberbar pilot test. No new pilot tests have been developed at UCD.
3. Companies working with REAMIT partners do not have resources to allocate to REAMIT during the pandemic which is causing delays in pilot test implementation, and responding to emails from REAMIT partners.

Other risks in REAMIT:

1. Weyers lorry drivers' objections have been causing delays.
2. UU may not be able to find a lab that sells samples of clostridium bacteria which means they need to grow themselves this bacteria, which takes 12 weeks and will cause further delay.

RR asked partners to announce any other risks and/or comment on risk ownership.
KP was concerned about the risk at UCD caused by hiring delays.

RR asked FM to consider contracting a short term person in the meantime to facilitate communication in order to expedite the work. FM stated that hiring an outside person would not be in the budget but they could organise this with one of the students. KP noted that UCD should request funds as soon as possible with the extension as budget unspent will be budget lost. FM responded that she is aware of this.

4) 4th REAMIT project activity and finance report and payment claim (July-Dec 2020): calendar and points to remember.

5) 5th meeting of RAC/WP/RSC: 7-8 July 2021, hosted by Ulster University.
RR requested a face-to-face meeting if possible or a blended meeting (physical/online) should also be considered depending on the pandemic situation.

Other Meetings
REAMIT Jan-2022 meeting will be hosted by NTU. Last meeting hosted by BED in March 2022 will now change due to REAMIT 12-months extension. This will be confirmed in advance.

6) 3rd REAMIT Symposium in December 2021, hosted by UCD.

RR reiterated that the feedback discussed earlier should be used when organizing this symposium. Ram encouraged UCD to engage with the other partners in summer about this event. FM confirmed that UCD will do this.

Action: UCD to engage with LP and PP to organise 3rd REAMIT Symposium.

21.11

12.00 – 12.30: REAMIT project 12-month extension (Chair BED)
KP confirmed that BED sent a request to JS for a 12 month project extension. JS formally granted this extension including a budget extension. The new end date of the REAMIT project is 9/7/2023.

KP stated that the REAMIT budget needs to be revised in eMS by LP and PPs. This will be done as soon as the extension has been formally approved by the JS.

KP explained what the 12-month REAMIT project extension means. In the eMS, dates in all WPs will need to change to include the new period that will be added. A period covers the whole year in eMS. KP will meet with the JS REAMIT officer and will send a follow up email to partners. KP stated that she needs input from all partners by 29/1/2021 in line with the excel sheet that would be sent to all PPs.

RR discussed the revised dates for RSC, WP and RAC meetings which will be edited due to the project extension. RR provided a plan which he talked through and invited partners to comment. Two new RSC meetings will be required with the extension project. RR requested that Whysor host one (July 2022) and UCD host the other one (hopefully in person, in January 2023). FM stated that the 18-19th of January is the first week of term so she requested to move the dates back, to 11-12th January 2023.

Q&A
UR: regarding budgeting for the extension project, what is included in staff costs?
KP confirmed that external expertise is not included.

GM asked about the Symposium to be hosted by Valorial in December 2022.
RR presented the revised list and dates of future meetings and Symposia.

- 3rd REAMIT Symposium to be organised in December 2021. Dates can be arranged based on everybody's convenience.
- Any underspent conference budget (for example in organising online symposium) can be carried forwarded towards future conference budgets. Any additional amount needed for the future event can be included in the capitalisation budget.
- If the capitalisation proposal is successful, two integration workshops are planned – 1 hosted by Maastricht University or Sensipdx in the NL and another one hosted by BED in Luton, UK.
- RR requested UU to hold another symposium in March 2023. RR requested William to pass on this information to Joan, because Maastricht did not agree to host this one.
- Jaap confirmed that if necessary they can organise the aforementioned workshop event. RR suggested it could be small 5 hour meeting with a refreshment lunch and to add a corresponding costs to the capitalisation budget. Ram requested Jaap to forward the final budget to Ram and Lohit. Imke, Whysor offered help to organise this if needed as they are situated only 35 kilometres away.

12.30 – 13.00 Lunch break

21.12

13.00 – 14.00: Introduction to Technology Readiness Levels (TRL) and Market Readiness Level. Developing shared REAMIT approach to TRL (Presentation by UU)

KP introduced Jaap Drenth from Sensipdx, The NL. His experience and insight will be valuable in technology readiness and bringing REAMIT technologies to the market.

Technology readiness Levels – presentation by WD, Ulster

- TRL developed in 1970's to express how a technology was evolving through a systematic, metrics-based approach. Initially used for aerospace and electronics industries but has moved into most industries now. Maturity measured on a scale from 1-9, with 1 being the earliest level of development and 9 being a completed product. It is used to describe the maturity level of which a project will begin and end.
- TRL helps understanding the technology status. It can help with risk assessment and overall management of the project. It can be used for decision making with technology funders.
- Two examples were presented – TRL of chemical fuel cell in lab development phase and a computer mouse.
- TRL definitions were presented for TRL 1-9. TRL 1 lowest level of technological maturity. TRL 9 highest. TRL 1 is basic principles observed, TRL2 is the Technology concept formed, TRL3 is basic Lab Experimentation, TRL4 is working at lab level such as with a prototype, TRL5 is validating in a relevant environment, TRL6 is the technology is demonstrated in relevant environment, TRL7 is demonstrating in operational environment, TRL8 is the system has been completed and qualified, TRL9 is actual system proven in operational environment.
- WD described the TRLs in further details on his presentation slides. TRL 1,2,3,4 is related to academic research, proof of concepts, publications etc. TRL 5, 6, 7 is known as the 'valley of death' past research but not ready for consumers. At this stage the project can face trouble. WD provided material on how to identify what level the technology is at and some example projects within his slides.
- For REAMIT it may range from TRL 2 to TRL 6.

Q&A
RR: At what level will you put the pilot tests with WD Meats?
WD: May be TRL 2.
RR: Dry aging pilot may be slightly more than TRL 2. It is for all of us to keep thinking on TRLs of each pilot. When the project started, RR reminded everyone that we started on the note that we are exploiting commercially available sensors to benefit companies and applications. We are working with proven technologies with unproven environment. So in some cases, TRLs can be claimed higher than, say for example TRL 5, or TRL 6 instead of basic level TRL 2.
SM: It is difficult to progress forward to each TRL level. We are prototyping use cases, to find user needs. We don't know how good the saving will be. So, it is TRL 4.
Market Readiness Levels (MRLs) presented by WD, UU

- While TRL finds "if we can build it" MRL finds "will they adopt it".
- Mentioned the various 'Fit' which are ways to identify MRL. Definition of MRLs 1-9 were presented.

Jaap Drenth, Sensipdx, The NL, was invited to advise and share his expertise.

TRL and MRL presented by Jaap Drenth, Sensipdx

- TRL is important and it shows where you are with technology.
- Researchers tend to develop prototype without having a customer in mind which is common mistake and we should be looking for potential customers continuously once the technology has achieved TRL 3-4. The question "who in the market is waking up in the middle of the nights because they are looking for solutions that they don't have that we may be able to provide."
- Tests to go past TRL 5, 6, 7 will need large scale testing. With every test costing around EUR 20 000, and at least half a million for a set of 20-30 tests, you need investors to achieve this which can be found only if you are focussed.

Q&A
KP: When you start looking for customers at TRL 3-4, will you look for 1 customer or more customers at this stage or will you look to address 1 company completely and if successful look out more companies?
JD: For example, Sensipdx is a spinout of Maastricht University. MU has found two patterns with what they can measure microparticles in fluids. It is specialised in results on bacteria and small molecules. I am looking for very specific customers for whom I can make a prototype. They are customers, companies, managers. I will be able to do it at low cost, easy protocol, fast and with reliability, which are the features the companies are looking for. An egg company produces 1.6 million eggs are doing 30 tests per day. They have to wait 2-3 days to multiply the bacteria to see the results. If I can show the results immediately, that will help to improve their processes quickly. Another example: I spoke to oil business who trades tons and tons of oil. An immediate measure will also help them save costs. The most difficult part of TRL 4 is that people in the market want to use ready-to-use products. We won't sell to everybody because we have to be in a place where we can replace the existing process in the company.
KP: Is it possible to speed-up the WD Meats pilot test with more funds allocated to this pilot test and with the current timelines?
Elain (UU): We are still in the research process and at TRL 2. JC thinks that it is a long way to go to reach TRL 4, which may be out of the scope of REAMIT.
RR: There will be opportunity for us to discuss this on a future date and with more engagement between JD and UU through the capitalisation proposal, we hope to work more efficiently.
IH: How certain are we to be successful in the Capitalisation proposal?

RR: No clue from any one as to the possibility of success, but I am very hopeful. Although we may have quoted an expensive budget because of so many partners, I am still less concerned because we were advised that money is not an issue as long as we can show value for the budget claimed.
KP: In the reports from partners from UCD and UU, the two technologies, Cyberbar and clostridium bacteria problems are attracting interests from outsiders. Would it be ok to consider additional finance or investors to expand this technology or this would be at a later stage, or a different project?
JC: JC and FM confirmed that this would be too early to look at investors and could be looked at as a separate project.

14.00 – 14.30: REAMIT Capitalisation proposal (Chair BED)
The REAMIT Capitalisation project has been discussed earlier.

14.30 – 15.30: Other points to discuss (Chair BED)

Research articles from REAMIT activities:

21.13.01

Research work at BED, presented by LM

A. Paper on sensor review – extension of EurOMA 2020 accepted paper (UU and BED)
   - Different types of sensor technologies were highlighted such as (1) Environmental sensors (2) Motion and optical sensors (3) Physical sensors.
   - Sensors were chosen on the temp requirements, whether it is moving, and the connectivity requirements. LM showed the basic matrix used to determine sensor selection.
   - LM described the parameters within a questionnaire which was designed and interviews conducted for the conference paper.
   - LM noted a similar literature review will be conducted for fish and meat. Lohit intends to conduct more interviews to achieve a total of 10 interviews.

B. Multi-objective modelling for waste aware agri-business supply chain
   - LM presented a sample scenario for modelling an online food supermarket using Picnic as a case study. IH noted that each crate is ordered by a different customer which has multiple products which would be difficult to relocate to a food bank for example. RR stated that it has to be assumed it is the same items in this model, but the real-life setting will be considered later down the line.
   - DB noted that this is containerisation: a container within a container, at a certain point the QC1, QC2 and QC3 cannot go any further.
   - DB noted that what will happen is having fish at different temperatures to vegetables for example. RR noted that we need a baseline model first which can be adapted at a later point in consultation with partners.
   - LM went on to outline the modelling framework including the input/parameters and outputs.
   - FM asked would they consider adding environmental impacts as a parameter in the model. LM acknowledged this and will consult with FM on adding this parameter in the future. RR agreed this will be considered in a multilevel model.

C. EurOMA 2021 Extended abstract (BED)

- LM described this abstract stating the title "xxx" and its purpose to build and solve a cost optimisation model that captures various items as listed in the slides.
- LM highlighted the basic network configuration and model features. LM also addressed the objective function, constraints and decision variables.
- LM mentioned the methodology, expected results and its contributions.

Q&A
TA asked in terms of model, she agrees that the environmental impact is very important and must be considered with cost and time. Needs to have it as an important aspect at the start of the model as a foundation instead to input it later on. She pointed out that on the first paper in the questionnaire it may be helpful to include the health implications which relates to Weyer's trouble with truck driver concerns.
IH: Each crate has groceries ordered by customer, so rerouting to an alternate demand point would be difficult. You can't just put it into a different box and get it to a food bank.
LM: The QC point should be placed in such a position that the items can be rerouted and cannot be put in a place where the orders cannot be disassembled.
RR: This should be renamed as Picnic type case rather than a Picnic case. Unlike the practical setting, in academic and modelling sense, some assumptions need to be done to capture the implications of practical situation. To begin with we will assume a homogenous item, or multiple items, and other practical intricacies would be ignored. Such a model may not practically applicable but can be slowly improved once we have a working model.
DB: The food will be placed in different containers and QC1, QC2 or QC3 may not fit any more.
LM: I agree. It may not be practically applicable right away, but the idea is to develop a baseline model to study the flow of fresh food and food wastage involved.
FM: Would you consider adding environmental impacts as a parameter in your model that captures the Picinic type case. I have done this before and done the Greenhouse gas emission modelling before and given that REAMIT also has focus of studying impact of GHG emissions.
LM: Absolutely, the model can be extended further in future to consider GHG emissions. But for this case, we are considering the second dimension as time.
RR: One way of including sustainability is by including penalty cost function, or by minimising CO2 emissions as a second objective. Also minimising waste can be included as another objective.
TA: In terms of your final model, I don't think we can consider cost or time on its own without considering the environmental impact as FM was also showing that even storing the data in the big data hub also has a contribution towards environmental impact. We need to consider all these comprehensively and would be wrong to ignore such aspects. For example, to study truck transport with temperature measurement and monitoring, it might not be necessary all the time, that temperature control will reduce the food waste in terms of the overall benefit. So, including all factors is important to have a holistic view.

For the sensor review paper, in light of what Whysor has highlighted, it is also important to consider health impacts of using wireless sensors. Making comparisons on different types of sensors with Bluetooth routers with respect to their emissions may be good value to the work, if possible, to be included.

RR: We will consider all these points which are very useful. In REAMIT these are not the only research works that can be conducted, but the idea is to kindle the research thought process. We have not yet started building data analytics models towards which we intend to work with greater effort in the future once we have models.

TA asked what platform.
LM confirmed it was MATLAB.

RR asked partners to submit ideas for future modelling work/journal articles.
Action: All partners to submit to LP ideas for future modelling work/journal articles.

21.13.02

Research work at UU, presented by WD, UU

- 'Sensing technologies for maximizing quality and minimizing waste of meat", journal paper on sensors submitted to JCP, May 2020, by UU.
- WD stated that the paper was submitted to a different journal as the initial journal was not suitable. WD stated it is under review and is currently doing the first round of revisions.
- The paper is essentially about beef waste along the supply chain and how it can be managed through sensor intervention.

Q&A
RR: Has it been published?
WD: It is sitting in the first review stage.
TA: You have no data yet from WD Meats?
WD: No. We are using secondary data.

21.13.03

Research work at UoN, presented by Ali Assaf – Raman Spectroscopy, UoN

- AA described the basics of Raman spectroscopy using graphics.
- The Raman effect is named after Indian scholar Raman. He won the Nobel Prize for discovering the Raman effect which is the basis for Raman spectroscopy.
- It captures several spectra such as fluorescence, phosphorescence, heat produced from the sample. We also have small fraction of photons in the Raman spectrum.
- Equipment: To do Raman spectroscopy, we need Laser, light sources, sample with some chemical bonds active for Raman, a probe, microscope. Then you need to interpret results by statistical analysis/data exploration. MATLAB can be used and analysis' such as PCA, DA, PLS, SVM, KNN may all be used but depends on the application. The equipment has evolved continuously from large laboratory setups to smart phone-based Raman spectrometer measurements.
- Raman spectrum for bacteria from Salmonella was presented.
- Benefits: Fast analysis, ability to check on small quantities, no sample preparation required, ability to do simultaneous verification of presence/absence of pathogens, lipids, proteins, carbohydrates etc. Therefore widely applicable with thousands of scientific publications
- Applied on several cases of food: meat, beverages, dairy, fish, oil, honey, egg, vegetable.
- Detection of micro-biological contamination of food. Microorganisms are analysed by Raman spectroscopy and they are compared with a database to give the name of the species present in the bacteria. We can use it for the detection of more than micro level organisms.
- Some industries use Raman spectroscopy to detect sex of an egg and kill the eggs that are going to hatch hens (male) before the hatching of an egg at the earlier stage of incubation.

Q&A
RR: Have you produced any publications from REAMIT project and if you have produced, have you acknowledged REAMIT project in your publications?

AA: We have one publication in progress from REAMIT project, which focusses on the control or the evaluation of the quality of chicken meat by Raman spectroscopy. One paper was accepted in a conference in Spain.
TA: What wavelength ranges do you use for chicken sample?
AA: We use 785 nm wavelengths for chicken samples. This is chosen as wavelength level based on best results from experiments.
TA: What kind of light source do you use?
AA: We use diode laser source.
TA: Is 785 nm the wavelength of light source or emission?
AA: It is the light source. If we use a powerful laser, we may disrupt the sample. It is important to note that the power of around 100 mW on the sample. It depends on the time. If we run the spectrometer for short time, this power strength should be ok for larger time usage, even this would be powerful.
TA: Is it on/off system?
AA: Yes. We do have another system with continuous laser. But we don't use it for chicken samples as it would end up cooking up the chicken sample itself.
GS: Do you think the wavelength range in which this operates will have any health impacts?
TA: There are of course health impacts of using high intensity lasers. This kind of laser is being used by UoN for a split second and not for a very long time. There isn't any effect on people due to use of this technology as the probes are placed very close to chicken. But when this technology will be used alongside other sensors/routers to transfer the data and if these need to placed near a truck driver or a person, there may be concerns that need to be addressed during the stage of integration with a gateway/router to transfer data.
AA: The use of laser source is of course very harmful to human, but for REAMIT pilot test, the technology used Raman probes directed on the chicken samples. Also the truck drivers may have to appraised of required caution measures while they open/close the boxes etc. during the actual implementation.

21.13.04

RR briefly introduced the REAMIT pilot case study work being conducted by NTU, BED, and UU on WD Meats. A meeting was held between the three partners to discuss the ideas pertaining to showcasing of benefits from the two WD Meats pilot test. A draft document is currently being prepared.

UR summarised that we are collecting operational data from the case study company, WD Meats, WD is collecting the data and Lohit is working on the use of IoT related technology for the paper. Finally, it is going to be combined with the objective of REAMIT. UR shared sample case studies with LM and WD to show examples of case studies.

21.13.05

RR offered support with any publications but noted that authors should be restricted to 3 - 5. He clarified that this does not mean others cannot contribute. In line with RR's comment, UR proposed to create a shared table to fill in everybody's expertise area so that they are visible and accessible to all for mutual benefit.

21.14

KP shared that she is also interested to collect feedback from partners via email on how the meetings were organised. For example, opinions on what could be done better, any other feedback for improvement. RR welcomed all to provide their criticism as well only to use them for our own improvement.

TA congratulates and thanks Ram, Kate and all REAMIT members for the good meeting. She appreciated the progress made in all pilot tests.

UR asked whether this platform is only for REAMIT partners or are other partners also welcome. For example, if anybody want to present their work on using drones to measure food quality, can they participate if there is some take home for the REAMIT project?

RR said the RSC meeting is primarily for internal purpose of the REAMIT partnerships. We can have one or two sessions from external partners like we had one from Jaap in this meeting. We will start having separate meetings on research, to which anybody can be invited.

Action: Usha will create a table in the SharePoint for REAMIT partners to fill in their research interests and area of expertise.

RR asked if there were other questions or comments.

RR thanked all partners and closed the RSC meeting.

Matters arising and actions from RAC/WP/RSC online meetings on 20-21 January 2021

Date	**Minute/ Item**	**Action *identified***	**Responsibility**	**Update: *Confirmation of completion or reasons for non-completion***
21/01/20	21/02	Remove BbaMV from the list of REAMIT Associated Partners (associated to I&R).	BED	Completed
21/01/20	21/03/07	Update Pilot Test Roadmap in first semester of 2021.	I&R	Ongoing
21/01/20	21/03/07	Upload all presentations of pilot tests in Sharepoint.	All pilot test leads	Completed
21/01/20	21/03/07	Update the 'pilot COVID impact assessment document' based on inputs from pilot test leads at WP T1 meetings.	I&R	Ongoing
21/01/20	21.04	UU to send to Lohit a document describing UU's efforts to connect sensors to the cloud.	UU	Ongoing
21/01/20	21.04	Whysor to send to Lohit a document describing Whysor's efforts to connect the sensors to the cloud.	Whysor	Ongoing
21/01/20	21.04	To send to Lohit a document describing their efforts to connect sensors to the cloud.	All pilot test leads	Ongoing
21/01/20	21.04	BED, based on inputs from pilot test leads, to develop an overview of approaches taken by partners to connect sensors to the cloud.	BED	Ongoing
21/01/20	21.04	BED will request for updates to the sensor connectivity document from Whysor if there are more connections of different nature from other pilots to the REAMIT cloud.	BED	Ongoing
21/01/20	21.04	Whysor to send to Lohit a brief document describing the different elements of the REAMIT dashboard and updates made from time to time.	Whysor	Ongoing
21/01/20	21.04	BED and Whysor to update the document in previous action with pilot specific or generalised data transfer procedure from REAMIT cloud to REAMIT Big data hub. Whysor will need to contribute with data conversion or pre-processing and SQL script creation procedures, BED will	BED and Whysor	Ongoing

		contribute to description of SQL instance architecture to receive the data from REAMIT cloud and, store and view the data on the REAMIT Big data hub.		
21/01/20	21.04	BED and Levstone will create and configure SQL instance for Levstone on the REAMIT server. BED to work on provision of access to this instance for Levstone.	BED and Levstone	Completed
21/01/20	21.04	BED will create University network access, SQL instance, access to this instance and Windows server remote desktop access for MTU.	BED	Completed
21/01/20	21.04	BED will create SQL instance and access to this instance for other partners.	BED	Completed
21/01/20	21.04	BED will conduct a meeting with all technical partners for opinion and consent for creating and providing access to a shared SQL instance on the server.	BED	Completed
21/01/20	21.04	BED will work with Levstone for creation of shared SQL instance and accesses to this instance for all partners.	BED and Levstone	Completed
21/01/20	21.04	BED will work with Whysor to transfer all pilot data from REAMIT Whysor cloud to REAMIT BED server once there is actual data from the pilots.	BED and Whysor	Ongoing
21/01/20	21.04	BED will continue liaising with Softcat on getting licensing quotes to license additional user connections to the server via Windows server remote desktop and to the MSSQL database software installed on the server.	BED	Ongoing
21/01/20	21.04	BED will organise a meeting to discuss next steps for implementation of mobile App on pilot test data.	BED	Ongoing
21/01/20	21.04	Whysor will convert UoN sample data to blob format.	Whysor	Competed
21/01/20	21.04	Whysor and BED will work together to deposit UoN data to REAMIT Big data hub.	Whysor and BED	Completed
21/01/20	21.04	After the data from either the UoN pilot or the Picnic synthetic data is ready, Levstone will have a look over the data and see if they can be used for the App.	Levstone	Ongoing

21/01/20	21.04	Whysor, Levstone and BED will start testing the App on synthetic data from Picnic pilot.	Whysor, Levstone and BED	Ongoing
21/01/20	21.06	Imke to ask Frank from Picnic whether he can provide data on individual products in a cool box transported by a Picnic truck, or otherwise whether he can determine composition of a cool box on average. This is needed for LCA carried out by UCD.	Whysor	Ongoing
21/01/20	21.06	Imke, Fionnuala and Frank to meet to discuss conducting LCA with Picnic. FM will contact IH to organise this meeting.	UCD	Ongoing
21/01/20	21.06	Imke to collect from Picnic details relating to the amount of wasted food per track.	Whysor	Ongoing
21/01/20	21.06	Ram and Lohit to determine the embedded energy needed for creation of the Big Data hub server at BED.	BED	Ongoing
21/01/21	21.08	NTU to finalise a storyboard.	NTU	Completed
21/01/21	21.08	NTU to deliver one-to-one sessions on social media to partners, upon request.	NTU	Ongoing
21/01/21	21.10	UCD to engage with LP and PP to organise 3rd REAMIT Symposium.	UCD	Ongoing
21/01/21	21.13.01	All partners to submit to LP ideas for future modelling work/journal articles.	All	Completed
21/01/21	21.14	Usha to create a table in the SharePoint for REAMIT partners to fill in their research interests and area of expertise.	NTU	Completed

Actions for WP T2 (arising from WP T2 monthl meetings) with an update on progress (developed by Lohit)

Date	**Minute/ Item**	**Action *identified***	**Responsibility**	**Update: *Confirmation of completion or reasons for non-completion***
200709	20.38.03	**WP T2 – Actions** REAMIT sub-team (BED, Whysor, SenX, Levstone, ITT) to develop a scenario enabling the REAMIT server to receive and manage other types of data received from all pilot tests (not only data on temperature, humidity and VOC). **Progress:** Discussed the implementation plan in 1 separate meeting b/w the BED Whysor, SenX, Levstone and MTUKerry (previously aka ITT) and in 1 WPT2 monthly meeting. It was decided to create separate SQL instances for every partner and a shared SQL instance which will show the sensor data for download to all partners. BED and Levstone met twice for the actual implementation. **Sub Action: BED and Levstone will create and configuring SQL instance for Levstone on the REAMIT server. BED to work on provision of access to this instance for Levstone (Completed)** **Sub Action: BED will create University network access, SQL instance, access to this instance and Windows server remote desktop access for MTUKerry.** **Sub Action: BED will continue and complete the work on BED University network access, separate partner specific SQL instance creation and providing access to this instance for other partners. (Ongoing)** **Sub Action: BED will work with Whysor to transfer historical data from Picnic pilot (Completed)** **Sub Action: BED will conduct a meeting with all technical partners for opinion and consent for creating and providing access to a shared SQL instance on the server. (Completed)** **Sub Action: BED and Levstone will continue and complete creating and providing accesses to shared instance creation. (Ongoing)** **Sub Action: BED will work with Whysor to transfer all pilot data from REAMIT Whysor cloud to REAMIT BED server once there is actual data from the pilots (Ongoing)** **Sub Action: BED will continue liaising with Softcat on getting licensing quotes to license additional user connections to the server via Windows server remote desktop and to the MSSQL database software installed on the server. (Ongoing)**	BED, Whysor, SenX, Levstone, ITT	• Separate SQL instances created for Whysor, BED, Levstone, MTUKerry, and SenX, others are ongoing. • Subsequently, rough historical data from Picnic pilot transferred onto the Whysor SQL instance. • Shared SQL instance creation is ongoing.

200709	20.40	**BED, Levstone and Whysor to collect data from sensors, including developing step-by-step written procedure for collecting data from each REAMIT pilot test and sensor.** **Sub Action: UU to send to Lohit a document describing UU's efforts to connect sensors to the cloud. (Completed)** **Sub Action: Whysor to send to Lohit a document describing Whysor's efforts to connect sensors to the cloud. (Completed)** **Sub Action: Whysor to send to BED a brief document describing the different elements of the REAMIT dashboard and updates made from time to time.** **Sub Action for all pilot test leads: To do the same as above Sub actions, i.e. to send to BED a document describing their efforts to connect sensors to the cloud. (This can be ignored if the procedure is same as in the document sent by Whsyor) (Ongoing)** **Sub Action: BED, based on inputs from pilot test leads, to develop an overview of approaches taken by partners to connect sensors to the cloud (Ongoing).** **Sub Action: BED will request for updates to the sensor connectivity document from Whysor if there are more connections of different nature from other pilots to the REAMIT cloud.**	BED, Levstone and Whysor	Ongoing until real data is transfered
200709	20.40	BED and technical partners to develop a template for how WP T1 is connected to WP T2. **Sub Action: BED and Whysor to update the document in previous action with pilot specific or generalised data transfer procedure from REAMIT cloud to REAMIT Big data hub. (Whysor will need to contribute with data conversion or pre-processing and SQL script creation procedures, BED will contribute to description of SQL instance architecture to receive the data from REAMIT cloud and, store and view the data on the REAMIT Big data hub).**	BED, Whysor, Levstone.	Ongoing
200709	20.38.03	Levstone to work with Whysor in using Levstone's new platform for REAMIT.	Levstone	Ongoing Working on release of the software , The mobile app
200709	20.41.01	Levstone, to launch the first version of the APP, which gives the ability to connect the sensor and start collect data. Response: this was discussed in 2 monthly WPT2 partner meeting and was decided to stat implementation of App for UoN pilot and Picnic pilot. 1 other meeting between Whysor and UoN was held to discuss UoN data conversion **Sub Action: Whysor will convert UoN sample data to blob format, status: Ongoing**	Levstone,BED , Whysor	Ongoing – Connected to previous action –

		Sub Action: Whysor and BED will work together to deposit UoN data to REAMIT Big data hub, Status: Dependent on previous sub action Levstone to assist Whysor in using this approach with Picnic. Levstone and Whysor to assist other pilot test leads use this approach for other sensors in order to make comparison to see temperature profiles. **Sub Action: Whysor Levstone and BED will start testing the App on synthetic data from Picnic pilot Status: Not started**		
200709	20.41.01	Whysor to provide data Whysor is gathering at the moment through their API and to send it to Levstone's APP. (needs to be slightly rephrased need to work with BED to transfer data from BED server to and from App – feedback from DA to go to Bed and to be taken from Levstone) this required interaction with BA partners, how the will trigger an event to generate. Whysor already have a rule engine, to do this. Forward analytics to their API, in the form of a phone call or email or text message. Response . Meeting with Whysor, BA partner, Levstone and BED needed. Discuss this next week. Existing pilots UoN ? No data since last weeks. (**Completed**) UoN data a starting point for next weeks meeting (**Whysor is doing the UoN data conversion**) Can also use shock sensors for exercise with Levstone's App.(**Not started**) Meeting 11am between, BED, Whysor, Levstone, SenX, ITT, UoN (if available)(**Completed**) Elaborate different steps for mobile App implementation. Davinder to send a 2page description. Davinder to send before Monday.(**Completed**) **Sub Action: After the data from either the UoN pilot or the Picnic synthetic data is ready, Levstone will have a look over the data and see if they can be used for the App.**	Whysor	Remaining parts For example, mechanism of hosting the data analytics module (client side or server side), mechanism of getting and sending the feedback from data analytics module to the smartphone App and mechanism of displaying the outcomes on the App, alert generation mechanism are all linked with previous action – Ongoing till previous action is completed (Atleast till data from one of pilots is available on the REAMIT server for access by Levstone in the format they need)
200709	20.40	BED, Levstone and Whysor to develop guidance on managing data collected from REAMIT sensors. Progress: This has been addressed in previous actions	BED, Levstone and Whysor	Ongoing – MTU Kerry has prepared a document on data requirements
200709	20.40	Levstone to propose self-enrolment APP for end-user clients.	Levstone	Ongoing -
200709	20.41.01	Levstone to propose an early version of enrolment (to have a second database). This is to ensure that REAMIT partners have something to show to new companies (to be engaged in REAMIT pilot tests)	Levstone	Ongoing – Levstone will come back after having a chat

		i.e. to show real data so these companies can see what REAMIT can offer.		
200709	20.41.01	Levstone to provide information about Levstone's database i.e. how organisations can self-enrol, what information organisations will be required to provide, how customers can access this database	Levstone	Ongoing -- Will come back
200709	20.40	Levstone, BED, Whysor, SenX and ITT to propose how data will be presented to end-user clients.	Levstone, BED, Whysor, SenX and ITT	Ongoing -
200709	20.40	Levstone to develop a web progressive APP for visualisation and data presentation. (Last step) Take the data and use Whysor dashboard if possible to save repetitive efforts. Progress: Levstone suggested that previous actions must be completed before we can move to this action	Levstone	Ongoing task- - Under development
200709	20.41.01	Levstone to prepare a demonstration about the trial journey idea so that all partners can execute this and generate some data.	Levstone	Ongoing – hoping after a release in a months time
200709	20.41.01	UoN to send some data to LM (BED), MS (Whysor) and SM (Levstone) to have a first look at the data. Action: Lohit followup with Ali	UoN	Completed
200709	20.39	BED to finalise purchase of equipment to build the Big Data hub at BED.	BED	Completed
200709	20.39	BED to finalise purchase of software necessary for the Big Data hub at BED.	BED	Completed
200709	20.39	BED (with the help of ICT at BED) to prepare a room at BED (Luton campus) where the Big Data hub will be mounted.	BED	Completed
200709	20.39	With the help of equipment supplier, BED to finalise building up of the Big Data hub, including installation of software.	BED	Completed
200709	20.40	Whysor to send responses to the questions on data collected in cloud (i.e. Is the common cloud platform going to be Whysor? Will vehicle route data be also transmitted? What is the capacity of Whysor cloud to store data?	Whysor	Completed
200709	20.41.01	BED, Whysor and Levstone to come together and make a decision on the best architecture to receive and send data to the cloud, data formatting and method of sharing with partners. The options to consider are to either use the server at BED or the reamit cloud set by Whysor and Levstone.	BED, Levstone and Whysor	Completed

200709	20.41.01	Levstone and Whysor to ensure that all sensors used for REAMIT pilot tests are compatible with the smart phone APP from Levstone.	Levstone and Whysor	Completed
200709	20.41.01	Levstone, BED and Whysor to decide where data from sensors will reside, in what format it will reside and how it will be shared.	Levstone, BED and Whysor	Completed

Draft minutes from REAMIT Advisory Committee, Work Packages and Steering Committee meetings, 7-8 July 2021 (Teams online meeting room hosted by NTU)

Attendees present:

Name	Institution	Name	Institution
Ram Ramanathan (RR)	BED	Richard Cook (RC)	SEMLEP
Katarzyna Pelc (KP)	BED	Fionnuala Murphy (FM)	UCD
Joy Eze (JE)	BED	Shane Ward (SW)	UCD
Tahmina Ajmal (TA)	BED	Tamiris Da Costa (TC)	UCD
Yanqing Duan (YD)	BED	Xavier Cama (XC)	UCD
Gillian Weaver (GW)	HMF	Nevedha Saravanarajan (NS)	UCD
Gael Maugis (GM)	I&R	Ali Assaf (AA)	UoN
Simon McGraw (SM)	Levstone	Gerald Thouand (GT)	UoN
Davinder Bola (DB)	Levstone	Pratheepan Yogarajah (PY)	UU
Wayne Baker (WB)	Levstone	James Gillespie (JG)	UU
Fabien Tencé (FT)	SenX	Bryan Gardiner (BG)	UU
Gerard Corkery (GC)	MTU	Joan Condell (JC)	UU
Gautam Samriya (GS)	MTU	Adrienne Gentil (AG)	Valorial
Usha Ramanathan (UR)	NTU	Chris Nankervis (CN)	Weather Logistics
Sasha Bennett (SB)	NTU	Imke Hermens (IH)	Whysor
Alena Pivavarava (AP)	NTU	Tom Verstraten (TV)	Whysor
Frank Gorte (FG)	Picnic	Abi Adefisan (AA)	Yumchop

Apologies:
Matthew Thompson (MT)

Day 1. Wednesday 7th of July 2021 – Morning Session

09:00 - 09:10: Welcome to REAMIT meetings (Chair BED)

21.15

It was announced that the next RAC/WP/RSC meeting will take place on 19-20 January 2022, hosted by Ulster University.

A general overview about the meeting agenda was provided by RR, who also requested all partners with associated partners to keep chasing to know about their progress so far.

09.10 – 10.30 REAMIT Advisory Committee (RAC) meeting (Chair BED)

21.16

REAMIT project progress in the period: 01/01/2021 – 30/06/2021, including extension and capitalization proposal (presentation by KP, BED)

The Advisory Committee partners were not available for the meeting. A progress report had been sent to them in advance, though feedback had not been yet received.

A list of associated partners, to whom REAMIT progress reports are sent, was shown on a slide. Those were: GIQS, East Netherlands Development Agency, Radboud University, Jean Routhiau, Société Des Transports Européens Frigorifiques (STEF) and Bioresearch NI.

Feedback from the East Netherlands Development Agency was received (more at the end of the presentation).

21.16.01

WP T1: Adapting and pilot testing sensor technologies in agri-food supply chains.

Deliverables:

- Deliverable T1.1.1. Deadline for recruiting companies through Open Challenge Call was extended until the 30th June 2022.
- Deliverable T1.1.2. Recruiting of five companies from across agri-business supply chains to participate in REAMIT.
- List of companies that have been recruited and progress has been made: Picnic - NL, WD Meats (2 pilot tests) - UK, Routhiau - France, Yumchop - UK.
- New companies recruited for pilots: Human Milk Foundation – UK, Musgrave – UK.
- Pilot tests in the pipeline: Biogros - LU, Van de Huijgevoort Groep (VHG) – NL, a box with sensors (UCD) pending company recruitment - IE.
- Pending responses from the following companies: Glen Affric – UK, IGRECA – FR, Prince de Bretagne - FR, Carton Group – IE.
- Company lost: Weyers – DE.

Action: As REAMIT is still recruiting companies, all partners have been encouraged to keep approaching companies for pilot tests.

- Deliverable T1.1.3: Working prototypes using sensor technology:
    - Temperature and humidity sensors (Picnic, WD Meats, Yumchop, HMF, Musgrave, Biogros, VHG)
    - Raman spectroscopy (Rothiau, IGRECA)
    - 3D fluorescence (WD Meats)
    - A box with sensors (being developed by UCD)
    - MTU exploring Freshbox initiative
    - Bluetooth IoT sensor (being developed by Levstone)

Other activities in WP T1:

- A template for a non-Disclosure agreement was developed

- NTU/BED connected with Weather Logistics company (UK)

21.16.02

WP T2: Big Data integration and applications to reduce food waste.

Deliverables:

- Deliverable DT2.4.1. Creation and launch of interface: REAMIT dashboard has been improved; Whysor and SenX working on integrating "WARP-10" into the dashboard.
- Deliverable DT2.4.2. User manual on launching interface: Whysor has delivered two parts of the manual.
- Deliverable DT2.5.1. Big data platform that can store and collect all pilot data: a server was set up at BED. Connections between the data server and REAMIT partners were established; each partner was granted access. Preparatory work was started to handle incoming data from pilots. Data analytics partners are currently evaluating which data is needed. As for the license big data server, consortium would opt for the unlimited access.
- Deliverable DT2.5.3. Web-interface with self-enroll for potential suppliers/consumers of food produce: Levstone has developed a web page available for initial client enrolment. Complete system to be developed by the end of the year.
- Deliverable DT2.7.1. Launch of smartphone APP for linking food owners, drivers, warehouses: Levstone developed a working app. Available in Google Play store.
- Deliverable DT2.7.2. User manual for the app: Levstone is working on it.

21.16.03

WP T3. Business development of REAMIT technologies.

Deliverables:

- Deliverable T3.1.1. Assessment of REAMIT technologies (mapping/systematic review): UCD started collecting information regarding the amount of food waste in different supply chains and the location in the FSC where it occurs.
- Deliverable T3.1.2. Life Cycle Assessment (LCA): UCD developed the REAMIT questionnaire with the data requirements.
- Deliverable T3.2.1. Current and identified future REAMIT technology assessment report: Ulster University has started collecting information regarding Market Readiness Levels and Technology Readiness Levels.

21.16.04

WP Communication

Deliverables:

- Deliverable C1.1. Communication strategy document has been updated – available in SharePoint.
- Deliverable C2.1. Website launch: continuously being updated. NTU also had an initiative to develop a stand-alone website; NTU going ahead with purchasing and developing REAMIT stand-alone website.
- Deliverable C2.2. Social media. Increase in communication from partners (LinkedIn, Twitter).

- Deliverable C3.1. Project banners, posters and flyers: 2 videos and 2 banners have been developed for Picnic and WD Meats (pending company approval).
- Deliverable C5.1. Journal articles. The following have been developed:
    - A book chapter (Research team in BED): "Fighting Food waste: How can artificial intelligence and analytics help" – submitted.
    - A conference abstract: "A theoretical sustainability model on using IoT sensors and cloud systems for reducing food waste and emissions in the fresh food sector" - accepted for presentation at Logistics conference. Authors: Lohitaksha M Maiyar, Ramakrishnan Ramanathan and Lakshmi Swamy.
    - A conference paper. "An optimisation model for cost effective integration of transportation network design with quality control to reduce fresh food wastage" Authors: Lohitaksha M Maiyar, Ramakrishnan Ramanathan, BED.
    - Sensor review journal paper (no further progress done since last meeting).
- A number of partners have started working on case studies for: WD Meats, Picnic, Routhiau, Yumchop, HMF.

21.16.05

WP Management

- A number of new staff has been recruited in REAMIT:
    - Dr Tamíris da Costa started working on life cycle assessment of REAMIT technologies from UCD.
    - Dr Xavier Cama started working on REAMIT pilot tests from UCD.
    - Dr Trevor Cadden assists in finding additional pilot tests at UU.
    - Dr Lakshmi Swamy started working part time on developing research publications from BED.
    - Dr Joy Eze started working part time on setting up the Big Data server from BED.
    - Tobias Leenders, a graduation student, assists with integrating WARP-10 in the Whysor platform.
    - Dr James Gillespie replaced William Duffy at UU.
    - Dr Sahar Ahmadzadeh replaced Dr Lohit Maiyar and will coordinate the implementation of WP T2 and other REAMIT activities at BED.
    - Dr Alena Pivavarava joined the project on the 1st of July 2021 from NTU.
- Deliverable DM 1.1. Project Handbook - All information about reports, minutes of meetings and presentations are included in the Project Handbook. The project handbook is stored in SharePoint and the partners are welcome to review it.
- Deliverable DM 1.2. Minutes of meetings of RAC/WP/RSC - The minutes of the REAMIT meeting in January have been developed and shared with partners and will be discussed and approved on July 8th.
- Deliverable DM 1.3. Intermediate Work Package coordination - A list of all the different meetings that took place in the last semester are, as follow:
    - RAC/WP/RSC on 20-21/01/2021
    - 5 monthly meetings of WPT1 (I&R)
    - 4 monthly meetings of WPT2 (BED)
    - 2 bi-monthly meetings of WPT3 (UU)
    - 10 bi-weekly meetings of REAMIT sub-group (BED, NTU, UU, UCD, MTU)
    - 5 monthly meetings of REAMIT team at BED

- Deliverable DM 2.1. REAMIT Risk Log - New risks were identified in the REAMIT project and updated based on the inputs from the partners:
    - Risk for not having a pilot test in Germany due to losing Weyers and no success in recruiting a new company in Germany.
    - Absence of a proper French pilot test and an Irish pilot test.
    - The sensors cannot be fitted at Yumchop and HMF by Whysor physically due to travel restrictions.
    - Risk for sending the sensors by post from Whysor to Yumchop and HMF.
    - Risk of less effective communication if pilot test partner companies insist on remaining anonymous in REAMIT communication activities.
    - Risk of further delay in WP T1 implementation due to the lengthy procurement process at BED.
    - Risk of shortage of IoT sensor equipment provided by suppliers: Whysor confirmed that some of Whysor's equipment suppliers do not have much equipment in stock and these companies have warned Whysor about delays (caused by COVID-19) in getting equipment in stock again.
- Deliverable DM 3.1. Project progress report - 4th REAMIT progress and finance report submitted to JS in Mach 2021. Everything was approved.

21.16.06

WP Long Term

- Deliverable DLT. 1.1. Network prospectus - The first deliverable is a list of actors approached by different partners in the last semester when partners engaged with different actors to invite them to participate in the pilot. The list includes:
    - BED: Human Milk Foundation, Unilever, Ocado, Weather Logistics, SEMLEP
    - NTU: TTK Confectionery, Glen Affric Brewery, Weather Logistics, local agri-business companies, IoT companies, The D2N2, Growing Notts, large supermarket chains & food suppliers.
    - UU: Musgrave, Knockbracken (the catering branch of HSCNI / NHS), Aurivo, Dale Farm, Henderson group, NIFDA and Kepak, HSCNI.
    - Whysor: Biogros, Van de Huijgevoort Groep (VHG).
    - I&R and Valorial: Prince de Bretagne Vegetables Cooperative
    - UoN: IGRECA
    - MTU: Meat Technology Ireland, Enterprise Ireland
    - UCD: Carton Group
- Deliverable DLT. 1.2. Networking events - 3rd REAMIT Symposium will be hosted by UCD (Nov / Dec 2021)

21.16.07

Challenges encountered by the consortium in the past semester (January – June 2021) with the implementation of the REAMIT project:

COVID-19 pandemic and lockdown (2nd lockdown from Dec-2020 until May 2021) caused delays in the implementation of all WPs for at least 18 months.

- WP T1:

    - Agri-food companies prioritized primary processes, not research.
    - Businesses were not responsive. It has been difficult to maintain a productive relationship with pilot test partner companies.
    - Lost pilot test company in Germany as Weyers decided not to proceed with pilot test.

- WP T2:
    - Very few data generated for analytics so far.

- WP T3: Limited progress in WP T3.

- WP Management:
    - All meetings of REAMIT partnership took place online.
    - Responses from PPs and colleagues were slow, causing delays.
    - Payment from LP to PPs has been delayed at BED.
    - Purchase of equipment at BED for pilot tests has been delayed.
    - Not possible to travel to the sites of pilot tests in the NL, DE, UK.
    - Staff turnover at BED and UU may cause risks of lost continuity and expertise in the implementation of WP T1 and WP T2.

- WP Communication:
    - NTU were not able to travel to visit sites of REAMIT pilot tests to take high quality video footage. Instead, videos had to be made based on materials sent to NTU by PPs via email.

- WP Long Term:
    - Due to delay in WP T1, WP T2 and WP T3, it was not possible to develop briefings for policy actors about the REAMIT approach, or effectively promote REAMIT, its achievements and impact among local, regional and national businesses and policy.

21.16.08

Feedback from BED's Associated Partner: East Netherlands Development Agency.

They have had some questions, e.g.:

- What is the biggest progress you've made compared to the last project meeting we have attended?
- What are the biggest issues, besides COVID causing delay?
- And consequently, which actions can we as an associated partner, take that could help the REAMIT consortium?
- The East Midlands Netherland's agency is planning to develop another project proposal (for H2020 or INTERREG Programme).

21.06.09

Overall progress observed in REAMIT:

- In the last month different companies showed interest in conducting a pilot test.
- The idea is really appealing, and it is only a matter of time that we are able to find more French, British and German companies to engage in pilot tests.

- The installation of a big data server, which implies that the partners and analytics partners can start receiving the data once the data starts flowing.
- Work in progress related to two new case studies: Yumchop and Human Milk Foundation.
- From a project management point of view, the big achievement was also to complete the recruitment of new staff at UCD, BED, UU.
- Communication materials and videos are coming at frequent intervals.
- Benefit of having the new, stand-alone REAMIT website, in addition to the one provided by the Interreg NWE Programme, and its role in attracting more companies and audiences.

- Biggest issues faced by the REAMIT consortium, besides COVID:
    - Losing the German pilot test with Weyers was not necessarily because of Covid, but due to the attitude of lorry drivers who were hesitant to having a new device installed in the driver's cabin.
    - Current difficulty in France and in Ireland in finding pilot test companies.
    - Due to Brexit, there is extra paperwork related to moving goods from the Netherlands, from Whysor partners to pilot test companies in the UK.
    - Most companies participating in REAMIT pilot tests prefer to stay anonymous, which does not help to promote the REAMIT project. However, new partners like Human Milk Foundation and Yumchop are positive about being associated with REAMIT and agree that the consortium use their names in REAMIT communication materials. This is important as it may help convince other companies to participate in REAMIT pilot tests.

- How associated partners can help the REAMIT consortium:
    - There are three associated partners associated with BED: GIQS, East NL Development Agency and Radboud University from the Netherlands. East NL Development Agency continuously keeps sending some information and updates about the REAMIT project within their network; while GIQS has been very supportive in the past in approaching new companies in Germany and the NL for REAMIT pilot tests.
    - The REAMIT partners will keep linking with associated partners from France to find out how we can get more support from them.

Meetings of Work Packages

10.45 – 13.15: WP T1: Adapting and pilot testing sensor technologies in agri-food supply chains.

21.17.01

1) Deliverables as per the REAMIT Application Form

Deliverables to be submitted by June 2021 => June 2022 (as per the extension). There are three main deliverables to report:

- Deliverable 3.1. Working prototypes using sensor technology - The sensor and scanning technologies will be tested along with other traditional sensors where needed and adaptations carried out wherever needed. Data flow to be checked. At the end of the pilot test, new working prototypes will be developed.

- Deliverable 3.2. User manual for each pilot test - A user manual documenting the experience of the pilot test and a step-by-step guide of good practice in each pilot test will be developed for the benefit of users willing to test REAMIT technologies in the future.
- Deliverable 3.3. Report on the pilot test and development of the sensor prototypes - A report on the 5 sensor-based pilot tests will be compiled by participating partners and posted on the project webspace. It will describe in detail the experiences with the pilot test and give recommendations for future pilot tests.

Action: each pilot test lead to develop a user manual for each pilot test. A user manual for each pilot test shall document the experience of the pilot test and a step-by-step guide of good practice in each pilot test.

Action: Each pilot test lead to write a report on the pilot test and development of the sensor prototype. The report will describe in detail the experiences with the pilot test and give recommendations for future pilot tests.

2) Presentation of pilot tests by pilot test leads and pilot test partner companies

21.17.02

Pilot test in Ireland inspired by Freshbox (Xavier Cama, UCD):

- CyberBar is being developed by UCD and is a system that provides traceability of food, and this is achieved by incorporating QR codes onto food directly, which can later be read by a smartphone.
- Provides full chain traceability, i.e., can give information on origin or where the food is coming from.
- It is designed to prevent variability from the food processor to the consumer and it can assist in the reduction of food waste and in the compliance with legislation or product withdrawal.
- Ongoing Covid restrictions in Ireland is a challenge because it generates difficulties for commercial partners to engage in effective pilot testing.
- Another challenge: laser etching of samples onto food matrices – assessing the scale and cost of pilot design for successful implementation.
- The first phase of the pilot test will last approximately two months (July and August 2021) and aims to prove the concept and gain knowledge on both strengths and limitations. It is expected that demonstrating the tests and producing some outputs will encourage other companies to establish partnerships.
- Associated partners: Munster Technological University.
- The pilot is constituted mainly by a readily deployable box or container that will contain the food product and the temperature sensor.
- The location will be incorporated via smartphone GPS.
- The next steps will be to implement the pilot in pilot scale testing conditions and at the agribusiness company environment, evaluating how food waste can be reduced in the food supply chain.

Action: UCD to report the results of the first stage (prove the concept carried out in July-August 2021) of the pilot test in Ireland inspired by Freshbox.

Action: UCD to approach min 10 companies in agri-food supply chains in Ireland to demonstrate the tests inspired by Freshbox idea, to encourage their participation in REAMIT pilot tests. To do this, UCD may ask for help Innovation & Enterprise service at UCD, Interreg NWE Programme Contact Point person for Ireland or Enterprise Ireland (or equivalent services).

21.17.03

Pilot Test with Raman Spectroscopy (with Routhiau, IGRECA, ADRO) in France (Ali Assaf, UoN)

- The aim of this pilot is monitoring of the quality of food during storage or transportation by an optical sensor across the Raman spectrometer inside a refrigerated truck.
- The data generated should be sent to the driver or the operator in order to have an idea about the quality of food and if they have any problem or any damage during transportation, the operator should be alerted to go to the nearest point of shipment.
- Pilot lead: I&R / UoN (Gepea).
- Company: Routhiau (chicken meat), IGRECA (egg products), Markets & Prince de Bretagne (fruits & vegetables), Stef (refrigerated food transport), Pescanova (seafood).
- Technology: Raman spectroscopy, optical technique, and sometimes additional national physical chemical sensors to validate the observations.
- Routhiau: It is a company located in the west of France. The pilot test started on chicken samples. Many experiments are ongoing, more than four hundred and sixty spectrums, transmission to data storage server. The next phase is the transition between the lab experiment to the real condition in the food trucks (Scheduled on 9th July), including renting a truck.
- IGRECA: Started the discussion about the pilot with the company. Many samples were analysed.

Action: UoN to move the Raman spectroscopy pilot test to the next phase – transition from the lab experiment to the real conditions in the food trucks (Scheduled on 9th July 2021). This includes renting a truck.

Action: UoN to confirm whether IGRECA and Prince de Bretagne will participate in the pilot test with Raman Spectroscopy.

21.17.04

Pilot test with Human Milk Foundation in UK (Dr Natalie Shenker and Gillian Weaver, Co-Founder and Director of Human Milk Foundation, UK)

- The Human Milk Foundation is a UK charity, funded to support research and education, but also specifically into human milk banking.
- Mothers who are breastfeeding their babies, if they have surplus milk, either from home or from hospital, they're able to donate.
- As with blood banking or tissue banking, the donors all undergo health and serology screening.
- The milk is stored frozen by the donor at home or in hospitals. The milk is collected and transported frozen. Then it is heat-treated at 62.5 ºC for 30 minutes and stored until tests confirm it's safe for consumption.

- The Human Milk Foundation provides the milk to hospital neonatal units for particularly premature and very sick babies whose mothers temporarily or in the long term aren't able to provide any or enough of their own milk.
- Whilst the milk is being stored at home or in the hospital, the temperature is monitored by the donor or by the hospital.
- In the milk bank, all freezers are monitored by temperature sensors together with alarms linked up to computers, but also to emergency phone systems.
- The sensors from REAMIT have been dispatched from Whysor's office in The Netherlands but have not arrived yet at HMF. So, the Human Milk Foundation hasn't been able to start testing yet.
- The Human Milk Foundation is unable to accurately monitor the temperature during the transportation, but they want to ensure that the milk has remained in optimal conditions throughout the whole period – from when the milk has been extracted until when the milk has been delivered to a prematurely born baby.
- There are national guidelines and international guidelines for the storage and transportation of human milk. Once the milk reaches the hospital, it's down to them to ensure that they follow the guidelines.
- At the moment, four to five hours on the back of a motorbike is the maximum time that they believe human milk can be transported. But it would be useful to be able to transport milk over longer journeys and not have to stop, because if they have to bring the milk, for example, with milk coming down from Scotland to somewhere in the south of England. Then they have to stop midway and get it into a freezer and break the journey and then transport it again later not to risk it stays in the transport box for too long.

Q&A

Q: What is the financial cost associated with human milk waste?

GW: Human milk donation is a very noble service. It is not just about the financial cost of not being able to use milk, but it is about the fact that human milk is a very special product. It's donated, it's akin to blood or donation of tissue. We do everything to ensure we are able to use all the milk maximally and optimally. But inevitably we are not always able to use the milk if it fails the very stringent microbiology test before and after pasteurization. But one of the things that would be an unnecessary waste of milk would be a problem in the transportation if we were not able to monitor the temperature in which the milk was transported, for example. If the milk arrives at the milk bank and we do not know for how long the milk has been at a certain temperature, we could quickly test and pressurize it. But if we don't have any record of transportation temperatures, then we have to discard it. For this reason, the REAMIT project could make the difference for us – between being able to use the human milk or not. The impact on the donors and on the milk bank staff who are committed to ensuring that this precious resource is used, can't be underestimated. The social cost is the most important. We can't ignore financial costs whenever we have any waste, but we can take steps to minimize those wherever possible.

Q: Are the motor-bikers volunteers?

GW: Yes, in terms of transportation, HMF use volunteers almost unique to the UK. Transportation of human milk is outside the framework for transportation of food. Although it is regulated as a food in the UK, however some aspects of food regulation are very difficult to apply to human milk, particularly the labelling, because every container of donated human milk has a different nutritional content. Their contents make it impossible for HMF to properly label each milk container.

Q: How HMF is financed?

GW: When human milk banks operate within a hospital, they're funded by the hospital, either within women and children's services or by the neonatal unit. Human Milk Foundation is self-funded, we raise money, do some fundraising, and have donations to the charity. The costs related to milk that HMF supplies to hospitals is reimbursed. All the costs related to this milk are reimbursed. The REAMIT would be of great help because transportation of human milk is only going to grow. And human milk needs to be transported into emergency situations, emergency scenarios.

Action: Whysor to assist online with installation of sensors at HMF.

Action: BED to obtain from HMF images and videos documenting installation of sensors at HMF, for the purpose of developing REAMIT communication materials.

21.17.05

Pilot test with Picnic in NL (Frank Gorte, Picnic and Imke Whysor)

- The aim of the pilot is to have a personalised cooling profile per cooling box at Picnic transport in small trucks.
- It will be accomplished by analyzing the outside weather conditions combined with the delta temperature inside the cooling box during transport.
- The second aim is to link complaints of customers to how the box was handled.
- They are going to analyze data regarding xyz acceleration of the box with shock detection.
- The pilot test will start in July 2021, so Tom and Imke will be visiting one of Picnic's fulfilment centers to install the sensors and start collecting data.
- The equipment used for this pilot test is the MS sensor, which measures temperature, humidity and acceleration.

Action: Whysor to install sensors at Picnic's fulfillment center.

Action: Whysor to confirm whether sensors installed in Picnic's trucks will be re-programmed to also collect correct data on shock detection.

21.17.06

Pilot Test with WD Meats in UK (Joan Condell and James Gillespie, Ulster University)
Dry-Aging pilot test:

- WD Meats have chambers where they put the meat after being processed in the factory, they store the meat in the chambers for approximately 3 weeks.
- The temperature in the chambers can be inconsistent from one side to the other and for this reason temperature and humidity sensors will be installed.
- There is an alerting system to warn if certain areas will cause (meat) loss.
- The pilot started on 6th July 2021 and the first trial will end 3 weeks later (27th July 2021).
- 5 sensors have been installed in dry aging chamber: two installed closest to the door (one left and one right), two sensors installed closest to the refrigerator (one left and one right) and one sensor in the middle of the chamber.

- The gateway has a range of 10 kilometers with the sensors. Problem with one sensor, which wasn't recording the data. The dry aging chamber is insulated and there's many layers of metal in there, which can compromise the signal strength.
- A dashboard with data was presented. It was observed that when the doors are opened there are significant spikes in both the temperature and humidity.
- There's about 1ºC of difference between the left and the right side of the chamber that can be due to the airflow in the trailer or it could be a slight variance on the sensors and some calibration can be required.
- Marc suggested different structuring of carcass's/sensors after findings from the first trial before running the experiment again to observe the effects.

Action: Ulster to obtain from Marc at WD Meats information about weight of carcass before entering dry aging chamber and when leaving dry aging chamber.

Action: Ulster to specify what lessons have been learnt from first pilot test with dry aging chamber, discuss it with WD Meats and based on it propose how the second pilot test in dry aging chamber will be run.

Action: Ulster to run a second pilot test in dry aging chamber (for another 3 weeks).

21.17.07

Pilot Test with WD Meats in UK (Joan Condell and James Gillespie, Ulster University)
Clostridium Bacteria pilot test:

- Clostridium is an anaerobic spoilage-causing bacteria, so it doesn't depend on oxygen to reproduce. It produces a non-toxic gas which spoils products early, can spread easily and the current detection system is slow. The bacteria result in significant amounts of wasted beef globally.
- Metrics to detect currently unknown, but PCR will be used initially.
- A similar system is being developed at Maastricht University, they said that it could be configured for various bacteria, but the level of detection is unknown.
- REAMIT pilot test on clostridium bacteria aims to offer a faster method of detection of CB allowing for immediate clean-up of surfaces when detected.
- A UU student is going to do the swabbing and testing and is currently being trained in this process.
- Professor of Microbiology James Dooley brought on the project to advice.
- Marc from WD Meats has said Clostridium Bacteria has started appearing on the production line again. He is freezing swabs for Ulster to collect and perform tests on.
- Ulster have submitted a purchasing request for the DNA extraction kit required to process the frozen swabs. The company selling this equipment said they had no more of this kind of kits and offered another type of kit.
- UCD agreed to provide half of their Clostridium supply, but no updates on when this will be delivered.
- COVID has caused delays by restricting access to university facilities as well as WD Meats facilities.
- A machine in the lab at Ulster used to analyze swabs is broken. Analyses of swabs from WD Meats can be done when this machine is repaired or replaced by a new one.

Action: Ulster to purchase DNA extraction kit required to process the frozen swabs from WD Meats.

Action: Ulster to get an update internally when a new machine will be purchased and when swabs from WD Meats can be analyzed.

Action: Ulster to analyze swabs from WD Meats.

21.17.08

Pilot Test with WD Meats in UK (Joan Condell and James Gillespie, Ulster University)
3D Fluorescence pilot test

- 3DF sensors can be used to make determinations of total bacteria count on products or liquids.
- Current progress – conducting interviews of sensing companies to find an appropriate device.
- Further meetings held with WD Meats and Sensipdx/Maastricht University.
- On-going analysis to get the limit of detection for the bacteria.

Action: Since James and Xavier expressed interest in working closely on developing this pilot test, they are requested to develop a plan of actions to take this pilot test forward. Ulster and UCD to develop a plan of actions to take 3D Fluorescence pilot test forward.

21.17.09

Pilot Test with WD Meats in UK (Joan Condell and James Gillespie, Ulster University)
Musgrave pilot test

- Pilot test involving delivery vehicles with a cash and carry system based in Belfast. They provide food around 15-to-20-mile radius of Belfast.
- They use refrigerated vans; however, they don't have any sort of temperature or humidity sensor.
- There is potential for reducing food waste in the delivery vehicles with refrigeration by essentially installing temperature and humidity sensors, so the people in the office will receive an alert of the risk of spoilage.
- The start date for the pilot is the end of August 2021.
- The decision support system consists in collecting data from the temperature and humidity sensors. The sensors will be connected to the phone using Bluetooth. Bespoke android app on phone updates data to cloud using 4/5 G.
- The next steps involve developing an android app required to handle data from the sensors, which will be done by Ulster. Application will need to be tested prior to deployment. Install sensors within vans.
- A bespoke app is going to have to be developed which connects to the thermobeacon and uploads the data to the Reamit cloud. Developing the app will be a non-trivial task and hence will take time to create and test.

Action: Ulster to work with Whysor to specify which sensors to be installed in Musgrave vans.

Action: Ulster to install sensors within Musgrave vans.

Action: Ulster to develop an android app required to handle data from the sensors in Musgrave pilot test. Application will need to be tested prior to deployment.

21.17.10

Pilot Test with Yumchop in UK (Abi Adefisan, Yumchop and Katarzyna Pelc, BED)

- Abi Adefisan is the co-founder of Yumchop together with Michael Adefisan.
- Yumchop was set up in 2016 and officially launched in 2018 when the business got the tender with TUCO to supply into universities across the UK through the vending kiosks. In 2019 they started deploying their meals into universities.
- The aim is bringing accessibility of the African flavors into meals. Not only introducing African meals, but they are also bringing the culture together.
- They offer meals from around the world, e.g., Italian pasta, and they put African flavor to it.
- The meals are frozen, are free from preservatives, and free from any additives.
- They use a special technique where they flush food, freeze it within a very short time period and another team labels it. So, they keep the consistency and enable a good shelf life (18 months of shelf life) to preserve the meals and also make sure that the meal still stays the same quality from the time that it's been frozen all the way to when people eat it.
- There is a microwave that's incorporated within the vending machine that allows people to not only get the frozen food but prepare the food to eat there.
- They supply the food in universities and had the NHS approval to supply into hospitals in UK.
- In the factory, during the manufacturing process they need to ensure not only the temperature of the fridge, but also that in case of any drop in temperature or any increase in temperature, there are appropriate corrective actions to address it.
- There was an episode when all the temperature in freezers increased (the freezers have got to be -18 ºC) and because of that, the company lost the products.
- When the temperature inside the freezers increases, the quality of the meals not only goes down, but also the safety of the meals becomes problematic.
- In terms of solving the problem, Yumchop are working with the project Reamit with the sensors that can automatically send data to their emails or phones.
- The project would enable Yumchop owners to make sure that they are taking appropriate actions to tackle any potential risk. It would also reduce the loss of revenue.

Q&A
Q: Did you have situations where you had to throw away food because the products were older than 18 months?
AA: We don't overproduce at the moment, but with the expansion of the company, expansion of our client base, we're going to be looking at producing more in advance, much more. But at this moment, we've never had a situation where we've had the food for more than 18 months. We have tested our products for 18 months for 10 years and we've seen that the quality has been consistent.

Q: Can you tell us about the regulatory requirements that you need to respect? Producer needs to follow test temperatures in the morning and in the evening. Do you do it manually at the moment?
AA: We do it manually, we have to do it in the morning, in the daytime. We have hazard analysis, political control points for managing the food manufacturing or production process. The food temperature is a

hazard of microbial growth. The regulations make sure that our produce is in the temperature that is always at -5º C or lower.

KP: How do you monitor vending machines?
AA: Yes, we are monitoring the vending machines. We get real time data at the vending machines if it's dropped below a certain threshold. The data goes to our email. That's something that we want to validate, having a regular sensor that actually does much more, not just a special mode when the temperature falls below the temperature settled. It would be great to be able to have temperature monitored automatically on a regular basis.

Q: We need to have much more focus on temperature because even a single degree of something to drop is causing a huge wastage. There is a temperature drop certainly to trigger the alert. If you have an app within your mobile phone and you receive an alert you need to go physically to set it off. Is there any way they can do it through mobile devices to control the temperature?

Answer: We do have sensors which you can connect to the smart phone app, and which give you real time tolerances, and send alarms.

RR: There are certain things that are causing these problems in the case of Yumchop, these are anomalies in temperature. In many cases, the anomalies need to be fixed manually, and the automated systems may not help. For example, if somebody has opened the door, there is no way for the machine to close the door.

Action: BED and Whysor to support Yumchop online with installation of sensors and connection to the cloud.

21.17.11

3) How to recruit partner companies/organisations for REAMIT pilot tests. Overview of possible routes (Katarzyna Pelc, BED)

- Own networks, talking, discussing, presenting within professional networks.
- Making presentations about the Reamit project at external events (conferences, networks, food networks).
    - BED has PowerPoint presentations ready which can be shared with PPs for this purpose.
    - You may also play REAMIT videos to present the REAMIT project and pilot tests at various events. The videos are short and offer a concise summary of the REAMIT pilot tests.
- National Contact Point persons in Interreg NWE Programme. Contact details of these persons are available on the website of our founder. We have at least one contact point person for each country in our region. And the role of this process is precisely this kind of support linking us to the target group that we need, in this case, companies or agrifood companies in supply chains. Some pilot companies in REAMIT have been recruited in this way. Normally these people are very supportive, and they genuinely want to help. So, this is a very strong group and it's a very effective way of approaching new companies and finding new companies for pilot tests. However, this still dependant of the organization in charge in the country. In France, they do not have possibility of promoting on a large agri-food network.
- Approaching clusters in agri-food, bioeconomy can enlarge as well as other clusters like organization network (Trace & Track euverion network by Valorial).

- Participate in online B2B meetings to find potential new contacts as a lot of events are now online, and allow to participate event if there is a limited number of companies that are relevant. For example, VALORIAL participated in several brokerage events co-organized by EEN.
- Approaching Innovation & Enterprise (I&E) service (or similar) at your university. Most universities, at least in the UK have this kind of service. I&E services usually face local businesses and may be able to help you identify the right company for a new REAMIT pilot test.
- Reamit Symposium in November/December 2021 will be an opportunity to recruit ideally at least one new pilot test company in Ireland.
- Personal contacts, just talking to people you know, your family, your friends about the REAMIT project.
- Approach actors that help companies to handle the waste in order for them to include REAMIT technology as one additional tool that could be combined/suggested to have even higher results. VALORIAL has contacted food waste handing companies, associations, online plateforms for example.
- Communicating about REAMIT through local communication channels.
- The project also needs to communicate in German because for small companies in Germany, German is the first language. This is also a case in France. REAMIT communication team will be developing videos and cases in French and German. [NTU to check if it is possible to put a voice recording on top of the current videos, to have it in French or German. Explore if this would be financially feasible]. Translation services, make use of the free translation on Google. Videos with captions written at the bottom of the video in French that can be automatically translated.VALORIAL has developed a flyer in French which explain the technology, the company, the gain for and what the get engage to when getting into a end user approach.
- More than 30 companies were contacted, most of them are afraid to explain to their customers the amount of food waste that they produce. An idea is to try to promote REAMIT in a more positive way, not only by talking about reducing food waste but also by talking about 'preventing food waste', 'being more sustainable', 'and increasing quality of food production and distribution'.

Action: I&R, MTU and UCD to approach contact point persons for Ireland and France to recruit new Companies for new pilot tests.

21.17.12

4) COVID-19 Pilot impact assessment (Gael Maugis, I&R).

- France: Lockdown from April 3rd to May 19th 2021 (some regional lockdown had been decided in March 2021).
- The Netherlands: Lockdown from Dec 14th to April 28th 2021.
- Ireland: Lockdown from Dec 26th to May 10th 2021 restriction continues to relax.
- UK: Lockdown from Jan 4th to March 8th 2021 with the progressive steps to move to a normal way afterward.
- After a difficult year in 2020, the beginning of 2021 has also been impacted with the pandemic crisis (Home office, difficulties to reach end-users, etc.).

21.17.13

5) Action plan at I&R, Valorial, MTU to recruit a pilot test company in France and Ireland, Gael Maugis I&R and Adrienne GENTIL, Valorial.

Action: I&R, MTU and UCD to approach the contact point person for France and Ireland (contacts available at Interreg NWE Programme website) to recruit new companies in France an IE for new pilot tests.

Wednesday 7th of July 2021- Afternoon session

14.15 – 14.30: Work Package T1 Pilot Tests continued – recruitment of new Pilot Tests, (Chair I&R)

21.18

NTU – Glen Affric Brewery
NTU published their wish to recruit new pilot tests on the NWE Programme website. Based on that advertisement, University of Liverpool, who are collaborating with Glen Affric Brewery, contacted Usha to join REAMIT. Glen Affric would like to reduce waste in terms of usage of barley. NTU have had multiple online meetings with the brewery and the University of Liverpool and have spoken for approximately 5 hours so far. The next stage is for Imke to go for a virtual tour of the company; however, it has been postponed due to unforeseen business demands and thus expansion of the company. This has come about due to the huge demand for alcohol due to relaxing Covid restrictions and the summer season in UK. Glen Affric now hope to conduct the virtual tour for REAMIT consortium over the summer (July, August 2021.)

Action: Whysor to go on a virtual tour of Glen Affric and propose what sensors shall be used in this pilot test.

NTU – TTK Confectionery
Derby and Nottinghamshire Enterprise Partnership in conjunction with Nottingham City Council released a press release at the end of last year (Dec 2020) advertising the REAMIT project and the desire for trial recruitment with suitable agri-food businesses. TTK Confectionery contacted NTU on the basis of this advert, who are a chocolate manufacturer based in Nottingham who supply supermarkets like ASDA and Sainsbury's. They were very much interested originally in collaborating for a pilot study, however after an initial call with SB and UR they haven't shown additional interest. SB said they are a contact she is happy to follow up with.

UU – Dale Farm, NHS
Ulster University have added a new academic to the REAMIT project, Trevor Cadden, Senior Lecturer in Supply Chain Management, to aid in the recruitment of new pilot tests in Northern Ireland. Trevor has an extensive network of contacts and has been able to assist in recruiting both Dale Farm and Knockbracken Foods (NHS) for pilots if a solvable problem can be identified.

Ulster also collaborated with Harry Hamilton from the Northern Ireland Food and Drinks Agency (NIFDA) for trial recruitment. He had also been exploring a collaboration with Dale Farm on Ulster's behalf. However, it was ultimately Trevor's contact who was utilized.

Dale Farm are a large dairy producer in Northern Ireland and produce £350 million of cheese each year. Exploratory calls are being held with Dale Farm to see if REAMIT technology could assist in reducing wastage in the cheese maturation process. James said that he intends to have follow up calls with them over the summer, and that perhaps they have not spoken to the correct person in the business thus far.

James feels like Dale farm need to suggest to Ulster how technology could be utilized to reduce their waste as they are the industry experts.

Action: Ulster to identify the right person at Dale Farm to discuss Dale Farm participation in the REAMIT pilot test focused on reducing food waste in the cheese production process.

Knockbracken Foods prepare pre-cooked meals to the hospitals in the Belfast Trust of the NHS. One application of REAMIT temperature monitoring technology could have been in their chill room post preparation, however they have unfortunately just purchased a commercial alerting system for this. Exploratory calls are being conducted to see if REAMIT technology could be applied to provide quality assurance regarding micro-bacterial analysis in sandwiches to prove freshness, or for allergens in foods.

Ram said that the primary objective in REAMIT is utilizing temperature and humidity data and helping companies maintain these variables. Contamination (e.g., which is in the interest of NHS) is not the primary focus of the REAMIT project. A REAMIT pilot test should be related to temperature and humidity data. Most pilots in REAMIT should follow the standard architecture proposed by controlling temperature and humidity.

Whysor – BIOGROS, Luxemburg
Whysor approached a company in Luxemburg (BIOGROS) at the beginning of May 2021, who sell biological products to supermarkets and small village shops. They are interested in starting a pilot test, testing in trucks that transport Luxemburg goods – for example mushrooms and celery crops. They are currently having problems with too much moisture. They are also wanting to measure temperature and humidity in their warehouse as they are experiencing some issues with mold here. Whysor are hoping to meet with them again in the next few weeks.

Whysor – Van de Huijgevoort Groep, The NL
They are also working with a Dutch company who own 3 supermarkets in the south of the Netherlands and also a meat processing factory. There they process semi-finished produces e.g., minced meat for sausages. They mostly have microbiological issues there with salmonella etc. They are very interested in trialing the fresh detect system. Imke is hoping to meet with them next week with RR and KP, and they are very interested. The two potential pilots could both start in the next few weeks or months.

UoN – Prince de Bretagne, France
Prince de Bretagne are a producer of fruits and vegetables located in the north of Bretagne, France. The company packs and ships directly from the farm to consumers. They are having some issues with degradation during the transportation of broccoli and are interested in applying REAMIT technology. They are hoping to schedule the pilot for September / October 2021. AG mentioned that they have also tried to approach a lot of companies who prepare fish, meat, and vegetables, trying to reach as many end users as possible.

BED – German trial
KP has contacted the NWE Programme contact-point person for Germany to help with the recruitment of a German company for a REAMIT pilot test. The contact point was able to provide names of 6 agri-food companies who were approached, however unfortunately none of them followed up. Kate mentioned that the German language barrier is a big problem, as well as geographical distance. Also, they are having to use a third person to speak on their behalf.

BED – Unilever, UK
For Unilever, they also decided not to pursue with a REAMIT pilot test, as they do not have fresh food waste. AG told KP that due to the trace and track project she is involved in, she has contacts in Germany. She will send them on to Kate and also Imke, who speaks German.

BED – other companies, UK
RR said that BED is hoping to approach many companies for pilots through the Southeast Midlands Local Enterprise Partnership and invited RC from this organisation to speak (later on the day).

UCD – update on new trials
Xavier said there are no further leads from UCD apart from what was discussed at the morning session, but they are still planning on following up with the previously mentioned mushroom trial. The trial with Carton group has not progressed, and they have been unresponsive since they changed ownership.

21.19

Southeast East Midlands Local Enterprise Partnership (SEMLEP) – presentation by Richard Cook (invited by BED)

Richard Cook works for the SEMLEP who are responsible for promoting economic growth in the South-East Midlands region of the UK. Within the SEMLEP, Richard is responsible for food and drink enterprises for the region. Richard mentions that one of the most powerful things we have is the collaboration with universities – specifically BED, Cranfield, Northampton. Richard works with retailers, food manufacturers, and logistics companies. Waitrose have their largest distribution center in our patch in Milton Keynes. Richard is in frequent contact with them and said he will check with them if there's any pilot which could be explored between Waitrose and REAMIT at the next meeting.

RC mentioned that themes focused on reducing food waste appear more and more often in the press and media. The topic of food waste is linked to sustainability and reducing carbon footprint. However, food manufacturers are very busy individuals and they're only going to respond to what the consumers and government want. Hence reducing food waste needs to be presented to them in connection to improving their businesses, process, financial tables.

13:45 - 14:15 Weather Logistics Ltd – An introduction by Dr Christopher Nankervis, CEO of Weather Logistics Ltd, UK

21.20

Christopher Nankervis (CN) provided a presentation on the research his company, Weather Logistics Ltd, is currently completing and how it could fit under REAMIT and/or be scalable to the REAMIT project. Weather Logistics Ltd provides seasonal forecasting, i.e., climate predictions from 2 to 15 weeks in advance, which can be used in the agriculture sector to identify risks. CN has been able to provide predictions for the UK, Turkey, and Spain and is currently collaborating with the European Space Agency.

Weather Logistics Ltd provide data as a service and have a high level of technology readiness. As an example, CN mentioned that with one lettuce farm he collaborated with, they were able to reduce food wastage by £0.9 million pounds. Weather Logistics have the capability and technology to provide heatwave planning to reduce food wastage, forecasting and analysis. CN is happy to collaborate with

REAMIT partners for potential weather-based food waste applications or provide additional contacts. He mentioned that risk-based decision making and scenario analyses for projections of surplus / deficits in food waste, operational adjustments to mitigate upcoming risk, and > 2 week logistics planning are the best options to explore for involvement with him.

DB asked CN if his system could accurately predict weather extremes 5 days from now. CN said that they are not focusing on short term weather predictions at present, but in terms of extremes where they are adding value is that their forecast model can predict extremes, not simply stating warmer than average.

RR said if any partner is interested in collaborating with CN, please contact him and keep RR in the loop.
14:30 - 15:30: Work Package T2 Big Data integration and application to reduce food wastage (Chair BED)

21.21

Tom Verstraten (Whysor), Dashboard Development

Tom Verstraten (TV) from Whysor showed new development progress on the REAMIT dashboard. Now, templates have been created to allow for consistent dashboard creation while also reducing the workload. They are designing a reporting tool / module, which will generate a periodic link containing a PDF which can be shared with interested stakeholders. Users can set up the reports themselves. Whysor have also added an alerting system, so you get email alerts to check the dashboard, and export the dashboard as a PDF.

Tom is currently thinking about how to display the data for the Picnic trial.

YD asked if the dashboard is limited to the Picnic trial only or if it can be used for other REAMIT pilots.
TV said that the sensor would need to be connected to their architecture - i.e., the data in their platform. Once they have been connected, the user will have access to it.

TA asked how transferable the dashboard is to the data on the big data server at BED.
TV said that for now, they are choosing a parallel approach where Whysor also warehouse the data for the visualisation. They have scripts to transfer the data from the Whysor platform to the Bedfordshire server. This is a manual process, but it has been written in such a way that it can be automated.

KP asked if there is a difference between the REAMIT dashboard and the Whysor dashboard, additionally if they are displaying raw data or cleaned data.
TV said they will schedule a follow up meeting to discuss this further.

GS asked if the dashboard cannot be connected to the BED server to visualise all data.
TV said that it would take some work to convert the data type from the BED format to their dashboard format. He said that it would certainly be doable for time series data e.g., the data which comes from the Picnic pilot, but visualisation would be more difficult for something like spectroscopy data. The dashboard was really designed for time series data, but this is something to discuss in a follow up meeting to see what the possibilities are there.

Action: Whysor to hold a meeting on dashboard and data in Whysor cloud.

21.22

REAMIT App, presentation by Davinder Bola, Levstone

DB made a presentation on behalf of Levstone giving an overview of the REAMIT phone app currently being developed. DB was able to give a live demonstration of the app in the presentation. Levstone demonstrated the app working with a temperature and humidity sensor provided by *blue maestro,* which operates on low powered Bluetooth. The cost of each sensor is approximately 50 pounds. Data recorded by the sensor on the app can either be viewed in the app itself, or the app can send the sensor recordings to the back end big data server to let the client view the data. DB mentioned that Bluetooth sensors are only useful up to 10 meters, so they may not work for larger lorries, if the mobile phone is placed in the cabine and the sensor is located at the back of the lorry. However, the blue maestro has internal storage for up to 6000 records and has an estimate of 9 months battery life. If recordings are made once every 10 minutes, the internal storage would store 60000 records. The app could also be configured to send alerts, although this has not been implemented yet. There is currently a version of the app downloadable on the Android Play Store.

TA asked what the difference was between his app and the Whysor dashboard.
DB explained that the app is used for connecting to low power Bluetooth sensors and sending this data to the cloud.
TA asked if WIFI sensors could be added to the app as well as Bluetooth sensors.
DB said that this would be possible if desired.

An Introduction to Data Analytics, Gautam Samriya, MTU

21.23

GS (MTU Kerry) provided an introductory session on Data Analytics, specially aimed for partners from non-analytics background. He explained the basics and principles of a Data Analytics process, and its life cycle. GS presented the Data Requirement and Collection in the REAMIT document. The document provided a base blueprint and reference for data requirement and data collection strategies of all the pilot tests in the REAMIT project. Apart from summarizing all the data collection needs of all the pilot tests in a single document, the aim of this activity was to brainstorm and discuss data requirements of all the pilot tests and to come up with suggestions on new and important data capturing needs for all the pilot tests in the REAMIT project.

Big Data Server – Presentation by Joy Eze, BED

21.24

JE gave a presentation on behalf of Lohit to update the team on the progress on the big data server at University of Bedfordshire. Currently, the university is procuring the big data server user license. The final choice of server was made with the IT department in BED. Originally, they had checked the price of Amazon AWS / Azure cloud server, however it was found that purchasing a server was going to be much cheaper.

GT asked who would be footing the cost of the licenses.
KP confirmed it was coming out of BED's budget.

It was noted that a WP T2 meeting between the technical partners will be required.

Action: BED to organize a technical meeting of technical partners regarding license for Big Data Hub at BED, connections to the Big Data server, etc.

Third REAMIT Symposium, presentation by Shane Ward, UCD

21.25

SW gave a presentation in relation to the third REAMIT Symposium, due to be hosted by UCD and take place in Nov/Dec 2021. SW noted that if the symposium were to happen in December it would need to be early December due to the Christmas break. Ideally, agribusiness and technology SMEs would be invited to participate in the symposium. SW proposed three options of format for the meeting. Either 1 full day, 2 full days, or 2 half days. He also asked whether it should be virtual, hybrid, or an on-site event. How far should the net be cast? It was agreed that a specific meeting would be required to finalise the details.
RR said he would prefer the event to be in person, but we will have to see how COVID-19 restrictions are closer to the time. SW proposed 3 dates for the symposium: 2 week of November and 1st week of December. RR said for SW to choose the 2 best days that he prefers and the rest of the REAMIT team will book it in their diary. RR said the COVID landscape of vaccine supply chains could be nice to include. What do you want to achieve from the symposium? KP says we should be able to be ambitious at the third symposium. RR mentioned that the emphasis on recruiting new companies will be less at this symposium.

Action: UCD to organize in September an online planning meeting with BED and NTU on the 3rd REAMIT Symposium in Ireland.

Day 2. Thursday 8th of July 2021 – Morning Session

09:00 - 10:00: WP Communication (Chair NTU)

21.26

A presentation about the Central Laser Facility in NTU was presented by AP

- The Central laser facility hosts the most advanced lasers in the UK and the Food Network, that brings together STFC researchers and facilities research with industry in the agri-food sector in order to develop an application for sustainable production site with remote sensing techniques for the industry.
- It also provides technical application for the supply chain in manufacturing food industry and nutritional and human behavior, e.g. food fraud, packaging, waste, rerouting, by a combination of technology through the most advanced microscopy department with Raman spectroscopy.
- They are able to image and track single molecules in multiple dimensions and send them the spectroscopy to track the changing system of foods over time.
- They have collaborations with Coconut's Collaborative, PepsiCo and Syngenta.

21.27

WP Communication meeting – presented by Prof. Usha Ramanathan and Sasha Bennett.

- One to one interaction started and SB is contacting the partners to create small social media news and, if possible, this can be converted as local news in local languages.

- Main objectives of WPC are:
  - (1) influence agribusinesses to decrease amount of food waste in food supply chains by 10% by 2021,
  - (2) raise awareness of the potential from combined technologies and
  - (3) convince agribusiness users of the value of REAMIT's technologies and increase knowledge.
- The role within the project is coordinating the process of designing the project's communication strategy in close cooperation with the Project Coordinator/Lead Partner and project partners.
- NTU have started to develop a storyboard, which is a collection of different stories from around the globe on actions to avoid food wastage through technology, all through social means like charities.
- Coordinating the implementation of communication activities. Managing REAMIT's web space and social media. Not only leading and posting on social media, but trying to help other partners to put something new on social media. Managing the spaces and social media to make sure that at least two posts happen every week.
- Liaising with JS and lead partner on project/programme communication.
- Several ways of communication will be used in engaging the target groups:
  - Installing project banners and signboard.
  - A new, stand-alone REAMIT web page will be developed by September 2021 (domain is being transferred).
  - Creation of TV programmes. There is some funding for certain skills, especially video recording or to get some airtime on Nottingham TV station. A short 10-15 minute documentary is planned.
  - Journal articles and case studies are ongoing work.
- The Communication Strategy Document has been updated with new activities and it is available in SharePoint. Updates include:
  - New Video Production Plan for 2021.
  - Communication strategy for reaching local stakeholders across the North-West Europe region.
  - List of networking events attended from Jan-July 2021 by REAMIT colleagues.
- An overview about the REAMIT new, stand-alone website was presented:
  - Domain secured in 2019 – www.reamit.eu, redirects to main Interreg North-West Europe Programme REAMIT project page. New website will have the same domain name that we originally purchased back in 2019 just to keep it consistent.
  - New features included on the website: Sign up form for newsletters, Call to Action. When people sign up, they can automatically subscribe to any newsletters and they can sing out and also unsubscribe from any future news as well.
  - New Events and News Feature.
  - New website for REAMIT is currently being developed.
- Social Media:
  - Updates are continuing being posted on LinkedIn and Twitter (aim for at least two posts on LinkedIn and Twitter a week). A total of 110 tweets were made in this period. LinkedIn views increased by 83% in the last 6 months with an addition of 33% of unique visitors.
  - Twitter page (https://twitter.com/reamit4nwe).
  - LinkedIn page (https://www.linkedin.com/company/reamit4nwe).
- Project Banners, Posters and Flyers :

- Promotional materials created so far: Animated Video, Roll Up Banners, updated the REAMIT brochure in February 2021; released two newsletters so far with the third newsletter on the way in July 2021; Posters; Leaflet; REAMIT partner video; infographics; and large format A2 vehicle magnets (available online).
- New materials developed in this period (January – June 2021): (1) Two new animated videos for pilot tests (Picnic and WD Meats). These are yet to be published as we're still awaiting confirmation from Picnic; (2) New Posters have been developed (Picnic, WD Meats, IGRECA); (3) New interactive slide decks of Food waste stories has been added to the REAMIT website.

- Policy Briefs:
  - The objective for REAMIT communication team and PPs is to keep contacting local councils and food associations to promote and disseminate REAMIT work. E.g. SEMLEP is a local public policy organisation within South East Midlands of UK that BED are connected with, to communicate about REAMIT.
  - There are opportunities for impacting policy in the EU and in the UK, because REAMIT is looking to support policy makers to make sure that there are suitable policy mechanisms to encourage people and companies to reduce food waste. The challenge is to identify the right kind of contacts and then approach them in a proper way. Policy briefs will take time because the pilots are starting to collect data only now, and we have to produce appropriate materials and data analysis to substantiate any claims. For these reasons, the research studies and the case studies will be crucial because REAMIT is talking about policy and we are bringing out some of the new knowledge from our work and will present it to policy actors as tools to help achieve policy objectives.
  - REAMIT consortium have at least three concrete opportunities to influence three different policies:
    - The first one was mentioned by GW from the Human Milk Foundation. She works on designing human milk banks in Europe and has access to ministries, etc.
    - The second entry point to policy was mentioned by Yumchop, because they have to follow some rules, governmental rules to make sure that they check the temperatures in the morning and in the evening. There is an opportunity to influence or propose a solution, which includes this kind of policy to monitor temperature in which food is stored.
    - Third one is through RC of SEMLEP. He can be an entry point for REAMIT to national policy level in the UK. In his role, he is based between the national and regional policy levels.
  - The next step is to identify the local and national policy-makers and stakeholders within the North West Europe region to disseminate information about REAMIT approach.
  - From the experience from other projects, the approach for local policy level is to contact policy makers and they can inform if the technology can be adapted to the local council.

- Report on REAMIT Networking Events:
  - It has been difficult to attend physical events, but partners attended 2 Interreg North-West Europe Networking events in 2021. UR presented in May and SB presented in June. Many food organisations on board who are seeking solutions for waste. Attended by many Interreg projects linked with low carbon and resource efficiency themes.
  - REAMIT Networking Events reports have been presented in Newsletters, this is also reported to JS through REAMIT project report.
  - REAMIT is presenting regularly in external academic and practitioner events. This is reported in CS document and social media.

- Articles and Case Studies:
  - Case Studies are being developed for pilot-tests: WD Meats (UK), Picnic (NL), Human Milk Foundation, Yumchop, Routhiau in France (UoN).
  - Book chapter was submitted for publication and two more conference papers have been submitted and will be presented in the next few months.
  - Data analysis papers will be ready once the data is analysed.
- REAMIT Website Updates:
  - New section on impact of COVID-19 on food waste and food supply chains
  - Call to action: Newsletter subscription sign-up form.
  - Link to Mailchimp newsletters that takes the users to the most current newsletter. The July 2021 newsletter will be ready in July 2021 featured on the Mailchimp service.
  - New website for REAMIT currently being developed.
  - The changes on the REAMIT website were presented, such as the tabs on the website were re-arranged, news and events featured on the homepage, subscription session, etc.
- Update on Newsletters & Videos
  - Sharing social media database among partners, which is a list of all of the partners social media, twitter and account details.
  - 3 newsletters have been prepared so far in 2021: February 2021, April 2021 and July 2021 newsletters. Urge for partners to promote REAMIT Newsletters regularly. Partners could share it amongst their networks and email it to their stakeholders and other partners and associated partners, to policyholders and various target groups.
  - New Mailchimp platform, which is where the newsletters were developed and it is an easier and much more automated service rather than the kind of manual creation that was used before.
  - 2 new videos created on pilot tests with Picnic and WD Meats and more videos in the pipeline- HMF, Yumchop, and Routhiau.
- Communicating through local communication channels:
  - Active participation is encouraged through supportive approach of production of short news to actively communicate about REAMIT to their local stakeholders through local channels and online networks - NTU contacted partners individually. All the partners have the responsibility to communicate through social media.
  - Communication template has been created and sent to partners to help create social media posts.
  - University of Nantes, Valorial, Images & Reseaux, University of Bedfordshire, Nottingham Trent University and Ulster University have made active communication actions – Other partners are requested to join this initiative of communication.

Actions: Each partner to develop at least one piece of news about REAMIT to be communicated in social media. This can be converted as local news in local languages.

Action: NTU to have one-to-one interactions with PPs to assist with creating small social media local news.

Action: NTU to finalize a storyboard, which is a collection of different stories from around the globe on actions to avoid food wastage through technology, all through social means like charities.

Action: NTU to develop a new, stand-alone REAMIT web page and send it to PPs for feedback.

Action: PPs to identify the local and national policy-makers and stakeholders within the North West Europe region to whom they will disseminate information about REAMIT approach.

10.00 – 10.15: Status of REAMIT project 12-month extension (Chair BED)

21.28

Based on input from PPs, BED developed the REAMIT 12-month extension budget proposal. On 12/05/21 it was sent to JS for initial feedback. JS requested formal approval at BED and it is currently in approval flow at BED.

Action: BED to finalize the paperwork related to the approval of REAMIT project 12-months extension budget.

10:30 - 12:00: REAMIT Steering Committee (RSC) meeting

21.29.01

- The minutes of 4th RSC meeting (20-21 January 2021) were presented, agreed and considered as final (approved) by the whole partnership present in the meeting.
- The action log (as part of the minutes) was reviewed, updated and approved.
- Feedback from RAC meeting and the decisions of the WP meetings will be discussed and approved after discussion.
- Some feedback was received from East Netherlands Development Agency, but not from the other associate partners. There are two companies listed as associate partners at Ulster University (e.g. Biosensor is an associated partner of UU). UU partners were asked to talk to the associated partners, get their feedback on REAMIT 5th progress report and share it with BED.

Action: Ulster to get feedback from associated partners on 5th REAMIT progress report and share it with BED.

- Regarding WP T1, the consortium is still looking for more pilot test companies, while hoping for the pandemic to end.
- Regarding WPT 2, three critical activities are: (1) purchasing the additional licenses, (2) providing access to all partners to big data hub (and any other installation related activity related to the big data server), and (3) completion of the mobile app development.
- Regarding WP C, the main takeaways are: to address language related challenges when producing REAMIT communication materials; refocusing the messages in REAMIT communication materials and channels (i.e. rather than 'reducing food wastage', we should talk about 'sustainability, avoiding food wastage, improving company's processes, quality of production lane', etc.).
- Regarding WP M: Revision of REAMIT risk log based on new risks identified in the REAMIT project.

Revision of REAMIT risk log

21.29.02

(1) Risk of not having a pilot test in Germany due to losing Weyers and no success in recruiting a new company in Germany (high risk).
How to address this risk? Developing some communication materials in German language will make it possible to reach out to some potential companies in Germany. It is important to produce at least one video and one flayer information in the German language. Whysor offered help in translating text to German and liaising with GIQS (national contact point for Germany).

Action: NTU to develop communication materials about REAMIT in German language with Whysor's help regarding translation.

Action: Whysor to liaise with GIQS (national contact point for Germany) about new companies in Germany for REAMIT pilot tests.

(2) Absence of a proper French pilot test and an Irish pilot test (high/medium risk)
How to address this risk? Developing communication materials in French language (e.g. one short video about pilot tests in the REAMIT project) would be helpful.

Action: NTU to develop communication materials in French language i.e. one short video about pilot tests in the REAMIT project will be in French, with support from I&R, Valorial and UoN.

Action: UCD and MTU keep making efforts to recruit new companies in Ireland.

French partners are very focused on Raman spectroscopy, however it would be important to have other types of traditional sensors, i.e. temperature and humidity sensors piloted in France as well.
GM advised that Prince de Bretagne are not interested in traditional sensors, and they want Raman Spectroscopy only. According to GM, Raman Spectroscopy has added value for the REAMIT project.

Ram suggested exploring whether Prince de Bretagne would be keen to connect their sensors to the REAMIT cloud, allowing REAMIT analytics team perform data analytics and come up with the alerting system.

Action: I&R to ask Prince de Bretagne if they are keen to connect their sensors to the REAMIT cloud and obtain from the REAMIT consortium an alerting system for this data.

(3) The sensors cannot be fitted at Yumchop and HMF by Whysor physically due to travel restrictions (High risk)
There are travel restrictions in the UK and in The Netherlands (summer 2021) because COVID infections are rising again. Whysor partners have tried to find somebody with experience in sending goods to the UK using LinkedIn, but no answers so far. How to address this risk?

Action: BED to support Whysor with sending sensors to Yumchop and HMF in the UK.

Action: Whysor to provide online support for fitting sensors at Yumchop and HMF.

Action: Levstone to support Yumchop and HMF physically with fitting the sensors.

(4) Risk for sending the sensors by post from Whysor to Yumchop and HMF (High/medium risk).

BED will explore sending sensors with another courier.

(5) Risk for less effective communication if pilot test partner companies insist on remaining anonymous in REAMIT communication activities (low risk).

(6) Risk of further delay in WP T1 implementation due to the lengthy procurement process at BED (low risk).

Other risks:
(7) IH raised concern that delaying the payment from LP to PPs is a big issue for small companies who are forced to wait for money for 7 months. Whysor are still waiting for the payment for the work completed in 2020.

RR confirmed that he had talked to the finance department at BED several times that partners in REAMIT should receive the funds from the funder without delays.

21.29.03

5th REAMIT project activity and finance report and payment claim (January-June 2021) calendar.

KP presented the calendar for REAMIT 5th progress report:

- By 18th June 2021: Each partner has developed their activity report in eMS and shared (as a PDF file) with all REAMIT partners.
- By 13th of August 2021: each partner has finalised in eMS their FLC audit and submitted to the Lead Partner the certified activity and finance report, payment claim and forecast of expenditure for the next period.
- Evidence of deliverables. All partners were asked to upload evidence of deliverables in EMS.
- It is important to pay attention to the section about target groups.
- FLC audit: partners should have agreed by now the time of FLC audit of each partner's progress and finance report. It takes 3-4 weeks for an auditor to complete an audit of a partner's report.

21.29.03

Plans for the 6th meeting of RAC/WP/RSC: 19-20 January 2022, to be hosted by Ulster University, Joan Condell and James Gillespie, Ulster.

- Virtual or physical event? Ulster University is very much risk averse, and at present are not allowing staff to travel, even to the UK. However, in person teaching resumes in September 2021 and university travel restrictions may be revised then. The COVID situation will need to be monitored as many partners will be travelling from mainland Europe, where quarantining upon arrival may be a stipulation.
- Ulster University is planning a meeting in late September to decide about the format of the 6th meeting of RAC/WP/RSC. James will organise this with Joan and the BED teams.
- The idea is to plan a hybrid event, hosted online but also hosting some people if the situation allows. Ram's preference is to have the session as a face-to-face event if possible, but we will have to plan for both.

Action: Ulster to decide about the format of the RAC/WP/RSC meeting in January 2022 and communicate it to PPs.

21.30

12:00 - 12:30: WP T3 Business development of REAMIT technologies (Chair Ulster University)

- Review (mapping) of the technical and business landscape in the fresh produce food chain (JG of Ulster and TC of UCD).
- The timeframe for this deliverable was originally January 2021, but since REAMIT received a one year project extension, the new delivery date for the work is now September 2022.
- The output expected is one assessment report that will be an internal document for partners used as the basis for the business model development.
- The actions in progress included the establishment of networking activities with other partners. During the WP T3 meeting in the beginning of May 2021, it was suggested to start planning this review and the topics that should be included in the report.
- UCD started collecting data about the topics suggested during the meeting that include: (1) methodologies for food waste accounting; (2) where in the supply chain it becomes waste, (3) information on the amount of waste generated in different supply chains.
- A literature review is being performed for food waste accounting, which has found that 42% of food waste in supply chains come from fruit and vegetables. However, this is an indirect type of data collection which has much higher uncertainties with respect to accuracy compared to direct methods of data collection e.g. surveys / questionnaires with companies.
- Ulster started planning the collection of data about technical and business landscape. They proposed using a standardised questionnaire to survey companies that are already involved in the REAMIT project in the first instance (e.g. Yumchop, HMF, WD Meats) to collect consistent information about the technology and current business landscape. This will allow for grouping and analysis going forward. Proposed information to collect is as follows:
    - estimate of current food waste;
    - the main suspected causes of food waste;
    - what approaches are taken to try to reduce/handle this waste;
    - technology solutions to try to reduce food waste;
    - awareness of any technology solutions which could be applied.

RR proposed that these questions are appended to the case study questions that we are going to approach pilot test companies with, and has proposed that UU works with BED and NTU to develop the questionnaire further. RR said we should not approach pilot test companies individually, but rather as a group and we will select the most relevant person for this task given the pilot test company that is involved. YD agreed with RR and mentioned that as we only have a limited number of case study companies, we need to ensure a coordinated approach is used when conducting a survey otherwise they may get annoyed being approached multiple times. Also, perhaps we could rephase the questions in a more positive way as 'waste' is a negative word which companies may not like to use. How about 'potential' or 'how to avoid'. RR said please send questions to NTU as they are leading on the case studies and let them coordinate it, but JG , TC, XC, and GS will be contributing as they are involved in the case study too. UR mentions that these questions may not suit all companies, for example WD Meats. She proposes that the questions could be customized for each case given the pilot study. RR said we will need more meetings to ensure they are all exhaustive and appropriate. YD is extremely knowledgeable in these types of questionnaires and we should make use of her expertise.

- The Potential Sensor Technology for Continuous Monitoring of Food Quality in Transport report may overlap in some points with this deliverable. It is important to define the boundaries of this review in order not to overlap with the work already made.
- The plans for the second semester include: (1) the enlargement of networking activities with companies, in order to collect the data about their technical and business activities; (2) the production of a questionnaire to collect direct data from the companies; (3) start collecting data from the companies; (4) assessment of the economic impacts of food waste produced and the economic savings of food waste avoided that are expected by implementing the REAMIT technologies.
- The actions to collaborate include meetings between UCD and UU to start working on the questionnaire and the data collection.

Actions: Partners involved in case study development, to collect information from pilot test companies on their technical and business activities.

21.31

Life Cycle Assessment for REAMIT (Tamiris da Costa, UCD)

- The output expected is the life cycle assessment of the strategies implemented by the REAMIT project, which will allow the study of the environmental impacts and savings of the pilots.
- The life cycle assessment is the evaluation of the potential environmental impacts of a product through its life cycle, starting with the food production until the end-of-life.
- In the LCA task, it will be provided an estimation of the potential environmental impacts and environmental savings related to the strategies implemented in each pilot to reduce food waste.
- The actions in progress included the review about the LCA studies related to food waste. The establishment of networking activities with other partners, in order to understand what is being proposed in each pilot test and to define the data requirements for the LCA.
- The goal and scope of the LCA, include the definition of the objectives, the functional unit, the scope and the system boundaries. The objective of this assessment will be to identify the process that affects the environmental performance of the pilots in terms of the carbon footprint.
- As each pilot will be implemented in one stage of the supply chain per time, the scope of the study is a gate-to-gate, which means a partial LCA that looks at only one process in the entire production chain.
- The system boundaries of the pilots involved in the REAMIT project were presented. In food production, the system boundary includes the energy consumption, the raw materials (in this case, fertilizers, etc.), the wastes (wastewater, solid wastes, food waste), the pilots and the big data platform that will be used to reduce the problem with the food waste.
- The data requirements were grouped into five questionnaires organized according to each stage of the food supply chain that the pilots can be implemented: food production (Agri and animal origin), manufacturing, storing, distribution and retail. Part of the questionnaire will be completed by the pilot leaders, but information from companies is also required.
- One example of a questionnaire and the data needed for the distribution stage were presented, but the questionnaires are general and they will be adapted to each pilot.
- The plans for the second semester include: (1) enlargement of the activities with other project partners; (2) individual meetings with each pilot leader, since the LCA must be adapted for each type of case; (3) start collecting data from the companies and pilot tests after data compilation in WP T1 and WP T2.
- Individual sessions will be important to provide further guidance to complete the questionnaires.

- LCA work relies on data from pilot tests, case studies etc. Obtaining data is crucial to complete the LCA.
- Ram said a similar coordinated approach will be required for the LCA when approaching potential companies. Kate raised a concern that the questionnaire is asking a lot of questions, more than what some pilot companies may either know or be willing to share. TC said that the first preference is collecting primary data from the companies, but if we aren't able to do that we can try to find the data in the literature or databases. Ram said we have to start with the companies in the first instance, then we can use other means to fill in the blanks. LCA will help show that the use of technology is going to help reduce food waste.

Action: UCD to define the data requirements for the LCA for each REAMIT pilot.

Action: UCD to hold individual meetings with each pilot leader, since the LCA must be adapted for each type of case.

Action: UCD to start collecting data from the companies and pilot tests after data compilation in WP T1 and WP T2.

Day 2. Thursday 8th of July 2021 – Afternoon Session

13:00 - 13:45: Research studies from the REAMIT project (Chair BED)

21.32.01

Presentation by Prof. Ram Ramanathan – ongoing research studies on the REAMIT project at BED

1st study

- An optimisation model for cost effective integration of transportation network design with quality control to reduce fresh food wastage.
- Authors: Lohitaksha M. Maiyar, Ramakrishnan Ramanathan.
- The goal behind this study is to find out what are the incentives for companies to use REAMIT technologies, under what conditions they will prefer to use REAMIT approach and technologies.
- Problem environment: companies may choose from one of the following for transporting their goods, depending on the type of food, distance, but also because they may not be able to make the investment:
    a) Vans with no temperature control – cheapest option (excluding cost associated with waste).
    b) Vans with temperature control but no monitoring (more common in Europe) – companies would look at the temperature records at later stages to make sure there was nothing wrong, but no continuous monitoring of the temperature.
    c) Vans with temperature control and monitoring – REAMIT idea.
- The study assesses what conditions will make companies choose among these options.
- A factor is the cost or investment, temperature control and monitoring increase the cost. Companies may not choose the third option if they cannot afford it. The cost of transportation depends on distance, but also there is a cost arising from the food that becomes waste during transportation. On average 15 to 30% of the food is lost if there is no temperature control. The

third option is the most expensive initially, however, given that cost of wastage will be notably reduced, this will average out the cost of fitting for monitoring and control technologies.

- Although this is not a completed work, Lohitaksha performed some mathematical modelling.
- A first modeling approach showed a model (objective function: minimise transportation and food wastage cost) had several input parameters (e.g.: distance between farms and demand points) and outputs (e.g.: food waste reduced).

2nd study

- A theoretical sustainability model on using IoT sensors and cloud systems for reducing food waste and emissions in the fresh food sector.
- Authors: Lohitaksha M Maiyar, Ramakrishnan Ramanathan and Lakshmi Swamy.
- This study was accepted for presentation at the logistics research network conference (to be held at a later stage in 2021).
- The framework/modeling that was used for this study was a requirements-technology fit model. The objective of using this framework was to assess the impact on food waste and emission reduction of the technologies employed. The model takes into consideration the fit or matching level between technologies and the tasks requirements - the problem that needs to be solved - for example, in order to achieve food waste or emissions reduction, we need to engage in appropriate technology, i.e.: IoT sensors with the correct characteristics.
- Task requirements refer to the problem, which is trying to be mitigated, the situation that technology can help solve.
- **Example in the REAMIT context:** food waste in the supply chain can be saved to some extent with the help of technology - IoT sensors.
- The technology and task requirements need to match, that is the "Requirements Technology Fit". This matching level or fit can be measured/evaluated, and with these prerequisites food waste and emission reduction can be achieved.
- **Future work:** survey/questionnaire in order to collect data and validate the model.

3rd study

- Fighting Food waste: How can artificial intelligence and analytics help? Authors: Lohitaksha M Maiyar, Ramakrishnan Ramanathan and Lakshmi Swamy.
- This work consisted of a considerable amount of literature review, which was carried out to give a comprehensive overview on analytical techniques that can be used related to food waste.
- There are different criteria for using different artificial intelligence or technologies. Three categories: cost, quality and external environment.
- A detailed mapping of data analytics techniques was developed, showing which techniques can be used under specific circumstances.
- This is a work that has not been completed, Prof. Ram welcomed people to participate/contribute to this work.

4th study

- Data envelopment analysis (DEA)
- This study focuses on the possibilities of using the analytics methodology DEA, a mathematical method based on an application of linear programming.
- Traditionally, DEA has been used for comparing/assessing the performances of colleges, schools, banks, firms, etc.

- Companies/organisations produce many items (similar items as those companies of the same sector), and they consume many resources. Assessing the level of resource consumption and outputs produced, it can be evaluated which one of them is more efficient in their production. In other words, it is a performance measurement technique.
- The goal of this study is to determine the scope for applying DEA in REAMIT, especially for reducing food waste. The greatest opportunity for the REAMIT team is linking DEA with life-cycle assessment (LCA). The reason is that LCA produces a set of relevant data that can be used to benchmark a set of products, once the data of LCA has been collected, DEA can then be used to identify outputs and compare performances - DEA is used to rank agribusinesses/farms.
- Large scope for more DEA studies.
- To date, no DEA studies applied to food waste.
- As an example, prof. Ram showed previous work that he carried out which involved LCA calculations to determine carbon footprint for producing various fruits and vegetables. Once LCA calculations have been performed, then DEA can be used to rank agribusinesses/farms in the scope of food waste reduction, emission reduction, and so on.

Q&A
UR: Two of my students and I are working on sustainable impact assessment and LCA. If any assistance is needed, the NTU team is happy to assist.
RR: Expecting NTU to lead in the case studies.
UR: Another point is not to forget to mention that people writing case studies will be credited for the work.
RR: Any updates on the paper sensor technology for maximising quality and minimising waste?
JG: No updates on the publication. The paper was resubmitted to another journal, the Irish sensors journal.

21.32.02

Presentation by Ali Assaf – Raman spectroscopy, pilot with Routhiau (France)

- The main points the presentation will cover are:
    - Research work carried out on chicken samples, available data
    - Integration in a transportable cooling enclosure
- Raman spectroscopy works with a spectrometer and a laser source. This light source is focused onto the sample; Raman is based on the interaction between light and matter. A fraction of the light is then captured by the spectrometer and Raman spectra are obtained. These spectra contain molecular information about the chemical composition of the samples.
- Need to perform statistical analysis to explore the data and present results in an easier, understandable way.
- Experiments comprised 30 trays of chicken. 1 tray was measured per day, measuring three different pieces of chicken with Raman. To have a representative measurement, various points on the chicken sample surface were analysed (approx. 50 spectra per chicken piece).
- Experiments were carried out for 30 days. Temperature chicken was stored at was not constant throughout the study: from D0 to D8, 4 °C; from D8 to D30, 8 °C. The reason was to match the life cycle of chicken being transported, stored, etc. Also, at day 20, chicken was kept at 20 degrees for 2 hours to simulate a disruption of the cold chain.
- Alongside Raman, microbiological (total flora and lactic bacteria) and physicochemical (temperature and pH) analyses were performed.

- Each day, a Raman spectrum was obtained (an average of the 50 measurements).
- Since it is difficult to visually identify the differences between spectra, statistical analysis was performed to quantify this difference and predict the quality of samples.
- Principal component analysis (PCA) was performed to explore the data. Results showed some different groups, or different aggregation of days. Analysing the loadings of PCA, it was observed that protein and lipid bands were responsible for the variation in the spectra.
- Models for chicken quality were developed. A model that could give a number to the quality, or similarity/correlation to the chicken sample of reference (D0). Three categories were established: very good, good and "to check".
- Results showed that until day 25, quality was very good (equal or above 95% correlation). A decrease of correlation was observed for days 26 to 29. Day 30 fell under the category of must be checked and may not be good for consumption.
- Raman results were compared to those of microbiological and physicochemical traditional methods that were also performed. Results were in line with those of Raman. E.g.: from day 20 a large number of bacteria was observed.
- Overview, status of the pilot:
    - Step 1: Lab development. Task completed.
    - Step 2: Transition between lab and truck. Ongoing.
    - Step 3: Test in real conditions. To be started.
- Challenge: to adapt/simplify the analyses so that they can be carried out by unqualified users.
- Work was carried out to determine how to analyse chicken samples that are packages with plastic film and to account for the optical signal of plastic.
- Work was carried out to establish the best areas within the chicken samples to get analysis from, getting a score that determines if the signal was correct or poor.

Q & A
KP: What are you going to discuss in the meeting that you are going to have with Routhiau tomorrow, step 1 or step 2?
AA: In the meeting, the following will be discussed:

1. Validate the performance of the spectrometer.
2. Implementation of step 3, the integration of the spectrometer in real conditions (step 2 will be skipped for the time being).

21.32.03

Research work at Ulster University – James Gillespie

- UU worked on a paper, which was written last year, but got rejected by the journal. Since then, it has been resubmitted for publication to another journal.
- For further research studies, UU will wait until more results are obtained.

13:45 - 14:15: WP Project Management (Chair BED)

21.33

This section was skipped because Kate had already covered it in previous presentations.

14:15 - 14:45 WP Long Term (Chair BED)

Case studies with Yumchop and Human Milk Foundation – presentation by Xavier Cama, Tamíris Da Costa and Gautam Samriya.

21.34

- Activities in progress: initial meeting with BED and NTU; meetings amongst the three staff members working on the case studies; organisation of the work.
- Work carried out to date was organised into the different sections:
- Introduction
    - Problem with food waste
    - Gap in the present state of the art
    - Goals
- Company background
    - Financial
    - Organisational
    - Marketing
    - Technology
- History and product portfolio of the company
- Solution
    - Explain the new technology/idea being proposed
- To date, work has been conducted obtaining information that is available on the internet. Future work may include obtaining information directly from the company or project partners that, due to contact with them, have relevant information.
- An overview of the first section was presented introducing the companies/organisation Yumchop and HMF, but also the problem with food waste (economical, environmental, social costs) and the solution with digital tools – where REAMIT comes in.
- Future activities will include developing further the cases studies, their planning, objectives, section organisation, but also, collecting data from the company as well as results relevant to the pilot test is expected to take place in the near future.

Q&A
RR suggested having a common structure for all the case studies, although he acknowledged, different case studies may have different structures as per the case study needs.
RR suggested XC and team prepare questionnaires for the pilot test companies as a future activity, to collect data from them.
RR advised the team preparing case studies to be ready to expand the case study activity for other pilot test companies (WD Meats, Picnic), although for now the work should be focused on HMF and Yumchop.
KP suggested considering the policy impact in preparing the case studies by including another bullet in the company background section that addresses the legal framework/requirements.
RR highlighted that policy considerations can be different for a company view as compared to the government view.
UR and the team preparing the case studies to meet the following week to discuss the progress and next steps.

Action: Case study team to develop a common structure for collecting information for all the case studies, although it may be necessary to have different structures as per the case study needs. Case study team to also develop a questionnaire for the pilot test companies, to collect data from them.

Action log resulting from RAC/WP/RSC meeting, 7-8 July 2021

Date	Minute/ Item	Action *identified*	Responsibility	Update: *Confirmation of completion or reasons for non-completion*
21/07/07	21.16.01	As REAMIT is still recruiting companies, all partners have been encouraged to keep approaching companies for pilot tests.	Al PPs	completed
21/07/07	21.17.01	Each pilot test lead to develop a user manual for each pilot test. A user manual for each pilot test shall document the experience of the pilot test and a step-by-step guide of good practice in each pilot test.	Each pilot test lead	Link with WP T1 meeting. A template will be circulated by RR. Ongoing.
21/07/07	21.17.01	Each pilot test lead to write a report on the pilot test and development of the sensor prototype. The report will describe in detail the experiences with the pilot test and give recommendations for future pilot tests.	Each pilot test lead	Ongoing. RR will send templates for Yumchop and HMF.
21/07/07	21.17.02	UCD to report the results of the first stage (prove the concept carried out in July-August 2021) of the pilot test in Ireland inspired by Freshbox.	UCD	Discussed on 19/1/2022. Ongoing.
21/07/07	21.17.02	UCD to approach min 10 companies in agri-food supply chains in Ireland to demonstrate the tests inspired by Freshbox idea, to encourage their participation in REAMIT pilot tests. To do this, UCD may ask for help Innovation & Enterprise service at UCD, Interreg NWE Programme Contact Point person for Ireland or Enterprise Ireland (or equivalent services).	UCD	22 companies approached. More are being contacted for a pilot test. Completed.
21/07/07	21.17.03	UoN to move the Raman spectroscopy pilot test to the next phase – transition from the lab experiment to the real conditions in the food trucks (Scheduled on 9th of July 2021). This includes renting a truck.	UoN	Ongoing. Last stage of transition. Will be completed in 2 months. Routhiu's truck will be used.
21/07/07	21.17.03	UoN to confirm whether IGRECA and Prince de Bretagne will participate in the pilot test with Raman Spectroscopy.	UoN	Not participating.

21/07/07	21.17.04	Whysor to assist online with installation of sensors at HMF.	Whysor	Complete
21/07/07	21.17.04	BED to obtain from HMF images and videos documenting installation of sensors at HMF, for the purpose of developing Reamit communication materials.	BED	Completed. Videos have been requested.
21/07/07	21.17.05	Whysor to confirm whether sensors installed in Picnic's trucks will be re-programmed to also collect correct data on shock detection.	Whysor	Ongoing
21/07/07	21.17.06	Ulster to obtain from Marc at WD Meats information about weight of carcass before entering dry aging chamber and when leaving dry aging chamber.	Ulster	Completed.
21/07/07	21.17.06	Ulster to specify what lessons have been learnt from the first pilot test with dry aging chamber, discuss it with WD Meats and based on it propose how the second pilot test in dry aging chamber will be run.	Ulster	Completed.
21/07/07	21.17.06	Ulster to run a second pilot test in dry aging chamber (for another 3 weeks).	Ulster	Completed.
21/07/07	21.17.07	Ulster to purchase DNA extraction kit required to process the frozen swabs from WD Meats.	Ulster	Completed.
21/07/07	21.17.07	Ulster to get an update internally when a new machine will be purchased and when swabs from WD Meats can be analysed.	Ulster	Completed.
21/07/07	21.17.07	Ulster to analyse swabs from WD Meats.	Ulster	Ongoing.
21/07/07	21.17.08	Since James and Xavier expressed interest in working closely on developing this pilot test, they are requested to develop a plan of actions to take this pilot test forward. Ulster and UCD to develop a plan of actions to take 3D Fluorescence pilot test forward.	Ulster and UCD	Ongoing.

21/07/07	21.17.09	Ulster to work with Whysor to specify which sensors to be installed in Musgrave vans.	Ulster and Whysor	Completed.
21/07/07	21.17.09	Ulster to install sensors within Musgrave vans.	Ulster	Ongoing. – Next week.
21/07/07	21.17.09	Ulster to develop an android app required to handle data from the sensors in Musgrave pilot test. Application will need to be tested prior to deployment.	Ulster	Completed.
21/07/07	21.17.10	BED and Whysor to support Yumchop online with installation of sensors and connection to the cloud.	BED and Whysor	Completed
21/07/07	21.17.13	I&R and MTU to approach contact point person for France and Ireland to recruit new companies for pilot tests.	I&R, MTU	Ongoing for France. Completed for Ireland.
21/07/07	21.18	Whysor to go on a virtual tour of Glen Affric and propose what sensors shall be used in this pilot test.	Whysor	Completed.
21/07/07	21.18	Ulster to identify the right person at Dale Farm to discuss Dale Farm participation in the REAMIT pilot test focused on reducing food waste in the cheese production process.	Ulster	Ongoing.
21/07/07	21.21	Whysor to hold a meeting on dashboard and data in Whysor cloud.	Whysor	Completed.
21/07/07	21.24	BED to organize a technical meeting of technical partners regarding license for Big Data Hub at BED, connections to the Big Data server, etc.	BED	Ongoing
21/07/07	21.25	UCD to organize in September an online planning meeting with BED and NTU on the 3rd REAMIT Symposium in Ireland.	UCD	Completed.
21/07/08	21.27	Each partner to develop at least one piece of news about REAMIT to be communicated in social media. This can be converted as local news in local languages.	Each PP	Completed.

21/07/08	21.27	NTU to have one-to-one interactions with PPs to assist with creating small social media local news.	NTU	Completed.
21/07/08	21.27	NTU to finalize a storyboard, which is a collection of different stories from around the globe on actions to avoid food wastage through technology, all through social means like charities.	NTU	Completed.
21/07/08	21.27	NTU to develop a new, stand-alone REAMIT web page and send it to PPs for feedback.	NTU	Completed.
21/07/08	21.27	PPs to identify the local and national policy-makers and stakeholders within the North West Europe region to whom they will disseminate information about REAMIT approach.	PPs	NTU, Whysor, BED have contacted. Ongoing. A dedicated workshop with policy makers. Or, target the next symposium on policy makers.
21/07/08	21.28	BED to finalize the paperwork related to the approval of REAMIT project 12-months extension budget.	BED	Completed.
21/07/08	21.29.01	Ulster to get feedback from associated partners on 5th REAMIT progress report and share it with BED.	Ulster	Ongoing.
21/07/08	21.29.02	NTU to develop communication materials about REAMIT in German language with Whysor's help regarding translation.	NTU	Ongoing.
21/07/08	21.29.02	Whysor to liaise with GIQS (national contact point for Germany) about new companies in Germany for REAMIT pilot tests.	Whysor	Completed.
21/07/08	21.29.02	NTU to develop communication materials in French language i.e. one short video about pilot tests in the REAMIT project will be in French, with support from I&R, Valorial and UoN.	NTU	Completed. Video will be ongoing.
21/07/08	21.29.02	UCD and MTU keep making efforts to recruit new companies in Ireland.	UCD and MTU	Ongoing.

21/07/08	21.29.02	I&R to ask Prince de Bretagne if they are keen to connect their sensors to the REAMIT cloud and obtain from the REAMIT consortium an alerting system for this data.	I&R	Completed.
21/07/08	21.29.02	BED to support Whysor with sending sensors to Yumchop and HMF in the UK.	BED	Completed
21/07/08	21.29.02	Whysor to provide online support for fitting sensors at Yumchop and HMF.	Whysor	Completed
21/07/08	21.29.02	Levstone to support Yumchop and HMF physically with fitting the sensors.	Levstone	Not needed.
21/07/08	21.29.03	Ulster to decide about the format of the RAC/WP/RSC meeting in January 2022 and communicate it to PPs.	Ulster	Completed.
21/07/08	21.30	Partners involved in case study development, to collect information from pilot test companies on their technical and business activities.	UCD, Ulster, MTU, BED	Ongoing. NTU will also be involved.
21/07/08	21.31	UCD to define the data requirements for the LCA for each REAMIT pilot.	UCD	Ongoing.
21/07/08	21.31	UCD to hold individual meetings with each pilot leader, since the LCA must be adapted for each type of case.	UCD	Ongoing.
21/07/08	21.31	UCD to start collecting data from the companies and pilot tests after data compilation in WP T1 and WP T2.	UCD	Ongoing.
21/07/08	21.34	Case study team to develop a common structure for collecting information for all the case studies, although it may be necessary to have different structures as per the case study needs. Case study team to also develop a questionnaire for the pilot test companies, to collect data from them.	Case study team: UCD. Ulster, MTU, NTU, BED.	The case study on Yumchop is likely to be completed first and can form a reference point.

Approved

Final minutes from REAMIT Advisory Committee, Work Packages and Steering Committee meetings, 19-20 January 2022 (Teams online meeting room hosted by UU)

Attendees present:

Name	Institution	Name	Institution
Ram Ramanathan (RR)	Essex	Jean-Charles Vialatte (JV)	SenX
Katarzyna Pelc (KP)	BED	Fionnuala Murphy (FM)	UCD
Joy Eze (JE)	BED	Shane Ward (SW)	UCD
Tahmina Ajmal (TA)	BED	Tamiris Da Costa (TC)	UCD
Yanqing Duan (YD)	BED	Xavier Cama (XC)	UCD
Sahar Ahmadzadeh (SA)	BED		
Gillian Weaver (GW)	HMF	Ali Assaf (AA)	UoN
Natalie Shenker (NS)	HMF	Gerald Thouand (GT)	UoN
Gael Maugis (GM)	I&R	Pratheepan Yogarajah (PY)	UU
Gladys Gallott (GG)	I&R	James Gillespie (JG)	UU
Davinder Bola (DB)	Levstone	Bryan Gardiner (BG)	UU
Alexander Kalis (AK)	Milltrust	Joan Condell (JC)	UU
Gerard Corkery (GC)	MTU	James Dooley (JD)	UU
Gautam Samriya (GS)	MTU	Daniel Kelly (DK)	UU
Usha Ramanathan (UR)	NTU	Trevor Cadden (TC)	UU
Sasha Bennett (SB)	NTU	Adrienne Gentil (AG)	Valorial
Peter Campobasso (PC)	NWE	Imke Hermens (IH)	Whysor
Frank Gorte (FG)	Picnic	Tom Verstraten (TV)	Whysor

Apologies:

Day 1. Wednesday 19th January 2022 – Morning Session

09:00 - 09:05: Welcome to REAMIT meetings (Chair BED)

22.01
JC welcomed everyone to the 6th REAMIT consortium meeting on behalf of hosts, Ulster. RR thanked all partners for their contribution to the project over the last period, noting that they had each had a significant role in progressing the project thus far. RR introduced the first speaker, Peter Campobasso.

22.02
09:05-09:30 'Food waste policy in the EU' and 'Interreg North West Europe Programme and 2021-2027 outlook', Peter Campobasso, REAMIT Project Officer, Interreg North West Europe Programme Joint Secretariat.

The Trek towards a Sustainable European Food System

Interreg North West Europe Programme 2014-2020 is focusing on accelerating the transition to an innovative, low-carbon, and circular economy. The Programme's priorities cover the subject of circular economies, preventing and reusing waste and using resources more efficiently. REAMIT fits between two different priorities; P1 innovation and P3 resource efficiency. When we go into the next programming period 2021-2027, there is still going to be P3 resource efficiency, agri-food, etc.

Why are we talking about food waste? EU Commission has made it a priority. It was first mentioned in 2010; in 2011 the EU aimed to halve food waste by 2020. In 2014 it was framed within the context of circular economy. In 2016 EU platform for food losses and food waste was launched; 2017 resolution on food waste by the EU parliament; 2020 EU Farm to Fork Strategy unveiled.

What is the EU's role in reducing food waste? The policy is still quite scattered; there is Farm to Fork Strategy, but there is also the circular economy action plan which attacks food waste differently. Farm to Fork Strategy is just a communication at this stage. We will see policy and legislation come in 2023 where we will see legislative framework for a sustainable food system and mandatory targets for food waste reduction will be set across member states. There are no details on this framework at this time but it is going to be very consultative so I'm hoping members from the REAMIT project will be able to inform here.

Axes for further research and participation:

- Increasing food system efficiency
- Using AI to reduce food losses and waste, for example to better forecast demand
- New product development for products derived from co-products
- Data sharing to improve supply chain collaboration
- Marketing standards, especially for food best-by dates
- Behavioural changes through nudges
- Impacts of COVID-19 on the EU food system
- Contributions to the design of the legislative framework for a sustainable food system.

Future Interreg North West Europe Programme 2021-2027

We are still in the current programme 2014-2020; 102 financed projects; €376M EDRF allocated. Current programme covers the three themes of innovation, low carbon, and resource efficiency. Really interesting to see REAMIT cover two of these three.

The new 2021-2027 programme will focus on "promoting a green, smart, and just transition for all NWE territories with the aim to support a balanced development and make all regions more resilient". We will see a little more focus on the green objective than we have in the past.

Major changes: UK is unfortunately leaving the programme; at this stage there are no third country arrangement for UK partners to participate in Interreg (unlike Switzerland, as the Swiss government gave match funding for Swiss partners). Maybe this could change (e.g. UK are co-operating with H2020) but nothing for Interreg at the minute. There are also new regions added from Germany and Netherlands: Bremen, Leine-Weser, Weser-Enms; Groningen, Friesland, Drenthe.

We are planning on launching the first call for the '2021-'2027 programme in spring 2022. Themes are:
1) Smart climate resilience for NWE;
2) Smart and just energy transition;
3) Transition towards a place-based circular economy.

Each of the themes is addressing climate related subjects.

Where we see a little more of a change to the themes are Priority 4 and 5

4) Fostering innovation capacity in NWE regions – innovation to increase territorial resilience;
5) Transition to a socially inclusive sustainable and resilient society – increase to the labour market, ensuring equal access to healthcare, enhancing the role of culture and sustainable tourism.

Total budget is € 310 million euro.

Some NWE project having greatest impact are: HeatNet, eMEN, and ACE-Retrofitting, each which have influenced various policies over their project period.

Some NWE projects have generated outside funding; these projects have had it as an output indicator which REAMIT didn't have. CAN €15M, FORESEA €74M, HeatNet €43M. PC said he was keen to discuss this more in detail if we thought it would be appropriate for REAMIT project.

RR: We could invite policy makers to look at our pilot tests and how we are trying to support food supply chains to reduce their waste using technology which should in the long run be translated to some policy suggestions on potential legislation on using continuous monitoring to reduce waste.

KP: You mentioned EU platform for food loss which offers funding for food projects. I'm not aware of this platform?
PC: There is a very specific platform to consolidate a lot of the research that was happening, I will send a link. It combines some of the work happening on Horizon and showcases it.

KP: Regarding programme spending, do you think your current programme 2014-2020 are going to spend all their ERDF funding.
PC: We are not entirely sure at this stage as we have a lot of projects which haven't closed yet. I know you wanted an update on the REAMIT extension status. There are a lot of programmes which have also requested an extension, so we are going to group them all together and send them to the monitoring committee and hope to have an answer by the end of February 2022.

KP: Switzerland funding news gives me hope that the UK could still join the Programme in 2021-2027.
PC: It all depends on the UK government.

KP: I would be interested to follow up on the investment WP after this meeting. I also found the idea of involving policy makers in pilot tests interesting.

09.30 – 10.00 REAMIT Advisory Committee (RAC) meeting (Chair BED)

22.03
REAMIT project progress in the period: 01/07/2021 – 31/12/2021, including extension and capitalization proposal (presentation by KP, BED)

RR asked if any feedback has been received from the Associate Partners on the project reports. KP said she has sent the report to the UoB associated partners but has not received any feedback. AA said he has not sent the progress report to UoN partners yet, but he will. The Advisory Committee partners were not available for the meeting.

KP mentioned that all partners but one have submitted their progress reports to LP. KP urged the late partner to submit their report ASAP.

WP T1: Adapting and pilot testing sensor technologies in agri-food supply chains.

Deliverables:

- Deliverable T1.1.2. Recruiting of five companies from across agri-business supply chains to participate in REAMIT.
- Ten companies have been recruited and progress has been made: Picnic - NL, WD Meats (2 pilot tests) - UK, Routhiau - France, Yumchop – UK, Human Milk Foundation – UK, Musgrave – UK, Glen Affric – UK, BIOGROS – LU, Van de Huijgevoort Groep – NL
- RR adds that we promised five pilots, but given the uncertainties of COVID we need to continue to approach other companies at least until June 2022 in order to ensure we can complete full pilot tests with 5 of them. We shouldn't take these numbers as exceeding the target until 5 full pilots have been completed.
- PC asked what the risk is of not reaching 5 fully competed pilots without approaching more companies. RR said that each companies agenda may change as technology implementation is not their priority – anything can happen at any time due to COVID.
- New companies recruited for pilots: Blue Skies, UK
- Pilot tests in the pipeline: a box with sensors (UCD) pending company recruitment – IE, 3DF pending suitable application (UU)

Action: As REAMIT is still recruiting companies, all partners have been encouraged to keep approaching companies for pilot tests.

- Deliverable T1.1.3: Working prototypes using sensor technology:
    - Temperature and humidity sensors (Picnic, WD Meats, Yumchop, HMF, Musgrave, Biogros, VHG)
    - Raman spectroscopy (Rothiau, IGRECA)
    - 3D fluorescence (WD Meats, VHG)
    - A box with sensors (being developed by UCD and MTU)
    - Bluetooth IoT sensor (being developed by Levstone)

WP T2: Big Data integration and applications to reduce food waste.

Main progress in the last 6 months:

- Deliverable DT2.4.1. Creation and launch of interface: REAMIT dashboard has been improved with new functionalities and widgets added (Whysor); Whysor and SenX working on integrating "WARP-10" into the dashboard.
- Deliverable DT2.5.1. Big data platform that can store and collect all pilot data: a server was set up at BED. Troubleshooting performed by BED with help from MTU and Levstone. Connections between the data server and REAMIT partners were reset. Whysor are pushing new data once a week from REAMIT Whysor cloud to the Big Data Server at BED. Data analysis has started on the Picnic, Yumchop and HMF datasets by partners BED, MTU, SenX, Ulster, UCD and Levstone.
- Deliverable DT2.5.3. No updates from Levstone on this.
- Deliverable DT2.7.1. No updates from Levstone on this.
- Deliverable DT2.7.2. No updates from Levstone on this.

WP T3. Business development of REAMIT technologies.

Main progress in the last 6 months:

- Deliverable T3.1.2. Life Cycle Assessment (LCA): UCD have developed a generic questionnaire for LCA and have adapted it for Yumchop and HMF. UCD have had 2 meetings with these companies to collect details for LCA and more meetings are scheduled over the next weeks.

WP Communication

Main progress in the last 6 months:

- Deliverable C2.1. Website launch: A stand-alone website has been developed and launched by NTU and is operating in parallel with the original website.
- Deliverable C3.1. Project banners, posters and flyers: UCD developed a new REAMIT flyer, 3 REAMIT newsletters (July, October, December), and Case studies at HMF and Yumchop.

WP Management

- A number of new staff has been recruited in REAMIT:
    - Dr Sahar Ahmadzadeh has joined the team at BED as a Research Fellow and is responsible for the implementation of WPT2, supporting research, data analytics, and project management.
    - Dr James Gillespie has joined the team at Ulster in July 2021 and leads all REAMIT activates at Ulster.
    - Gladys Gallot leads work on REAMIT at I&R.
    - Jean-Charles Vialatte leads work on REAMIT at SenX.
    - Ram Ramanathan, PI of the REAMIT project has moved from BED to the University of Essex as of 1st November 2021. He remains PI on the REAMIT project and we are currently making arrangements with the Joint Secretariat to involve University of Essex as a sub-partner of BED.
- Deliverable DM 1.1. Project Handbook – All information about reports, minutes of meetings and presentations are included in the Project Handbook. The project handbook is stored in SharePoint and partners are welcome to review it.
- Deliverable DM 1.2. Minutes of meetings of RAC/WP/RSC – The minutes of the REAMIT meeting in July have been developed and shared with partners and will be discussed and approved on January 20th 2022.
- Deliverable DM 1.3. Intermediate Work Package coordination – A list of all the different meetings that took place in the last semester are, as follow:
    - RAC/WP/RSC on 07-08/7/2021
    - 5 monthly meetings of WPT1 (I&R)
    - 5 monthly meetings of WPT2 (BED)
    - 2 meetings of WPT3 (UU)
    - 10 bi-weekly meetings of REAMIT sub-group (BED, NTU, UU, UCD, MTU)
    - 2 monthly meetings of REAMIT team at BED and UEssex
- Deliverable DM 2.1. REAMIT Risk Log – New risks were identified in the REAMIT project and updated based on the inputs from the partners:
    - Delay in the supply of sensors provided by suppliers: Whysor confirmed that some of Whysor's equipment suppliers do not have much equipment in stock and these

companies have warned Whysor about delays (caused by COVID-19) in getting equipment in stock again.
    - Reluctance of pilot test companies (Yumchop, HMF) to provide detailed information for Life Cycle Assessment
- Deliverable DM 3.1. Project progress report - 5th REAMIT progress and finance report submitted to JS in September 2021. Last week (w/c 10th January 2022) Kate was informed by Finance that payments should have been made to partners by end of the week.
- Special REAMIT progress report and claim 3.3 was prepared by Kate to include claims from Whysor, NTU and UCD as they were not included in the original claim. This claim is now with the BED auditor.

Other project management activities which have been ongoing:

- Ram Ramanathan moved to the University of Essex
- Including UEssex as a sub-partner of BEDS
- Recalculation and re-submission of REAMIT 12-month and budget extension to the JS.

WP Long Term

- Deliverable DLT. 1.1. Network prospectus – The project is still engaging with new potential pilot partners.
    - BED: Blue Skies, Trace + Trust network
    - I&R, Valorial, and UoN are approaching companies
    - UCD and MTU have been active in approaching companies
- Deliverable DLT. 1.2. Networking events - 3rd REAMIT Symposium was hosted online by UCD 8-9/12/21

Challenges encountered by the consortium in the past period (1 July 2021 – 31 December 202) with the implementation of the REAMIT project:

COVID-19 pandemic and lockdown (2nd lockdown from Dec-2020 until May 2021) caused delays in the implementation of all WPs for at least 18 months.

- WP T1:
    - Lack of sensors on the market thus further delays in pilot tests

- WP T2:
    - Few data generated for analytics so far as a result in the delay of WPT1

- WP T3:
    - Reluctance of companies to provide data for LCA

- WP Management:
    - All meetings of REAMIT partnership took place online.
    - Not possible to travel to the sites of pilot tests in the NL, DE, UK – possibilities to travel and capture videos at pilot test companies is therefore very limited.

GT: We have a contact and worked with IGRECA – we have performed many experiments on eggs using RAMAN spectroscopy but the company did not follow the project. Prince de Bretagne (vegetable

company) also do not have time to continue – it's always the same problem when we are approaching companies. It is not a money issue, it's that they have no time to continue / the companies have no people / workers to collaborate with us. They are still interested in the project and suggest that it can be picked up in the future.

IH: We are starting a pilot with a Germany company Landgard.

UR: NTU office is requesting extension details. UR has requested that KP send a formal letter to the NTU team to allow them to plan for next year's budget.
RR said that the reason extension details have not been released yet is because he doesn't know. Peter will be submitting the extension request with a group of other projects by the end of the month. We should hear from the monitoring committee in 2 weeks' time.
PC said that there is always a risk that the monitoring committee do not approve the budget extension although he is very hopeful that it gets approved as there is a very strong justification for it, but we just need to wait for the official decision.
RR said he will send a formal email to UR so that she can pass it on to finance at NTU to allow for financial planning for the next year.

RR reminded all partners to talk to associated partners to get their opinion and feedback on our progress so far. We need an independent assessment of our work and the trajectory we're taking so far. Please send any feedback from AC to KP as soon as you can.

Meetings of Work Packages

22.04
10.00 – 13.15: WP T1: Adapting and pilot testing sensor technologies in agri-food supply chains.

22.04.01
1) Deliverables as per the REAMIT Application Form – presentation by Gladys Gallot, I&R – TBC

Deliverables submitted:
D.1.1 – Publication of open call (Mar 2019).
D.2.1 – Partner workshop on sensor and big data (Jun 2019).
D.2.2 – Test roadmap (Sept 2019).
D.1.2 – Minimum 5 companies recruited from agri-business supply chain for pilot tests (July 2020).

Deliverables to be submitted:
D.3.1 – Working prototypes using sensor technologies (Jun 2022)
D.3.2 – User manual for each pilot test (Jun 2022)
D.3.3 – Report on the pilot test and development of the sensor prototypes (Jun 2022)

22.04.02
2) COVID-19 Pilot impact assessment – presentation by Gladys Gallot, I&R
- Due to COVID 19, the project's activities have been impacted to some extent, and the partners have been trying to adapt their work.
- The number of cases has been rising since mid-November 2021 due to the Omicron-variant of the virus; countries are again putting in place some restrictions. In almost every country of the project, remote work is recommended.

- France: no lockdown, but remote work encouraged 3 days per week to the minimum.
- The Netherlands: Hard lockdown from 20/12/2021 until 15/01/2022, schools and stores have reopened, but remote work is encouraged when possible.
- Ireland: new restrictions since mid-November 2021 (pubs and restaurants must close at 8 pm, no indoor events after 8 pm, work from home is highly recommended.
- UK: work from home recommended since 13th December 2021.

After a respite during the summer, there are again some restrictions impacting the project's activities, although to a somewhat lesser extent after almost 2 years of pandemic crisis.

- UR suggested including missed opportunities because of COVID in the impact assessment. For example, Tesco agreed in 2019 to participate in the project before Covid and attended 3 meetings; however, after COVID, they declined to participate, and it is not possible to reconnect with the company because the contact point moved to another job. The same happened with a chocolate company.

3) Presentation of pilot tests by pilot test leads and pilot test partner companies:

22.04.03

1. Pilot Test with Raman Spectroscopy (with Routhiau, IGRECA, ADRO) in France, Ali Assaf, UoN.

- The aim of the pilot: Monitoring the quality of food during storage/transportation by Raman sensor. The companies involved are Routhiau (chicken samples), IGRECA (egg products) and Prince de Bretagne, but vegetables and fruits from local markets have also been tested.
- The pilot started in March 2020, and the data have been submitted to the cloud in collaboration with BED, Whysor, Levstone and Senx.
- The pilot presents the following steps: (1) technical development and optimisation of the Raman setup, (2) development of statistical models and the algorithm to explore Raman data, (3) test the technology in the real condition and (4) integrate all the setups in real condition (real food track or directly in a company).
- Prince de Bretagne pilot: the company is not able to pursue the project.
- Routhiau pilot: Routhiau is a company located in France with more than 400 employees and many kinds of fresh and frozen products, such as chicken, beef and desserts. The investigation started with the chicken products because it is essential to Routhiau to increase their productivity. A protocol to control the quality of the chicken was presented, and the sample is analysed daily for 30 days by Raman spectroscopy in 50 different areas. They also do additional analysis to control the microbiological quality and validate the Raman Protocol, as the enumeration of bacteria, temperature, and pH.

The results of the pilot test were shared with the company regarding the quality of chicken. According to AA, the main advantage of this method is to reduce the analysis time and avoid the use of culture media to control the presence of bacteria.

The next step is to directly prepare a sensor in real conditions in the industry. However, some challenges were identified to transpose this technology to the industry field, for example, the packaging used to protect the chicken during transportation, which can be problematic for the sensors. An automatic statistical script was developed to facilitate the analytics procedure to select the best area to analyse the chicken samples. In the beginning, the selection of the areas was made manually, which took much time. However, now they are integrating a monitored platform to reduce the time and analyse many samples. The setup Raman was also integrated into the monitored platform in a real cold room to simulate the same conditions as a real truck. The development of both systems is ongoing. The aim is to start the test of the real condition between May and June 2022.

- IGRECA pilot: it is a French company specialised in all egg products. Many samples of egg powder were tested, with different compositions, to develop a sensor able to detect the quality and the chemical composition of the samples without any extraction directly on the packaging. An analysis report was written and sent to IGRECA six months ago. The pilot leader is waiting for their confirmation, but no feedback has been received from them so far.

Plan for the pilot test (2022): At this moment, the automation and integration in the cold room are being finalised. In the next few months, the aim is to test the system in real condition (truck for a short distance or rent a refrigerated truck). Continue exploring the ability of Raman spectroscopy on fruits and vegetables from markets.

RR suggested highlighting the benefits of Raman spectroscopy analysis to the companies, as this is a non-destructive technique in which it is not necessary to open the food package to perform the tests. In addition, it is possible to obtain immediate results about the quality of the food.

AA mentioned that this is an innovative technology, and sometimes the food industry prefers to use their traditional technology and need more time to change their process with this sensor.

GT highlighted some difficulties in getting this technology more commercialised. He believes it is necessary to propose more extensive examples to the companies to prove that this technology is working. In addition, most of the companies approached mentioned that they do not have problems with food waste, which cannot be accurate, as food waste is a big problem in Europe.

RR suggested that all these difficulties in convincing people be documented.

Action: UoN to document all the experiences with the Raman pilot test, including experiences when approaching companies for pilot tests, in a story telling format to be used in future publications.

22.04.04

2. Pilot Test with Picnic in The NL, Imke Hermens, Whysor and Frank Gorte, Picnic.

This pilot test aims to obtain a personalised cooling profile per cooling box, analysing the external weather conditions combined with the temperature inside the cooling box during transportation. In addition, customers' complaints will be linked to how the box was handled, analysing the data regarding xyz/acceleration of the box (shock detection).

The pilot's architecture is based on sensor technology to measure temperature and shock detection insights inside the trucks. The information on ice packs used for cooling, customers' complaints, groceries inside the boxes, and the online weather data are sent to the big data server at BED and Picnic. The pilot started in July 2021 and Whysor installed 20 Elsys EMS sensors (temperature, humidity, and acceleration).

On 13th July 2021, Tom and Imke visited the Picnic company in Apeldoorn, The NL and installed 4 sensors there to define what is the best place to install the sensors and the best way to glue these sensors into the box because the boxes are made of Styrofoam, and it is not possible to use any glue inside. After defining these points, 20 sensors were installed and sent data. However, within a few weeks, all sensors stopped sending data. The sensor housing appeared to be not solid enough to withstand the force of heavy groceries. As a solution, flexible rings were 3D printed to protect the sensor's housing and 20 new sensors were purchased.

On 3rd December 2021, Whysor had a meeting with Frank Vollering, a data scientist from Picnic, and Thom Groothuis for data requirements and to discuss the cooling protocol and how many ice packs they use today.

Progress on Picnic Video with Sasha from NTU and Frank Gorte.
On December 24th 2021, 10 sensors were installed inside the boxes and data is coming in again. However, Imke noticed that two/three sensors are not sending any data now, which could mean either that they broke or are in a place where they do not have good connectivity. This subject will be investigated in the following weeks. The other 10 sensors will be installed if the flexible rings work.

The next steps include sending the data to partners to analyse, determining the cooling profile per coolbox, talking about the data requirements for the LCA analysis, improving the video for the communication strategy and talking about a non-disclosure agreement.

Remark on Picnic pilot test status by Imke when asked by Ram: the sensors broke down, and little amount of data had been received. In the next months, data analytics will be restarted as the sensors start sending info once again.

RR recommended documenting all these experiences with fixing sensors and start preparing a case study on Picnic, including all the descriptive information on how REAMIT adapted the technology to suit the company's needs and gain maximum benefit from them.

UR explained the difference between a reflective diary typically submitted for internal projects and a case study. The points learned, how it went through, and the next stage based on the previous experience reflect on what we are doing.

KP suggested that either the pilot test leader or the lead of the WPT1 develop this kind of storytelling report on each pilot test.

Action: Whysor to document all the experiences with the pilot test with Picnic in a story telling format to be used in future publications.

22.04.05
3. Pilot Test with Van de Huijgevoort Groep in The NL, Imke Hermens, Whysor and Luc van de Huijgevoort.

The Van de Huijgevoort is a group that contains supermarkets. Three of them are located in the South of Holland (near to the Belgian border, one hour), and they have two productions facilities (Walther's and Vers). At Walther's they produce meat and meat products for retail and business to business. At Vers they produce sauces and salads also for retail. Their yearly turnover is approximately around 45 million euros, and they have approximately 450 employees.

The pilot's goal is quality checks on bacteria, e.g. Listeria and Salmonella. Listeria is a quality parameter that the food industry must focus on according to legislation, which is very strict. Moreover, the second goal is the measurements of overpressure. The production facility creates an environment of overpressure, which keeps bacteria and insects out of the production room, but at this moment, there is no alarming system, which is something that REAMIT can help with. This pilot has not started yet, and they are still defining the architecture, and the fresh detects that can be used to determine pressure.

The progress highlights include a first meeting with Ard van de Huijgevoort on 1st June, 2021. On June 22nd a second meeting with Luc van de Huijgevoort and Ard. On 15th July 2021 an online meeting with NTU/BED/Whysor and Van de Huijgvoort group to get acquainted and talk about their use case. On 31st August 2021, a visit to the production facility. In October 2021, a Fresh Detect sensor was sent to Whysor by UU. On 17th December 2021, a meeting with Mathias (Fresh Detect) took place. On 12th January 2022, a meeting with the quality manager from VDHG regarding Listeria measurements, hygiene protocol and overpressure measurements. On January 18th 2022, a meeting with Luc van de Huijgevoort.

It was concluded that this sensor is not suitable for Listeria measurements because it can also detect other colonies. In addition, even if we were able to use Fresh Detect, the legislation does not consider it a valid measuring method.

The next steps include a discussion with the lead partner whether measurements of hygiene protocol are within the scope of the REAMIT project. Expected feedback from the quality manager regarding overpressure measurements. They are defining what sensors to purchase for measuring overpressure.

RR confirmed that overpressure measurements are within the scope of the REAMIT project.

Regarding Listeria bacteria, the manufacturer of the Fresh Detect told Whysor that this sensor could be calibrated for listeria bacteria. He also mentioned the time, money, and effort it would cost. It would be needed laboratory work, and it is necessary to find a laboratory that wants to work with this to create a new method to measure these bacteria, which could potentially create a competition regarding the patent of this new method.

According to GT, either Raman spectroscopy or 3D fluorescence sensors cannot directly indicate the name of the bacteria present in a sample. They can only observe the increasing number of bacteria. However, there can be no relation between the increased number of bacteria and the presence of a pathogen. In addition, determining the name of the bacteria takes a long time.

Action: Whysor to document all the experiences with the pilot test with VHG in a story telling format to be used in future publications.

22.04.06

4. Pilot test with BIOGROS in Luxembourg, Imke Hermens, Whysor and Christelle Nicolay, Biogros.

Biogros is an organic wholesaler for biodynamic and organic foods. They are situated in Luxembourg, have around 120 employees and work with fruits, vegetables, dry goods, and dairy products. It started as a biological farmer (BIOG) cooperative to bottle, package, and transport their products. It was founded in 1992 to guarantee an efficient distribution of BIOG products. It began to import organic food products to complete its local organic products. Their focus still lies in promoting their BIOG products. In addition, it also transports the farmer's products in Luxembourg to the processors (patching facility, packaging facility or the warehouse). The fruits and vegetables can also be packaged at the Biogros facility.

This pilot aims to gain insight into the climatic conditions (like temperature and humidity) in the complete supply chain regarding several fragile vegetables (mushrooms, onions, potatoes, celery root). They are grown in Luxembourg and transported by Biogros from the farmers to the warehouse and supermarkets. Another objective is to obtain information on the ripening of fruits and vegetables inside the warehouse.

The architecture's overview includes the temperature and humidity sensors placed inside the warehouse, the truck, and at the farmers. The pilot started in November 2021 and the sensor technology is a digital matter (Falcon and Eagle sensors).

They had a problem with the chip and needed to purchase other loggers. So, they started with the Falcon logger, and now they had purchased the Eagle logger, which does approximately the same, only has another size. The progress highlights include a visit to Biogros by Whysor on 4th May, 2021. On 8th November, a meeting with Biogros technician to define the use case. Between November and December 2021, Whysor analysed the connectivity in Luxembourg and specific usability with 2 sensor units placed at different locations. No connectivity problem was detected, and it is possible to start the real measurements.

15 Eagle loggers from Digital Matter have been purchased and arrived at Whysor. BED still needs to purchase 15 humidity and temperature sensors, and as soon as it arrives, Whysor will install the sensors and start collecting data. It is estimated that all sensors will be installed between February and March 2022. The next meeting with Biogros is on 1st February 2022.

Action: Whysor to document all the experiences with the pilot test with Biogros in a story telling format to be used in future publications.

22.04.07
5. Pilot test with Glen Affric in the UK, Usha Ramanathan and Sasha Bennett, NTU.

Glen Affric is a family-owned brewery company located in the UK (Liverpool), and they are interested in reducing their waste. The company started producing, canning and distributing beer and hard seltzer around the country in November 2016.

The pilot started in September 2021, and Imke visited and installed temperature sensors across the brewery Liverpool factory. Flow sensors will be installed in the future. Whysor's dashboard is currently collecting the data, and the company seems happy with the temperature fluctuation monitoring online because usually, they do it manually.

The pilot is essential for the brewery company because the production of Lager beer is made at low temperature, while the production of Ale is made at a higher temperature, so it is vital to maintain this standard from the production until its delivery. Currently, they have difficulty monitoring and optimising the production processing conditions of the beer in the brewing plant and fermentation plant. Malted barley grain is mixed with water during the fermentation process. The current monitoring of these processes is done manually and can be time-consuming. The wasted barley is currently given away as food for animals but can be used more effectively.

The goal is to minimise wastage during the brewing and maintain the highest quality in beer production, considering temperature and flow level factors. Potential parameters: oxygen levels, gravity levels and yeast content. Glen Affric would like to have a system to monitor and regulate the beer, where the sugar content, CO_2 content, temperature control etc. is all optimised.

The most critical point is between the water tank and mash tank. The water tank operates at 100 °C, but the temperature is the most critical point in the mash tank with grains (max 80 °C). The main problem is the insufficient accuracy of the current meters.

A virtual tour and one physical visit were completed, but more visits need to be made. A LORA-WAN Gateway device and one temperature sensor has been installed successfully at Glen Affric. Meeting held with JUMO, one of the leading manufacturers in industrial and automation technology, Whysor and NTU on 6th January 2022. They have offered a temperature sensor and a thermowell. They do not sell clamp-on flow sensors. NTU is awaiting confirmation from Glen Affric on the position of the temperature sensor, thermowell and flowmeter and once confirmed, NTU will begin purchasing the equipment.

NTU will lead the case study. Data analysis and modelling from REAMIT partners will produce a research journal article. NTU will produce one documentary with all UK pilot tests. It is estimated that in March 2022, the pilot test will be running.

Action: NTU to document all the experiences with the pilot test with Glen Affric in a story telling format to be used in future publications.

22.04.08

6. Pilot test with WD Meats (Dry ageing chamber) in the UK, Joan Condell and James Gillespie, Ulster University.

Dry ageing beef is a premium technique used for flavour development and tenderising the beef. It is the process of hanging beef carcasses or hindquarters in a refrigerated room uncovered and left to age for several weeks or even months at a controlled temperature, relative humidity, and airflow. It is costly because of high ageing shrinkage, trim loss, risk of contamination, and requirements of ageing conditions and space. Trim loss occurs when too much moisture is extracted from the beef, resulting in unusable "Dark facing" which need trimmed and disposed of prior to the sale of the meat. Therefore, dark facing and trim loss (waste) can be reduced through accurate tuning of environment parameters.

The goal is to find the ideal parameters that will result in the latest dark facings occurring while also ensuring the harmful bacteria do not grow on the meat. The abattoir would like to accurately monitor/record temperature and humidity data in 4 zones of the ageing chamber. These results can then be mapped to dark facings trim loss. Refrigeration parameters can accurately be tuned to minimise dark facings. Potential to identify restricted airflow zones in the chamber. Propose a new restructuring of hindquarters to reduce dark facings.

It was installed a multi-tech MTCDT LoRa gateway and 4 Ursalink UC11 temperature/humidity sensors, but more sensors can be purchased if it is of interest to WD Meats. The pilot started on 6th July 2021, collecting data for a 14-day run.

It was presented the location where the sensors were installed in the ageing chamber (40-foot refrigerated lorry) and some quick plots from the dashboard. The sensors were configured to record every 20 minutes. Differences between the data from the sensors installed in the front and the rear of the container were observed. The front of the container presents a temperature around -1 °C, while in the rear, the temperature is around 0.3-0.5 °C. The same trend was observed for humidity, which is slightly more humid at the front of the trailer.

The lessons learned from this pilot demonstrated that Velcro was not a suitable mounting solution due to the amount of moisture generated by the drying hindquarters. It was changed by cable ties. The quantity of meat was likely attenuating (affecting) the signal of the sensors rather than the material the ageing

chamber is constructed. In the next pilot, less meat will be loaded. The sensors will be repositioned from mounted on the wall to mounted on the rails. This should provide a better line of sight from the sensors to the gateway. One sensor was damaged beyond repair. For this reason, the sensors were restructured to have 2 at the front and 2 at the back. The sensor supplier, Concept13, was contacted, but the sensor has been discontinued.

The next steps for this pilot include testing the sensors in the 2/2 configuration and recording consistent readings over 7 days. The effect of the ageing process will be observed over the entire 21-day cycle by the end of February 2022. Marc suggested different structuring of carcass's/sensors after finding from the trial before rerunning the experiment to see effects (does airflow affect dark facings). Marc would like to discover the ideal dry ageing parameters that minimise dark facings while avoiding harmful bacteria formulation. The fluid dynamics will be analysed to observe a statistically significant difference between the front and the rear HQ weights due to the refrigeration unit located at the front of the lorry.

RR suggested documenting all the experiences with this pilot in a case study in a story about the difficulties and how the technology was adapted.

UR sent a file with the information required to complete the case study on WD Meats in December 2021 and would like to discuss it in February 2022.

Action: Ulster to document all experiences in the Dry Aging Chamber pilot test with WD Meats in a story telling format to be used in future publications.

22.04.09

7. Pilot Test with WD Meats (Clostridium Bacteria) in the UK, Joan Condell and James Gillespie, Ulster University.

Clostridium Bacteria is one of the most challenging problems for the industry, a multi-billion-dollar problem. This bacterium is anaerobic and psychrophile, which grows exceptionally slowly at low temperatures. It is successful in the abattoir area because it contaminates packaged meat and then grows over weeks to spoil the meat. Produces non-toxic gases, which spoil products early and can spread quickly.

The goal is to establish a well-recognised molecular test for this organism. Commercial and molecular tests are available for around £35 (PCR), which the company does. However, the time they detect it is too late, it is got into a batch and potentially will cause problems. So, the idea is to rapidly monitor this organism's presence in the environment because PCR is not a sensor.

Progress to date: qPCR machine broke down over the summer 2021, which delayed ordering the master mix clostridium kit. Mastermix kit ordered from Cole-Parmer (9/9) and arrived at Ulster on 27th October 2021.

JC has some collaborators in other universities in Ireland that promised to send some control materials, but when they managed the materials, they noted that some had expired or degraded. For this reason, JD bought the control materials from an established commercial supplier.

Ulster had a conversation with Sensipdx, who has some technology that could be applied for detecting Clostridium Bacteria. The equipment will be tested to check if the sensor is sensitive enough and

determine the minimum detection level. Sensipdx was initially approached for the capitalisation call, but it is essential to know how we can incentivise them to still collaborate with the project.

Action: Ulster to document all experiences in the Clostridium Bacteria pilot test with WD Meats in a story telling format to be used in future publications.

22.04.10
8. Pilot test with Musgrave in the UK, James Gillespie and Trevor Cadden, Ulster University.

Musgrave deliveries chilled food products to various small businesses, fast food restaurants, etc., within an approximately 15-mile radius from the warehouse using wholesalers' own logistics networks based in Belfast. They have a fleet of five refrigerated vans performing the deliveries.

At present, there is no way of knowing in the cab/office if the refrigeration units are correctly functioning. Breakdowns with the refrigeration units can cost the wholesaler full vans of spoiled food. The wholesaler would like an alerting system if an issue arose, available to both driver and head office, so that the van can be redirected back to base, thus minimising the risk of food spoilage.

Temperature and humidity will be monitored at regular intervals (5 mins max). Send an alert if the temperature is recorded twice higher than the threshold. Alerts should only be sent when the car is in transit/operation. The objective is that this solution is standalone, i.e. do not rely on mobile phone tethering etc. (pairing sensors when switching drivers was deemed a high-risk, costly overhead).

The solution should be completely automated, thus decoupled from potential driver logging/intervention, so the idea is a novel automated sensing algorithm incorporating accelerometer data. A cellular sensor was selected, containing its Simcard and connecting to the 4G network. The sensor logs temperature and humidity and uploads the data to the cloud.

Ulster worked with the device manufacturer to enable motion data logging from the sensor, and the logger is now reporting accelerometer data, and this data is being integrated into the REAMIT platform. One Eagle logger/sensor programming module arrived at UU on 10th December 2021, and the cellular recording is working fine in Belfast, with recordings being made every 5 minutes.

Next steps include Marco from Whysor working on the trip detection algorithm, using accelerometer and GPS data logged by the Eagle device to trigger when the trip has commenced and ended. This algorithm will also be used to improve the battery life of the logger, using sleep/wake information. Accelerometer reporting has been added to the REAMIT test environment and is undergoing testing.

The battery life of the loggers seems a big problem at HMF, so Marco suggested using accelerometer data when the trip started, providing the recordings every five minutes. Outside those times, when the farmers just park overnight, the recordings should happen every hour and store only 12 recordings offline.

Four further Eagle loggers have been ordered from South Africa and arrived at Whysor. Four temperature/humidity sensors were ordered from Farnell to wire into these loggers. The expected trial launch is in February 2022.

RR suggested documenting all the experiences with this pilot in a case study in a kind of story to be used in further publications.

Action: Ulster to document all the experiences with Musgrave pilot in a story telling format to be used in future publications.

22.04.11
9. Pilot test with Yumchop in the UK, Katarzyna Pelc, BED.

Yumchop is UK based family-owned business where they produce ready to eat frozen food with African flavours. This food is sold primarily through vending machines located currently at hospitals and universities, but in the future also train stations, airports, etc. In addition, the idea is to deliver this kind of food in plastic boxes, like paper boxes, to consumers' homes.

This pilot aims to ensure that frozen food is stored at the right temperature in the Yumchop food factory, transported at the correct temperature to vending machines, and provided food fingerprints (data on the condition in which Yumchop produces food has been stored and transported).

10 digital temperature sensors (ELSYS) have been installed in the freezers and cold rooms at Yumchop's factory in September 2021. Whysor developed the dashboard for these sensors with different colours and clients can choose different parameters.

On 18th November 2021, Whysor organised an online meeting where Yumchop were trained about the dashboard. They requested access to modify the functionalities of the dashboard, so they can adjust what they want to see on the system. The owner of the Yumchop mentioned that thanks to the REAMIT system already in operation, they have realised they do not need temperatures of the freezers at -30 °C. It is too low temperature, too much energy is consumed, and they can reduce it to -24 °C, which means significant energy savings for the company.

On 10th December 2021, an online meeting with Yumchop took place, which focused on LCA and case study attended by Tamiris and Kate. It was suggested to send questions to Yumchop in advance, split questions in smaller chunks, arrange one 1h meeting with Yumchop to collect data for LCA and case studies. The next meeting is planned for 21st January 2022.

Yumchop reported that all sensors installed at the factory worked well. The temperature in one freezer raised from -30 °C to -15 °C. This lasted for some hours, and the sensor did not pick up on it. The temperature dropped again to – 20 °C.

On 16th December 2021, an online meeting on the REAMIT dashboard for Yumchop was organised by Whysor and attended by REAMIT partners.

No data coming from Yumchop since 9th January 2022.

The next steps in this pilot test include data analysis from sensors installed at Yumchop's factory. Internal meeting of data analytics partners.

UR needs some information to conclude the case study on Yumchop, as logistical information for every product, how long it takes to come from the supplier, which has been collected with the help of the recent meetings. She requested the pilot test leaders to ask the companies to cooperate with the case studies.

Kate believes that part of the information from the meetings with the companies is lost because it is not correctly recorded. She suggests a very detailed document for each case study and finds one person to collect all this detailed information.

Action: BED to document all the experiences with Yumchop pilot in a story telling format to be used in future publications.

22.04.12
10. Pilot test in Ireland, Xavier Cama, UCD.

Covid-19 has been a limiting factor when recruiting a suitable company in Ireland to join the project. Priorly established contacts came to an end during the lockdowns.

The REAMIT team has been seeking industrial partners in Ireland for pilot testing technologies, including IoT sensors (e.g., temperature, humidity) connected to the big data server and CyberBar system. MTU and UCD have been jointly developing proof-of-concept trials.

UCD in collaboration with REAMIT partners, focuses on the implementation of sensors combined with a novel food traceability system.

Cyberbar utilises smartphone technology to identify the food product and monitor its progression through the food chain, all the way to the consumer at home. Smartphone-readable codes are imprinted onto food using laser technology and a unique food-grade paste, which is not toxic. The resultant code information can be readily interpreted using smartphone devices and provides information on the origin, expiry date, and it can link to sensor data (temperature, location). CyberBar can be employed with IoT sensors and Big Data to reduce food waste. Sensors will be used to monitor the conditions during shipping or storage automatically.

A total of 22 companies have been approached by the UCD team in collaboration with REAMIT partners. These companies have been contacted thanks to the Southern Regional Assembly EU officer Sarah Davoren (Interreg North-West Europe Programme contact point for Ireland). Also, the contact point in BiOrbic Centre, the REAMIT project idea, was sent to BiOrbic's industrial partners. Companies that could be interested in joining the project were also directly approached. A company in Sligo seems interested in an initial talk about the project.

The Freshbox project originally inspired the proof-of-concept. The idea is to deliver a carrier food box fitted with sensors to monitor key quality parameters during transportation to help reduce waste. It aims to simulate transportation conditions that can match those of agri-food businesses. A vehicle will travel a distance approximating that of producers cover for distribution. A traceability feature with QR codes will also be assessed and implemented as an added value.

A food carrier box will be equipped with a temperature data logger, and data will be monitored as a critical perishability parameter. The proposed itinerary is from Dublin (UCD) to Kerry (MTU), which can simulate the transport of food products within Ireland (approx. 3h 30 min journey). Smartphone GPS location will also be recorded. Other intermediate locations along the journey will be determined to simulate redistribution to the nearest distribution points.

The data logger has been purchased (Elitech USB Temp Datalogger RC5+ with internal sensor). The insulated carrier box was purchased (Vogue EPP insulated food carrier box 1/1 GN 200 mm 46 L). The rental of the vehicle still needs to be finalised. Preliminary experiments to be started as soon as possible.

It could be utilised by food and logistic companies as a readily deployable box that incorporates IoT sensors connected to the Big Data server to monitor key quality parameters. The box fitted with IoT sensors could continuously monitor the conditions (e.g., temperature, humidity) during transportation to reduce food waste by sending alerts and allowing rapid action, including redistribution to the nearest points. QR codes could be used to check for product information and the possibility of incorporating sensor information and GPS data as a traceability feature, providing added value to the deployable box.

Action: UCD to document in a story telling format how ideas at UCD developed for fresh box and proof of concept pilot tests; how these ideas evolved and what actions were taken to implement them. Please include names of all companies that have been approached to participate in these experiments.

22.04.12
11. Pilot test with 3D Fluorescence sensor (Ulster, BED, Whysor).

The general premise of the 3D fluorescence trial is using some form of 3DF equipment to perform rapid measurements to reduce food waste because traditionally, methods took a long time to procure. Fresh detectors can only retain surface-level information, but 3DF sensors can make deep determinations of total bacterial count on products or liquids.

Two fresh detect sensors were lent by Matthias from Fresh Detect. One fresh detect was lent to UCD, which has now been lent to Whysor. One fresh detect has been lent to Tahmina at BED where a master student examined using the fresh detect device to approximate the ripeness of soft fruit (strawberries, raspberries, etc.).

Meeting with Matthias was held on 17th January 2022 to discuss the use of fresh detect for the VHG project (for detection of Salmonella, Listeria bacteria, etc.). After the consultation, it was agreed that this is outside of the scope of the REAMIT project. Whysor and VHG have a new idea for rapidly detecting the total viable count (TVC) of preparation surfaces as this measurement is directly linked to the expiry date they can use on their products. A high TVC reading would allow them to deep clean surfaces before continuing food preparation.

Potential use in checking poultry products being delivered to Musgrave Cash and Carry. Matthias confirmed that some testing had been trailed using Raman Spectroscopy through cellophane; however, it would need to be pressed right against the poultry fillet to achieve an accurate reading.

Additionally, the fresh detect needs to be used on a flat surface of the poultry to produce accurate readings. James requested that the fresh detect returns to him for testing and to validate the potential of this trial (how long does it take for TVC to increase when chicken is left at room temperature?).

Action: Ulster to document in a story telling format how ideas at Ulster, BED and Whysor developed for 3DF pilot tests; how these ideas evolved and what actions were taken to implement them (input from Matthias, Gypsy's experiments, SensipDx, etc.). Please include actions taken and names of companies that have been approached (manufacturers of 3DF sensors suggested by Tahmina) to advance the work on 3DF pilot test.

22.04.13

12. Pilot test with Human Milk Foundation in the UK, Katarzyna Pelc, BED and Nathalie Shenker from HMF.

The Human Milk Foundation (HMF) is a charity that aims to ensure entirely equitable access to donor's human milk across the UK and equity of access of being able to donate milk, particularly in circumstances where mothers are struggling with lactation, where they have too much supply or where their baby has been sick in hospital or indeed had died.

The hospitals need human milk to prevent babies from developing complications related to being born prematurely or fed with formula. Moreover, those complications can be devastating, including a condition called necrotising enterocolitis (NEC), which has a mortality rate of about 40%. So, these babies must have access to human milk while their mothers are supported to build their supplies.

HMF are responsible for the operation of a human milk bank in the north of London based at the Rothamsted Research Institute, called the Hearts Milk Bank. It was founded in 2017 and is now the most prominent human milk bank in the country and supplies frozen human milk to hospitals across England and Wales in 47 different hospital sites. They have a very innovative programme of work with mothers in the community who would not be eligible for access to donor milk.

On the National Health Service, they may be mothers who cannot breastfeed, e.g. being treated for cancer or having other reasons where breastfeeding is impossible, and they run a programme of lactation support to make sure that each mother has individualised optimised lactation support. So, they are growing rapidly, and logistics is a significant part of their workday. Today they recruit donors from across the country, and to support that work, they are establishing a network of donor milk where milk can be stored locally and then brought down together. However, sometimes they need to send the milk over hundreds of miles.

HMF also need to guarantee that the packaging they use is appropriate and adequate for transport. The REAMIT project will support the HMF in this stage, enabling the HMF to understand how the temperature behaves and put in place a process by which they can optimise their transportation. Currently, the milk is transported using specialised insulated freezer bags explicitly created to transport donor milk, but once the milk goes into that bag, they have little idea about the milk temperature. They work according to the national guidelines, and those guidelines state that milk should remain at specific temperatures during transportation.

They work with several sensors that they tried to calibrate, but they can be ineffectual, the battery discharges very quickly, and it can be technically challenging for the team to work. They have around 10-15 deliveries into the milk bank and a similar number of deliveries going out of the milk bank per day. For this reason, they need a system that is easy to visualise and simple for the team to administer.

The pilot test aims to monitor the temperature at which human milk is transported between a donor – human milk bank – hospital/home and send alerts if these conditions change. The optimal temperature for the transportation of human milk is equal to -20 °C. The transportation of a few bottles of milk per trip is made in a motorcycle or car.

Sensor is battery-driven, has a GPS locator inside and sends data every 2 min when the car is driving. Data can be sent at a lower frequency when the car is standing.

Two online meetings took place (BED and HMF) in May 2021, and Whysor attended one. Whysor configured and shipped 2 sensors to HMF (July 2021), and HMF identified two donors to participate in the pilot test. The pilot test started in July 2021.

On 26th August 2021, an online meeting between HMF, Whysor, and BED took place to address connectivity and update the configuration of one of the sensors. On 27th September 2021, Whysor visited HMF, corrected the connectivity issue of one of the sensors, installed 2 sensors, created a dashboard for HMF and explained how it works.

In October 2021, Whysor reported that both sensors were working well and sent lots of data to the REAMIT cloud at Whysor. However, the data indicates room temperature only. This implies that both sensors are not sent on trips with human milk. Both sensors were sent on 8 trips in October 2021. On 12th November 2021, Whysor shared BED sensor data from HMF in table format and 2 graphs.

In Nov/Dec 2021 data analytics partners carried out data analysis based on data from 2 sensors at HMF and suggested that context for each journey is needed, including length, schedule, what sensors are used, etc.

HMF confirmed they were keen to scale up the pilot test by installing 10 new sensors. In December 2021, Whysor reported a shortage of sensors due to the lack of chips caused by COVID-19. Whysor secured 10 sensors from a new supplier in South Africa. BED actioned purchase of 10 new sensors secured by Whysor.

On 14th January 2022, an online meeting of REAMIT data analytic partners took place. On 17th January 2022 an online meeting of data analytics partners with HMF took place. HMF agreed to send a google sheet with information on when trips take place. The main challenges include short battery life, longer distances, quantification of human milk transported by HMF and estimating if the bag is full.

Next steps include data analytics of data for HMF, online meeting with HMF every 2-3 months, improvements to the IoT approach for HMF. Data to be sent only when sensors are in motion, create an alerting system for HMF without human intervention, lightning sensor to pick up when the bag is opened/closed, disable sensor alarming in certain situations, deliver standard operating procedures for the driver transporting human milk.

Action: BED to report in story telling format experiences with the pilot test with HMF.

22.04.14

4) Updates on the action plan for developing pilot tests in France and Ireland, including through approaching the Contact Point Persons for France and Ireland at Interreg NWE Programme (UCD, I&R, MTU)

In order to recruit new companies for pilot tests, I&R, UCD and MTU:

- Promote REAMIT project in social media/call/monthly newsletters.
- Presented the project during specific events: CFIA exhibition on food process and ingredient in Rennes (March 2021), an event organised by Valorial on Future seen by Start-up, "the success food day" (May 2021), general assembly of Valorial and Image et Reseaux (June 2021) and an exhibition on agriculture and process in Rennes (September 2021).

- Organise a symposium and implement the communication strategy of REAMIT.

RR: if you need any help producing targeted material please let us know. You should showcase some of the existing successful pilot tests – why and how these companies are involved in REAMIT and showcase that there is already a lot of commercial interest in the project – you can translate these message to French.

Sasha has made an infographics in French for help with recruitment. This will be presented tomorrow.

MTU
GS said that to promote the REAMIT project MTU have posted it on the MTU main website and MTU Kerry website – as well as contacting meat technology Ireland, Enterprise Ireland, circular economy research group. They have got a positive response from Food Cloud Ireland, and GS was able to meet with one of the co-founders last week. They expressed interest in exploring further opportunities for pilot tests. They are a charity group and deal with redistribution of food from large food suppliers to the point where they are required. They work with Nestle, Aldi, Lidl, SuperValue. Food Cloud have suggested that the MTU team (Gautam and Gerard) visit one of their facilities in Cork over the coming days. By studying their processes more closely we can think about how we can help them.

13.45 – 14.30: Work Package T1 Pilot Tests continued – recruitment of new Pilot Tests, (Chair I&R)

UCD
Xavier provided updates at the earlier WPT1 session. UCD used the Interreg NWE Programme Ireland contact point and the contact at the research institution at UCD. UCD also directly contacted a few companies. UCD used promotional material from REAMIT and a specific leaflet for the pilot in Ireland was developed at UCD. The latest update is that there are at least two companies based in Sligo who are interested and want to have an initial meeting to explore technologies and approaches offered by REAMIT.

RR: If you need one of us to be around for the initial meetings with companies, please let us know.

Whysor – Landgard, Germany
Whysor got connected to Landgard through their associate partner GIQS. Landgard are a large supplier of flowers, fruit and vegetables just across the border from Whysor. They have differences in quality of produce between producers – they have 2 producers producing the same products but there's a difference in quality. Producer 1 deliveries a product with no quality issues, but producer 2 has quality issues. They wish to measure temp, humidity, and VOC to investigate the cause of the quality differences between the two suppliers. Whysor have met with them twice so far, and are trying to organise a visit to the Landgard warehouse later this month or the beginning of February 2021.

UoN – Pescanova group, France
Pescanova group are an international company specialised in the fishing, farming, processing and commercialisation of seafood products. Gerald contacted this company at the start of the project and they were interested – but not at this stage of the project. When our full system is finalised UoN will try it with them as an end user. We will use the same setup that we've been testing on chicken sample – perhaps some parameter tuning will be required. We will contact them after June 2022 to present our system and tell them it's ready to test.

AA: It will be good for REAMIT project.

BED – Blue Skies, UK
Blue Skies are a company based in the UK whom BED approached and had initial talks with in July 2021. They produce fresh fruit snacks, already peeled pineapple, mango, etc. which are sold in supermarkets in the UK - Aldi, Sainsbury's, Waitrose. These pre-peeled snacks are transported in containers in planes from Brazil, South Africa, Egypt, etc. The planes tend to have a stopover in the Middle East, e.g. Qatar. Unfortunately, some deliveries arrive in the UK already perished and this food is wasted. They therefore are wanting to monitor remotely the temperature of these containers during their stopovers, to see what factors are accelerating the perishing process. The next step is to sign NDA's, and the company is to send videos from their food subsidiary in Ghana, Amsterdam, and Heathrow so we can gain insights into their operation.

RR: Is there a chance for us to work with NHS at Ulster? JG said that NHS is still a potential lead as it was a lead of TC, he just hasn't had time to explore it yet.

RR: Tesco / Pepsi have stopped replying to UR after COVID so these companies need to be removed from our list.

RR: What about Carton Group and mushroom company from UCD?
XC said that they became unresponsive after COVID too so these should also be removed from our list.

IH: Sometime this year you had a contact with a company which sold wine, it was to do with theft. Did you hear anything more about that?
RR: No, we didn't hear anything more. It is less about food waste and more about food loss. They should be moved to the archives too.

Ram concluded that Tesco and Pepsi would be removed from the list of possible pilot tests but the Chocolate company would remain for the time being as Sasha would try to follow up on it.

KP asked JC what the plan is for the Ulster budget for 3DF trial; if there was plans to recruit a new colleague. JC was not in the call to answer. JG said he would ask JC to provide comment when she returned to the meeting.

WP T2 Big Data integration and application to reduce food wastage (14:30 – 16:30)

22.05.01
1) Deliverables as per the Application Form:

- Creation and launch of interface for each of the pilot tests for collecting data from sensors and sending it to cloud for use in a transnational Big Data infrastructure (by July 2021 as per original application; extended deadline July 2022).
- User Manual on launching the interface (by July 2021 as per original application; extended deadline July 2022).
- A big data platform with capability to collect and store sensors data from all REAMIT corridors (January 2020– July 2021 as per original application; extended deadline July 2022).
- Reports on Big Data platform performance (January 2020–July 2022 as per original application; extended deadline July 2023).
- A web-interface with self-enroll facility for enrolment of potential suppliers and consumers of food produce (January 2020 – July 2022 as per original application; extended deadline July 2023).

- User manuals for the Big Data platform and the web-interface (January 2020 – July 2022 as per original application; extended deadline July 2023).
- Launch of smartphone APP for linking food owners, truck drivers and warehouses (January 2020 – July 2021 as per original application; extended deadline July 2023).
- An additional deliverable: launch of second database of potential buyers (food charities, convenience stores, etc.) in REAMIT corridors – the route where trucks would travel. This database will be developed by Levstone.
- User manual for the use of the APP (January 2020 – July 2021 as per original application; extended deadline July 2022).
- Deployment of the integrated IoT/Big Data analytics/Decision support technology (January 2019 – July 2022 as per original application; extended deadline July 2023).
- A user manual for the integrated IoT/Big Data/analytics/Decision support technology (January 2019 – July 2022 as per original application: extended deadline July 2023).

22.05.02

2) Introduction to FloWaste – presentation by Rian McDonell

"The company's focus, approach to data analytics, and experience with raising recently $1.1 from a pre-seed investment fund to reduce food waste with machine learning' – Rian Mc Donnell, CEO, FloWaste Inc."

Rian McDonell was not available and could not attend the consortium meeting.

22.05.03

3) Big Data Hub at BED – presentation by Sahar Ahmadzadeh, BED.

Sahar's presentation was divided into 5 sections:

1. Big data and IoT

The application of IoT is crucial in every day society, but it results in massive amounts of data: the big data hub comprises the integration of IoT and big data. Considering the following steps: tracking, identification, sensing, and data collection and storage followed by analysis; the role of the big data hub is to collect the generated data from the different pilot tests, which is then analysed by the data analytic partners. Information from sensors is gathered in the big data hub, analysed, and ultimately an alert is sent to smartphones.

2. Showing BED Big Data Hub

Sahar showed the computer that serves as storage, the big data hub, securely kept at the University of Bedfordshire. Also, at the moment, work is being done so that data in the Whysor cloud can be transferred to the BED big data server as well.

3. Data collection from various pilot tests

Sensors can collect different types of data. For instance, at Yumchop, temperature sensors were installed in fridges and freezers. A visit by the REAMIT team was carried out at their facilities to install these sensors.

4. Data analysis

Sahar showed graphs of temperature over time generated from the collected data at Yumchop (currently using the Whysor Dashboard). Sahar also showed an excel file containing measurements of these sensors and the different parameters (time, battery, etc.). Similarly, example graphs of temperature and sensor

battery versus time were shown for HMF and Yumchop, as well as acceleration data that was recorded for the Picnic pilot test.

5. Maintenance and management
There is a need to routinely check that users have access to the Big data server. As well as checking that real time data is being uploaded regularly. If partners should have any issue, or a password change was required, these need to be dealt with. Also, login instructions for new partners could be prepared. Regarding licenses, the situation was analysed to see if it was better to get an unlimited user licence or a limited one.

Discussion

- Ram asked if user manuals had been developed – how to log into the server, how to navigate through different menus, etc., to which Sahar explained that there was some introductory work done on that. Sahar's proposed work would entail providing a user manual on how external users can connect to the server showing screenshots for each step. Ram asked Sahar to present this work on the manuals at the following WP TP2 meeting.
- Ram asked if a separate manual was needed with regard how the Whysor server is connected to REAMIT Big data server. Sahar explained that there had been issues regarding connectivity but she was not fully aware of the situation. Ram asked if progress could be made on this – with Joy's help if needed.
- Ram asked in relation to issues with REAMIT the server. Sahar explained that there had been some technical issues for sending data, and that some partners were not able to connect at certain occasions. She had meetings with Joy and Gautam to address this.

Action: BED, Whysor, Levstone and data analysis partners to determine whether a separate manual is needed on how the Whysor server is connected to REAMIT Big data server.

22.05.04
4) 'Blue maestro sensor and its suitability for REAMIT pilot tests', presentation by Davinder Bola, Levstone.

Davinder's presentation revolved around Levstone's mobile app and meaningful data for transaction. Davinder explained that what REAMIT had at the time [of the presentation] was a REAMIT central database (BED), a Levstone cloud, a Whysor cloud, Nantes and other pilot tests. The overall idea was to push or pull the data into this big data repository and partners do analytics in their own way. That is what REAMIT has at the moment.
He then introduced the concepts of block chain and transaction. For a successful transaction, all of the datasets from whichever pilot tests need to be converted into meaningful information/data, and logged into a ledger.

As to REAMIT's current pilot tests, Davinder observed that challenges are different for each of them. For instance, in the UK, Yumchop consists of storage, transport and delivery; Glen Affric, the brewery, is batch processing – because they go from one tank, wait until the process finishes, and then on to another tank; the meat trial is mainly storage and delivery; and HMF is challenging because of regulations, handover, plus the product itself is priceless.

In the past, Levstone had worked with *Mini scada* systems to address some similar challenges. Mini scada systems are supervisory control systems – some can be quite big, whereas some small. These systems

basically log everything locally in a small computer and display whatever control mechanism that need to be energized.

Davinder talked about the Levstone app, *Transport tracker: IoT sensors & vehicle tracker*, a high security, private-group GPS tracking and IOT sensor monitoring app available on Android phones. With the app, one can get alerts, people in and out and more. In the context of REAMIT, sensor locations can be fixed, like Yumchop, and others on the move.

Levstone had been experimenting with sensors on the move. They had 8 sensors logging to their cloud: some on the move (car, dog collar) and some static (fridge).

Features:

- Drivers interfering with it is not desirable: their technology bypasses this challenge because once a sensor is installed, no group member needs to do anything else.
- Offline storage (when no connection available).
- Private secure groups.
- Story line (to follow a sensor, a user)
- GDPR compliant - easy for the user to select the desired options.
- Multiple languages available.

Davinder added that more features were also available. E.g.: journey/works handover, manual acknowledgement required, among others. The sensors that Levstone used are *Bluemaestro,* low energy Bluetooth sensors. Tests carried out by Levstone showed that the battery life is considerably high. Davinder then showed a live demo of the app as seen on his phone, showing different devices (phones) connected to the app, with their respective sensors. The app can show averages of parameters in the last 24 hours. The app can also show a *Route map*, GPS location for sensors on the move. More options of the app included: tasks by which one can create a journey, reminders, etc. Davinder concluded that the Bluemaestro sensors are a good fit for the REAMIT pilot tests.

Discussion

- Natalie expressed interest in the app as some features could be relevant to their operations, such as limiting the messaging, where the recipients are, keep track of the volunteer movements, among others.
- Ram observed that details on how to integrate Levstone systems in the pilot tests needed to be sought, and asked for discussions between the pilot test leads.
- James asked about driver's intervention, how the app handles different drivers, to which Davinder said that there were no problems with having different drivers. No intervention from them was needed.
- Davinder observed that, in logistics, especially if alerts are desired, the system was a great fit, adding that battery life was fantastic.
- James pointed out that these were two different systems [the current and Levstone's] and, at the time, the system about to deploy, was not interchangeable with Levstone's.
- Ram asked for having separate meetings, one for each pilot test, HMF, Picnic, Musgrave, etc., to see if that system would be beneficial to have it implemented.

Action: Levstone and pilot test leads (HMF, Picnic, Musgrave, etc.) to meet and discuss if the Blue Maestro system proposed by Levstone would be beneficial for them.

22.05.05

5) 'Development of a Smartphone APP for REAMIT and a second database of potential buyers (food charities, convenience stores, etc.) in REAMIT corridors', presentation by Davinder, Levstone.

No presentation was provided at the time. Davinder explained that they needed to understand the datasets, what the fields were, what was supply and demand, to which Ram asked for a meeting to push the activity forward as REAMIT needed to take some action on it as part of a deliverable.

- Ram asked Davinder to lead a meeting to tell the rest of the relevant partners what was needed from each pilot test.
- Davinder explained that what was needed at that stage was to sit down and discuss what data areas were required – readings, but also metadata (i.e. data informing about the actual data) – to build a scheme to ultimately generate the dataset. Ram mentioned that James and Davinder should meet to discuss Musgrave.
- Imke proposed a meeting with only a few people to start with: e.g. Davinder, Kate, James, Tom, Ram. And then more people could be invited along as necessary. Ram expressed his approval on such a meeting taking place in the next month [February 2022] or so.

'REAMIT data analysis: first results presented by REAMIT data analytics partners.

22.05.06

Jean-Charles Vialatte, SenX

Analysis was still ongoing from Jean-Charles' part. Presentation to be shown at the next WP T2 meeting. However, an update on the type of work he was carrying out was:

- Jean-Charles had access to a few datasets. A difficultly was that all datasets were independent from one another and he did not have a context for every dataset.
- Jean-Charles was working on applying an algorithm, or performing statistical analysis, using a tool that will search for patterns. In this regard, he was looking for subseries of the data: for a given number of subseries length, he was carrying out an analysis to check if useful information could be extracted from the data. Another approach he was conducting was a comparison of the distribution using a convertible dimension matrix. Also, another method using matrix profile.
- Ram asked about the news on the integration of the Warp system with Whysor: Jean-Charles confirmed it and explained that he was collecting the data of the database into a Warp 10 system that allowed him to use Warp script functions and use them to generate statistic documents. Jean-Charles observed that REAMIT needed statistic results rather than looking at graphs.

Ram: The data from Nantes (Raman) had not been collected at the central server to that point, but in the next following weeks, in WP T2, the REAMIT team would have the chance to look into it.

Action: UoN to make sure that data from Raman pilot test is transported to the Big Data server at BED.

22.05.07

Gautam Samriya, MTU – WPT2 Data Activities

Gautam provided a summary of the work and progress done on WP T2 so far: in the past six months, pilot tests have started generating data from the sensors (Picnic, Biogros, Yumchop, Glen Affric, etc.) placed in different storage and distributions devices. MTU and data analytics partners, had been continuously trying to find meaningful insights and patterns in the data from the pilot tests. Discussions taking place were also on how data analytics should be done – each pilot test has its own requirements, hence, shaping the strategy for data requirements and analysis had also been continuously carried out.

Picnic was the first pilot that started generating data. At the time, various partners, including MTU performed some analytics. Gautam studied acceleration: it could be inferred that there was something wrong with the handling of the boxes or the sensors and later, it was known that sensors broke down, which reassured the importance on performing such analysis.

6 WP T2 meetings had been conducted to date. Gautam observed that as a standard practice, in each presentation, MTU and partners always tried to present or elaborate conclusions on new data needs to keep taking the work forward.

Similarly to Yumchop, Biogros started generating data. Gautam and the team tried to infer as much insights as possible from it, for instance, identifying abnormal behaviours, so that REAMIT could always try to find the reasons behind them. Additionally, data was generated for Glen Affric, WD Meats and Yumchop. All the insights extracted from these analysis can also be helpful for identifying SOPs for these companies as to handling of the product, storage and more.

Future plans:
- To conduct more exhaustive analysis, tailoring strategies according to each pilot test.
- MTU had been having discussions with FoodCloud for a new pilot test.
- MTU partnering with UCD on transportation simulation trials.

Gautam explained what other possibilities could be in the future to keep making progress in the REAMIT project: what further data REAMIT needs according to each pilot test – Gautam explained that data regarding quality of the food could be collected and linked to customer behaviour as a means to provide valuable information to the company. Also, to define all kinds of alerting mechanisms, as well as what other data such as humidity, GPS, etc., to provide added value.

Discussion
- Davinder gave two remarks:
    - He asked for EPOC time format in the time field of data.
    - For HMF, he observed that the records were consistent - good quality data.
- Gautam pointed out that a step could be included that allowed storage of time formats in EPOC or whatever format desired.
- James said that it could be added at a base level, but that he would prefer to keep the existing time format recordings at the moment.
- Ram mentioned that keeping or storing both should be possible, or in anyway, to find a solution that fits everyone.

22.05.08
James Gillespie, UU – WPT2 Big Data Hub
James delivered a presentation on the 3 stages of data analysis and future scope for existing pilots.
James' tech stack used for analysis was:
- Python, Jupiter (IDE)
- Libraries: Pandas, numpy, pyodbc, matplotlib.

The first step in data analytics is data import. James showed how he connected to the data server to pull the data using Python and pyobdc, and showing the actual script for anyone who would like to use it too.

Following this method allowed for real-time analysis rather than importing a csv file and then having to analyze it separately.

From there, the data could be queried to check for noise (James showed the example Picnic - acceleration). He checked for the number of null values and showed a plot to see what noise looked like over all of the recordings; James showed in red circles the missing values.

The second step is cleaning the data. To that end, the missing fields seen in the example form Picnic could be cleaned. In his example, he used an interpolate method that provided a predicted value of what the actual, measured value should have been. The original data had some battery, humidity and temperature missing values but the cleaning performed replaced them with predicted ones.

The third stage is performing the analysis. One interesting thing to consider is that data analytics, opposed to an alerting system which only uses the real time data to create the alert, looks at all of the historical data, to make predictions, for example, to help businesses' operations.

1. Picnic trial – future ideas/work to be done
James explained that REAMIT could help Picnic in identifying roots or causes as to the factors contributing to customers being dissatisfied or getting damaged products. For that, REAMIT would need to get access to customers' complaints, data, as he suggested perhaps, in the form of customer surveys via an app once delivery is received. This would allow to establish a ground truth, labels that identified products as damaged, that the team can then look into the factors that made it unsatisfactory. Maybe that could ultimately translate into an alert to a driver or some solution of the sort (final stage of Picnic).

2. WD Meats
James explained that one of the goals was to reduce dark facings. On how to quantify dark facings, James explained that Mark confirmed they would start weighing them off, but he had to trim them at the end of the dry-ageing process. What they had at the time being, for the dry-ageing trial, was start and end weights of the hindquarters of beef which they used to calculate the percentage of weight loss. It was seen that it was colder at the front of the truck compared to the back. To see how it affected weight, they compared the lost percentage at the rear hindquarters versus the front ones. James calculated percentages and found 4.3 3% for back weights and 3.87 % for front weights. Additionally, James conducted an ANOVA test to confirm the significance. They were able to conclude that meat at the back was losing more weight. Plans for the future included efforts to balance this out. Also, as to reducing the amount of dark facing, this will need another set of analysis in the future.

3. HMF
James had met with Natalie two days prior the consortium meeting. In this meeting, it was discussed the option of including external weather data – the purpose was to see what factors affect the milk, e.g.: intense sun heat. A plan for the future would be to include weather data for each journey, and to use historical data to make a prediction based on the forecast. Additionally, journey length, traffic, and other types of data could be collected to perform other analytics – added value that REAMIT could offer as well for the pilot test.

Discussion

- Ram was happy to explore more and more of these options in the future.
- Yanqing pointed out that GDPR should be considered, however, when making these attempts to collect more data form customers or users. Also, to be aware that drivers do not like being

monitored and it could be a sensitive issue to them [REAMIT resulting in alerts on the type of driving taking place].

Gautam asked Imke and Tom about the importance of establishing models, and in the Picnic case also involving getting customer feedback.
Imke explained that at the moment what needed to be done first was to sign an NDA agreement. After that, they could talk to Picnic to see what other information REAMIT needs. Imke was going to ask Kate for help on the NDA as Picnic had actually sent their own rather than the standard REAMIT one.

22.05.09
Sahar Ahmadzadeh – WP T2
Sahar made a presentation on her data analysis work. She had used the software tool Matlab and performed the following steps:

- Import the data.
- Separating each column.
- Draw the graph for visualization.
- Analyse the data.

Sahar looked into the acceleration data of the Picnic pilot test, proving graphs comparing acceleration in the x, y, and z axes. Also, Sahar showed a visualization analysis of motion acceleration. Additionally, Sahar generated several graphs trying to determine visually what the relationship between different parameters, such as humidity and temperature was to battery consumption. Sahar showed an example of the HMF data excel files, showing the fields of temperature and battery. She explained that work had been done to make separate folders to include the excel files related to each of the pilot tests. She then showed the graphs she had prepared for HMF, which included comparisons between recorded temperatures and number of measurements from two sensors: sensor 1574 and sensor 8516. She explained that the observations made by MTU and the team on this data were:

- Sometimes readings are taken more often than every 5 minutes when temperature is dropping (not always though).
- Also, at some instances data was missing.

Sahar concluded that from the drop in temperature, the number of trips by the HMF team could be inferred.

Ram pointed out that the team had to think of going beyond time series analysis and move to predictive analytics rather than descriptive.

Action: Data analytics partners to go beyond time series analysis and move to predictive analytics (rather than descriptive).

22.06
WP T3 Business development of REAMIT technologies (16:45 – 17:30)

22.06.01
1) Overview and Deliverables as per the REAMIT Application Form – presentation by James G, UU
The main aim of the WP T3 is to bring outcomes of WP T1/T2 closer to the market and the development of business cases as far as TRL8.

The key objectives of the WP T3 are:
1. Understand development potential of REAMIT technologies.
2. Development of technologies towards consumer grade.
3. Attract future end-users.

The WP T3 mainly consists of 4 activities:
Activity 1: Risk, technology and sustainability assessments of REAMIT technologies (led by UCD, supported by NTU,UU and BED) – Jan 2021 – July 2023
Risk assessment identifies potential risks to the marketability of REAMIT technologies in the long run. Technology assessment will study how user perceived usefulness of the rumored technologies to identify potential bottlenecks in the long term adoption. Financial buyers will also be analysed as part of technology assessment with to support enterprises. Life cycle assessment and Sustainability assessment is used to highlight the impact of the REAMIT project in reducing food waste using the waist measurement framework.
There are two deliverables in this activity.

Deliverable 1.1. – Sep 2022: An assessment report of REAMIT technologies including comprehensive systematic review (mapping) of the technical and business landscape in the fresh produce food chain.

Deliverable 1.2 – July 2023 The life cycle assessment system will allow environmental impact data to be integrated with the REAMIT IoT sensor and big data solutions.

Activity 2: Future-proofing REAMIT Technologies (led by UCD, supported by BED) – Jan 2020 – July 2022
Technology assessment will study how users perceive the usefulness of REAMIT technologies to identify potential bottlenecks in the long term adoption. The synergy that exists between the sensor development, big data analytics and food quality analysis requires that novel sensoring technologies and existing sensor technologies be continuously created and adapted respectively. To this end screening and assessing of alternative food quality analysis sensors will be performed.

Deliverable 2.1 – July 2022: Current and identified future REAMIT technology assessment report.
Current Updates: We've had conversations regarding case studies, qualitative and quantitative information that we want to collect for REAMIT technology assessment report. There was talk getting qualitative data from Yanqing and she's already creating a questionnaire which could be useful for collecting data. Tamiris and Yanqing can update more on this.

Activity 3: Market assessment (led by UU, supported by BED, I&R, Valorial and NTU) – Jan 2020- July 2023
It is essential that SMEs consider the market opportunities which are growing in the food sector. REAMIT partners will jointly develop a market foresight report which will inform SMEs of market opportunities for the REAMIT technologies. Partners will draw upon the expertise of enterprise agencies and sector specific organisations to identify potential markets for new technology approaches in reducing food waste.

Deliverable 3.1 – Market readiness report – July 2023
A market analysis and foresight report identifying forthcoming opportunities for REAMIT technologies to be developed into marketable products.
Current Updates: It is at a very early stage. There has been some initial work on pulling together a template for the report. A white paper, originally written by Brian Gardner and Daniel Kelly of the Ulster team, would be used into the introduction and literature review of the report. A lot of report will be based on the findings of pilot tests which are currently running.

Activity 4: Development of business case (led by UU, supported by BED, I&R, Valorial and NTU) – Jan 2020-July 2023

Deliverable 4.1 – Business prospectus – July 2023
An outward-facing document will be made available to SME technology developers, to potential buyers of technology approaches (large agri-business and logistics companies) and potential investors whi can see the possibilities for product development.

Deliverable 4.2 – Business case for achieving 40,000 tonnes of waste reduction – July 2023
The business case will use REAMIT data from continual monitoring of sensor data for identifying/saving potential food waste and subsequent analytics to understand patterns of food waste in NEW with justification for saving 40,000 tonnes of food waste.

Current updates: There hasn't been any progress on this activity yet. Since we're still waiting for data for meaningful analytics to be undertaken. Because of Covid-19, a lot of pilots have launched much later than planned, so we are waiting for data and analytics to be performed before we can start work on business perspectives and business case. James mentioned that he just gave an overview on the work package and

Tamiris can give further details on work by UCD for this work package.

22.06.02
2) "Working with an Investment fund – Benefits for agri-business companies" – presentation by Alexander Kallis of Miltrust International Group

Alexander Kallis of Miltrust International Group made a presentation on benefits for agri-business companies working with an investment fund company like theirs and the criteria used by them to asses and work with any company. The key excerpts of his presentation are:

Background of Miltrust International Group
Miltrust International Group is a London and Singapore based asset management company, running the money primarily for institutions, local authority & pension funds and international pension funds, focused on the key mantra – sustainable prosperity. So everything we do has to have an angle of sustainability and this boils down to investments in four key areas - the emerging markets, the healthcare/health tech and the future of health, climate change and agriculture & food technology. These are both across the venture or private markets and public markets as well. We've won a number of awards and we have some very strong partnerships in the likes of WWF in Hong Kong for some of our investments.

Motivation
Global challenges create global investment imperatives. We believe that there are strong challenges in below areas that are creating not just huge investment imperatives, but also investment returns to be made.

- Healthcare - With the growth of global population that will reach about 10 billion by 2050 and a number of people over the age of 65 will double. We feel that there's along a strong impetus for momentum for healthcare companies who strive within this environment.
- Food and farm - Growing population will demands greater demand for food. There is a lack of agricultural land and crop output set that is just a big bottleneck that needs to be addressed.

- Emerging economies - There's growing economic and technological importance happening in these areas, and they're really the drivers of the next generation.
- Climate Change - By 2050 we're heading towards a world that's well above 1.5 degrees warmer and that will lead to very wrong in in dire environmental consequences.
- Technology - We see technology and artificial intelligence as something that would be widely felt across all aspects of our daily lives and which will have the potential to solve a lot of the world's greatest challenges.

Miltrust Venture Investment Platforms

On the venture capital side of our business, we have been running various investment venture capital investment funds backed by some local authority pension funds, one of which is called British Innovation Fund, which has been investing in Spinouts and start-ups of UK universities but not exclusively. That's been the primary source of deal flow across the different domains that we invest in primarily, which are:

Future Health

- Food & Agriculture
- Climate Impact

Within these venture investments we created 3 dedicated investment platforms and code investment platforms who have a wide network of contacts and investors who are approaching us. We find originally great ideas that are pre-screened and vetted and we are always very happy to meet new entrepreneurs and businesses who have strong technology and businesses, and work with them to feature them on RRR platforms or through different platforms here and bring. So if you have interest in companies that you would like to approach, please feel free to get in touch with us. In Food and Agriculture, we've run a number of real assets funds focused on farmlands investments. We've deployed hundreds of millions of dollars in and actively managed over 20,000 hectares of sustainable farm lands in the southern hemisphere, mainly Australia and New Zealand. We've been backing a number of entrepreneurs that have pioneered in technologies in genetics, diagnostics, animal welfare farming practices with the aim of delivering sustainable solutions for the challenges of feeding and clothing and ever growing population. We've been quite successful with that and very proud of our achievements.

Angel Investors vs Venture Investors

What is the difference between Angel investing and venture investors? We fall within more of the venture camp, but basically it comes down to average ticket size and stage of investment. So an Angel investor will invest around $25,000 to, $100,000 on average. Usually, they provide some financial assistance to help the company start-up. Their involvement is minimal. It depends on the investor to decide the amount of time that these can devote. Venture investor is hired for bigger ticket size on average. This basically is $7,000,000. Typically based on the amount of investments, we would seek board seats and seek active role in the management and decision making process. We are evaluating a large number of deals and in portfolio investments.

Investment Criteria for Miltrust – how agri-food companies become ready for investment?

We typically like early stage companies as we believe that that's where there's the most potential for returns. So the idea is to get in early and you can make significant returns. Obviously it might be riskier, but we've been running and doing this for on average for over 20 years. But beyond that, we typically like to hear from companies that are beyond the concept stage and that have an existing business. They ideally should be revenue producing and already have some contracts in place, have some products, technology, have a strong team and a strong track record of managing business previously. We typically prefer when there's unique science driven technology and IP coming as part of the proposal.

How an investment firm assesses a proposition?
We have a team that's always scouting for new deals. We have our very large network of industry research and group from university space too. Angel investor groups to other groups who come and show us and propose deals to us all the time. Once we are quite interested in the idea, we will have a meeting, carry out initial research and will do a deeper dive analysis. We will carry out some more industry research and will look at all the fundamentals of the company or where they are in their journey, and then if it ticks all our boxes, we will call on our investment advisory committee, who are typically specialists within the different areas in which we invest in. These could be medical practitioners, agronomists, technologist and investment bankers. We have a dedicated investment advisory community that's helping us make sure that we're dealing with the best companies for our investments. Then we would structure a deal, negotiate terms and come up with the valuation. It could also be the case that the company is not quite ready, then we would, look to probably include them on one of our platforms to showcase them. Maybe at one point that company will reach a certain level or stage of their business that is big enough that we can maybe consider them for investments.

How an SME knows which investor is right for them?
There are different ways that investors can find different types of investors out there. At Milltrust, we differentiate ourselves and found our unique spaces that were at the epicenter of agriculture, healthcare and climate impact. And we draw on our wide range of networks including all these different companies here which are either peers, or they are companies in which we have invested in or screened and where we have great relations then they can really bring expert knowledge within these fields. Most of these fall within one or two or three of these different categories and we feel that this is where our expertise lies.

SME and 'Death Valley'
This is usually a term to describe the critical phase when a company starts and they have some existing initial capital, but they need to operate without having any revenue. This is critical and dangerous time for companies when they're starting off to be able to survive the Death Valley. It means being able to generate sufficient revenues to become self-sustainable before the capital runs dry.

Surviving 'Death Valley'
The companies can address this through different ways. The easiest way is to do routine jobs and run this company on the side, but a lot of venture and professional investors don't necessarily want to see an entrepreneur doing different things and want to see them completely focused on one area. There are a lot of university angel investors or incubator platforms even outside the university space to help bring these different companies to various investors. They can apply for a contest and get some business grants from governments or other area, could use crowdfunding micro finance, find a venture capital or angel investors to help before going into series ABC etc.

Some successful investments of Milltrust

Some examples of the companies that we have been investing in are:

Example 1 – Roslin Technologies
Roslin technologies was launched in 2017 as the largest European academic start-up, where we were the founding investor and put in about GBP 10 million into the business. Roslin Institute has all the access rights to the IP coming from the Roslin Institute in Edinburgh, and as well as the Royal (Dick) School of Veterinary Studies. About 20 years ago, the Institute was responsible for cloning Dolly the sheep, and thus they have tremendous amount of world leading expertise in life sciences and genetics, and today Roslyn

has become a world leader in animal stem cells and genomics, and they've developed the world's first perpetually self-renewing patented stem cells. These are basically one of the main ingredients for cultivated meats. They are developing the meat in a lab and in this way, supporting the food supply chain. They're also involved in animal health and elimination of antibiotics. Rather than trying to replicate the taste of meat through vegetable, in this case, they are creating real meat, but without having to kill an animal every time because these are self-perpetuating cells. They had IP and were finding investors. Our investments have grown by over 100% since we invested and the is expected to grow tremendously in coming times as this could be a solution for gap in protein and climate impacts of meat.

Example 2 – Protenga
Protenga is another interesting company and they are working on cultivating an insect called the black soldier fly. They have tremendous amount of protein content, about 50%, a lot more than soy. With the less need for water and lands, it's more sustainable. It also has unique properties, it's natural composter is very strong in composting wasted food. This is used for primarily animal feed such as chicken who love this food. Going forward, they're talking to animal food companies like dog food. There's tremendous amount of opportunities within this idea with this sector.

Example 3 – Attomarker
This company spun out of the University of Exeter and has developed a small and simple to use blood testing device that's able to perform blood tests from a single pin prick of blood, with results in about 5 to 10 minutes. It collects the sample and put on a disposable credit card sized chip, which then slots into a mobile device such as iPhone and then the iPhone can visualize the blood test and interpret the results. It's been used for a number of different things. During Covid-19 pandemic, the company shifted focus in the interim, given the need. Today they're able to analyze and find out the antibodies information for a person in just a of couple minutes, and based on whether you've had COVID, whether you had antibodies from having had the disease, or from having had the vaccine or the booster. The company is banking on the fact that it’s more important for vaccines to be given out or boosters to be given out to the population that has low thresholds or whose unity has waned compared to just a blanket age based decision to vaccinate or boost a certain age group. They are also able to test from allergens subsist to diabetes. They are going to start using some of these for animal testing as well.

Example 4 – Vaccitech
One of our most successful investments, this company spun out of Oxford University. This is the platform licensed out of the Jenner Institute for Vaccine Research and was instrumental in developing the COVID-19 vaccine which was licensed to AstraZeneca. The company has been credited for saving countless lives, and the company is also involved in other clinical product candidates for infectious diseases and cancer indicators. We identify them very early on when the valuation was around $68 million and then we invested and the valuations then grown by 8.6 times at peak shortly after its listing on NASDAQ in April 2021.

Alex concluded his presentation by thanking the consortium and welcomed any opportunity for communication on info@miltrust.com.

Kate thanked Alex for his presentation and asked few questions.

Q&A
Kate: Do you think a meeting like this with your presentation can possibly result in spotting a new deal? Is it how some of the deals are spotted?

Alex: Absolutely. We are always reaching out and are always interested in hearing if you have businesses that fit within our sectors of focus. Please do feel free to reach out and we'd be happy to collaborate with feedback or maybe invest.

Kate: In the REAMIT project, we are working on 10 pilot tests, when we develop technology and test it. We also have two or three SMEs which actually would be hungry for investment capital. So would you be open to look into where they are and their potential for an investment?
Alex: Yes, absolutely. They can send me an email along with a quick profile of the company. If it looks interesting then we'll get a team of colleagues to do initial screenings and then we can go through the different investment process and get various experts onboard. So happy to hear from you.

Kate: What is your experience with EU grant funds helping develop some ideas into a stage where an investment company like yours would be willing to invest? Does Milltrust participate in a programme where you have blended funding – first grants and then investment funds. This is a question whether grant funding is actually creating opportunities for an investor? In the REAMIT project we are developing ideas and helping companies to get to the stage where they are ready for an investor.
Alex: Yes. In some cases we even have experience where we've actually helped the company that we were already investing in to obtain grant funding from the British Government, future fund, etc. It's in our interest, once we invest, to help the company grow and succeed. We do have experience and we do support blended finance as a way for the company to grow.

Kate: Regarding Protenga company, do you think the proteins from insects can be added to the human meals in addition to the animal meals?
Alex: I think it can. I know there are some insect companies doing that as snacks, but you ought to be more careful in that. There's more regulation when it concerns human feed. The biggest market at this point in time is definitely the animal feed. I'm not sure how ready the people are to start insects as a main source of protein, but it could happen in the future.

Ram thanked Alex for the interesting presentation and Kate for the Q&A session on behalf of the consortium. Ram expressed belief of getting in touch with Alex in future again for exploring funding opportunities for the project.

22.07
3) WP T3 Activity 1 – by Tamiris Da Costa, UCD

The activity has two deliverables:
Deliverable 1.1 – Systematic Review (UCD & UU) – An assessment of REAMIT technologies, including comprehensive systematic review of the technical and business landscape in the fresh produce food chain. Actions made - Review of the potential sensor technologies, produce it by UCD and University of Bedfordshire.

Actions in progress – The actions in progress include a review paper proposed by UCD – A comprehensive review of real time sensor technology to reduce food loss and waste and its potential applications to support dynamic life cycle assessment.

Objective: This paper aims to understand how, where, and which real time sensors have been applied to monitor food loss and waste until now, and which lessons can be learned from these findings? In addition

it will be analysed how the exhaustive data collection from the sensor based equipment can support life cycle assessment analysis process.

Progress until now:
So far we started the article screening process to assess the case studies on real time sensors at food supply chains. The review was carried out by combining searching terms as food waste, food laws, dynamic real time, and sensor via web of science database in the last 20 years. The literature search resulted in a total of 200 potential relevant articles. We excluded all preceding abstracts, review articles, book chapters. The second step had total 166 articles. In the third step, we did an additional screening to check the elements of the articles based on the abstracts and after this step we selected articles which met the inclusion criteria, which means it's related to real time sensing or articles assessing food waste in the food supply chains, and which were in English and published online. In LCA studies, we had 426 articles and after the screening process we selected 39 studies for the quantitative analysis.

Plan for next steps:
The next step was to start the collection of data from these articles. We selected some parameters to assess, for example food type, sensor technology, supply chain stage, the wireless device, the clue database and the data modelling. I believe in more few weeks we can conclude this step.

Deliverable 1.2 – LCA
This will allow us to understand the main environmental impacts and the benefits associated with the REAMIT technologies implemented in the pilot test. We have 4 stages in the life cycle assessment and at this moment we are at the second stage. The event over analysis in which data is being collected to quantify inputs and outputs of the systems. We can have different data requirements and install the sensors depending on the company that we are working with and stage of the supply chain. Tamiris explained further on this with her experience with Yumchop.

Impact Assessment
The data collected from the last step will be converted into environmental impacts. Every product has some emissions associated in the impact assessment phase, which is the third phase of the LCA. We translate the inventory data into environmental impacts and classify them into some categories like climate change or human health. This translation is made by converting the emissions using this characterization factors. We can have more than 1000 characterization factors. We can group these emissions into a common indicator, for example C O2 equivalent. The software is used to perform these assessment. In the last phase we can determine the total impact and identify which process contribute most to the impact.

Current updates:
The definition of the data requirements for the life cycle assessment to determine the pilots environmental impacts and environmental savings and the production of general questionnaire to collect the data for the life cycle assessment. That is being refined to reflect the specific aspects of it pilot test. Questionnaires are created to collect the data from the companies and organised according to the stage of the supply chain where the pilot is implemented.

Updates on HMF LCA:
The sensors were installed at the storage stage. The idea here was to focus on this stage and perform a gate to gate LCA. In August 2021, we had a meeting with HMF to explain the LCA task and start collecting the data from HMF. However, the director at HMF confirmed they have already done this and agreed to

send us this study, once it is published for our analysis. However, Tamiris still does not have any feedback from HMF since August 2021.

Updates on Yumchop LCA:
In October 2021, the partners from Whysor installed 10 sensors in this company and we started updating the questionnaire to collect the data. We focused on the stage where the sensors were installed. In November 2021, we had a meeting with Whysor and Yumchop about the REAMIT dashboard. During this meeting, the LCA task was introduced. In December 2021, we had another meeting to start collecting data for LCA analysis. Tamiris introduced its concepts and the main benefits. During the meeting she also presented questionnaire on requirements. The company explained the process involved in the food production at the shop factory. However, no data has been collected as it involves the analysis of some recordings. Kate suggested to send these questions to Yumchop in advance, and splitting the questions in smaller chunks chokes. The next meeting is this Friday (January 2022). Tamiris will try to collect data for the process included in the manufacturing box.

Plan for next steps:
Start collecting data to help the pilot phase. Contacting sensor installers and manufacturers regarding the big data server. Collaborating with partners from WP T2.

Ram commented that we should be persistent and would try best to get the data for LCA. Kate and Ram discussed that meeting the partners once a month for LCA requirements is fine for now but we can adapt and reduce frequency as per partner needs in future.

Ram thanked everyone for their contribution to the meeting and concluded the day.

Day 2

WP Communication (09:00 – 10:15)

22.08
WP Communication – Dr. Usha Ramanathan and Sasha Bennett - NTU, UK

4.1 Objective of WP Communication
Dr Usha began with highlighting the main objectives of WP Communication package which are as below:
- Influence agribusinesses to decrease amount of food waste in food supply chains by 10% by 2022.
- Raise awareness of the potential from combined technologies.
- Convince agribusiness users of the value of REAMIT's technologies (aimed at reducing Risk) and increase knowledge.

4.2 Role of NTU in REAMIT – UR and SB
Dr Usha updated about the role of NTU, Dr Usha and Sasha in the project.
a) Coordinating the process of designing the project's communication strategy in close cooperation with the Project Coordinator/Lead Partner and project partners.
b) Coordinating the implementation of communication activities.
c) Managing REAMIT's web space and social media.
    - Sasha has created a new website. We observed linear growth in number of viewers for REAMIT website and social media posts in past months.
d) Liaising with JS and lead partner on project/programme communication.

- Kate and Ram help NTU in contacting JS as and when needed.

e) Several ways of communication will be used in engaging the target groups:
   - Installing project banners and signboards. Physical pamphlets not being used currently due to online remote meetings.
   - Project web space, which is updated frequently to reflect new activities in the project.
   - Exhibition, flyers and posters in Industrial and academic events - Poster production happening for every new pilot test. NTU seek content from all the pilot test partners.
   - Press & media (Newsletter, TV programmes, promotional video, promotion through local business, web articles & Journal articles) - Newsletters being published every month. Publishing web articles, journal articles, through PRME, NTU local newspapers. Encourage partners to publish in local media in respective regions. Presented in annual conferences in NTU.

4.3 Policy Briefs

Objective for us is to contact local councils and food associations to disseminate REAMIT work. Dr. Usha informed that work on this is currently behind schedule although it is to be completed in Jan 2023. She highlighted that we do not have enough policy documents. We need to bring more policy contributors to be involved in the project. We can involve policy committee members in pilot test and case studies. Usha is to prepare template on Policy Briefs after referring templates from other projects.

Ram suggested we need to accelerate on Policy Briefs work. He highlighted the inclusion of Alex from Miltrust and Peter of JS in the RSC meeting as a good starting action on Policy Brief work. Ram also highlighted that we need some data analytic results to substantiate the work on Policy Briefs for presenting it outside REAMIT.

Kate suggested Usha to approach Peter and JS Communication Officer for support and guidance on designing Policy Brief template which Usha agreed with. Usha welcomed suggestions and thoughts from all the partners on what other policy impact REAMIT may have.

Action: NTU to present policy brief examples from projects supported by Interreg NWE Programme.

Action: NTU to present ideas for policy briefs in REAMIT.

4.4 Communication Strategy Document

- It is available in REAMIT SharePoint and is being updated every six months.
- Usha asked all the partners to update this document with their updates on various events and conferences relevant to REAMIT that they attended.
- Usha updated that Case studies are being developed for various pilot tests. She updated that case study with Yumchop has been completed 50%. Good progress has been made on case study with HMF. UU would update on case study with WD Meats. Started case study with Picnic but not much further progress has been done recently. With Routhiau, Ali (UoN) would support the case study development.
- Usha aims to complete case studies on 6 pilot tests by end of 2022.

Action: NTU to advance work n 6 case studies.

- On Routhiau, Ram suggested Usha that we can involve other visiting lecturer in BED Lakshmi to produce the case study with the support from Ali, to reduce burden on Dr. Usha.

- Book Chapter is accepted and is being published.
- Conference presentations and publications regularly happening.
- Sasha updated that we launched new website for REAMIT project other than the NWE Programme's website. The advantage with having new website is to be able to monitor the user traffic visiting the website and have full control over the design of website. Sasha got similar reasoning from other Interreg project communication officers for having a separate website.
- Sasha gave a demonstration of the new website with its newly added features.
- Sasha mentioned that she would also like to have a login functionality on this website to login to BED REAMIT server. Sasha would work with team at BED and data analytics partners to implement this.
- Ram suggested to have at least one video per pilot test and requested all the pilot test leads to facilitate this and share their activities in the pilot test through the video.

Action: NTU to advance work n 6 case studies.

- Usha updated that earlier we used to have animated videos, but we still have not much actual video. Usha suggested we can have a combination video of animated and actual videos.

Action: NTU with support from partners to propose (and develop) actual videos on REAMIT (not only animated).

James expressed doubts on technical feasibility on implementing accessing REAMIT server through REAMIT website could be technically challenging. He advised to rather provide a link to instruction set for accessing the REAMIT server. Ram suggested that we should first explore and try implementing this functionality, otherwise we can look for having a link for the instruction set.

Action: NTU to explore and implementing a new functionality on the REAMIT website: add a log in button to access the Big Data server.

James inquired about budget for the documentary videos. Usha updated that NTU has the budget and can assist the partners in filming documentary videos. Sasha suggested ideas about possible content of documentaries video.

Ram suggested James to present to the team the documentary video he had made.

Action: Ulster to present to the team the documentary video made at Ulster.

Usha updated that target audience for REAMIT videos is the general public and television audience.

Sasha thanked everyone for their feedbacks and suggestions on the REAMIT website.

4.5 Report on REAMIT Networking Events

Sasha presented a report on the networking events that REAMIT PPs attended. We compiled record of all the events REAMIT PPs have attended and seek partners to regularly update NTU on various events they attend. Sasha updated about progress on REAMIT promotion through key metrics of Symposium promotion through social media in terms of tweets, hashtags, likes, traffic website, subscription and trends which has been a success.

4.6 Project Banners, Posters and Flyers
Sasha updated about work on project banners, posters and flyers. We published 3 newsletters in past months. New posters were developed for UCD cyberbar project, promotional material was developed for Symposium 2021. Sasha informed about use of Mailchimp platform for developing Newsletters. It is an automated platform for mailing list and timers and useful for monitoring traffic and managing subscriptions smoothly. She informed that subscription and views increased by 20% in the period. Sasha urged all the partners to share news for Newsletters regularly.

4.7 Communication through local communication channels
Sasha highlighted that NTU has been regularly pushing the partners to communicate through local channels and social media platforms. She updated that REAMIT partners have published 19 external social media posts on the social media in past 6 months. It's a great achievement and shows power of our collaboration. She thanked all the partners involved. There were 8 tweets and retweets 8 by Southern Regional Assembly in Ireland in support of Symposium 2021. NTU published PRME report for 2021, featuring REAMIT. An article on HMF was also published. Case studies are also being developed with the help of various RAs in REAMIT.

Action: PPs to communicate about REAMIT through social media platforms.

Ram thanked NTU for the work on Communication activities and requested all the partners to share content with NTU.

22.09
5) Status of REAMIT project Extension by 12 months
Ram updated that Peter of JS has already informed earlier that he would submit the Project extension request for REAMIT along with other projects extension request to JS monitoring committee this month end (January 2022) and the committee would decide in two weeks subsequently. Hopeful about approval of the budget extension request and would send a formal email to LP about this after the approval.

22.10
REAMIT Steering Committee meeting (RSC) (10:30 – 12:30)

22.10.01

Action log resulting from RAC/WP/RSC meeting, 7-8 July 2021

Date	Minute/ Item	Action *identified*	Responsibility	Update: *Confirmation of completion or reasons for non-completion*
07/07/2021	21.16.01	As REAMIT is still recruiting companies, all partners have been encouraged to keep approaching companies for pilot tests.	Al PPs	Completed
07/07/2021	21.17.01	Each pilot test lead to develop a user manual for each pilot test. A user manual for each pilot test shall document the experience of the pilot test and a step-by-step guide of good practice in each pilot test.	Each pilot test lead	Link with WPT1 Meeting – a template will be circulated by RR. Ongoing
07/07/2021	21.17.01	Each pilot test lead to write a report on the pilot test and development of the sensor prototype. The report will describe in detail the experiences with the pilot test and give recommendations for future pilot tests.	Each pilot test lead	Ongoing RR will send templates for Yumchop and HMF
07/07/2021	21.17.02	UCD to report the results of the first stage (proof of concept carried out in July-August 2021) of the pilot test in Ireland inspired by Freshbox.	UCD	Discussed on 19.01.2022 Ongoing
07/07/2021	21.17.02	UCD to approach min 10 companies in agri-food supply chains in Ireland to demonstrate the tests inspired by Freshbox idea, to encourage their participation in REAMIT pilot tests. To do this, UCD may ask for help Innovation & Enterprise service at UCD, Interreg NWE Programme Contact Point person for Ireland or Enterprise Ireland (or equivalent services).	UCD	22 companies approached. More are being contacted for a pilot test. Completed.
07/07/2021	21.17.03	UoN to move the Raman spectroscopy pilot test to the next phase – transition from the lab experiment to the real conditions in the food trucks (Scheduled on 9th of July 2021). This includes renting a truck.	UoN	Ongoing. Last stage of transition. Will be completed in 2 months. Routhiau's truck will be used.
07/07/2021	21.17.03	UoN to confirm whether IGRECA and Prince de Bretagne will participate in the pilot test with Raman Spectroscopy.	UoN	Completed Not participating
07/07/2021	21.17.04	Whysor to assist online with installation of sensors at HMF.	Whysor	Completed

07/07/2021	21.17.04	BED to obtain from HMF images and videos documenting installation of sensors at HMF, for the purpose of developing Reamit communication materials.	BED	Completed. Videos requested from HMF
07/07/2021	21.17.05	Whysor to confirm whether sensors installed in Picnic's trucks will be re-programmed to also collect correct data on shock detection.	Whysor	Ongoing
07/07/2021	21.17.06	Ulster to obtain from Marc at WD Meats information about weight of carcass before entering dry aging chamber and when leaving dry aging chamber.	Ulster	Completed
07/07/2021	21.17.06	Ulster to specify what lessons have been learnt from the first pilot test with dry aging chamber, discuss it with WD Meats and based on it propose how the second pilot test in dry aging chamber will be run.	Ulster	Completed
07/07/2021	21.17.06	Ulster to run a second pilot test in dry aging chamber (for another 3 weeks).	Ulster	Completed
07/07/2021	21.17.07	Ulster to purchase DNA extraction kit required to process the frozen swabs from WD Meats.	Ulster	Completed
07/07/2021	21.17.07	Ulster to get an update internally when a new machine will be purchased and when swabs from WD Meats can be analyzed.	Ulster	Completed
07/07/2021	21.17.07	Ulster to analyze swabs from WD Meats.	Ulster	Ongoing
07/07/2021	21.17.08	Since James and Xavier expressed interest in working closely on developing this pilot test, they are requested to develop a plan of actions to take this pilot test forward. Ulster and UCD to develop a plan of actions to take 3D Fluorescence pilot test forward.	Ulster and UCD	Xavier and James met. Ongoing
07/07/2021	21.17.09	Ulster to work with Whysor to specify which sensors to be installed in Musgrave vans.	Ulster and Whysor	Completed
07/07/2021	21.17.09	Ulster to install sensors within Musgrave vans.	Ulster	Ongoing. Next week.

07/07/2021	21.17.09	Ulster to develop an android app required to handle data from the sensors in Musgrave pilot test. Application will need to be tested prior to deployment.	Ulster	Completed
07/07/2021	21.17.10	BED and Whysor to support Yumchop online with installation of sensors and connection to the cloud.	BED and Whysor	Completed
07/07/2021	21.17.13	I&R and MTU to approach contact point person for France and Ireland and Ireland to recruit new companies for pilot tests.	I&R, MTU	Completed for MTU. Ongoing for I&R
07/07/2021	21.18	Whysor to go on a virtual tour of Glen Affric and propose what sensors shall be used in this pilot test.	Whysor	Completed
07/07/2021	21.18	Ulster to identify the right person at Dale Farm to discuss Dale Farm participation in the REAMIT pilot test focused on reducing food waste in the cheese production process.	Ulster	Ongoing
07/07/2021	21.21	Whysor to hold a meeting on dashboard and data in Whysor cloud.	Whysor	Completed
07/07/2021	21.24	BED to organize a technical meeting of technical partners regarding license for Big Data Hub at BED, connections to the Big Data server, etc.	BED	Ongoing
07/07/2021	21.25	UCD to organize in September 2021 an online planning meeting with BED and NTU on the 3rd REAMIT Symposium in Ireland.	UCD	Completed
08/07/2021	21.27	Each partner to develop at least one piece of news about REAMIT to be communicated in social media. This can be converted as local news in local languages.	Each PP	Completed
08/07/2021	21.27	NTU to have one-to-one interactions with PPs to assist with creating small social media local news.	NTU	Completed
08/07/2021	21.27	NTU to finalize a storyboard, which is a collection of different stories from around the globe on actions to avoid food wastage through technology, all through social means like charities.	NTU	Completed
08/07/2021	21.27	NTU to develop a new, stand-alone REAMIT web page and send it to PPs for feedback.	NTU	Completed

08/07/2021	21.27	PPs to identify the local and national policy-makers and stakeholders within the North West Europe region to whom they will disseminate information about REAMIT approach.	PPs	Ongoing NTU has been in contact with local councils. UCD has contacted local policy makers in Ireland for the Symposium BED connected with Trace and Trust in Germany and SEMLEP A dedicated workshop with policy makers. Or, target the next symposium on policy makers.
08/07/2021	21.28	BED to finalize the paperwork related to the approval of REAMIT project 12-months extension budget.	BED	Completed
08/07/2021	21.29 .01	Ulster to get feedback from associated partners on 5th REAMIT progress report and share it with BED.	Ulster	Ongoing
08/07/2021	21.29 .02	NTU to develop communication materials about REAMIT in German language with Whysor's help regarding translation.	NTU	Ongoing
08/07/2021	21.29 .02	Whysor to liaise with GIQS (national contact point for Germany) about new companies in Germany for REAMIT pilot tests.	Whysor	Completed
08/07/2021	21.29 .02	NTU to develop communication materials in French language i.e. one short video about pilot tests in the REAMIT project will be in French, with support from I&R, Valorial and UoN.	NTU	Completed. Video needs voiceover. ongoing
08/07/2021	21.29 .02	UCD and MTU keep making efforts to recruit new companies in Ireland.	UCD and MTU	Ongoing
08/07/2021	21.29 .02	I&R to ask Prince de Bretagne if they are keen to connect their sensors to the REAMIT cloud and obtain from the REAMIT consortium an alerting system for this data.	I&R	Completed
08/07/2021	21.29 .02	BED to support Whysor with sending sensors to Yumchop and HMF in the UK.	BED	Completed

08/07/2021	21.29.02	Whysor to provide online support for fitting sensors at Yumchop and HMF.	Whysor	Completed
08/07/2021	21.29.02	Levstone to support Yumchop and HMF physically with fitting the sensors.	Levstone	Not needed
08/07/2021	21.29.03	Ulster to decide about the format of the RAC/WP/RSC meeting in January 2022 and communicate it to PPs.	Ulster	Completed
08/07/2021	21.30	Partners involved in case study development, to collect information from pilot test companies on their technical and business activities.	UCD, Ulster, MTU, BED, NTU	Ongoing. NTU will also be involved.
08/07/2021	21.31	UCD to define the data requirements for the LCA for each REAMIT pilot.	UCD	Ongoing
08/07/2021	21.31	UCD to hold individual meetings with each pilot leader, since the LCA must be adapted for each type of case.	UCD	Ongoing
08/07/2021	21.31	UCD to start collecting data from the companies and pilot tests after data compilation in WP T1 and WP T2.	UCD	Ongoing
08/07/2021	21.34	Case study team to develop a common structure for collecting information for all the case studies, although it may be necessary to have different structures as per the case study needs. Case study team to also develop a questionnaire for the pilot test companies, to collect data from them.	Case study team: UCD. Ulster, MTU, NTU, BED.	Ongoing. The case study on Yumchop is likely to be completed first and can form a reference point

The minutes have now been confirmed and actions have been reviewed.

The feedback from RAC meeting and the decisions of the WP meetings will be discussed and approved after discussion during RSC meeting.

No feedback has been received so far. Ram asked if any significant decision was taken in the WP meetings yesterday. No input was received.

22.10.02
Revision of the REAMIT risk log.

New risk in REAMIT Pilot tests:

1. Delay in the supply of sensors. Lack of supply of chips for sensors. Whysor found sensors from a company in South Africa for HMF and Musgrave. How to address the risk: Whysor has requested

different loggers from the same supplier. Levstone has contacted a new supplier in China who have provided new sensors. Medium risk.

2. Reluctance of pilot test companies such as HMF, Yumchop to provide detailed information on LCA. Low risk. Some information for these pilot companies can be readily available online.

22.10.03
Calendar for 6th REAMIT project activity and finance report and payment claim (July – December 2021).

By Friday 17th of December 2021, most partners have provided their reports. By 11th of February 2022, partners will have submitted the certified reports by their FLC auditors.

22.10.04
Plans for the 7th meeting of RAC/WP/RSC: 6-7 July 2022, hosted by Whysor, Imke Hermens, Whysor.

RR says we are hoping to host the next RAC/WP/RSC meeting in person in the NL. KP will meet with IH in February 2022 to discuss the plans.

22.10.05
Plans for the 4rd REAMIT Symposium in December 2022 hosted by I&R and Valorial. Gael Maugis and Gladys Gallot from I&R; and Adrienne Gentil from Valorial.

AG from Valorial presented an interactive brain storming session to present ideas for the December 2022 Annual REAMIT Symposium in France.

22.10.06
Research studies from the REAMIT project (13:00-13:45)

RR: Related to the paper Usha worked for special issue it is about food waste, that would be an incentive for business.

RR wishes to progress the three papers that Lohit started but has not had the time to revisit it yet. RR asked if anyone had time to help with these papers it would be greatly appreciated.

Lakshmi carried out quantitative analysis related to factors why companies incorporated IoT sensors.

YD has completed questionnaire, which will be sent to food companies in the UK, Europe and possibly beyond (e.g. Lohit in India is a possibility).

The case studies can generate new knowledge in some journals, however we are far from publishing this piece of work as the case studies are still in their infancy.

Sensors review is an unfinished paper, which has not progressed further due to only 3 or 4 people participating in the interviews. Time constraints have meant this paper has not progressed any more at present.

RR highlighted that paper publishing does not end at the end of the project. We can use the data from the project and produce more papers after the project ends.
RR: Welcomes producing more papers.

RR asked for input from the rest of the group.

TA: Jipsy' sensor review paper is looking at optical sensors and other sensors, detecting freshness of fruits. TA plans to publish this paper with the help of Sahar. TA said she would be happy to collaborate cross-institutionally if others are keen to help. James and Xavier have expertise in this field and would be good to have them join on this paper.

TA is interested in producing a paper on the deployment of sensors in businesses, giving an overview for anyone else who wants to do this. TA requests the help of IH since Whysor have provided the sensors. It is more a paper rather than a case study.

RR invites partners, especially academic partners to come up with producing more papers. We are ultimately producing a huge amount of data and knowledge which will benefit the academic community at large.

RR: Ulster were developing a paper related to sensors – any updates?
JG: William worked on a paper and had submitted it to two journals both of which rejected it. The paper is sitting written and could be tried elsewhere.

RR: There are huge opportunities for analytics partners. MTU and BED work on analytic side instead of mathematics. SA will collaborate on some related parts. RR suggested that SA could lead on this work.

RR asked AA if they are producing any scientific papers out of their findings so far.
AA: we are not writing anything at this stage, but aim to produce some scientific papers later in 2022.

RR asked for any plan for publishing initial LCA work.
XC mentioned that there is a systematic literature review being prepared of sensor technology linked to LCA.
RR supports the plan to publish this work, and highlighted that they should include REAMIT name in acknowledgement.

Huge opportunities in publication of case studies – these may not be research journals but they are considered equally important for teaching etc. NTU is leading on case studies development, and asked if there is a plan to publish them.

UR: For publication, you can go for a paper style of case study or a real industry style of case study. Industrial or academic case studies. UR cannot confirm at present which way we are going to go ahead.

RR thinks that if we publish a paper through case study mode, there is still a chance to publish some of it in a journal research paper.

RR: We should publish in a good way. Research paper; finding new way of knowledge and related to the case studies, how to improve a method.

RR is interested to submitting a paper based upon some REAMIT work at the British Academy of Management conference (31st August – 2nd September 2022). The call for papers has just opened on 10th

Jan and deadline for submitting is 25th Feb. RR asks if there is any possibility to write a paper for this he would like to chat more with us.

SA explained about her literature review, related to the application of IoT for food waste management. She has finished the section reviewing the sensors and is currently working on the second part related to data analysis. She proposes creating a second paper based on the paper RR sent to her instead of combining it with her current literature review.

SA asked if these papers have been published yet. RR said not yet.

RR encouraged non-academics partners to participate in some part of research and publication. Nowadays, papers which contain authors from non-academic partners are considered more valuable than papers which come completely from academic partners only.

RR put a conference in the chat box and requested that we work on a submission for this together.

TA is interested in working together on practical sensor paper involving Levstone and Whysor. RR asked IH to contribute into several publications. He stated that IH has a lot of knowledge on how businesses behave when approached about implementing IoT systems which would be great to document in these papers. IH said she can help.
SA is going to send a paper. Try to include non-academic partners. Encourage academic and non-academic partners to collaborate.

RR hopes to produce a book based on his experiences from the REAMIT project.

22.11
WP Project Management (13:45 – 14:15)

KP provided a presentation regarding REAMIT management. Report 3.2 has been completed by each of the partners. However, KP encouraged partners to revisit their reports and update their target groups to reflect who the project had been disseminated to in the last reporting period.

The REAMIT target groups were shown as follows:

- Local public authority
- Regional public authority
- National public authority
- Interest groups including NGOs
- Higher education and research
- Enterprises (Excluding SMEs)
- SMEs
- Business support organization
- Sectoral agency

Logging the names of all the companies reached is important. There's a special section in eMS just above preparation called target groups reached. If you click the plus you can add in all the target groups. KP already contacted some of the target groups and tried to approach them with the aim of promoting REAMIT.

REAMIT 3.3 special report has been created for NTU, Whysor and UCD. This has been created because these partners' reports were not included in the previous progress report. Currently this report is with the Bedfordshire auditor. If the reporting is not done properly then a special report must be created. Kate showed a worked example to explain to the group what went wrong previously. An excel spreadsheet from eMS was shown. Staff cost calculation is done, but for part time employees there is an issue.

The new REAMIT officer at JS is requesting correction in eMS, to specify which method is used to calculate staff costs. The report has been reopened and will need to be resubmitted. If it was reopened it incurs additional costs as it will then need to be re-audited (Auditing costs for BED, UCD, NTU and Whysor).

A new REAMIT officer has joined, who has a differing opinion on how to correctly complete reporting compared to the previous 2 officers who have worked on the project.

KP will send the manual to UR to have a look at section 5.5. The new officer did not know we cannot open the report which is certifying by the auditor.

Risks had already previously been discussed in the meeting.

KP has asked for all minutes from any WP meeting to be shared to be included in the project handbook.
RR: one point regarding internal meetings: there are internal meetings happening at UoB and Essex. RR asked if there are internal meetings happening at other institutions.

JG confirmed that Ulster tend to have meetings every month, though they had quietened down over summer.

UR: We have a meeting every week, though it is just the two (SB and UR) who make up the communication team participating in these.

AA: We have a meeting every 2 weeks.

RR: requests that minutes from internal meetings are submitted and included in the project handbook. It is important to keep all staff up to date on the project progress.

KP asked MTU and UCD for their input on their internal meetings.

GS confirmed that he meets with Gerard every week and every 3 weeks they also meet with Pat. GS has also met with UCD a couple of times to discuss Irish pilots.

For UCD, XC confirmed he has had a few meetings with Shane however there is no protocol on the regularity of the meetings. He estimates he has met with Shane 4-5 times.

KP has observed that junior colleagues have been left quite on their own from more senior colleagues, and considered it a risk. However, she has not included it as a risk yet. KP highlights that working from home and covid has made the issue worse.

XC thinks that it is better now than it was before. XC confirms he is in regular communication with TC.

Action: All PPs to include minutes from internal meetings in Project Handbook in SharePoint.

RR confirmed that contracts have been agreed and dispatched to the relevant contacts at both Beds and Essex which means UoE will be officially a sub-partner of BED. Ram hopes this will be finalized in a month's time and UoE logo will be included in REAMIT materials. RR will continue as PI of REAMIT.

22.12
WP Long Term (14:15-14:45)

22.12.01
The only updates for WP long term is as follows:

- **DLT.1.1 Network prospectus:**

New actors were approached in the previous reporting period:

- Trace+ Trust network, DE;
- Milltrust, UK;
- Blue Skies, UK;
- Circular Bioeconomy Research Group, IE
- FoodCloud, IE
- Enterprise Ireland, IE
- Meat Technology Ireland, IE

UCD approached 9 companies through research institution, Biorbic.

22.12.02

- **DLT.1.2 Networking events**

3rd REAMIT Symposium was hosted by UCD, 8-9 November 2021.

RR: In terms of LT, one of the deliverables of the project is to expand the REAMIT technology beyond food in other areas, for instance pharmacy, or for vaccine transportation (need to be kept at explicit temperatures in transport). Since these are higher value products, most likely they have technology in place already. If any partners have contacts in any other areas, please reach out to them. We can be confident that our technology makes business sense so we can expand.

KP suggested that these kinds of companies should be targeted for the REAMIT symposium.

TA asked about the deadline for invitation for pilot companies. RR confirmed that this has been extended to Jun 2022.

RR mentioned that applications with the blood supply chain, between hospitals to hospitals, and fresh flowers are some ideas that can be considered to expand the REAMIT technology beyond food. TA agreed that expanding to flowers first is a great idea since it isn't as critical as blood or vaccines.

IH will check with someone she knows who owns a flower shop to see if there is a possibility for collaboration. Flowers are produced in the West of the Netherlands, so IH doesn't have many contacts.

TA suggested that Timber could be an important material to monitor temperature and humidity, RR suggested wine.

22.12.03
Case Studies

UR provided a presentation on the case studies. UR stated that the essence of these case studies is capturing what the unique / exclusive challenge is of the pilot company, and what contribution we make with REAMIT technology.

UR gave an overview of the HMF case study, including basic description of the company's operation. UR asked if we are only monitoring temperature of the milk at the transport stage. KP confirmed that currently REAMIT technology is only deployed at the transport stage, although different phases of the pilot have been discussed with Natalie at HMF. KP is unsure if the REAMIT trial would expand to their storage facility as she thinks they already have their own monitoring equipment there.

UR is aware that we should not be repetitive in our case studies when it comes to technical description – we are aiming for each case study to be unique. UR got new training last week in case study writing; She learnt some new techniques which she hopes to use. Yumchop is a fine example of a neutral case study, so UR is using the traditional case study approach. She is hoping to finish the Yumchop case very quickly, and lessons learned from collecting this case study will inform further case studies.

Yumchop prepares African delicacy meals which are frozen and served from Universities, Hospitals and Vending Machines across the country. Freezing is a long-established food preservation approach; however, freezing is not free from errors. The freezing process can have a fluctuation in temperature, which can result in spoiling they taste of the product, so REAMIT is intervening in this process and helping them to maintain the quality and taste, which in turn is attracting the customers. REAMIT technology is giving market value to the product in terms of quality enhancement / quality maintenance.

XC explained the process flow of Yumchop. Yumchop collect spices, vegetables, meats, and oils from local producers, for example the meat comes from local butchers which are Halala friendly. The ingredients are transported to a local warehouse where they are washed, chopped etc. and then put in refrigeration. After this, it undergoes flash freezing and packing, and then it is ready for distribution to vending machines, hospitals etc. It is also possible to purchase the products online. REAMIT technologies will be useful at the refrigeration stage to monitor the temperatures, but it could also be deployed in their own brand vending machines.

UR feels like due to the unique approach of sensor technology for food waste reduction we should be able to publish the work as a paper even if the case study company name needs removed. UR hopes to have at least one case study submitted for publication by the time of the next RSC meeting.

UR said there is still some open questions regarding legislation, and if the work is going as a full fledged case study this detail will be required. Companies may be reluctant to share this information. However, this level of detail would not be required if it is going as a journal.

YD asked if we should provide a concise definition of REAMIT technology, that could be used for all communications etc. RR stated that he would like to avoid using the term REAMIT technology since REAMIT has not actually created its own technology; rather it is uniquely combining sensors, Internet of Things and Big Data Analytics to provide a solution. REAMIT based technology is the preferred terminology. RR said we should either define this term at the start of each paper etc. or just refer to the technology as IoT sensors with big data analytics.

YD suggests that we could use REAMIT project if REAMIT technology has been used too many times; RR said KP has previously suggested using REAMIT approach.

22.13

Any Other Business
KP asked if all partners had received their money yet. DB said he would check tomorrow. JC said she will check too.

RR asked partners for their opinions on the format of the consortium meeting going forward; he said there are too many items to discuss to fit the meeting into one day. JG suggested moving one session from day one to day two so that both days were a little more evenly balanced (in this consortium meeting day one was much longer than day two). JC said she would like to see the next consortium in person; IH agreed and said it is easier to be fluid with the agenda when you are sitting together (for example if people need a longer break at a stage). RR said he thinks it is a good idea to move one session from day one to day two for the next meeting to allow for slightly longer breaks / lunch.

RR thanked partners for their attendance.

End of the day 2.

Action log resulting from RAC/WP/RSC meeting, 19-20 January 2022

Date	Minute/ Item	Action *identified*	Responsibility	Update: *Confirmation of completion or reasons for non-completion*
19/01/2022	22.03	As REAMIT is still recruiting companies, all partners are requested to keep approaching companies for pilot tests.	Al PPs	BED connected with Blue Skies (UK).
19/01/2022	22.04.03	UoN to document all the experiences with the Raman pilot test, including experiences when approaching companies for pilot tests, in a story telling format to be used in future publications.	UoN	Ongoing
19/01/2022	22.04.04	Whysor to document all the experiences with the pilot test with Picnic in a story telling format to be used in future publications.	Whysor	Ongoing
19/01/2022	22.04.05	Whysor to document all the experiences with the pilot test with VHG in a story telling format to be used in future publications.	Whysor	Ongoing
19/01/2022	22.04.06	Whysor to document all the experiences with the pilot test with Biogros in a story telling format to be used in future publications.	Whysor	Ongoing
19/01/2022	22.04.07	NTU to document all the experiences with the pilot test with Glen Affric in a story telling format to be used in future publications.	NTU	Ongoing
19/01/2022	22.04.08	Ulster to document all experiences in the Dry Aging Chamber pilot test with WD Meats in a story telling format to be used in future publications.	Ulster	Ongoing
19/01/2022	22.04.09	Ulster to document all experiences in the Clostridium Bacteria pilot test with WD Meats in a story telling format to be used in future publications.	Ulster	Ongoing
19/01/2022	22.04.10	Ulster to document all the experiences with Musgrave pilot in a story telling format to be used in future publications.	Ulster	Ongoing

19/01/2022	22.04.11	BED to document all the experiences with Yumchop pilot in a story telling format to be used in future publications.	BED	Ongoing
19/01/2022	22.04.12	UCD to document in a story telling format how ideas at UCD developed for fresh box and proof of concept pilot tests; how these ideas evolved and what actions were taken to implement them. Please include names of all companies that have been approached to participate in these experiments.	UCD	Ongoing
19/01/2022	22.04.13	Ulster to document in a story telling format how ideas at Ulster, BED and Whysor developed for 3DF pilot tests; how these ideas evolved and what actions were taken to implement them (input from Matthias, Gypsy's experiments, SensipDx, etc.). Please include actions taken and names of companies that have been approached (manufacturers of 3DF sensors suggested by Tahmina) to advance the work on 3DF pilot test.	Ulster	Ongoing
19/01/2022	22.04.14	BED to report in story telling format experiences with the pilot test with HMF.	BED	Ongoing
19/01/2022	22.05.03	BED, Whysor, Levstone and data analysis partners to determine whether a separate manual is needed on how the Whysor server is connected to REAMIT Big data server.	BED, Whysor, Levstone	Ongoing
19/01/2022	22.05.04	Levstone and pilot test leads (HMF, Picnic, Musgrave, etc.) to meet and discuss if the Blue Maestro system proposed by Levstone would be beneficial for them.	Levstone, Whysor, BED and Ulster	Complete
19/01/2022	22.05.06	UoN to make sure that data from Raman pilot test is transported to the Big Data server at BED.	UoN	Ongoing
19/01/2022	22.05.09	Data analytics partners to go beyond time series analysis and move to predictive analytics (rather than descriptive).	BED, MTU, SenX, Ulster	Ongoing
20/01/2022	22.08	NTU to present policy brief examples from other projects supported by Interreg NWE Programme.	NTU	Ongoing

20/01/2022	22.08	NTU to present ideas for policy briefs in REAMIT.	NTU	Ongoing
20/01/2022	22.08	NTU to advance work n 6 case studies.	NTU	Ongoing
20/01/2022	22.08	NTU with support from partners to propose (and develop) actual videos on REAMIT (not only animated).	NTU	Ongoing
20/01/2022	22.08	NTU to explore and implementing a new functionality on the REAMIT website: add a log in button to access the Big Data server.	NTU	Ongoing
20/01/2022	22.08	Ulster to present to the team the documentary video made at Ulster.	NTU	Complete
20/01/2022	22.08	PPs to communicate about REAMIT through social media platforms.	PPs	Complete
20/01/2022	22.11	All PPs to include minutes from internal meetings in Project Handbook in SharePoint.	PPs	Ongoing

Approved

Draft minutes from REAMIT Advisory Committee, Work Packages and Steering Committee meeting, 06-07 July 2022

Hybrid meeting hosted by Whysor
Venue: Brightlands Campus Greenport Venlo Address: Villaflorawegl 1, 5928 SZ Venlo, The NLBuilding: Villa Flora Room: Inspiration Room
Teams online meeting room hosted by Whysor

Attendees present:

Name	Institution	Name	Institution
Ram Ramanathan (RR)	Essex	Jean-Charles Vialatte (JV)	SenX
Katarzyna Pelc (KP)	BED	Fionnuala Murphy (FM)	UCD
Yanqing Duan (YD)	BED	Shane Ward (SW)	UCD
Tahmina Ajmal (TA)	BED	Tamiris Da Costa (TC)	UCD
Sahar Ahmadzadeh (SA)	BED	Xavier Cama (XC)	UCD
		Ali Assaf (AA)	UoN
Gael Maugis (GM)	I&R	James Gillespie (JG)	UU
Gladys Gallott (GG)	I&R	James Dooley (JD)	UU
Davinder Bola (DB)	Levstone	Imke Hermens (IH)	Whysor
Gautam Samriya (GS)	MTU	Tom Verstraten (TV)	Whysor
Usha Ramanathan (UR)	NTU		
Sasha Bennett (SB)	NTU		
Adrienne Gentil (AG)	Valorial		

Day 1. Wednesday 6th July 2022 – Morning Session

09:00 - 09:05: Welcome to REAMIT meetings (Chair BED)

RR thanked all partners for their contribution to the project over the previous period. RR asked to have updates of WP Communication package in place of report by BED, as KP would join around noon (due to unexpected family circumstances – an ill child).

22.14

09:05: REAMIT Advisory Committee (RAC) meeting

- **REAMIT project progress (presentation by BED)**

So far there were no comments from RAC on the progress of the project. RR mentioned that although it is a good sign, it would have been helpful to receive feedback, suggestions as well as compliments from Advisory Committee members.

RR asked if KP had prepared the lead partner progress report covering January – June 2022, which would summarise each partner's progress so far. KP said that she has not had a chance to prepare the overall report yet as some partners submitted their report late, while others still have to submit it. Also, she was on annual leave for the last week. KP suggested she can present the Bedfordshire updates and ask WP leads to present summaries of their respective work packages' progress over the last six months.

RR asked anyone who has not yet submitted their progress report to make sure it is submitted today (06/07) if possible.

RR shared his screen and presented the project report completed by BED. This report covered most tasks completed over the last reporting period since BED is coordinating many of the project's activities.
BED has completed some activities relevant for all the work packages. This includes the activities that BED has collaborated with other partners on. BED has supported pilot test leads (WP T1): Whysor who is responsible for Picnic, VDH, BioGros, as well as supporting hardware, cloud and dashboard provision; UU that is leading on Musgrave and WD Meats; UoN leading on the Ramen Spectroscopy pilot tests; UCD who have started working with Burns Meats Farm. I&R is coordinating monthly meetings of WP T1. NTU has been working on the Glen Affric pilot test and is leading on communication activates about all pilot tests.

RR noted that so far, we have linked with 14 pilot test companies which are currently in various stages – some of which did not work out in the end and so not all of them will finish. However, we have promised and are hoping that we will deliver a minimum of five pilot tests, but the more we have the better. We have also developed a template for pilot test story telling. We need to show the activities that are performed for each pilot test. We believe it is pilot test leads who are better positioned to produce the description of the test.

Action: all pilot test leads to fill in the template for pilot test story telling.

I&R will make more updates during the WP T1 session in the afternoon.
Regarding WP T2, BED will prepare a separate presentation on the progress of this WP later. RR highlighted that BED has organised four meetings of WP T2 over the previous 6-month period. Special support from MTU and UU has been provided for the maintenance and optimisation of the big data server. BED is also working with Whysor to ensure the data from the Whysor cloud is pushed to the BED cloud on a regular basis.

Regarding WP T3, BED has supported UU's lead on the implementation of the activities. UCD are leading on LCA activities. Data has been collected from HMF and Yumchop, and RR believes we have good data from BioGros from the company visit performed on 05/07/2022. If TC needs more data, RR will ensure we get the necessary data for her.

BioGros has been very supportive and helpful and spent all morning with us yesterday. RR is hopeful we will get a good pilot test from them.

KP has taken lead on WP T3 on what can be done when the project will be closing in July 2023. KP will provide further information on this today or tomorrow. RR also had a brief meeting with Marcel yesterday to try to understand what we can do after the closure of the project next year – he will share these points at WP T3 meeting.

Regarding WPM, we have had an exceptional number of meetings which always helps with the progress of the project. We are now in the 7th RAC meeting, thanks to Whysor and BED. KP has taken extra responsibility from finance in this period to prepare for audit at BED.

Regarding WP C, our communication partners have already made their presentation informing partners on what newsletters, posters, case studies, tweets, and others have been produced in this period. RR requested partners to share tweets and posts on LinkedIn too. The project has also participated in many external events.

We have not made much progress on WP LT. This will progress in the next period given the upcoming REAMIT Symposium.

We have completed redeveloping the REAMIT project extension budget and getting it approved by the JS. Last month, the updated budget was officially included and approved in the REAMIT application form. We are in the extension phase as of now.

The development of the sustainability special issue journal is important. RR is using it as a chance to showcase our work in the form of published papers. It is a little extra effort; we've done so much work, it's useful to put it in a paper. This is mostly useful for academic members of the consortium. Hopefully, everyone can support our work in the preparation of the journal. If there are other opportunities in various journals, conferences, etc. please feel free to submit your papers there.

RR requested that each partner sends their progress report to the RAC committee. Each partner should know the committee person for their institution to send it to in order to receive views and feedback.

10:45 – 13:15 REAMIT WORK PACKAGE (WP) MEETINGS

22.15

- **WP T1 Pilot Tests (Chair I&R)**

Adapting and pilot testing sensor technologies in agri-food supply chains (GG - Images et Réseaux)

According to GG, Images et Réseaux have already submitted several deliverables, including:
D1.1 Publication of open call (March 2023): no new submission, note to be submitted.
D2.1 Partner workshop on sensor and Big Data (Jun 2019)
D2.2 Test roadmap (March 2023): no new submission, note to be submitted.
D1.2 Min 5 companies recruited from agri-business supply chain for pilot tests (Jul 2020).
Regarding the deliverables to be submitted by March 2023, these will include:
D3.1 Working prototypes using sensor technology
D3.2 User manual for each pilot test
D3.3 Report on the pilot test and development of the sensor prototypes

Regarding the last deliverable, each pilot test's leader has started to work on it and Images et Réseaux encourages them to continue this work so they will be able to submit it by March 2023.

Pilot Tests
1) Pilot test with Van de Huijgevoort Groep in the NL (Whysor, IH)
Van de Huijgevoort Groep owns several companies. One of them is a production company for salads, a meat processing company for cold cuts, and semi-finished products like mincemeat, sausage rolls, and stuff, and they also own three supermarkets. In June 2021, Whysor had two meetings with them, and in July 2021, Whysor had an online meeting with NTU, BED and Whysor to talk about their use case. In August 2021, Whysor visited their production facility.

Initially, the goal of this pilot test was to do quality checks on bacteria, mainly Listeria bacteria, and measure overpressure in their production facility. Creating overpressure inside the production room keeps insects out. It is something that companies must do by legislation, and they have overpressure inside the production facility only. However, they have no alarm system when the pressure drops. There is no proof of overpressure, and that is something they would like to do.

The pilot test's start date was July 2022. Whysor investigated several sensors, starting with the fresh detect sensor. The fresh detect sensor was sent by UU and Whysor did some tests. They had a meeting with Matthias Heiden from FreshDetect in February 2022 and decided not to proceed with this part of the pilot, because fresh detect technology was not yet suitable for measuring specific germs, but only for total colony counts and did not fit the question of this pilot company.

For the overpressure architecture, the company has a production room, and two pressure sensors were installed, one inside the production room and one outside. They measure the difference and use an alarming system when pressure falls in the production room. Whysor had meetings with the quality manager from Van de Huijgevoort Groep in January. They talked about measurements on hygiene and measurements on overpressure, and in February, Whysor defined the architecture.

DOL 18 sub-pressure sensors were selected to measure the overpressure. Whysor did some testing inside the office and purchased two electronic sub-pressure sensors for this case. The sensor is designed for use in livestock facilities, however, Whysor believes it is also suitable for the purpose of this pilot test. Whysor plans to install the sensors in July 2022. The tests have been finalised at Whysor office and now they want to start testing at the production facility. The next steps of this pilot include installing the sensors, start measuring the pressure, creating a poster, writing the pilot test storytelling, and analysing some data.

Action: Whysor to install sensors at VHG, start measuring the pressure, create a poster, write the pilot test storytelling, and analyse data.

Action: Whysor to complete the pilot test storytelling of VHG.

2) Pilot test with Picnic in the NL (Whysor, IH)

Picnic is an online supermarket that delivers groceries to the costumer's home. They use trucks to transport groceries from their fulfilment centre in the Netherlands to local hubs and from the hub to the customers. Picnic started with four delivery vehicles in 2015 and now there are over 1000 vehicles in the Netherlands and they deliver groceries in 120 Dutch cities and villages. Marcel contacted Picnic in 2020 because he thought the company would be a suitable partner for the pilot test. He pursued them over several calls, and the first contact was established with Frank Carter. In July 2021, TV and IH visited one of the fulfilment Centre of Picnic, and installed 20 Elsys EMS sensors (temperature, humidity and acceleration).

The goal of this pilot test was to deliver a personalized cooling profile for the cooling box and link it to the complaints of customers on how the box was handled. After the installation in 2021 data were coming in fine, however within a few weeks all the sensors stopped sending data. The sensor housing appeared to be not solid enough to withstand the force of heavy groceries. As a solution flexible rings were 3D printed to protect the housing of the sensor (September 2021) and 20 new sensors were purchased and installed (December 2021).

Between the installation until July 2022 Whysor noticed that all these sensors broke down again, not over a few weeks, but over months. Only one sensor is still functioning, which means that the sensor housing is probably still not strong enough, even with the flexible rings on it. Whysor had a discussion with Picnic in March 2022 to find out why these sensors were not working anymore, to discuss if they want to install ten new sensors and the data that the project needed from the Picnic for related projects.

In May 2022, Whysor had a meeting to solve the problems with the sustainability of the housing of the sensors and they had two issues because these sensors were placed in a box that was made of styropor and they needed an adhesive suitable for both hard plastic of the housing of the sensor and the styropor. In addition, they also wanted to change the battery of the sensors, so they would not have to throw away the sensor when the battery runs out.

Picnic agreed to send part of the sensors to Whysor for testing with the adhesive to use and with better protection of this sensor housing. Whysor still has ten sensors left that are not installed and they are going to test them with more of these flexible/protective rings. The next steps include linking the data received from Picnic to the data that is coming from the sensors to see if it is possible to recognize a trip in the data. In the meantime, the sensors that were working have already sent a lot of data, so the analysis of this data can start. Next steps also include the determination of a cooling profile for cool box, the production of the poster and the video.

RR suggested searching for alternative designs of housing for the sensors. IH suggested to schedule a separate meeting to analyse the data from Picnic. RR requested GS, SA and JE to look at the data and conduct a descriptive analysis. KP asked if this pilot test will be linked to the app. IH mentioned that the company would like to have a personalized cooling profile. RR commented that once the project starts getting data from their sensors on a very regular basis, the partners will be able to assess whether there is stability in their system and whether the amount of ice that they are packing is adequate to meet the requirements.

Action: Whysor to link the data received from Picnic to the data that is coming from the sensors to see if it is possible to recognize a trip in the data.

Action: BED, MTU and SenX to start the analysis of data for Picnic.

Action: BED, MTU and SenX to determine a cooling profile for cool box.

Action: NTU to produce Picnic poster and the video.

Action: Whysor to complete the pilot test storytelling of Picnic.

3) Pilot test with BioGros in Luxembourg (Whysor, IH)

BioGros is a wholesaler of high-quality organic and biodynamic foods in Luxembourg. BioGros is a company with a complete supply chain. They have fresh vegetables such as celery, lettuce and mushrooms produced by organic farmers from the cooperative. The products are transported from the farmer to the BioGros warehouse by vehicle trucks. The vegetables are packaged and then transported to retail in small village shops, etc.

The goal of this pilot test is to gain insight into climatic conditions like temperature and humidity in the complete supply chain and then especially regarding several fragile vegetables like mushrooms, onions, potatoes, and celery roots. The company also would like to have more information on the ripening of fruits and vegetables inside the warehouse.

BioGros sometimes experiences quality issues in transporting fresh foods, and they wish to gain insights into climatic conditions there. The architecture includes installing sensors at BioGros grower, warehouse and inside the trucks. The information will be transmitted from the Lori to the Whysor cloud. The sensors selected are digital meter Eagle loggers with temperature and humidity sensors. Whysor wants to find a solution which would allow real-time data upload while the products are moving in the trucks.

Whysor spent two months testing connectivity at different locations as growers, at BioGros and in trucks while on the move. Whysor selected these loggers because of their connectivity, and because they also include the feature of detecting whether a truck is moving or stationary, so-called trade detection. The trade detection enables not only to alarm when trucks are in use but also enables to measure and send data with a lesser frequency when the trucks are not on a trip, which results in much longer battery life.

In December 2021, Whysor researched connectivity in Luxembourg and specific usability with two sensor units. In January 2022, they purchased 15 Eagle loggers and 15 RV/T sensors. In March 2022, BioGros self-installed 15 of these sensors. In May 2022, Whysor had a meeting to discuss the dashboard built for BioGros and to define the settings of the sensors because the default setting sends data every five minutes, and then batteries run out fast. In June 2022, the settings were changed, as well as the batteries. At this moment, Whysor has installed seven sensors in different areas of BioGros' warehouse and ten sensors inside the trucks. The data is coming in fine since the beginning of July 2022.

The next steps include defining the thresholds in which the temperature is correct for each part of their warehouse. The possible loss of quality due to humidity is still unknown, so the range is all green on the dashboard. One sensor is not working, possible because of the battery. In July 2022, Whysor installed three sensors at growers and started collecting data at growers as well. Whysor already started with the pilot test storytelling of BioGros.

Action: Whysor and data analytics partners to define the thresholds in which the temperature is correct for each part of BioGros warehouse.

Action: Whysor to complete the pilot test storytelling of BioGros.

4) Pilot test with Raman Spectroscopy with Routhiau, IGRECA, ADRO in France (AA, UoN)
The pilot on Ramen Spectroscopy is at the end of the validation step, and the development of the sensor has been finished. UoN validated this in lab conditions despite the absence of technical stuff from February/January 2022. UoN has required a new postdoc in 2022, and the candidate (Omar Dib) has been selected as he has experience in data analysis and Raman Spectroscopy.

Routhiau is a French company located in France that produces and sells a range of food products, such as e.g. chicken. Despite using chicken samples to validate the system, many fruits and vegetables from local markets were tested, and the system worked very well.

The pilot test aims to monitor food quality during storage and transportation by utilizing a fast, rapid technique known as Raman Spectroscopy. To reach the pilot aim, the first step is the experimental design, same food samples will be tested in the lab, and the results will be uploaded to the server. Then they will test the technology in the same conditions as the refrigerated truck, and the last stage will be testing in real conditions. The main objective of installing the Raman spectrometer is its capability of informing the company or driver whether the product quality is still in good condition and thus arriving safely to its destination or alerting the driver to deliver the product to the nearest point in case the product quality started deteriorating and thus help in reducing food waste.

The pilot test's experimental design will focus on three main stages. Stage one is lab development, stage two is the transition transitioning phase between the lab and the real condition, and stage three will be the testing in real life conditions. Stage one includes setting up the Raman sensor, testing on foot samples, running data analysis, using specialized scripts, and lastly, uploading the data to the servers. All actions required to complete stage one were executed or accomplished by the pilot test.

Stage one was completed with the help of the company Routhiau. The role of Routhiau was to provide a sample and share their needs. For instance, during stage one, samples acquired from Routhiau were analysed over 30 days by Ramen spectroscopy, taking about 50 spectra per day taking into consideration the temperature. Additional analyses were added, such as microbiological analysis and other physical-chemical measurements like temperature and pH. The Raman analysis was conducted directly on the chicken sample, without the package in stage one. The quality decreased, especially on the 26th day, but the samples were still in good condition. However, on the 30th day the quality decreased to an alarming level.

Stage two included system modification, automatisation, simulation and validation. All actions required to complete stage two were accomplished, except for validation which has still been ongoing. At this stage, the system was transferred into a refrigerated room to simulate the same condition as in the refrigerated truck. The Raman analysis was done manually, but a motorised stage was introduced to minimize personal interference. The challenges faced using this system include surface topology. The products can present flat and sloped surfaces, which can quite affect the sensitivity of the Raman results. With the help of a motorised stage, UoN was able to move through 13 different zones and take the spectra of each zone. The zones were grouped into two main categories, the flat surface and the sloped surface. UoN analysed each group alone and concluded after several trials that no matter where the Raman signal was acquired, the same signal was obtained.

Another challenge related to the Raman analysis was using packages. To overcome this issue, they compared the Raman signal of the plastic with the chicken samples. They obtained four additional new peaks identified as protein and lipids. The next step included the validation of the results. They started the quality monitoring process on the 6th over 60 days and acquired 30 spectra in the morning and another 30 in the evening, making a total of 60 spectra per day. The temperature was also monitored over the process. After this process ends, UoN will upload the data to the server, analyse the results and validate the outcome. After validating the results, they will contact the company and start the last phase of this project, which is testing in real conditions. Currently, the pilot test has completed stage one (lab development), stage two has still been ongoing, and stage three is expected to start in September 2022.

UoN prepared the first draft of the storytelling using the template, which includes a brief description of the pilot test, its role in REAMIT, the communication between different partners, and the project progress. UoN also prepared the draft for the user manual. Both manuals will regularly be updated until the date of submission.

Action: UoN to complete the pilot test storytelling of Raman Spectroscopy.

Action: UoN to conduct stage 3 of the pilot test in real life conditions in a truck.

5) Pilot test with WD Meats (Dry aging chamber) in the UK (UU, JG)

Dry ageing beef is a premium technique used for flavour development and to tenderize the beef. It involves hanging beef carcasses or hindquarters in a refrigerated room uncovered and left to age for several weeks or even months at controlled temperature, relative humidity, and airflow. It is costly because of high ageing shrinkage, trim loss, risk of contamination, and the requirements of ageing conditions and space. REAMIT project is interested in reducing trim loss, which is a phenomenon that occurs when too much moisture is extracted from beef resulting in unusable dark facings which need trimmed and disposed of before the sale of the meat. UU is trying to reduce the dark facings by tuning the environmental parameters of the refrigeration setup.

The solution proposed includes accurately monitoring and recording the temperature and humidity data in four zones of the ageing chamber. These results can be mapped to determine the dark-facing trim loss, and UU expects to tune the refrigeration parameters to minimise those dark facings. The equipment selected

includes a multi-tech Lora Gateway, and four Ursalink UC11 temperature/humidity sensors. The first study took place on 6th July 2021 and ran for two weeks, but, normally, they age the beef for three weeks.

WD Meats are the sole supplier of premium beef to Lidl in Ireland, and they're also one of the main suppliers for McDonald's Europe. Therefore, a lot of the meat they are processing during the study will be sold to Lidl for their premium range. The meat is always dried for 21 days. In the first trial, two weeks were monitored because of when the sensors got installed. On 30th March 2022, the sensors were used for 21 days, and the trial ended on 20th April. Two sensors were installed at the front of a large, refrigerated lorry container with all the hindquarters hanging up, and two were installed at the rear of the lorry. The sensors were integrated with the Whysor dashboard and contained some analysis done after the first iteration of the trial. The most reoccurring temperatures were in the back left and back in front of the truck.

Lessons learned from the first iteration of the trial demonstrated that Velcro was not a suitable mounting solution due to the amount of moisture generated by the drying hindquarters. The Velcro was changed by cable ties. Some signal issues were observed with the sensors because of the amount of meat in the trucks, which attenuated the signal. To correct this issue, the location of the sensors was changed to be in a more direct line of sight with the gateway. The sensors were also moved from the walls and now are being hung on the hooks at the hindquarters also hanging from.

James visited WD Meats on 10th March 2022 to launch the second iteration of the pilot test. At the visit, he discovered that network architecture used as an interface between the sensors and the Whysor cloud had been deprecated. Marco upgraded all gateways that are maintained by Whysor in 2021, but the gateway used by WD Meats was commissioned by UU, so Marco did not have access to it.

James reconfigured the gateway with the new endpoints for the thins stack. The sensors were re-paired to the gateway since it was running a fresh install. Tom provided the webhook details to connect the gateway to the Whysor cloud. On 30th March 2022, the gateway and four sensors were reinstalled on a trailer which had been loaded the day before. The lorry was unloaded on 20th April 2022, and sensors were taken off. A full 21-day cycle was recorded.

Next steps, James is still waiting for Marco to provide start and end weights for the last trial. Different structuring of carcass's/sensors or different temperature and humidity parameters for the refrigeration unit after results from the baseline trial will be suggested. There are two questions to explore: (1) does airflow affect dark facings? Airflow depends on how many carcasses are located in the trailer and also the structure. (2) are there more optimal parameters which exist for the temperature and humidity which would minimise the dark facings while avoiding harmful bacteria formulation? The plan for the next steps includes changing some of these parameters on 21-day cycles. At present, two more runs are planned for the summer and different combinations of temperature and humidity parameters will be tested to try to reduce the dark facings.

Action: Ulster to perform two more runs of tests with WD Meats when different combinations of temperature and humidity parameters will be tested to try to reduce the dark facings.

Action: Ulster to complete the pilot test storytelling of Raman Spectroscopy.

6) Pilot test with WD Meats (Clostridium Bacteria) in the UK (UU, JG)

Clostridium is an anaerobic spoilage-causing bacteria found on farmyard or animal hide and has a high prevalence in abattoirs. It is a multi-billion-dollar problem because it produces non-toxic gases which spoil products early. In addition, it can spread easily and only grows once the products are packed.

Currently, WD Meats do swabbing with PCR in a lab based at the University of Bristol, which takes at least 48h and sometimes 72h. As WD Meats are processing tons of meat per time, they are hoping to find a quicker way of detecting it so that they can clean up the factory quicker, which means fewer products are affected. The trial plan is to investigate alternative methods of detecting the bacteria using a trace source of clostridium using DNA sequencing. The goals are a faster method of detection, allowing for immediate clean-up of surfaces when detected that will inevitably reduce the beef waste in abattoirs, retailers and homes.

There has been a lot of waiting to get the relevant materials sourced for this trial. UU needed to get the PCR Mastermix kit required for testing the clostridium, which took almost two months. A positive trace of PCR is required to perform the benchmark testing. JD, professor of microbiology, said that his colleague in UCD had promised half of their supply in mid-2021. They retrieve this material from their freezer and discovered that the bacteria were dead after seven or eight months.

UU purchased Clostridium DNA from DSMZ (a German microbiological company), which was delivered to UU on 17th June 2022. UU met with Marco and Victoria (lab technician at WD Meats) on 3rd May. They have purchased their own PCR machine (Genesig), which processes samples in approximately three hours. However, they were having issues with calibration and requested UU to support this process and compare results between their lab and UU lab PCR machine to ensure it is functioning correctly.

The next steps were going to perform that validation using the positive strains of Clostridium DNA and confirming same results at WD Meats. JD also wants to perform a DNA sequencing study to identify the source of the Clostridium. Marco is very interested in this research because he suspects that a lot of Clostridium is coming from imported cattle and WD Meats brings in a lot of their beef from the UK, and he would like to identify the exact suppliers and farmers for where these issues occur.

UU is still interested in calculating the minimum level detection using the DNA strain. They had a meeting with a company called Sensip-dx, and they apparently had a machine which could perform this analysis based on some spectroscopy type of technology. The company was involved in the capitalization call, and the next step is to check if they are still willing to collaborate and how the project can incentivise them.

RR expressed his three main concerns. The probe used by Sensip-dx is applied to analyse items in liquid form, so additional effort is necessary to obtain a liquid from the products under analysis. There may be errors in detection, and we still are not sure about the quality of the probes. They may not be interested in working with the project unless there is an incentive for them. RR was positive about the progress made in this pilot test, yet he was not positive about its suitability. RR recommended that JG discuss with JD and JC whether this pilot will be analysed under the REAMIT project or outside the project. According to AA, Raman spectroscopy could be used for this type of analysis and asked James to send some samples for testing. AA mentioned that they have much experience in the detection and identification of microorganisms by Raman spectroscopy, but the analysis directly on food may be very complicated.

Action: Ulster and BED to determine whether Clostridium Bacteria pilot will be analysed further under the REAMIT project or outside it.

Action: Ulster to discuss with UoN whether and how Raman spectroscopy can be used for this type of analysis. Ulster to send some samples for testing at UoN.

Action: Ulster to complete the pilot test storytelling of Clostridium Bacteria.

7) Pilot test with Musgrave in the UK (UU, JG)

Musgrave is the largest wholesaler of groceries in Northern Ireland. They supply one in every four homes. Musgrave deliveries of chilled food produce are performed to various small businesses, fast food restaurants, etc, within approximately 15-mile radius from Musgrave's warehouse, using their own logistics network. Vans performing deliveries are refrigerated, but at present, there is no way of knowing in the cab or the office if the refrigeration units are currently correctly functioning. Breakdowns with refrigeration units can cost the wholesaler full vans of spoiled food. Therefore, they would like an alerting system to know if any issues arise, which should be available to both the driver and the logistics staff in the head office, so the van could be redirected back to base loss, minimizing the risk of food spoilage.

Their larger fleet vehicles already have some temperature sensing devices built into them. However, REAMIT will analyse their smaller vans which deliver to smaller shops. The vans have a big refrigeration unit at the front that creates a freeze zone of around -10 degrees Celsius. Therefore, the vans should be connected to the cloud to allow for real-time data reporting/monitoring while the vans perform deliveries. The vans have both a chill and a freeze zone, and they wanted both of those to be monitored at regular 5-minute intervals. Alerting system should send SMS messages to drivers and logistics warehouse staff, notifying them if any anomalies occur. Alerts should only be sent if the van is in transit, i.e. they should not receive an alert if the van is stationary when it is parked overnight or if it stopped performing delivery because the temperature can normally increase at those points.

The power consumption of the system should be such that maintaining the equipment does not become an arduous task. The company is not interested in changing the batteries every week or two, so they were concerned about a system that would run on battery power. The solution should be standalone, i.e. it should not rely on mobile phone tethering etc (pairing sensors when switching drivers has been deemed a high-risk, costly overhead).

As a solution, UU selected a cellular logger (Digital Matter Eagle), which both acts as a sensor recording device and a gateway (it contains its own sim card and connects to the 4G network). The logger contains multiple communication buses. It has been configured with two sensor probes, one which logs temperature and humidity and the other logs only temperature. The logger uploads the data to the cloud. For the trip detection algorithm, it needs accelerometer and GPS data. This data is recorded by internal modules on the loggers.

UU worked with the device manufacturer to enable trip detection from the logger. Accelerometer data and GPS coordinates are combined to detect internally if a trip is in progress. This binary trip data (1/0) is then uploaded to the cloud. This algorithm is also used to improve the battery life of the logger, using ‘sleep/wake’ information.

The architecture of the pilot includes two eagle loggers, which will act as the gateway but also contains the sensor. It uses a cellular connection, and it is connected to the digital matter cloud. The Whysor database makes an IP call to the digital cloud and receives the data from the logger. The data can then be analysed in the dashboard or used by the alerting algorithm, which then generates either text messages or emails sent to any relevant staff.

James worked with Marco on adding a second temperature probe; this involved adding a new sensor which had not been trialled by Whysor before (due to the limitation of the communication buses) because the new sensors were on 3m cable runs to facilitate temperature monitoring in the rear of the van. The sensors needed a 5V power supply, but Eagle loggers only provide 3.3V regulated supply. The solution would be to add a 5V step up regulator to each sensor.
On 23rd April, James installed the dual-zone monitoring sensors in three delivery vans at Musgrave. The system monitors both the frozen and fresh produce refrigeration areas of each van in 5-minute intervals while deliveries are being performed. Logistics staff at the warehouse were given access to the Whysor

dashboard for real-time monitoring of the vehicles and were added to the alerting service. When no trip is detected, recordings are made every hour and uploaded to the cloud every 12 hours.

Early results show that the system is robust and avoids sending false alerts due to the trip detection algorithm which was developed. Until July, the batteries have not needed to be replaced in the loggers, proving that the bespoke system developed with trip detection technology is energy efficient and of minimal maintenance. After successful initial testing, two more IoT temperature monitoring systems have been prepared and are due to be installed in summer 2022.

The next steps include installing the loggers in the remaining vans. Rule logic for text alerts still needs to be defined. James will monitor the initial data and help Musgrave decide what the threshold temperatures should be for the freeze and chill zones and how long the delay should be before reporting an alert.

8) Pilot test with Glen Affric in the UK (NTU, UR and SB)
There has been no progress with this pilot test since January 2022. The company is not responding, so NTU decided to stop this pilot test. IH installed one sensor that need to be retrieved. NTU contact point has left the company.

Action: NTU to recover equipment installed at Glen Affric.

Action: NTU to complete the pilot test storytelling of Glen Affric.

9) Pilot test with Human Milk Foundation (KP, BED)
Human Milk Foundation was founded in 2016 in the UK. It is a charity that helps more families feed their babies with human milk. HMF provides screened, pasteurized donor milk to sick, premature babies in Neonatal Intensive Care Units and to mothers suffering from conditions such as cancer, which prevent them from breastfeeding their babies.

While HMF has full control of conditions in which human milk is processed and stored at the human milk bank, they have no control of conditions in which human milk is transported between donor human milk bank and hospital. This is where the REAMIT project comes into the picture because the project offers an approach that allows them to constantly monitor temperature at which human milk is transported (-20 degrees), and take action when these conditions change in time to save human milk from becoming waste or becoming not suitable for nutrition.

By working with HMF, REAMIT will not only help save human milk from becoming waste but will also help save several premature babies. The recent meeting with the HMF staff in May 2022, confirmed that human milk banks operate across the globe, so potentially there is a great potential for scalability of the REAMIT approach outside of the UK.

The aim of the pilot test is to monitor the temperature at which human milk is transported between a donor human milk bank and a hospital. This temperature must be -20 degrees, and they have approximately 30-50 trips per day. The milk is transported in very small bottles by motorcycle or car.

This pilot test started in May 2021. Whysor lent two temperature and humidity sensors, which were configured and shipped to HMF in July 2021. Whysor fitted both sensors in September 2021, and since October 2021, REAMIT has started to collect data. The sensor is battery driven and has a GPS locator inside.

ELT Lite logger sensor (ELSYS) and digital temperature sensor (ELSYS) were currently collecting data on temperature. Data is sent to Whysor cloud. Data is then transported to BED server and analysed. At the

beginning, Whysor reported connectivity issues with one of the sensors, and it was poorly connected to the Internet, so it sporadically sent data. Colleagues from Whysor came to the UK and fixed the problem physically. In October 2021, Whysor reported that they were receiving data from both sensors. However, data indicated room temperature, which implied that both sensors were not sent on trips with human milk. We had a break-up in communication with HMF for some months last year, but everything was reassumed early this year.

HMF was very happy to scale up the pilot test, so BED purchased 12 loggers and sensors, temperature, humidity and binary sensors for HMF. Natalie Shenker from HMF attended the RAC/WP/RSC meeting in January 2022 and Levstone proposed a Blue maestro sensor and system for HMF, and the team at BED tested it in home conditions first. BED had a meeting with Davinder from Levstone, and he explained the Blue maestro sensor. In the meantime, 12 new sensors arrived at BED, and JG helped wire the sensors. Mike from HMF shared with BED and Whysor a google form, which collects data on trips of human milk. There have been no updates on Blue maestro and system proposed by Levstone.

In May 2022, REAMIT visited Human Milk Foundation and had a very nice tour. At this meeting, JG, SA and other technical partners installed all the sensors, totalling 12 sensors installed. The next steps include data analysis from the sensors installed at HMF and proposing an app for HMF conditions.

HMF is keen to keep developing the system. They are a foundation running based on venture philanthropy. They do not have the funds to keep investing in the system we proposed to them, but they are keen to keep exploring and working with impact investors and venture philanthropy to find additional funds to help them develop the system. The system has the potential to be scaled up not only across the UK, Europe, but also across the world. Natalie and her colleague Jillian work as advisories to different ministries across the world, helping them design human milk banks. Therefore, the next steps for REAMIT also include developing policy briefs / policy proposals based on the pilot test with HMF.

Feedback from Mike (HMF): Because of the few staff at HMF, Mike does everything: collecting the milk, accepting, counting, pasteurizing, reviewing, putting in bottles, putting in freezers, preparing for transportation, etc. He's also the only one who does all the sensor practical things, and he is not able to play with the opening and closing of the sensors so many times when they are not connecting properly. He said they would appreciate a ready-to-plug-in solution because of the staff shortage. Thus, they had this breakdown of contact in November 2021, when they were just unable to deal with the connectivity issues. Opening up the sensor, and changing the batteries, he said he had to do it five times before the sensor caught connectivity again. This took a lot of time.

Action: BED to complete the pilot test storytelling of HMF.

10) Pilot test with Yumchop in the UK (KP, BED)

Yumchop is a British-based family-owned company producing ready-to-eat frozen meals with African flavour sold through vending machines. Currently, REAMIT is looking for controlled temperature and humidity data. The pilot started in December 2020. There are different locations in the food factory, different zones, freezers, cold rooms, vending machines and kitchen fridges. In total, ten sensors have been installed by Whysor, providing information on the temperature levels inside different zones. There are different temperature ranges for different zones, and when the temperature goes above this range, the alerting system sends an alert to Yumchop.

One of the positive aspects of having this pilot test was that Yumchop realized that they do not need temperature -30 degrees in some freezers. So, they can increase the temperature to -24 degrees, which means a lot of energy saving for the company.

BED and UCD recently had meetings on life cycle assessments, and there was some break in obtaining data from Yumchop in January this year. The company partners can have access to the dashboard, they have all the permissions to change things by themselves. Weekly reports are generated by Whysor for each fridge and freezer. Recently, BED was also advertising placement opportunities at Yumchop for students or graduates. Between January and April, there were different alerts sent to Abby, who is the co-owner of the company. Whysor helped resolve the issue. On 25th May, some partners from UCD, UU, NTU and BED visited the factory, and the problem was corrected. Abby confirmed her willingness to expand the pilot test and move to the vending machines and vans. The next step would be data analysis of data from Yumchop and the connection to the application.

Action: BED to complete the pilot test storytelling of Yumchop.

11) Pilot test with Burns Farm Meats in Ireland (XC, UCD)

Burns Farm Meats is an Irish company recruited by REAMIT partners in UCD in February/March 2022. It is a small family-run business. They have their own farm, which also works as an abattoir in Sligo (northwest of Ireland). They slaughter animals, but they are committed to animal welfare and providing high-quality meat. Their operations include an abattoir, dry ageing of beef and lamb, wholesale of beef, lamb and pork to the catering and hospitality sector, delivery of retail orders to the public and processing organic beef, lamb and pork.

The company has refrigeration units where they store beef and lamb carcasses during the meat maturation of the dry-ageing process. The latest efforts in the company revolve around modernizing and equipping themselves with the appropriate tools to monitor and control the environmental conditions of these rooms to avoid loss of meat. Specially, attention should be paid to two refrigeration units of the company where they store beef carcasses during the dry ageing or maturation. Maturation of the meat takes 15 to 21 days approximately. They have observed the spoilage of the meat, and they are trying to equip themselves with the appropriate tools to monitor and control the environmental conditions of these rooms.

XC, JG and GS visited the company on 23rd March 2022. They have observed that they lose around 5% of every piece of beef, especially the areas of the meat that are more exposed to the surrounding air, i.e. surface areas around the end parts of the carcass. They suspect these rooms remain open for too long, thus the temperature is not remaining within a proper range. Monitoring humidity is also of interest to help prevent microbiological activity. These two rooms have the following dimensions: one large room of approx. 20m2 and a smaller one with 10m2.

The aim of the pilot test is to monitor the temperature and humidity conditions in the cold storage rooms and try to solve the problem of spoilage during the dry ageing process, especially concerning the parts of the meat with more exposure to the environment. The plan is to deploy ten sensors in total, six in the big room and four in the small room. The equipment purchased is an Elsys ELT-2 with a micro IoT LoRaWAN Gateway and two internal antennas for temperature and humidity. Pilot start date plan is August 2022.

Getting the supplier in the UCD's approved supplier list has been a lengthy process, however, a purchase order has already been sent out to Sensational Systems (UK) for the purchase of the gateway and the sensors. The supplier is pending payment from UCD invoice office to ship the equipment. A site visit to install the sensors is estimated to occur by the end of July 2022.

Action: UCD to complete the pilot test storytelling of Burns Meats Farm.

12) Pilot test with 3D Fluorescence sensor (UU, JG)

The idea of doing something with 3DF originally came because Matthias Heiden was originally on the REAMIT application form. However, by the time the project got funded, his company had gone into administration, and the project still has a pilot test associated with 3DF.

One FreshDetect was lent to UCD, which has now been lent to IH. One Fresh Detect has been lent to TA at BED where a master's student examined using the FreshDetect device to approximate the ripeness of soft fruit (strawberries, raspberries, etc.). TA investigated the use of FreshDetect for VDH project (for Salmonella, Listeria, etc). After the consultation with Matthias, it was agreed that this was outside of the scope of the REAMIT project.

IH/VDH Group have a new idea for the rapid detection of the TVC of preparation surfaces, as this measurement is directly linked to the expiry date they can use on their products. A high TVC reading would allow them to perform a deep clean on surfaces before continuing food preparation.

Thoughts of potential use in the checking of poultry products being delivered to Musgrave Cash and Carry. Matthias confirmed that some testing had been trailed through cellophane, however the cellophane would need to be pressed right against the poultry fillet in order to achieve an accurate reading. Additionally, FreshDetect needs to be used on a flat surface of the poultry to produce an accurate reading.

TA performed some initial studies with her Master's student and said that operating FreshDetect through cellophane significantly decreased the performance and reliability of the measurements. JC hopes to hire a researcher to lead this study over the summer at Ulster. She may hire a third party/contractor to help with the study if required too.

RR mentioned that FreshDetect appears to be a good way to detect the total bacteria amount. Yet, in his opinion, this is not useful for the project. The REAMIT experiments have indicated that 3D fluorescence cannot detect anything relevant to reduce food waste, so that may be out of the scope of the project.

Action: Ulster to complete the pilot test storytelling for 3DF sensor.

22.16

13:45 – 15:45 WP T2 Big data integration and application to reduce food wastage (Chair SA, BED)

Deliverables as per the Application Form:
- Creation and launch of interface for each of the pilot tests for collecting data from sensors and sending it to cloud for use in a transnational Big Data infrastructure (by July 2022).
- User Manual on launching the interface (by July 2022).
- A big data platform with capability to collect and store sensors data from all REAMIT corridors (deadline December 2022).
- Reports on Big Data platform performance (deadline December 2022).
- A web-interface with self-enrol facility for enrolment of potential suppliers and consumers of food produce (deadline December 2022).
- User manuals for the Big Data platform and the web-interface (deadline December 2022).
- Launch of smartphone APP for linking food owners, truck drivers and warehouses (deadline July 2022).
- An additional deliverable: launch of second database of potential buyers (food charities, convenience stores, etc.) in REAMIT corridors – the route where trucks would travel. This database will be developed by Levstone.
- Deployment of the integrated IoT/Big Data analytics/Decision support technology (deadline July 2022).
- A user manual for the integrated IoT/Big Data/analytics/Decision support technology (deadline July 2023).

- **Presentation by an external speaker, Rian Mc Donnell, CEO of FloWaste**

Rian Mc Donnell, CEO of FloWaste, presented "FloWaste, Reducing Food Waste Automatically". FloWaste is a food analytics platform that reduces food waste automatically for cafeterias and industrial protein processors – beef, pork and chicken. They work with companies such as Kepak, ABP and Gourmet Gorilla. Their customers want to reduce their yield loss, food costs and food waste. But their customers do not have the information required to do so. FloWaste installs sensors at various stages of the food supply chain that can understand the food in question and return key features of it. For instance, they can see how thick the backstrap of a sirloin steak is, how well trimmed it was by the butcher, etc., which translates to how efficient these companies are. Analysing all of these features informs them of how well the companies do in terms of yields.

Their process is the following: 1. They collect data; 2. They analyse it in real time with machine learning and computer vision techniques; 3. They provide the associated or learned insights, 4. This leads to increase of margins – more food yields, increased accountability, quality control.

FloWaste targets a big market across USA, EU and UK - companies like ABP, Tyson, and cafeterias (smaller businesses). Rian talked about a 259M USD as serviceable obtainable market. They are currently a team of six, and, in addition, two part-time people. Rian concluded his presentation by informing that the profiles of people they are mostly looking for are operations managers at beef and pork processors, and also food tech partners or strategic partners in general.

During Q&A, RR asked what type of sensors they used. Rian explained that they relied on one sensor unit for all of their installs – that is an intel real sense depth camera. This camera has stereo vision (including volumetric vision), IR (infrared) emitter and receiver, RGB images – all of these are the data they use to get insights.

- **Big Data Hub at BED (SA and JE)**

Regarding metadata requirements, SA, JE, KP, and GS had a meeting on 23rd June 2022. They discussed five issues, which SA provided an overview of.

First, she talked about the availability of new data every Thursday. JE and SA always check for availability of new data every Thursday. They kept communicating with TV (Whysor), as there had not been data export in the last month – there was an issue with the VPN that prevented access to the REAMIT server. As for the real-time transfer between Whysor cloud and BED server, REAMIT partners from BED, UU, MTU should be working on resolving this issue in the next months.

Second, regarding consistency of data for the new period (all pilot tests), and what are the data requirements specific to each pilot test. GS clarified that data consistency should be maintained for each pilot test. More responses on the google form are desirable. A data collection strategy folder was created (SharePoint) and contains documents specifying data requirements specific to each pilot test.

Action: Levstone to send any extra data parameter required for the app development as it may differ from modelling data requirements.

Third, the scope for cleaning the data should ensure consistent data labels. Thus, data labels must have unique indexes to avoid duplicates. Whysor should implement the indexes (in progress).

Action: JE to arrange a meeting with GS and tech team to ensure consistent data labels.

Fourth, development of a framework for metadata and documentation for each pilot test. Metadata documentation to be done from data collection strategy documents and every already existing document for each pilot test. GS was working on the first draft for HMF which was then under review. Editing of this document will continue further.

Fifth, regarding data analysis strategy for each pilot test, partners had not been able to develop this point in full at the time. Also, it was concluded that there was no need to keep meeting regularly to discuss these five points, but partners may decide to meet and share ideas regarding data analysis strategies.

SA explained the data analytics journey with HMF, from early discussions with the organisation to infrastructure set up, further development on data analysis strategies, among others. Sahar presented updates on the pilot tests. In late March 2022, JG had wired ten loggers, ten temperature and humidity sensors and ten binary sensors. A visit at HMF took place on 23rd May 2022 and included a tour around the premises, presentations, and checking the installed equipment.

- **'Blue maestro sensor and its suitability for REAMIT pilot tests', presentation by Levstone**

Earlier this year, Davinder had asked KP if some partners could evaluate their technology. Three blue maestro sensors were given to KP, SA and TA. A couple of meetings were held with DB to explain how it worked. The original idea behind the application was that the user can configure everything themselves. DB mentioned that it looked complicated. He gave a recap on the application and he said that data can be captured, even Whysor data, but that it needed to be a "meaningful data" for transaction in some sort of block form, so that people could analyse it.

Levstone looked, namely, at the UK pilot tests, how can these transactions in block be built. As Davinder mentioned, Yumchop is static, mini-scada systems, as they (Levstone) call it. Contrarily, HMF is on the move, and regulations play a big part in his opinion. They had launched an application, a high security private group with GPS tracking. One can integrate it with IoT sensors at present. They had two sensors available: Blue maestro and Miniew. Blue maestro had a few issues, while Miniew seemed promising with a more range. Good battery life for the sensors was tested.

The application showed sensors whether on a car, house, person, depo, etc. One can see their battery life. A screen showed a graph with temperatures over time. This being real-time as Davinder pointed out, the graph is designed to show what was going on in real-time rather than historic. Once you have the sensors configured, there was no app interaction needed. Also, the system was GDPR compliant.

In Davinder's opinion, it was crucial to build in metadata to know when a journey starts, by who, etc. KP, TA and SA, who carried out testing, concluded that the application was too complicated. Going forward, Levstone proposed another idea. This new idea was to create another, private (not on Google Play store) application from the existing one and make modifications based on the idea of test road. This application would only have full functionality for admins. Drivers, however, would only have access to three buttons - based on traffic lights. Once they pressed start this would give a point in time - when the journey starts. All one can do after the sensor have popped up, is to kill the application with the red button. Since February 2022 they have introduced Miniew scanning on the application.

Discussion regarding Levstone application

After Davinder's presentation a discussion on the present application took place. RR mentioned there was no need for a new application to be on Play Store. Davinder expressed his concern on having a new application Google-approved. RR also asked about the compatibility of the application with the Whysor system and what could be done so that REAMIT used both. Davinder insisted on having two points in time,

start and end of the journey, to be able to query the data. Whysor was purely logging data and it was needed to give the data some context, he mentioned. RR proposed for Davinder to work with Marco, Tom, etc, data to be collected from their system. Davinder mentioned their data structures were fine, and that it should not be an issue to retrieve the data from Whysor. But he insisted on the two points in time to know when to query. As he said, Whysor data was not real-time.

RR mentioned that real-time data was needed, as much as historical data. Davinder would marry data first and then store it. Davinder said that they would need to configure the existing systems in their system. The issue was, once they have that configuration, they needed to know what the "task" was – to match time and sensor ID.

RR clarified two points about the needed application. First, a smartphone system that used data collected by Whysor – a smartphone version of that. Second, a smartphone system on the road with GPS and related information.

RR asked if we had an application that could work with already collected data and that could send alerts – Whysor produced the computer-based version, but REAMIT needed to have the smartphone-based one. Davinder was not completely sure about working directly with Whysor cloud.

TA clarified that the main issue with the application was that it was not a REAMIT application. Instead, it was an existing application, with many functionalities that were not needed, and that they were trying to adapt it for REAMIT use. TA emphasised that REAMIT needed something similar to Whysor, as made specifically for REAMIT, and ideally customisable for each pilot test. An additional complexity at present was, however, that it would need to work with the Whysor system.

Analogously, KP also said that she was expecting a REAMIT-tailored application. Levstone had developed a non-REAMIT application which they were now trying to fit in REAMIT. As a result, REAMIT did not have a dedicated application.

Davinder insisted on the two points in time and pointed out that to customise the application for each pilot test, there was probably no time left. To make the data contextual, they had added "tasks" in the current application, other data would be meaningless.

RR asked if REAMIT could trial both Whysor and Levstone systems in the new pilot test (perhaps a new pilot at NTU) at the same time. Also, RR asked if Levstone could develop a smartphone-based application. Davinder explained that there was one already. RR said that, hopefully, in a new pilot test, the REAMIT team could trial both. Whysor would still be there until the end, he added. IH mentioned she did not see a problem with this.

RR concluded that the two systems should be trialled together, that it was the best way to go forward.

YD reminded the team to prioritise work, accordingly, given constraints of time.

KP asked about implementing this in HMF given its huge social impact and potential funding opportunities. RR said that it was an option that could be explored. Davinder liked the idea of implementing it in HMF but mentioned the difficulties of integration. RR suggested to include Levstone sensors along with Whysors sensors and trial them in parallel.

Action: Levstone to develop REAMIT specific App.

- **'Development of a SmartPhone APP for REAMIT and a second database of potential buyers (food charities, convenience stores, etc.) in REAMIT corridors', presentation by Levstone**

RR mentioned to Davinder that REAMIT had promised another database for potential demand points, for self-registering and that would have information about various demand points alongside routing that REAMIT trucks would go (the "second database"). The deadline was December 2021 and we needed to have it in operation.

Davinder said he believed that once they had the traffic-light based system in operation, we would naturally have the second database.

Action: Levstone to develop a second database for potential demand points.

- **REAMIT data analysis: further results presented by REAMIT data analytics partners: MTU, SenX, BED, Levstone**

MTU
GS presented WP T2 data activities (HMF, Yumchop, Picnic, BioGros, WD Meats, Raman). He provided a summary of the activities in the last six months and the progress accomplished so far. GS talked about the different aspects of WP T2 activities. In particular, he covered three main components: continuous data analysis, setup and maintenance of Big Data server, structuring and formulating data and, finally, meat data requirements and strategy for each pilot test.

GS talked about the number of WP T2 meetings (no. 5) and other multiple meetings on data architecture and metadata requirements. Efforts were in place to make further analysis to reduce food waste. GS explained that there was more data in these six months than in the past and that each pilot had a different journey. From the performed analysis, partners tried to obtain relevant findings, and based on those, keep refining analytics to provide the company with valuable insights.

HMF: The team was performing time series analysis at the beginning. Later, Google form metadata was obtained, and the team tried to make further analysis, trying to answer, for instance, how does temperature change when the milk is on the move? Based on results then, Gautam tried to predict maximum journey duration and performed ANOVA analysis.

GS presented graphs on the rate of temperature change. He categorised the data into six journey durations and tried to find how the rate of change of temperature in time (from the bottom most temperature value data point) is being affected by different parameters such as bike size, vehicle type, quantity of milk, among others. He performed linear regression models and ANOVA, and he found that the temperature rise is lesser for higher quantity of milk, as well as lesser for lower temperature outside. Based on the models it was possible to predict the maximum recommended journey lengths and advise HMF accordingly. GS concluded that REAMIT will need more Google form type data to continue this analysis further as it was only a limited amount that there was available at the time. Also, this analysis could be extended to traffic information, weather, etc.

Yumchop
An initial analysis showed that there were glitches in the data which Gautam assessed and tried to identify their patterns. GS explained that it was seen that when there were spikes in the temperature, the temperature was raising at a constant rate. From this, he explained that a pre-emptive alert mechanism could be implemented to inform Yumchop of possible spikes in the near future.

GS showed the pre-emptive alert that had been already tested by himself and Whysor partners. If the raise in temperature was more than 2 degrees Celsius in more than three consecutive data points, an email was received. This could also be configured for a mobile phone (SMS).

GS discussed also statistical process control (SPC) analysis. He performed SPC for data spanning over a month and he found relevant insights. He showed that three graphs were produced with SPC: x bar, R chart and process capability analysis. These charts could be obtained every day and could be integrated into the dashboard. SPC would be a useful analysis in addition to the already existing graphs and also an appropriate way to indicate whether the sensor data was under control. This could lead also into proving pre-emptive indication of process being beyond statistical control limit. SPC graphs could be generated every day, for all sensors, and for other pilot tests, not only Yumchop, and provide reports on a real time basis.

Future work would include further exhaustive analysis moving from descriptive to prescriptive and predictive analysis. In the future, more metadata will be useful to gain some more valuable insights, for example customer feedback data. RR pointed out that SPC could be really interesting for the Picnic trial as it would be possible to advise them on the amount of ice they need for cooling in a controlled manner.

SenX

JV presented the various contributions of SenX on WP T2. What relates to partner contributions, they include the following: 1) to pull data from the SQL server. As JV explained, a conversion to time series structures was developed. This was in the form of automatic data synchronization scripts that JV had uploaded on SharePoint. Second, to qualify sequences of data, he implemented an algorithm called matrix-profile, which was able to find motifs (typical patterns), and able to find discords (patterns that are anomalies/atypical). JV showed example graphs demonstrating the different types of motifs that could be found using the algorithm. Jean-Charles explained that it might not be useful for REAMIT current data but that it was a tool that could be implemented in the future if needed. He had uploaded the scripts for Matrix profile (Warp scrips) on SharePoint.

Third, finding seasonality on the data set. JV had been working on how to find seasonality and remove it for analysis, that was to make the data stationary for some data analysis techniques like ARIMA. JV showed an example of an auto correlation function that provided seasonality candidates and could be implemented for REAMIT data. Fourth, a script that returns descriptive analysis statistics per time series including cardinality, modes, mean, standard deviation, minimum maximum, median time step, and any desired custom function. Firth, automatic forecasting; JV presented his work on forecasting based on collected data. First, he split the data into appropriate subsets based on thresholds and time steps. He found that ARIMA and SARIMA performed the best. He also conducted a Dickey-Fuller test for integration order. The auto-regressive and moving average orders were grid-searched. Jean-Charles showed a forecasting dashboard example with ARIMA.

Sixth, connecting dashboard to the data - Discovery (Warp10) to build dashboards. There was a dashboard for each dataset, and tables with seasonal cycle candidates and descriptive statistics. Graphs were dynamic allowing time shift, zoom in and zoom out.

JV showed an example for HMF, a “Discovery explorer” dashboard.

Moreover, alerting system building blocks. JV explained that the need of building blocks was because the data was not live at the time being. The building blocks generated time series of alerts. This alerting system could be linked to a connector for sending notifications.

Alerts could be raised based on different criteria. Three criteria over which functions can be implemented included: threshold, statistical outliers, and forecast errors. To manage the alerts, JV had generated scripts - available remotely on Warp fleet repository.

JV provided details on the deviations to be aware of. First, Warp10 was implemented on Jean's computer, thus, access to the BED server was needed. Second, the data was not coming in real-time at the moment.

SenX discussion
RR asked about the potential use of these alerts for REAMIT clients and how it could be implemented in REAMIT. JV had been working on a Warp based alerting system for the REAMIT clients but it was not yet implemented in the REAMIT platform. JV explained that he would need access to the BED server to install and link the Warp platform.

Also, RR asked for some clarification on ARIMA and SARIMA: they were implemented with HMF data, but the same script can be used for other datasets, Jean-Charles explained.

RR was interested in the forecasting potential of the automatic forecasting: the automatic forecasting could predict a change in temperature, for example, in the next five minutes. Forecasts were based on the last hour or two hours, JV explained, as this was data collected during the journey of a vehicle, in this case it would not be possible to forecast, for example, two days in advance but it still could be useful to predict during the course of a journey. For other pilot tests, this situation may be different as they are not journey-dependent.

The automatic forecasting can indicate whether temperature could cross an undesired value in minutes.

RR also inquired about the feasibility of integrating JV system in the REAMIT server, to which JV expressed that it should be possible.

TA asked if the system could be integrated with Whysor – as BED server not being real-time. JV pointed out that this would need to be discussed with Whysor. Marco Kull proposed that JV could use Whysor's API to request the data or alternatively create a data route to a customer server that would need to be set up so that sensor data would be pushed in real time.

James pointed out the future objective/possibility of converting the BED server into a real-time server.

TA and other partners concluded that it would be more robust to try the Whysor's API approach for the time being.

Action: SenX and data analytics partners (and Whysor) to integrate SenX system for data analytics with Whysor API approach.

Whysor
TV presented the new functionalities within the Whysor Dashboard and made the point that the new features were included in the last months.

A map widget adds support for GPS moving sensors. TV showed that it can display sensor locations on a map – where a sensor was at the time, but also display historical spots. It was also possible to visualise a trip, applying certain conditions to display temperatures or sensor data. Additionally, it was possible to monitor trips "live".

The map showed many markers on the map – it is possible to zoom in and select the specific point of interest. A click on the marker would then show the corresponding values.

Generating a dashboard on the go from the map. A simple click on a button in the map widget could generate a dashboard automatically – this could be useful when someone needed to track a lot of sensors but did not want to generate dashboards from scratch all the time, TV explained.

Whysor had also been working on making more languages available. They added Portuguese and they were working on Italian.

A function to add favourites to your dashboards. It permitted quick access to the desired dashboards. Within a dashboard, a new feature was added to quickly add filters that updated the whole dashboard automatically. For example, it shows data only in the last seven days.

22.17

- **WP T3 Business development of REAMIT technologies (Chair UU)**

JG (UU) introduced WP T3. While discussing it, he made the point that the outcomes of WP T1/T2 should be brought closer to the market. Also, business cases as far as TRL8 should be developed.

Regarding objectives, we should understand development potential of REAMIT technology and development of technologies towards consumer grade. Finally, how to attract future end-users.

Activity 1 - Risk, technology and sustainability assessments of REAMIT technologies (led by UCD with support from NTU, UU and BED) - Jan 2021 – July 2023

Risk assessment identifies potential risks to the marketability of REAMIT technologies in the long run. Technology assessment will study how users perceive the usefulness of REAMIT technologies to identify potential bottlenecks in the long-term adoption. Financial barriers will also be analysed as part of technology assessment to support enterprises. LCA and Sustainability assessment is used to highlight the impact of REAMIT project in reducing food waste using the waste measurement framework.

- Deliverable 1.1 – September 2022

An assessment report of REAMIT technologies including a comprehensive systematic review (mapping) of the technical and business landscape in the fresh produce food chain.

- Deliverable 1.2 – July 2023

The life cycle assessment system will allow environmental impact data to be integrated with REAMIT IoT sensor and big data solutions.

Activity 1 results by TC (UCD)

Activity 1 consists of 2 deliverables; 1.1 systematic review (mapping), and 1.2, life cycle assessment.

What regards Deliverable 1.1 (systematic review – mapping), an assessment report of REAMIT technologies will include a comprehensive systematic review (mapping) of the technical and business landscape in the fresh produce food chain. It will be a joint effort of UCD and UU.

At this point, a review article is being written, on "A comprehensive review of real-time sensor technology and its potential application to reduce food loss and waste: the use of Internet of Things in food supply chains". The objective of the article is to highlight to what extent direct measurements, in particular sensors, are involved in food loss and waste reduction. This paper also provides insight into IoT architecture as well as sensor technologies. The plan is to submit this article in special edition of Sustainability Journal.

As for methodology, initially a literature survey was carried out. A number of studies/articles were identified through database searching of terms "food waste" OR "food loss" AND "dynamic" OR "real-time" OR "IoT" AND "sensor". A total of 313 articles were identified through this search. Then after a further preliminary screening, 114 articles were removed from the result. A further screening related to relevance was conducted and as a result 45 articles were found suitable for analysis. A further 14 studies were also included from citations within the previously identified studies, thus making total study count as 59 for the analysis.

XC (UCD) presented the main findings from the analysis. As he noted, it was observed that there has been an increase of academic studies related to the challenges regarding food loss and waste. This could be due to the increasing commercialization of sensors over the years. The oldest publication in the sensor technology in food supply chains is from 2008. What's more, a network model was presented for the co-occurrence of keywords. The most cited term in the selected articles were IoT, sensors, internet, temperature, agriculture and cold chain. Also, the most common sensing parameters analysed by the selected parameters are temperature (36%), relative humidity (27%), gas concentration/composition (13%), and light intensity (7%). The most typical communication technology used to transmit the sensor data are Wi-Fi (24%), GPRS (12%), RFID (12%), and Zigbee (12%).

RR advised XC and TC to do more analysis and go through systematic review literature and he said that the current work looks preliminary.

With regard to Deliverable 1.2 – Life Cycle Assessment (LCA) for REAMIT, results were presented by TC (UCD). She emphasised that the life cycle assessment system will allow environmental impact data to be integrated with REAMIT, IoT sensor and big data solutions. The submission time of this deliverable is till July 2023.

For this deliverable, we are preparing a review paper on "Real-time data monitoring and its potential application to support dynamic life cycle assessment in food supply chains". It was submitted to International Journal of Life Cycle assessment.

Methodology used here was similar to the previous study. A total of 436 studies were identified initially through databases searching of terms "life cycle assessment" OR "LCA" AND "dynamic" OR "real-time" OR "dynamic life cycle assessment" OR "DLCA" AND "sensor". Then after a preliminary screening, 91 studies were excluded and after a screening for relevance, 317 more studies were excluded. After including 9 studies from citations based on previous studies, a total of 34 studies were finally shortlisted for analysis. As TC concluded, the adoption of IoT technologies can allow automatically real-time data collection essential to assess important variables for LCA, such as raw materials and energy consumption, emission flows, etc. Also, the real-time data collection allows performing dynamic environmental analysis while environmental damage is being caused, rather than statically relying on historical data. What's more, the effective integration between IoT technologies and LCA offers the possibility to predict appropriate corrective actions or alternate manufacturing scenarios based on real-time environmental impact. Many applications have demonstrated that the integration of IoT and LCA is effective and has potential applications. The environmental impacts that these technologies help to avoid must be balanced with the environmental impacts they generate themselves, keeping in mind that these impacts may not be of the same nature and therefore lead to dilemmas.

Main limitations include the following the fact the companies in the supply chain may consider the LCI-date related to their processes as sensitive data and would require protection measures or be reluctant to share it with environmental specialists, who occupy a central position in the LCA. Also, dynamic LCA relies on quantitative relationships among key input and output parameters to characterize any casual effects within a unit operation. Identification of these parameters for each unit operation can be also challenging. What's more, not always all flows associated with the product life cycle can be automatically tracked, e.g. during the extraction of resources or after the use phase. For these processes, it can be necessary to manually inject LCI-data. Finally, time and effort are required to process and modify the exported data from the IoT technology to match the required input format of LCA tools.

LCA for Yumchop

TC updated about key timeline dates about LCA for Yumchop and various processes in Yumchop that were considered for LCA. As she noted, sensor inventory was studied for Yumchop. Yumchop measured temperature and humidity.

TC shared the LCA results for using sensor by Yumchop. For example, PCB of sensor amounts to 0.983 kg CO2 equivalent, LoRa module is 0.13 CO2 eq., LiIon batteries 0.837 kg CO2 eq, etc. Total impact of sensor is 2.716 kg CO2 eq. TC showed data collection for Big Data server. The data for electricity consumption by Big Data Hub for its use for the pilot test was collected based on the memory usage. Then LCA was done using this data. For eg. for Yumchop, the electricity consumption was found to be 0.538 Kg CO2 equivalent. Also, TC presented data collected for Yumchop, most of which was collected during visits to the site. She showed LCA results for Yumchop pilot test too. The impact was mostly due to use of sensors.

LCA for HMF

TC updated about key timeline dates about LCA for HMF and various processes that were considered for LCA. Sensor inventory was studied for HMF. HMF measured temperature. She showed LCA results for the sensor inventory. Like other pilot tests, the PCB and batteries have been found to have the highest impact among all the sensor components in LCA.

For LCA, Big Data server inventory was studied. The electricity consumption data by the server corresponding to the HMF pilot test was collected and used for LCA. The global warming impact of Big data server was found to be 0.195 Kg Co2 eq, which was slightly lower than Yumchop.

TC presented data collected for HMF LCA, most of which was collected during visits to the site. The results for LCA for HMF inventory were presented. The two most significant impacts were by transport from donor house to the HMF and by the transport from HMF to the hospital/community.

TC discussed the impact contribution of various technologies in HMF pilot. She showed some future scenarios for LCA too. For example, if REAMIT is able to reduce the human milk waste by 100%, we will be able to reduce the impact by 277.5 kg of CO2 eq.

Finally, TC also showed the future work plan. HMF and Yumchop LCA are completed. TC is currently working on WD Meats LCA.

During Q&A, RR said that he liked the work and found it thorough. He asked, based on LCA study, if investing in sensors system is better if we compare it with the amount of waste we can avoid using the

sensor system. TC mentioned she had the information regarding the HMF, but for Yumchop she would have to explore it further.
RR also asked if TC was planning to feature it in Sustainability issue. TC said: Yes.

JG introduced Activity 2 of WP T3.

Activity 2 –Future-proofing REAMIT Technologies (led by UCD with support from BED) – Jan 2020 – July 2022

Technology assessment will study how users perceive the usefulness of REAMIT technologies to identify potential bottlenecks in the long-term adoption. The synergy that exists between sensor development, big data analytics and food quality analysis requires that novel sensoring technologies and existing sensoring technologies be continuously created and adapted respectively. Therefore, screening and assessing of alternative food quality analysis sensors will be performed.
One Deliverable has been identified.

Deliverable 2.1 – July 2022 (to be finished before Dec 2022)

Current and identified future REAMIT technology assessment report.

JG updated on the current status of this activity. What regards current REAMIT technology, Yan with support from UU carries out a quantitative survey. Last update meeting was held in mid-May. Also, Yan will make updates based on suggestions by Trevor and distribute a new draft. Trevor has analysed results from Survation. He has confirmed the results are very good and would recommend we proceed in using them to collect our survey responses based on his recent experience. “You just need to very clearly define what you are requesting from them”, he said.

Identified Future REAMIT technology
Literature review performed for Activity 1 will help inform the future technology section of the report by identifying current trends in the R&D space.
RR suggested that it would helpful to look beyond traditional articles in literature review for identifying future REAMIT technology.

Activity 3 – Market assessment (led by UU with support from BED, I&R, Valorial and NTU) Jan 2020 – July 2023

It is essential that SMEs understand the market opportunities which are growing in the food sector. REAMIT partners will jointly develop a market foresight report which will inform SMEs of market opportunities for the REAMIT technologies. Partners will draw upon the expertise of enterprise agencies and sector specific organisations to identify the potential markets for new technology approaches in reducing food waste.

It has one deliverable: **Deliverable 3.1 – Market readiness report** – **July 2023**
A market analysis and foresight report identifying forthcoming opportunities for REAMIT technologies to be developed into marketable products.

Activity 4 – Development of business case (led by UU with support from BED, I&R, Valorial and NTU) – Jan 2020 – July 2023

The REAMIT combination of technologies will have enormous potential for development into marketable products which can offer real-time solutions to agribusiness and food companies. In order to create the

greatest opportunities to derive from the work of the project, the partners will develop, leading to the Business Prospectus, based on the market readiness report and technology assessments above. Justification for achieving 40000 tonnes of waste reduction will be included.

Two deliverables have been identified:

Deliverable 4.1 – Business prospectus – July 2023
An outward-facing document will be made available to SME technology developers, to potential buyers of technology approaches (large agri-business and logistics companies) and potential investors who can see the possibilities for product development.

Deliverable 4.2 – Business case for achieving 40000 tonnes of waste reduction – July 2023
The business case will use REAMIT data from continual monitoring of sensor data for identifying/saving potential food waste and subsequent analytics to understand patterns of food waste in NEW with justification for saving 40000 tonnes of food waste.

22.18

- **WP Communication**

UR from NTU started giving updates about WP Communication package activities. What regards communication WP deliverables, the Communication Strategy Document will be available by January 2023. This document had been prepared initially with some elements and is being continuously updated. We are continuously adding events and improvements to this document every six months. Also, the website has been updated. Every week, SB adds new content to our social media platforms. There are also many posts made and publicized on a regular basis.

Moreover, UB currently learns how to prepare policy briefing document. She will share the draft with everyone by the end of this year and will take feedback from everyone. This will be submitted by January 2023. There are also reports on REAMIT networking events. Most of deliverables are ready except Policy Briefing (which will be drafted by December 2022). Journal articles have been prepared to a great extent too. RR will talk more tomorrow afternoon. NTU has already prepared three articles (deadline for which was July 2023).

WP Communication Objectives include a few objectives. First, to have an influence on agribusiness so it decreases amount of food waste in food supply chains by 10% by 2023. Second, to raise awareness of the potential from combined technologies. Third, to convince agribusiness users of the value of REAMIT's technologies (aimed at reducing Risk) and increase knowledge.

News regarding the REAMIT project go beyond the EU and UK.

What relates to our role within the project, NTU remains mainly responsible for WP communication. In addition, we are also involved in preparing of the journals and other articles. Our role includes also: in close co-operation with the Project Coordinator/Lead Partner as well as project partners, we co-ordinate the process of designing of the project's communication strategy. We also co-ordinate the implementation of communication activities. We manage REAMIT's web space and social media and liaise with JS and Lead Partner on project/programme communication.

There are several ways of communication which will be used in order to engage with the target groups. First, banners about the project and signboard will be installed. Second, project web space will be further developed. Third, exhibitions flyers and posters in industrial and academic events will be prepared and

distributed. Fourth, we will use press and media (newsletters, TV programmes, promotional video, web articles to promote the project through local business. Journal articles will be presented at annual conferences.

Currently, Rich is involved in creating Videography. Rich was brought in the project with the help of UU. Rich introduced himself. He said he makes videos for 21 years. He has made music videos, documentaries and has worked at the UU in the past two years.

Communication Strategy Document has been updated with new activities. First, preparation of the new logo banner, documentary video and communication materials. Second, REAMIT activities were scheduled until June 2023. Third, attendance of networking events from January to June 2022. Finally, the CSD is available in REAMIT SharePoint.

SB updated about REAMIT website activities. REAMIT website domain has been secured in 2019 – www.reamit.eu. The original Interreg North-West Europe project page for REAMIT is still live at: https://www.nweurope.eu/projects/project-supply-chains-by-minimising-waste-using-big-data-and-internet-of-things-sensors/. Both websites are regularly updated with news articles, the information about events as well as new communication materials. In this period (January – June 2022), so far there were 943 visits, compared to 516 visits in the previous period. SB asked everyone to give their thoughts and feedback. RR mentioned that he shares and promotes www.reamit.eu during every event he takes part in and encourages others to promote it as well. He also encouraged others to visit the website once every month. Also, three newsletters have been published during this period (since December 2021). Currently, we are preparing newsletter for July 2022. The Mailchimp Newsletter subscription platform has seen growth in engagement by 12% in this period. We urge partners to share newsletters regularly as well as to contribute to upcoming newsletters.

Case Studies have been developed for the pilot-tests. WD Meats (UK) is still in progress; Picnic (NL) is still in progress; Human Milk Foundation (UK) – will be completed in August/September 2022. Yumchop (UK) has been completed; and Burns Meats (IR) is still in progress.

Moreover, multiple REAMIT partners contributed to a special issue of the journal 'Sustainability'. Also, a paper for the ICT 2022 conference has been accepted.

SB updated about project banners, posters and flyers. Promotion materials created so far include animated video, roll up banner, brochure, newsletter, posters, leaflet, REAMIT partner video, infographics and large format (A2) vehicle magnets. Also, there will be new animated videos for pilot tests (Picnic and WD Meats), and new posters (Picnic, WD Meats, IGRECA).

New material developed in this period January to July 2022 include: newsletters published in January and March, five posters for pilot tests (HMF, Yumchop, BioGros, Musgrave and Cyberbar), new graphics and digital development of the REAMIT website, photos and video footage of pilot test visits, new logo banner, REAMIT documentary video being developed.

So far, posters created include: HMF, Yumchop, Musgrave (not published), WD Meats, Cyberbar at UCD, Raman spectroscopy at UoN, IGRECA and Levstone (all completed). In progress, we are still waiting for approval for Picnic and BioGros. New pilot tests will require posters for: VDH Group, Burns Meats, Musgrave, HMF, Raman, Levstone, Cyberbar – this has also been discussed.

What's more, a documentary is being filmed by Rich Osborn at Type40 Creative and will be broadcasted on a local TV channel. So far filmed interviews and pilot tests during visits at Yumchop, HMF, Picnic, University of Essex, BioGros and Whysor.

In August 2022, there are plans to film at: NTU, BED, I &R, UoN/Valorial, other partners (a confirmation from RR needed). Final documentary video will be completed before the end of 2022.

RR requested SB and Rich for video captured at UoN and requested UoN to facilitate this. RR also asked I&R if they are interested in getting such video filmed at their premises. SB showed video of REAMIT documentary. RR mentioned that he wanted representation from every partner in the video.

Regarding policy briefs, the objective for us is to contact local councils and food associations to disseminate REAMIT work. For example, SEMLEP is a local organization within South East Midlands of UK. SEMLEP and UoB are connected to communicate about REAMIT. The deadline for this deliverable is listed as January 2023. UR mentioned that she is trying to identify what should be part of the Policy Document. Different countries have different policy requirements. The idea is to draft a common set of policies. It would be short document and UR requested help from partners for its completion. She requested partners to share (if they have) any associated documents.

Reports on REAMIT Networking Events have been presented in newsletters, this is also reported to JS through REAMIT project report. REAMIT partners participated in more events. On 28-29th January 2022, International Conference on Science, Engineering & Technology (ICSET – 2022) took place. On 26th March 2022, Mayor's Climate Action Event – Residents' Fair took place. On 25th May 2022, the Research Day of College of Business Administration in Ajman University (UAE) took place. On 11-12th May 2022, Food Waste Fest 2022 took place. On 21st June 2022, Race to Zero – Decarbonization Conference for Food and Drink Manufacturing took place.

Regarding communicating through local communication channels, active participation has been encouraged through supportive approach of production of short news. Local channels and online networks could help communicating to disseminate REAMIT to all local stakeholders. NTU contacted partners individually and sent a template to partners. Partners have continued their efforts to actively communicate about the project, mainly through the use of social media channels.

What relates to REAMIT's presence in social media, NTU actively posts and engages on social media by posting minimum once each week on both REAMIT platforms. External publications include: a feature in the Nottingham Business School Newsletter, a press release on REAMIT by the University of Essex and NTU representing REAMIT through the Food and Drink Forum. What's more, our REAMIT twitter account has seen a 25% increase in engagement in this current period. There were 52 total retweets and 106 total likes on twitter.

RR requested everyone to support WP Communication team in their work.

SB took the group picture of online meeting.

KP joined the meeting. She will present the BED progress report after the tea break.

[Tea break 15 minutes]

Day 2. Thursday 7th July 2022 – Morning Session

22.19

Project extension (9:00-9:05)
RR said that redeveloping the extension, drafting the budget, and getting it approved by the Joint Secretariat has now been completed. As of the end of May, the updated budget is officially included in the REAMIT

application form. As of now, we are in the extension phase. The latest application available in the EMS has all the details of the extension. If anyone needs any official information, please direct your office to the EMS portal. No one had any questions.

22.20

REAMIT Steering Committee Meeting

22.20.01

RR reviewed the minutes from the previous meeting.

Action log resulting from RAC/WP/RSC meeting, 19-20 January 2022

Date	Minute/ Item	Action identified	Responsibility	Status: Confirmation of completion or reasons for non-completion
19/01/2022	22.03	As REAMIT is still recruiting companies, all partners are requested to keep approaching companies for pilot tests.	Al PPs	Completed
19/01/2022	22.04.03	UoN to document all the experiences with the Raman pilot test, including experience when approaching companies for pilot tests, in a story telling format to be used in future publications.	UoN	The draft is ongoing. Completed
19/01/2022	22.04.04	Whysor to document all the experience with the pilot test with Picnic in a story telling format to be used in future publications.	Whysor	BioGros is ongoing. Completed. The deadline is March 2023 Some drafts need to be sent. GlanAfric stopped.
19/01/2022	22.04.05	Whysor to document all the experiences with the pilot test with VHG in a story telling format to be used in future publications.	Whysor	Completed
19/01/2022	22.04.06	Whysor to document all the experiences with the pilot test with Biogros in a story telling format to be used in future publications.	Whysor	Ongoing

19/01/2022	22.04.07	NTU to document all the experience with the pilot test with Glen Affric in a story telling format to be used in future publications.	NTU	Ongoing
19/01/2022	22.04.08	UU to document all experience in the Dry Aging Chamber pilot test with WD Meats in a story telling format to be used in future publications.	UU	Completed
19/01/2022	22.04.09	UU to document all experience in the Clostridium Bacteria pilot test with WD Meats in a story telling format to be used in future publications.	UU	Ongoing
19/01/2022	22.04.10	UU to document all the experience with Musgrave pilot in a story telling format to be used in future publications.	UU	Ongoing
19/01/2022	22.04.11	BED to document all the experience with Yumchop pilot test in a story telling format to be used in future publications.	BED	RR asked if KP has started this work. This document is not ready yet. Remind KP to submit it. Ongoing.
19/01/2022	22.04.12	UCD to document in a story telling format how ideas at UCD developed for fresh box and proof of concept pilot tests; how these ideas evolved and what actions were taken to implement them. Please include names of all companies that have been approached to participate in these experiments.	UCD	Not completed. RR asked for the possibility of fresh boxes. Ongoing
19/01/2022	22.04.13	UU to document in a story telling format how ideas at Ulster, BED and Whysor developed for 3DF pilot tests; how these ideas evolved and what actions were taken to implement them (input from Matthias, Gypsy's experiments, SensipDx, etc.). Please include actions taken and names of companies that have been approached (manufacturers of 3DF sensors suggested by	UU	Completed Keep sending a draft time to time.

		Tahmina) to advance the work on 3DF pilot test.		
19/01/2022	22.04.14	BED to report in a story telling format experience with the pilot test with HMF.	BED	We have already provided posters. Completed
19/01/2022	22.05.03	BED, Whysor, Levstone and data analysis partners to determine whether a separate manual is needed on how the Whysor server is connected to REAMIT Big data server.	BED, Whysor, Levstone	Ongoing
19/01/2022	22.05.04	Levstone and pilot test leads (HMF, Picnic, Musgrave, etc.) to meet and discuss if the Blue maestro system proposed by Levstone would be beneficial for them.	Levstone, Whysor, BED and Ulster	Ongoing
19/01/2022	22.05.06	UoN to make sure that data from the Raman pilot test is transported to the Big Data server at BED.	UoN	Data is coming to the server. Connectivity issues. Completed. Ali to check it. RR suggested an additional analysis.
19/01/2022	22.05.09	Data analytics partners to go beyond time series analysis and move to predictive analytics (rather than descriptive).	BED, MTU, SenX, UU	Ongoing
20/01/2022	22.08	NTU to present policy brief examples from other projects supported by Interreg NWE Programme.	NTU	Ongoing RR suggested James to invite NTU in WP3 (in September/October)
20/01/2022	22.08	NTU to present ideas for policy briefs in REAMIT.	NTU	Ongoing
20/01/2022	22.08	NTU to advance work n 6 case studies.	NTU	Ongoing

20/01/2022	22.08	NTU to advance work n 4 case studies.	NTU	NTU will do 4 Whysor will support 2 more
20/01/2022	22.08	NTU with support from partners to propose (and develop) actual videos on REAMIT (not only animated).	NTU	AA to start special issue paper James can do some research on Bacteria Completed
20/01/2022	22.08	NTU to explore and implementing a new functionality on the REAMIT website: add a log in button to access the Big Data server.	NTU	Ongoing
20/01/2022	22.08	UU to present to the team the documentary video made at UU.	NTU	Completed
20/01/2022	22.08	PPs to communicate about REAMIT through social media platforms.	PPs	Ongoing RR is encouraging everyone to support
20/01/2022	22.11	All PPs to include minutes from internal meetings in Project Handbook in SharePoint.	PPs	Ongoing All minutes should be put in the SharePoint for all WPTs

The minutes have now been confirmed and actions have been reviewed.

The feedback from RAC meeting and the decisions of the WP meetings will be discussed and approved after discussion during RSC meeting.

No feedback has been received so far. RR asked if any significant decision was taken in the WP meetings yesterday. No input was received. RR asked AA for updates.

22.20.02

Calendar for 6th REAMIT project activity and finance report and payment claim (July – December 2021)

KP is not around. To be revisited later when Kate returns to the meeting.
IH showed an email, saying 'There was an email sent by KP. By 17 June 2022, partners have completed the narrative part of the progress report in eMS and shared it as a pdf file with partners. By 15 of August 2022, partners have completed audits of their progress and finance reports'.

22.20.03

Plans for the 8th meeting of RAC/WP/RSC: UCD will be the host. 11-12th January, Wednesday – Thursday 2023

RR encouraged PP at UCD to start planning in the next 2-3 months. The menu should be started, and hotels, flight options, and relevant information should be prepared to be shared with partners in advance, in the next two to three months. The date for the upcoming meetings are confirmed for 11-12th January 2023. RR encourages partners to participate in person but will also provide hybrid mode. RR has requested for UCD team to provide the best travel information ahead of time for the trip to Dublin.

22.20.04

Calendar for the 7th progress report – the narrative part of the progress report should be completed by 17 June 2022.

Final deadline for financial reporting is 15 August 2022. All dates have been confirmed as per Kate's email to partners about deadlines.

22.20.05

Plans for the final meeting in March 2023

All tasks should be done until March and should be wrapped up until March and the rest of the time is administration. Date has been confirmed for 22nd March 2023. This will be a wrap up of the project. No financial spend will happen after March 2023. RR hopes for us to complete the Special Issue articles by then.

22.20.06

Plans for the 4th and REAMIT Symposium in December 2023

AG from Valorial provided the update on Symposium planning. It will take place on 6th December 2022, and will be a one-day format. It will be a hybrid format, including both attendees online and speakers in Nantes. The plan for the day is following: the event will follow a conference format + B2B and round table discussion.

9-11:30 GMT – session on REAMIT
1-4 PM GMT – session for European Commission and industry.

The desire is to have 60-100 attendees. Organisers shall be Memona and Adrienne from Valorial. In addition, Gael and Gladys from I&R will support Valorial.

Memona is working on the organisation of the symposium. She is in charge of digital communication. Last year, she was an intern at Valorial. She organised our yearly event last year with over 300 participants so is a good fit for the job.

Plan for organisation of the Symposium

July – September 2022: work on a collective overview of the topic to address; a call for proposals for the speakers. Adrienne wants to work collectively with the consortium to decide what we want at the symposium and help to finalise the program.

September: confirmation of speakers; reservations including B2B platform and finalising who will be joining in Nantes as we will be planning a visit for in-person partners.

October – November 2022: communication about event and languages it should be communicated in - management of networks and participants. Valorial will work with SB on this. RR requested to display the documentary on multiple screens at this event. Also, he asked for each pilot test lead to make a presentation at this event (10 minutes each). RR requested posters to be displayed at the event. Finally, all partners attend the symposium in person as it will be the best time to meet. RR proposed to create a plan amongst ourselves for what we want to present ourselves. We have 2.5 hours for the project on the agenda.

RR requested partners to be proactive in submitting work to showcase to others what we have done in the project. The event will be a nice networking opportunity too. 60-100 participants is a reasonable number to target. With Valorial/I&R's connections we should do a nice job. AG requested that each partner promotes the symposium through their own channels since it is a hybrid event. In the afternoon, we will plan topics to catch the attention of the target groups (from pharmacology to flowers; policy makers etc.)

SB asked if all speakers needed to attend in person or whether speakers could join and present online too. AG said that we should be flexible to allow speakers to attend in person and online (to allow for example the EU Commission, pilot test companies, etc., to join). However, all REAMIT members should attend in person.

KP commented saying that it is good that the event in Nantes will have a hybrid format. Also, she emphasized to consider what the aim of the event is, especially because it will happen 6 months before the end of the project. Thus, in her opinion, we should create content to fulfil the aim, including the rollout of sensor technologies to different industries/sectors. If this is the aim, then, we should consider who the target audience is. What's more, there should be different businesses from these sectors, and we should think how we can convince businesses to use sensor technology to enhance their businesses. We should therefore define the aims, target groups, and show them what they will get from it. Another issue is what we expect from EU Commission if they are attending. This is a very important actor and we can make good use of their attendance if we have a clear objective. We can ask them for help to take REAMIT further. Lastly, since REAMIT is closing and we are thinking about the legacy of the project, perhaps we could invite investors: to let them see what we are doing, to see if they are interested in investing in REAMIT ideas. There are some VC's in France who may be interested. AG will have a meeting with 1 or 2 of them to narrow down the focus of the Symposium.

RR has requested that Valorial starts preparing a flyer for the symposium.

22.20.07

REAMIT Legacy

This includes: combining Interreg grant with venture capital to help further develop REAMIT technologies, developing and following up project proposals inspired by REAMIT, setting out a spin out company, etc.

22.20.08

REAMIT Risk Log

KP joined the meeting and started talking about the risk log. The risks with Levstone, UoN, and SanX relate to the amount of funds and the output. KP said she was interested to explore it in a more detail.

UoN is expected to go through a real-life experiment. Levstone has not progressed as much as it was expected. SanX is still under progress. There might be a need for an audit from the funder in case if it is required. The major risk is to not to offer the Pilot Test Companies what has been promised.

KP explained that a student has already designed an application with certain amount of money allocated (around EUR 30k). However, she said, the Levstone application is old.

RR suggested Davinder to add a REAMIT logo to the application.

KP added a few comments related to the REAMIT legacy. She has already talked with the funder, but she has not received a response. She is looking for some potentials.

Whysor and Levstone are interested in continuing the technology. IH explained that they are not in direct contact with clients, so they do not have the capability to contact all the companies and a company needed in between and they do not install sensors. They work mainly on hardware and software.

The amount of funds that intelligent farm uses depends on the number of users and the technology, etc.

22.21

11:15 Research studies from the REAMIT project

RR asked James to talk for 10 min.

James started talking about research and publication works. UU started five research works. The research combines the WD and Burns meat and focuses on a generic case study. As for the case study paper on Musgrave, this is in progress and the abstract was written. Also, the poster has been prepared. There is a review paper with Xavier on sensor technology, and it is ongoing.

James is working on a survey paper with the outline of pilot trial companies. Quantitative research will be added to Yan's research. By December there will be draft information about this paper.

YD started her presentation, but there was a technical issue on screen share.

SA spoke about her research papers in progress. She works on two review papers and one conference paper. The papers relate to IoT and sensors in the food supply chain. SA has already sent emails to Abi and Natalie. She also showed her contribution in the collaborative paper with XC and TC.

RR suggested SA to make sure that there is no overlap between papers and check if they are distinct from other research works.

TA confirmed that all that is written in SA's paper is based on her effort and her own word, in addition to the point that was raised by UR regarding concerning similarity issues.

[Break for 15 min]

YD started her presentation: 'Examining the influences of Ability, Trust, Opportunity, and Motivation on IoT sensors adoption for preventing food waste'.
YD explained that there is ongoing research focusing on IoT sensor adoption. It is expected that more reviews will be added to the model.

RR asked TA about her plans. TA explained that she attended the STFC food network at the end of the last month. Also, she investigated the micro toxins that affect spices, nuts, peanuts, etc. She decided that this was a fantastic opportunity to collaborate with colleagues in that area. She is going to write an article on Micro toxins. RR suggested TA to collaborate not only with academics but also with businessmen in this area.

RR asked UR to show and explain the poster. UR started her presentation.

UR explained a case study. TC, XC, and KP provided information on this case study related to the HMF case study.

UR explained the case study. She asked for help from TC, and XC related to the case study.
UR asked GS if he is available in August to add some inputs to the case study. She is going to make a change to a diagram.

She will send an email to James related to the WD Meats case study.

RR started talking about additional articles. He explained that there is an ongoing research on the behaviour of pilot test companies. He is preparing a paper related to the opportunities and what is the motivation of the companies to work in this area. He investigated the importance of top management. He is working on another paper too. It aims to explain that each food item is different.

22.22

- **WP Project Management**

KP explained WP project management as follows:

- DM 1.1 Project Handbook
  Updates on calendar for the 7th progress report
  Minutes of REAMIT meetings
  Stored in SharePoint
- Dm 1.2 Minutes of meetings of RAC/WP/RSC
  RAC/WP/RSC meeting (January 2022) and Action Log
- DM 1.3 Intermediate Work Package coordination – partnership meetings
  RAC/WP/RSC meeting in January 2022
  Over 20 online meetings of monthly WP T1, monthly WP T2, WP T3, bi-weekly sub-group, BED-UoEssex team
  Over 20 bilateral meetings between PPs

There were several meetings between project partners.

Reporting calendar:

- By Friday 17th June 2022 – partners have developed their activity report in EMS and shared it with all partners and Associated Partners
- By Mondays 15th August 2022 all partners have finalised their FLC audit and submitted to the Lead Partner their certified progress and finance report, payment claim, and forecast of expenditure for the next period
- On Thursday 8th September 2022, on the spot FLC audit of BED and REAMIT project will take place in the Luton campus

An eMS is shown and there is a cumulative cost issue. FLC funds are requested to be sent to the funder.

RR said that for the first time UoEssex is going to send such kind of information. He also said he would work with KP on this issue.

IH explained her experience on showing the technologies, posters, etc.

KP suggested to clearly show the timesheets for the REAMIT related works to separate from other activities.

Regarding long-term plans, RR emphasised the REAMIT symposium and the policy briefing in March 2023.

Deliverables as per the Application Form include the following:

- Network prospectus (January 2019 – July 2023)
- REAMIT three networking events (by July 2021)
- The agreed framework for measuring the impact of REAMIT technologies on food waste (by December 2019)
- Policy briefings (6, by March 2023)
- Cross-sector briefings (3, by June 2023)

Most of the deliverables have already been completed.

22.23

WP Long Term

RR explained there is an idea of expanding REAMIT idea in other areas, for example, vaccine supply chain or flower supply chain where the temperature control is needed. IH also suggested its applicability in the transport of blood.

RR suggested research on these areas. He suggested the following: pharmacy, livestock transport, fuel transport, cosmetics, industry, blood supply chains, flowers.

YD commented that as there is less than one year left, and as deadlines are coming in March 2023, more meetings are needed and leaders are asked to chase up the partners.

KP shared her observations regarding some of the funding that has not yet been used. Also, BED considered employing some research associates (Elias Eze, Marina).

TA suggested that Gipsy could also collaborate in case that funds are available.

RR suggested that underspent funds could be allocated for publication not only in ‘Sustainability’ but other journals too.

TA suggested IH that if they are interested, they could collaborate on a publication.

Finally, SB took a photo of all participants.

RR thanked all partners for their contributions to the project and closed the meeting.

End of Day 2 of RAC/WP/RSC meeting.

Action Log: Actions resulting from RAC/WP/RSC meeting (January 2022 and July 2022)

Date	Minute/ Item	Action identified	Responsibility	Status: Confirmation of completion or reasons for non-completion
19/01/2022	22.04.04	Whysor to document all the experience with the pilot test with Picnic in a story telling format to be used in future publications.	Whysor	BioGros is ongoing. The deadline is March 2023 Some drafts need to be sent. GlanAfric stopped.
19/01/2022	22.04.06	Whysor to document all the experiences with the pilot test with Biogros in a story telling format to be used in future publications.	Whysor	Ongoing
19/01/2022	22.04.07	NTU to document all the experience with the pilot test with Glen Affric in a story telling format to be used in future publications.	NTU	Ongoing
19/01/2022	22.04.09	UU to document all experience in the Clostridium Bacteria pilot test with WD Meats in a story telling format to be used in future publications.	UU	Ongoing
19/01/2022	22.04.10	UU to document all the experience with Musgrave pilot in a story telling format to be used in future publications.	UU	Ongoing
19/01/2022	22.04.11	BED to document all the experience with Yumchop pilot test in a story telling format to be used in future publications.	BED	RR asked if KP has started this work. This document is not ready yet. Remind KP to submit it. Ongoing.
19/01/2022	22.04.12	UCD to document in a story telling format how ideas at UCD developed for fresh box and proof of concept pilot tests; how these ideas evolved and what actions were taken to implement them. Please include names of all companies that have been	UCD	Not completed. RR asked for the possibility of fresh boxes. Ongoing

		approached to participate in these experiments.		
19/01/2022	22.05.03	BED, Whysor, Levstone and data analysis partners to determine whether a separate manual is needed on how the Whysor server is connected to REAMIT Big data server.	BED, Whysor, Levstone	Ongoing
19/01/2022	22.05.04	Levstone and pilot test leads (HMF, Picnic, Musgrave, etc.) to meet and discuss if the Blue maestro system proposed by Levstone would be beneficial for them.	Levstone, Whysor, BED and Ulster	Ongoing
19/01/2022	22.05.06	UoN to make sure that data from the Raman pilot test is transported to the Big Data server at BED.	UoN	Data is coming to the server. Connectivity issues. Completed. Ali to check it. RR suggested an additional analysis.
19/01/2022	22.05.09	Data analytics partners to go beyond time series analysis and move to predictive analytics (rather than descriptive).	BED, MTU, SenX, UU	Ongoing
20/01/2022	22.08	NTU to present policy brief examples from other projects supported by Interreg NWE Programme.	NTU	Ongoing RR suggested James to invite NTU in WP3 (in September/October)
20/01/2022	22.08	NTU to present ideas for policy briefs in REAMIT.	NTU	Ongoing
20/01/2022	22.08	NTU to advance work n 6 case studies.	NTU	Ongoing
20/01/2022	22.08	NTU to advance work n 4 case studies.	NTU	NTU will do 4 Whysor will support 2 more

20/01/2022	22.08	NTU to explore and implementing a new functionality on the REAMIT website: add a log in button to access the Big Data server.	NTU	Ongoing
20/01/2022	22.08	PPs to communicate about REAMIT through social media platforms.	PPs	Ongoing RR is encouraging everyone to support REAMIT communication team and activities
20/01/2022	22.11	All PPs to include minutes from internal meetings in Project Handbook in SharePoint.	PPs	Ongoing All minutes should be put in the SharePoint for all WPTs
06/07/2022	22.14	All pilot test leads to fill in the template for pilot test story telling.	BED	Ongoing
06/07/2022	22.15	Whysor to install sensors at VHG, start measuring the pressure, create a poster, write the pilot test storytelling, and analyse data.	Whysor	Stopped
06/07/2022	22.15	Whysor to complete the pilot test storytelling of VHG.	Whysor	Ongoing
06/07/2022	22.15	Whysor to link the data received from Picnic to the data that is coming from the sensors to see if it is possible to recognize a trip in the data.	Whysor	Ongoing
06/07/2022	22.15	BED, MTU and SenX to start the analysis of data for Picnic.	BED, MTU, SenX	Ongoing
06/07/2022	22.15	BED, MTU and SenX to determine a cooling profile for cool box.	BED, MTU, SenX	Ongoing
06/07/2022	22.15	NTU to produce Picnic poster and the video.	NTU	Ongoing
06/07/2022	22.15	Whysor to complete the pilot test storytelling of Picnic.	Whysor	Ongoing

06/07/2022	22.15	Whysor and data analytics partners to define the thresholds in which the temperature is correct for each part of BioGros warehouse.	Whysor and data analytics partners	Ongoing
06/07/2022	22.15	Whysor to complete the pilot test storytelling of BioGros.	Whysor	Ongoing
06/07/2022	22.15	UoN to complete the pilot test storytelling of Raman Spectroscopy.	UoN	Ongoing
06/07/2022	22.15	UoN to conduct stage 3 of the pilot test in real life conditions in a truck.	UoN	Ongoing
06/07/2022	22.15	UU to perform two more runs of tests with WD Meats when different combinations of temperature and humidity parameters will be tested to try to reduce the dark facings.	UU	Ongoing
06/07/2022	22.15	UU to complete the pilot test storytelling of Raman Spectroscopy.	UU	Ongoing
06/07/2022	22.15	UU and BED to determine whether Clostridium Bacteria pilot will be analysed further under the REAMIT project or outside it.	UU, BED	Completed
06/07/2022	22.15	UU to discuss with UoN whether and how Raman spectroscopy can be used for this type of analysis. UU to send some samples for testing at UoN.	UU, UoN	Ongoing
06/07/2022	22.15	UU to complete the pilot test storytelling of Clostridium Bacteria.	UU	Ongoing
06/07/2022	2.15	NTU to recover equipment installed at Glen Affric.	NTU	Completed
06/07/2022	2.15	NTU to complete the pilot test storytelling of Glen Affric.	NTU	Ongoing

06/07/2022	2.15	BED to complete the pilot test storytelling of HMF.	BED	Ongoing
06/07/2022	2.15	BED to complete the pilot test storytelling of Yumchop.	BED	Ongoing
06/07/2022	2.15	UCD to complete the pilot test storytelling of Burns Meats Farm.	UCD	Ongoing
06/07/2022	2.15	UU to complete the pilot test storytelling for 3DF sensor.	UU	Ongoing
06/07/2022	2.16	Levstone to send any extra data parameter required for the app development as it may differ from modelling data requirements.	Levstone	Ongoing
06/07/2022	2.16	JE to arrange a meeting with GS and tech team to ensure consistent data labels.	JE	Ongoing
06/07/2022	2.16	Levstone to develop REAMIT specific App.	Levstone	Ongoing
06/07/2022	2.16	Levstone to develop a second database for potential demand points.	Levstone	Ongoing
06/07/2022	2.16	SenX and data analytics partners (and Whysor) to integrate SenX system for data analytics with Whysor API approach.	SenX and Whysor	Ongoing

Approved minutes from the 8th meeting of REAMIT Advisory Committee, Work Packages and Steering Committee meeting, 11 – 12 January 2023
Hosted by University College Dublin, Ireland

Attendees:

Name	Institution	Name	Institution
Ram Ramanathan (RR)	Essex	Jean-Charles Vialatte (JV)	SenX
Katarzyna Pelc (KP)	BED	Fionnuala Murphy (FM)	UCD
Sahar Ahmadzadeh (SA) online	BED	Shane Ward (SW)	UCD
Tahmina Ajmal (TA)	BED	Tamiris Da Costa (TC)	UCD
Gael Maugis (GM)	I&R	Xavier Cama (XC)	UCD
Davinder Bola (DB)	Levstone	Omar Dib (OD) online	UoN
Gautam Samriya (GS)	MTU	Imke Hermens (IH)	Whysor
Usha Ramanathan (UR)	NTU	Marcel Steegh	Whysor
Sasha Bennett (SB)	NTU	Tom Verstraten (TV)	Whysor
James Gillespie (JG)	UU	Herve Rannou (HR)	SenX
Joan Condell (JC)	UU	Ali Assaf (AA)	UoN
Trevor Cadden (TC) online	UU	Elaine Ramsey (ER) online	UU

Day 1. Wednesday 11 January 2023 – Morning Session

11:00 - 11:30: REAMIT Advisory Committee meeting (Chair BED)

Kate presented the progress of REAMIT project in the past 6 months: July – December 2022. She made the overview of progress across all Work Packages.

WP T1: the aim was to establish connections with a minimum of five companies, and this goal was exceeded because a total of nine companies were successfully contacted. Ten functional prototypes have been developed, with nine utilising temperature and humidity sensors, and one utilising Raman spectroscopy. Furthermore, there is an additional Bluetooth sensor currently in the development stage. However, there have been some difficulties with the implementation of some pilot tests, mainly staff changes at Picnic and no personnel at Ruthiau dedicated to the Raman pilot test, which challenged communication with pilot test companies.

WP T2: Whysor developed a dashboard to monitor the temperature and humidity. It used the automatic data transfer.

WP Communication: a brochure, a new REAMIT timeline, four new posters, a documentary, six short videos, six posters and six case studies were all made. The policy brief document is still work in progress. A few public events were organised. In December 2022, Valorial, with the support of Images et Réseaux and the REAMIT partners, prepared and hosted a symposium in Nantes (France). Also, partners jointly completed 14 journal articles and, further, submitted them in November 2022 to the special issue of *Sustainability Journal.* P

WP Management: Project Handbook has been updated with the minutes from all the meetings. It is available in SharePoint. Minutes of the recent RAC meeting hosted by Whysor in July 2022 as well as action log have been shared with all partners. When it comes to intermediate work package coordination, BED and University of Essex facilitated over 30 online meetings and supported work package leads. BED is currently working on Project progress report 4.1 and 4.2. The Joint Secretariat has approved a permission for small budgetary changes in the REAMIT AF for MTU and BED. LP partner was informed that we have a new project officer at JS of Interreg NWE Programme since December 2022. Her name is Maelle Lebon.

One risk has been, mainly that NTU partners have experienced challenges with obtaining back REAMIT IoT equipment from Glen Affric, who decided to disengage from the REAMIT pilot test.

WP Long Term: REAMIT partners (MTU and UU) have approached four new business organisations. Valorial organised 4th REAMIT Symposium in Nantes, France. Ram (University of Essex) has initiated a discussion on the legacy of the REAMIT project with some ideas for developing REAMIT 2 project proposals. Finally, Ram developed a successful pitch for a spin-off company inspired by REAMIT and won £8000 from Essex Investment Fund to further develop ideas inspired by REAMIT.

Also, during the RAC meeting, Annemarie Van Vilsteren, as a guest speaker, presented their proposal on the reduction of food waste and invited REAMIT partners (from the eligible area) to join the team developing that project. The project proposal, which will be submitted to Interreg North Sea Region Programme, has three main objectives: to mitigate food waste in the supply chain for vegetable, dairy, and marine products; to promote collaboration and innovation within the food industry; to conduct research on tools that can be utilised during food production to identify areas for optimisation, with the goal of not only reducing food waste but also making the food industry more competitive. The project proposal foresees submissions from up to 30 projects, with at least two or three companies working together.

11:30 – 13:00: WP T1 Pilot Tests (Chair I&R): Adapting and pilot testing sensor technologies in agri-food supply chains

Gael started by presenting an overview of the deliverables that Images et Réseaux have already submitted. First, publication of open call (March 2023) (D1.1). Second, it organised a partner workshop on sensor and Big Data (June 2019) (D2.1). Third, it worked on a test roadmap (March 2023) (D2.2). Finally, it recruited minimum five companies from agri-business supply chain for pilot tests (July 2020) (D1.2).

By March 2023, Images et Réseaux aims to submit a few other deliverables (as per the extension, to be completed by 17 March 2023). This includes working prototypes using sensor technology (D3.1), user manual for each pilot test (D3.2), and report on the pilot test and development of the sensor prototypes (story telling template) (D3.3).

Gael shared the link to access the document regarding the above-mentioned deliverables. He encouraged everyone to access the document and add their contribution in the document before mid of March 2023.

Gael explained also that he exchanged several emails with partners regarding the above-mentioned deliverable. If something still seems unclear to partners, they are welcome to approach him, although, as he believes, partners should have some more clarity now.

Partners presented updates on the pilot tests.

1) Picnic (NL)

Imke from Whysor started a presentation on pilot test with Picnic (NL). As she explained, Picnic is an online supermarket that delivers groceries to the costumer's home. They use trucks to transport groceries from their fulfilment centre in the Netherlands to local hubs and from the hub to the customers' homes. Picnic started with four delivery vehicles in 2015 and now there are over 1000 vehicles in the Netherlands and they deliver groceries in 120 Dutch cities and villages.

As Imke explained, they faced several challenged during the pilot test with Picnic. First, there was a problem with real-time data reporting/monitoring during transportation; second, sustainable sensor housing; third, the personalised cooling profile; and, fourth, easily maintainable equipment. Eventually, Whysor applied the REAMIT solutions to resolve these issues. The team at Whysor installed 20 Elsys EMS sensors (temperature, humidity and acceleration) in Picnic food crates and established a system facilitating real time transmission of data having temperature, humidity and acceleration information from the food crates in delivery journey to a Whysor cloud-based database where further data analysis can be performed.

After the installation of sensors in 2021, data were coming in fine, however, within a few weeks all the sensors stopped sending data. The sensor housing appeared to be not solid enough to withstand the force of heavy groceries. As a solution, flexible rings were 3D printed to protect the housing of the sensor and 20 new sensors were purchased and installed. Few months later, Whysor noticed that all these sensors broke down again, which means that the sensor housing is probably still not strong enough. This experience from the pilot test with Picnic allowed drawing a few conclusions. First, technical specifications of the sensors meet the expectations. Second, protection of the sensor is challenging. Finally, we need to track broken sensors.

Deliverables that have been submitted for this pilot test include:

- Poster – done
- Case Study – not started
- Working prototypes (3.1)
- User manual (3.2)
- Story telling (3.3)

Imke mentioned that the deliverables 3.1, 3.2 and 3.3 are currently in progress. In past few months, Whysor has not been hearing any communication from Picnic despite having tried many times. However, just before Christmas 2022, Picnic got in touch with Whysor. Picnic updated Whysor that they were having organisational movements of staff and, thus, our initial point of contact in Picnic no longer worked in the same department. Picnic expressed a desire to continue and complete the pilot test with REAMIT. Whysor discussed with Picnic a possibility of installing 10 new sensors with new housing in January 2023. Picnic agreed, but they also emphasised that they would have to first look internally for the relevant personnel in Picnic to be in charge of the pilot test. Picnic also agreed to share extra data for some trips that Whysor could identify or define. Based on this, next steps in the Picnic pilot test include installation of ten new sensors in January 2023, defining trips for which we want extra data from Picnic for analysis, and defining cooling profile and looking for anomaly detection.

Ram commented that it is a good development and expressed happiness that Picnic wants to complete the pilot test with us. Ram also mentioned that with further progress on the pilot test in coming days, University of Essex can work together with Whysor team on the Picnic case study. He also welcomed contributions or inputs from other partners for the case study. Imke also expressed willingness to work together further on the case study. He mentioned that they are working with three types of protective rings for sensor housing too, but Whysor is unsure about the longevity and lasting capability of these protective covering of sensor. Ram asked if Whysor is planning trips in coming days. Imke replied that they would plan trips in summer months as the observations are more interesting and relevant then, compared to the winter time.

Ram added that apart from establishing sensing and monitoring system, finding personalised cooling profile and estimating amount of cooling ice packs for the food crates is an important objective of this pilot test. For this purpose, Ram mentioned that finding temperature gradient during delivery journey seems important and he seeks support from other partners to look into it based on incoming data. Ram thanked Imke for her presentation.

Elaine asked if we are capturing the cost of technology used in the pilot test. She commented that it will be important from a business perspective and for cost benefit analysis of using these technologies for the company.

Ram commented that although not actual cost, but through work in LCA we are capturing cost equivalents in terms of environmental impact of using these technologies. He also suggested Tamiris to work further on capturing the actual costs along with environmental cost equivalent. During the discussion, the group commented that we could calculate the costs associated with technologies without much difficulty as we know prices of various components purchased. Ram asked Kate if she could help with it as she has already dealt with ordering sensors and other components. Tahmina also emphasised the need to capture cost related to battery usage and server.

Kate made the point that we need a systematic approach or template to do such cost benefit analysis. She also added that she recently came across an interesting paper regarding cost and benefit of using IoT technology in companies. She said that a cost benefit analysis can be made with pilot test companies, such as HMF, by doing interviews with them and capturing the benefits and challenges they faced. Kate would share the research paper with partners. The group then made an observation that having such template and systemic approach though very useful from business perspective, is a big task in itself.

Action: Whysor with support from university partners (UEssex) to develop a case study document on the pilot test with Picnic.

Action: Whysor to install ten new sensors in Picnic in January 2023, to define trips for which we want extra data from Picnic for analysis, and to define cooling profile and look for anomaly detection.

Action: Whysor and BED to gather information on the prices of various components that were purchased. This could help to calculate the costs associated with the use of technologies (in addition to the environmental cost calculation).

Action: Kate to share with partners a research publication on costs-benefits analysis of using IoT technologies by companies.

2) BioGros (Luxembourg)

BioGros is a wholesaler of high-quality organic and biodynamic foods in Luxembourg. BioGros is a company with a complete supply chain. They have fresh vegetables such as celery, lettuce and mushrooms

produced by organic farmers from the cooperative. The products are transported from the farmer to the BioGros warehouse by vehicle trucks. The vegetables are packaged and then transported to retail in small village shops, etc. BioGros sometimes experiences quality issues in transporting fresh foods, and they wish to gain insights into climatic conditions there. The goal of this pilot test is to gain insight into climatic conditions like temperature and humidity in the complete supply chain and then, particularly, regarding several fragile vegetables like mushrooms, onions, potatoes, and celery roots. The company also would like to have more information on fruit and vegetables ripening inside the warehouse.

Whysor faced several challenges during the pilot test with BioGros. The first issue related to real-time data reporting/monitoring during transport. Second, real-time data reporting/monitoring during warehousing. Third, alerting system in case of anomalies. Fourth, alerts should not be sent when trucks are stationary. Fifth, easily maintainable equipment.

The REAMIT solution involved setting up architecture includes installing sensors at BioGros grower, warehouse and inside the trucks. The sensors selected are digital meter Eagle loggers with temperature and humidity sensors. Data is transmitted from the Lori to the Whysor cloud. Whysor tested connectivity in Luxembourg at two locations and found it to be fine. Whysor also tested battery life and used trip detection algorithm to enhance battery life. The initial conclusions from the pilot test demonstrated that technical specifications of sensors meet expectations, the system is robust and false alerts are avoided.

Deliverables for the pilot test and their status are the following:

- Poster – already done
- Case study – work in progress with NTU
- Working prototypes (3.1) – work in progress
- User manual (3.2) – work in progress
- Story telling (3.3) – work in progress

The next steps for this pilot test include two aspects. First, Whysor will meet with BioGros, the REAMIT analytics team and writers of the case study for discussion and brainstorming for additional questions to be asked and looked into, as well as additional information needed. Second, we are working on defining the anomalies with analytics team at REAMIT. They already held two such meetings and the next meeting is planned this month (January 2023).

Action: Whysor, the REAMIT analytics team and writers of the case study will meet with BioGros to further discuss other relevant issues that need to be explored and gather some additional information.

Action: Whysor and the REAMIT analytics team will continue to work on defining the anomalies.

3) Pilot test with Raman Spectroscopy with Routhiau, IGRECA, ADRO in France (UoN)

Omar (University of Nantes – UoN) started presenting progress update on Raman spectroscopy-based pilot test at UoN. The main aim of the pilot test is to test the use of a portable Raman spectrometer inside food delivery trucks as a means to continuously measure and monitor the quality of food samples in the delivery trucks, as well as alerting the truck drivers/stake holders in case of food quality getting degraded during the road trip.

The pilot test has been divided into three stages.

- Stage 1 – Lab development (test the system in lab and develop the required scripts)

- Stage 2 – Transitioning between lab and company (portable system placed in refrigerated chamber in trucks mimicking real transport conditions)
- Stage 3 – Test in real conditions

The Stage 1 included setting up Raman sensors in lab and testing on food samples. It then involved analysing the observed data using Matlab scripts and uploading the results and scripts to the server. The Stage 1, including all the sub-activities, has already been completed.

The Stage 2 included all the activities of Stage 1, and, additionally, the activities related to system modification, automatisation, simulation as well as validation. All the activities of Stage 2 have already been completed.

Omar demonstrated the results of Stage 2. The system was able to monitor the change in quality of meat samples as we go from Day 0 to Day 30 during our observation period. The system was able to distinguish between high quality and low-quality food samples. The system was also able to detect when the first shift in quality of food samples took place. In addition, the system was also able to detect the molecules that were impacted during change in food quality. For example, the system was able to detect impact on molecules of Tyrosine and Amide 1, which are good indicators food quality.

Stage 3 (test in real conditions) has been divided into two activities. During the first activity, UoN team tried to contact industry such as Routhiau company for testing in real conditions. However, they did not hear back further from them, thus, the team engaged with the other activity – renting a truck. UoN team rented a truck and placed portable Raman sensor-based system in the truck for taking the measurements. The system was installed with foams to protect it from shocks and held tight using rope and the system was tested. The next phase of this activity will be to test the system in journey, and this is planned to take place at some point in February 2023.

Omar also emphasised that they exchanged communication and, eventually, got an interest from Vivo Group (in France) to install Raman sensor-based technology on their premises. The REAMIT team visited Vivo Group during the REAMIT Symposium in December 2022. Their concern is to test quality of sea food before/while transporting it to other customers. UoN plans to discuss it further with the company.

UoN has also published a research paper on Raman Spectroscopy Application in Food Waste Analysis in a special issue of *Sustainability Journal*. Moreover, UoN is preparing a poster for a conference on Raman Spectroscopy which will take place in Brest (France) in January 2023. Omar shared the draft of the poster. UoN is also working on developing the Storytelling (Deliverable 3.3) and user manual (Deliverable 3.2).

Ram commented that the opportunity for using Raman spectroscopy-based food quality analysis with Vivo Group, which has already had a sophisticated technical system in place, seems like a good development, because it strengthens the usability of Raman spectroscopy for such use case.

Devinder asked Ali how long it takes for Raman spectrometer to detect quality of food sample. Ali explained that it measures the quality in less than a second, but we need to measure spectra at multiple locations on the food sample. Ali made the point that using baseline spectra, they can compare spectra of sample in real time and can generate alert for the operator if the spectra indicate change in food quality. Ali also added that Raman spectroscopy works better in cold temperature because noise is reduced in low temperature. Thus, it could be very useful for cases such as Vivo Group. Ali made the argument that Raman spectroscopy can also be used for fruits, vegetables and other food items in addition to meat, chicken, fish and seafood products.

Action: UoN will test the portable Raman sensor-based system in journey in February 2023.

Action: UoN will further explore the possibility to collaborate with Vivo Group and will discuss installing Raman sensor-based technology on their premises to test quality of sea food before/during transportation to other customers.

Action: UoN to develop the Storytelling (Deliverable 3.3) and user manual (Deliverable 3.2).

4) Pilot test with YumChop (UK)

Sahar from the University of Bedfordshire (BED) shared the updates on the pilot test with YumChop in the UK. First, she gave a brief overview of YumChop as a company. YumChop is a British-based family-owned company specialising in producing ready-to-eat frozen meals with African flavour sold through self-serviced automated vending machines. YumChop also delivers directly to customers' homes through purchases made on website, and also to retailers and large organisations.

Sahar updated that REAMIT team visited the company and installed sensors at various locations in YumChop such as different zones, freezers, cold rooms, vending machines and kitchen fridges. Sahar explained the system requirements for YumChop, in particular, types and number of sensors and gateway used during installation. There have been ten sensors deployed in the pilot test, and one sensor has been deployed per fridge/freezer. The acceptable temperature threshold defined by the company is -18 degrees Celsius in a freezer. If the temperature exceeds this threshold, alerts need to be sent to company owners. A proposed analysis that we are working on is early anomaly detection model.

Sahar explained that team is looking into the factors that could potentially affect the temperature of raw materials or processed food in a fridge. The danger zone refers to the temperature range in which bacteria grow most rapidly on food. The maximum temperature should be 5 degrees Celsius. For consumer foods, generally, if the food is exposed to temperature range above 5 degrees Celsius for more than 90 – 120 minutes, the food should be disposed due to the growth of pathogens. Some other causes of food degradation could be that food not cooked or reheated to the temperature required, or hot food is not cooled properly before being placed in cold storage, the fridge is not cooling as per the requirements to keep the food in safe zone. Thus, it is important to check the temperature regularly. Other aspects that we can look into include the impact of seasonal variations and using it for benefit. For example, there could be an increase in energy consumption during summer period as compared to winter. Also, with increased temperature monitoring, we can look for optimising the energy cost by avoiding scenarios such as desired temperature cut-off is -20 degrees Celsius, but food is kept in -30 degrees Celsius, causing extra consumption. We can also carry out a time series analysis of food waste in YumChop, before and after sensor installation.

Some of the plans that we are currently investigating are to optimise routes for reaching a set of vending machines, optimising the journey lengths, correlation between maximum journey lengths and outside temperature, alternative routes based on traffic information as well as the amount of ice packs/dry ice needed in trucks. Other updates can be provided in WP T2 section.

Action: BED to prepare a story telling document on YumChop.

5) Pilot test with Human Milk Foundation (BED)

Sahar (BED) presented updates related to HMF (https://humanmilkfoundation.org/) pilot test. First, she gave a brief overview of HMF. Human Milk Foundation, founded in 2017 in the UK, is a charity working to help more families feed their babies with human milk.

The goal of the pilot test is to monitor temperature in which human milk is transported between a donor, human milk bank, hospital and home; and send alerts if these conditions change. Optimal temperature for transportation of human milk is -20 degrees Celsius. In general, there are 30 – 50 donors per day. For milk deliveries, generally a few bottles of milk are transported per trip in a motorcycle or a car. We have prepared a poster for HMF pilot test highlighting collaboration of REAMIT with HMF. Sahar showed draft of poster. Sahar then gave a brief overview of sensor installation infrastructure deployed for the pilot test. Sensors monitor the temperature and send the data to cloud database where data is analysed. Whysor has built a dashboard for displaying data from HMF sensors. There were some challenges faced during the pilot test. There was an issue related to the connectivity between sensors and the cloud, as the sensors move from one location to other of varying connectivity, sensors loose connection with the cloud. Whysor is working with HMF team to resolve this connectivity issue. Also, another connectivity issue was due to communication breakdown. There were also some challenges related to alarming.

We are analysing the data coming from the sensors and we are monitoring temperature fluctuations over a period of time. Data analytics partners are also looking into the issue if we need other data also for the pilot test apart from regularly analysing the available data. BED also plans to purchase new sensors for HMF. The Whysor team is also working towards improving the dashboard by adding new features such as configuration for binary sensors.

Action: Whysor and the HMF team to resolve the issue of connectivity between sensors and the cloud as well as the communication breakdown, and alarming.

Action: BED to purchase new sensors for HMF.

Action: Whysor to improve the dashboard by adding new features such as configuration for binary sensors.

5) Pilot test with WD Meats (Dry aging chamber) in the UK (UU)

James from UU presented updates related to the pilot test with WD Meats for dry aging. WD Meats wanted to optimise the dry aging process that they deployed on their premises. Dry aging beef is a premium technique used for the flavour development and to tenderise the beef. It involves hanging beef carcasses or hindquarters in a refrigerated room uncovered and left to age for several weeks or even months at a controlled temperature, relative humidity, and airflow. It is costly because of high aging shrinkage, trim loss, risk of contamination, and the requirements of aging conditions and space. REAMIT project is interested in reducing trim loss, which is a phenomenon that occurs when too much moisture is extracted from beef resulting in unusable dark facings (which needs to be trimmed and disposed of before the sale of the meat). UU is trying to reduce the dark facings and, thus, trim loss, by tuning the environmental parameters of the refrigeration setup.

The REAMIT team deployed four LoRaWan sensors and a LoRa gateway in four zones of the dry aging chamber to monitor and record the temperature and humidity data. The equipment selected includes a multi-tech Lora Gateway, and four Ursalink UC11 temperature/humidity sensors. Two sensors were installed at the front of a large, refrigerated lorry container with all the hindquarters hanging up, and two were installed at the rear of the lorry.

The team performed three dry age trials, two of 14-day cycle and one of 21-day cycle in July 2021 (three weeks), March 2022 (three weeks) and August 2022 (two weeks). Normally, the dry aging process lasts three weeks.

James presented some results from the trial. A histogram of temperature values of left placed sensors was presented to look for most recurring values of temperature. Also, the temperature profile of dry aging chamber from front to back, over a period of 14 days. Since July 2022, one more dry aging cycle was performed and it lasted 14 days.

For next steps, James is waiting for Marco to provide start and end weights for April and August 2022 trials. The plan is to ideally perform one more iteration with different structuring of carcass's/sensors or different temperature and humidity parameters for the refrigeration unit after results from the baseline trial will be suggested. There are two questions to explore: (1) Does airflow affect dark facings? Airflow depends on how many carcasses are located in the trailer and also the structure. (2) Are there more optimal parameters which exist for the temperature and humidity which would minimise the dark facings while avoiding harmful bacteria formulation? Another idea is to compare this study with Burns Farm Meats pilot test data, this will be discussed in WP T2.

Action: Once WD Meats provide start and end weights for trials that took place in April and August 2022, James will try to perform one more iteration with different structuring of carcass's/sensors or different temperature and humidity parameters for the refrigeration unit.

6) Pilot test with WD Meats (Clostridium Bacteria) in the UK (UU)

James provided a background of the pilot test. This pilot test has proven to be tricky to kick off, partly due to the need of highly specialised knowledge of microbiology and some logistic issues. Clostridium is an anaerobic spoilage-causing bacterium found on farmyard or animal hide and has a high prevalence in abattoirs. It is a multi-billion-dollar problem because it produces non-toxic gases which spoil products early. In addition, it can spread easily and only grows once the products are packed.

Currently, WD Meats do swabbing with PCR in a lab based at the University of Bristol, which takes at least 48 hours and sometimes 72 hours. As WD Meats are processing tons of meat per time, they are hoping to find a quicker way of detecting it so that they can clean up the factory quicker, which means fewer products are affected. The trial plan is to investigate alternative methods of detecting the bacteria using a trace source of Clostridium using DNA sequencing. The goal is to find a faster method of detection, allowing for immediate clean-up of surfaces when detected that will inevitably reduce the beef waste in abattoirs, retailers and homes.

James provided an update about the current progress in the pilot test. UU met with Marco and Victoria (lab technician at WD Meats) on 3 May. They have purchased their own PCR machine (Genesig), which processes samples in approximately three hours rather than 48 hours, what WD Meats had experienced before. However, they had some issues with calibration. UU will help them with calibration/benchmarking and device validation using positive Clostridium DNA strains and comparing results between their lab and UU lab PCR machine to ensure their machine is functioning correctly. James Dooley also prepared ten samples of positive/negative Clostridium DNA and delivered to WD Meats on 4 August 2022.

WD Meats ran those ten Clostridium samples and sent their results. UU ran the Clostridium samples but only three rather than ten. We are awaiting for James Dooley to write a technical report which would further explain these results. The results between these two runs should match. WD Meats are having recurring issue with their positive/negative controls for Clostridium. James Dooley is going to investigate this and see if he can produce new controls for them to use in their Genesig machine. However, James updated that James Dooley has been very busy in past six months and it has been difficult to contact him and to progress further on this since past six months. Thus, we may need to redo another set of experimentation. James showed results of sample runs by WD Meats and UU. James Dooley shared his initial comments on the results and mentioned results of UU were along expected lines, however, more insight on these is needed.

For the next steps before the end of the project, we have to complete a technical report on Clostridium results. We also look to prepare new controls for WD Meats and ensure that their lab can replicate the same results as UU lab. James Dooley also wants to perform a DNA sequencing study to identify the source of the Clostridium. Marco is very interested in this research because he suspects that a lot of Clostridium is coming from imported cattle and WD Meats brings in a lot of their beef from the UK, and he would like to identify the exact suppliers and farmers for where these issues occur. DNA sequencing could help in proving that this is the case and then WD Meats can change the supplier.

Action: UU to help WD Meats with calibration/benchmarking.

Action: UU to complete a technical report on Clostridium results.

Action: UU to prepare new controls for WD Meats and ensure that their lab can replicate the same results as UU lab.

7) Pilot test with Musgrave in the UK (UU)

James gave a brief background of Musgrave pilot test. Musgrave is the largest wholesaler of groceries in Northern Ireland. They supply one in every four homes. Musgrave deliveries of chilled food produce are performed to various small businesses, fast food restaurants, etc., within approximately 15-mile radius from Musgrave's warehouse, using their own logistics network. Vans performing deliveries are refrigerated, but at present, there is no way of knowing in the cab or the office if the refrigeration units are currently correctly functioning. Breakdowns with refrigeration units can cost the wholesaler full vans of spoiled food. Therefore, they would prefer an alerting system that would let them know of any issues which should be available to both the driver and the logistics staff in the head office, so the van could be redirected back to base loss, minimising the risk of food spoilage.

The sensor system was deployed in the vans of the company to monitor and track temperature and humidity and trip detection algorithm was also implemented. For the current updates on the pilot test, the IoT anomaly detection system was deployed with `Musgrave Marketplace in April 2022 in three delivery vans operating in the greater Belfast area. The system monitors both the frozen and fresh produce refrigeration areas of each van in 5-minute intervals while deliveries are being performed. Logistics staff at the warehouse has been given access to the Whysor dashboard for real-time monitoring of the vehicles and has been added to the alerting service. When no trip is detected, recordings are made and uploaded to cloud every 12 hours. As of now, the batteries have needed replacement once after 180 days in one logger.

For the steps to be completed before project end, the ambient temperature monitoring, results suggest there are problems with the cooling profile of the vans. However, Musgrave have not flagged any issues. We are also looking into the question whether there might be a better sensor location to monitor the ambient temperature. James added that he spoke with a refrigeration specialist who advised placing sensors to monitor ‘air on’ at the refrigeration unit, which is where air is drawn into after circulating the entire van. He believes this is the most accurate representation of ambient temperature. We would try moving the sensor to ‘air on’ of the refrigeration unit and see we could get more accurate ambient temperature data.

Action: UU to move the sensor to ‘air on’ of the refrigeration unit inside the Musgrave van and to see if more accurate ambient temperature data is available.

8) Pilot test with Andy Keery (Rent - a - Fridge & Andy Keery Refrigeration) in Northern Ireland & Ireland (UU)

James updated that in the past two months, he started a small pilot test with Andy Kerry who is CEO of Rent-a-Fridge and Andy Keery Refrigeration in Northern Ireland and Ireland (https://www.rent-a-fridge.co.uk). Andy Kerry Refrigeration rents fridges and cold storage to customers in Ireland and Northern Ireland. He is very popular during festival seasons. He works with supermarkets too. Andy is a contact that we got through Musgrave, for whom Andy works on refrigeration units. Andy manufactures his own portable cold stores and rents them to various clients.

The problem with the company is that there is a potential for food waste in cold storage if equipment failure occurs. James deployed sensors for humidity and temperature & Digital Matter Eagle IoT logger in the company. The company wishes to have a dashboard for remote temperature monitoring in real time and text alerting system to warn if food is at risk of spoilage.

First pilot with the company was at Belfast Continental market between 19 November – 23 December 2022. On 19 November, James installed one Digital Matter Eagle logger with two temperature probes in one of Andy's rentable fridges, hired to Rocket's (a Dublin based burger company) who had a stall at Belfast's continental market. The cold store stayed at the fixed location for the duration of the market. Since the refrigeration unit runs in the cold store 24/7, the logger was hard wired into the fridge's power supply so that sending recording every five minutes was still possible.

James showed some pictures of the deployment in cold storage as well as data observed during the monitoring. From the data, one observation was there was an anomaly at some instant, indicating sudden rise in temperature. The temperature although was still within the threshold limit. Since, this was first trial, alerting system was not deployed then, but this anomaly provides a use case for having alerting system in place for the company.

Second pilot test with the company is for Artisan click and collect food service. It is planned for January – March 2023. On 4 January, James moved the logger into a second cold store destined for a click and collect artisan food service based in the greater Belfast area. The service is due to commence at the end of January. We will see how the monitoring performs.

For future work, Andy updated that he works with a range of clients, including ones outside of the agri-food sector. His past clients include florists, the pharmaceutical industry and wine storing clients. James has asked Andy about the possibility of monitoring some other produce in the future. As James emphasised, this could help us write our 'Business Development' deliverable, but also for future work. Andy generally only knows his clients a few weeks before the rental starts, so he does not know what is coming up yet. Andy also mentioned that he would like to toggle alerting on and off himself from the dashboard since his units are turned off while not in use.

Ram commented that it is good that we have some additional work with the companies, but we have to update them that the project is wrapping up in July 2023 and we can deliver only accordingly.

James replied that he mentioned that to Andy. Ram highlighted that we need to document a key objective of the work with Andy, so he can also discuss the potential advantages of the technological deployment to his clients.

Action: UU (James) to document a key objective of the pilot test with Andy Keery Refrigeration and to discuss the potential advantages of the technological deployment to his company.

9) Pilot test with Burns Farm Meats in Ireland (UCD)

Xavier from UCD presented the updates on the current status of the pilot test with Burns Farm Meats in Ireland. Burns Farm Meats is an Irish company recruited by REAMIT partners in UCD in February/March 2022. It is a small family-run business located in Sligo, Ireland. They have their own farm, which also works as an abattoir in Sligo (northwest of Ireland). Their operations include an abattoir, processing of organic meats, and delivery of retail orders to the public.
The company carries out dry aging process to deliver tender cut meat. They are interested in monitoring of dry aging process. Despite the increase in the flavour and tenderness of the meat, the dry aging process is still costly for abattoirs because of shrinkage of the meat, trim loss, and risk of contamination. They have two cold storage rooms in their facilities in which they carry out dry aging. They are interested in having the tools to monitor these rooms as they have detected a loss.

The aim of the pilot test is to monitor temperature and humidity in the cold storage rooms to reduce food waste. The problem they face is a loss of meat during dry aging, affecting parts that have been exposed to the environment for the duration of the process and need to be trimmed off as a result. We are sensing temperature and humidity data in the chambers. The goal of the pilot test is to establish and implement an alerting system that can warn BFM if the chambers exceed safe environmental condition values.

We placed ten sensors ELT-2 in the chamber, having internal antenna sensors for temperature and humidity, and a gateway. Data coming from the sensors is displayed on Whysor's dashboard and is stored in BED Big Data hub. We deployed six sensors in a larger chamber – two closer to the door, two in a central position and two close to the refrigeration unit. 4 sensors are deployed in a smaller chamber – two closer to the door and two close to the refrigeration unit. Xavier shared a screenshot of data display on Whysor's dashboard for temperature and humidity. Some glitches observed in temperature could have happened due to door opening and closing in their regular operation, though it can be due to some anomaly as well, for which alerting system could be useful.

The humidity sensor seems to have a problem as the readings shown by it are too high. The reason behind this might be that moisture is building up in the internal antenna sensors. We plan to validate its readings. From an analytical perspective, the priority is to ask for weight data from at least one cycle. This would allow to propose restructuring of beef carcasses if differences are observed, and to compare results from WD Meads and BFM.

We also need to work on improving the alerting system. The current system sends alerts also when BFM are working in the chamber (loading, unloading or cleaning) and it is not of help to them. The deployment of binary sensors (door open/closed) will be carried out to improve the alerting system. This would link door status to temperature and humidity readings. Also, there is potential for linking the readings with the Warp10 platform – and incorporate anomaly detection, seasonality analysis and other algorithms.

Next, we are planning to visit to BFM in the next few weeks and deploy a new Eagle logger with humidity probes and binary sensors. An additional Eagle logger will be deployed with a humidity probe (T9602). Two binary sensors will be installed as a means to improve the alerting system. This means that we will use that a more complex and optimised alerting logic.

Ram commented that although having sensors deployed is fine, sour final outcome should be to understand the factors that cause the meat to lose weight or get wasted. How are we planning to link meat loss with the temperature and humidity? Xavier replied that their priority was to first establish the monitoring and alerting system in place. However, we plan to suggest them to measure and share with use weight of trim loss and meat and link it with the temperature and weight loss.

Ram agreed that establishing a link between trim loss/waste in meat and the temperature and humidity is important.

Xavier made a presentation about Burns Farm Meats (BFM). BFM Ltd is a family-owned company located in north Sligo, Ireland. Their main activities include farming, operation of an abattoir, processing of organic meats, and delivery of retail orders to the public. BFMs are especially interested in the monitoring of the dry aging process. Despite an increase in the flavour and tenderness of the meat, dry ageing is still costly for abattoirs because of shrinkage of meat, trim loss and risk of contamination.

They have two cold storage rooms in their facilities in which they carry out dry aging. They are interested in having tools to monitor these rooms as they have detected a loss. Also, REAMIT pilot/scenario including the aim of the pilot, problem, data, and goal was explained to the company.

The aim of the pilot is to 'monitor temperature and humidity in the cold storage rooms to reduce food waste'. The problem was defined as 'a loss of meat occuing during the dry-ageing process, affecting parts that have been eeposed to the environment for the duration of the process and need to be trimmed off as a result'. Also, the data includes temperature and humidity sensor data. The aim is to establish and implement an alerting system that can warn BFM if the chambers exceed safe environmental conditions values.

The equipment selected is presented as follows:

- Tektelic Kona Micro IoT Gateway (Tektelic, Canada)
- 10x ELT-2 Internal Antenna sensors (Elsys, Sweden)
- Bedfordshire Big Data Hub
- Whysor dashboard for real-time data visualisation and alerting

The six sensors in the dry aging chamber were shown. There are six sensors in the large dry aging and four sensors in the smaller chamber. The designed dashboard was presented. There is some anomaly detected and there is an alarming system. 3D representation shows temperature fluctuations.

Pilot current status summary. Humidity reading values have been slowly, but steadily, increasing over time for all sensors. The reason may be that moisture is building up in the Elsys ELT-2 internal antenna sensors. There is a need to validate these readings.
From an analytical perspective the priority is to ask for weight data from at least one cycle. This would allow to propose restructuring of beef carcasses if differences are observed and to compare results from WD Meats and BFM.

Regarding the improvement of alerting system, the current system sends alerts also when BFM are working in the chamber (loading, unloading, or cleaning) and it is not helpful. The deployment of binary sensors (door open/closed) will be carried out to improve the alerting system. This would link door status to temperature and humidity readings. A visit is going to be organised. Also, the goal is to install binary sensors. Jean is working on anomaly detection system.

The next steps for this pilot study include a visit at BFM in the next few weeks and deployment of a new Eagle logger with humidity probes and binary sensors. Also, an additional (Eagle) logger will be deployed with a humidity probe (T9602). Two binary sensors will be installed as a means to improve the alerting system. James Gillespie and Marco Kull worked on a template forr Elsys ELT-2 that can decode binary sensors. The better controlling of the environment, the bigger amount of food waste to be reduced.

Action: UCD to visit BMF to install binary sensors (door open/closed) in order to improve the alerting system.

Action: UCD to improve the alerting system in Burns Farm Meats pilot test.

Action: UCD to visit BFM and deploy a new Eagle logger with humidity probes and binary sensors.

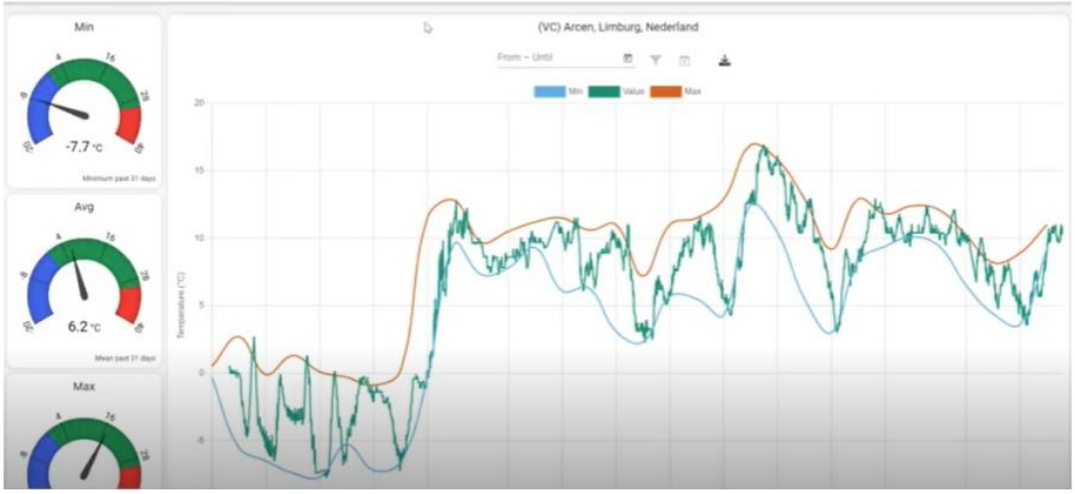
Action: UCD and data analytics team to ask BFM for weight data from at least one cycle of dry aging process as this would allow to propose restructuring of beef carcasses if differences are observed, and to compare results from WD Meads and BFM.

13:00 – 13:45 Lunch break

13:45 – 14:30 WP T2 Big Data integration and application to reduce food wastage

Whysor dashboard, graphical data and new features – presentation by Tom Verstraten, Whysor

TV discussed and demonstrated the new features Whysor is developing for the Whysor dashboard. The designed dashboard can show information of temperature in each selected day.



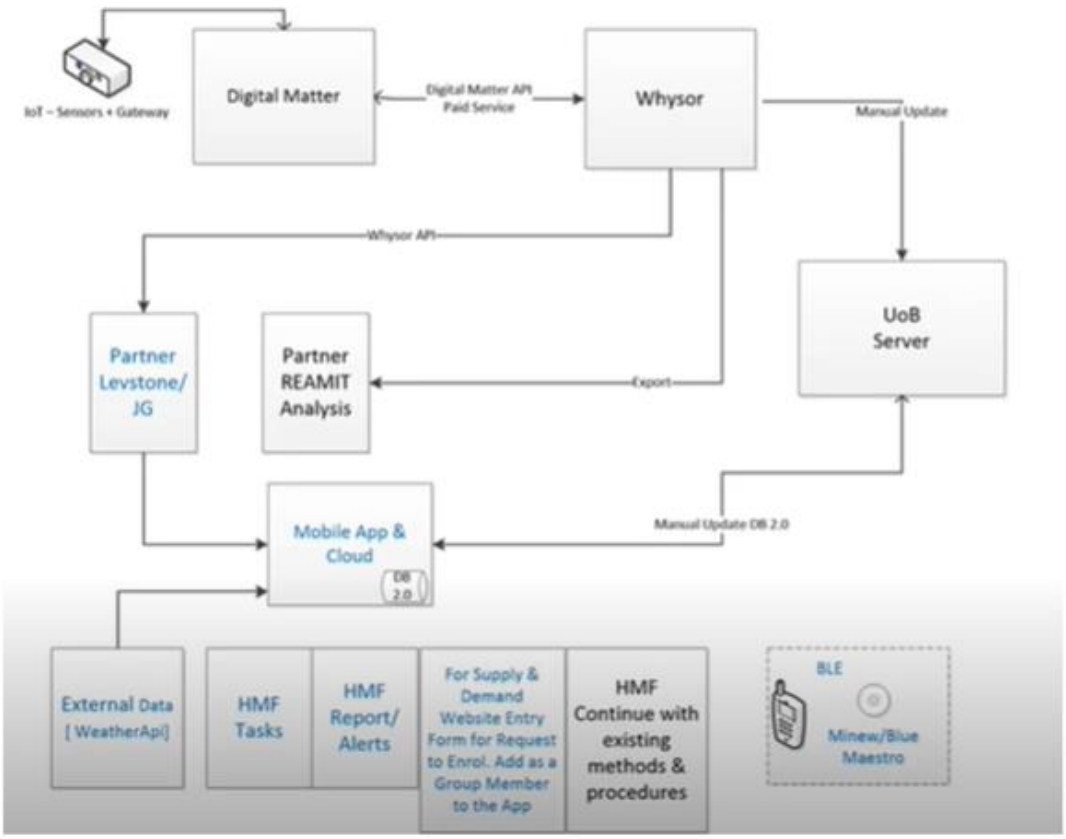
The designed dashboard can show information of temperature in each selected day.

Tom demonstrated also another dashboard and explained that Whysor is working on the data traffic to make it smoother. Tom added grouping data to make it more scalable and improve it. Also, Whysor is working with SenX data and with a new logger (its battery is chargeable).

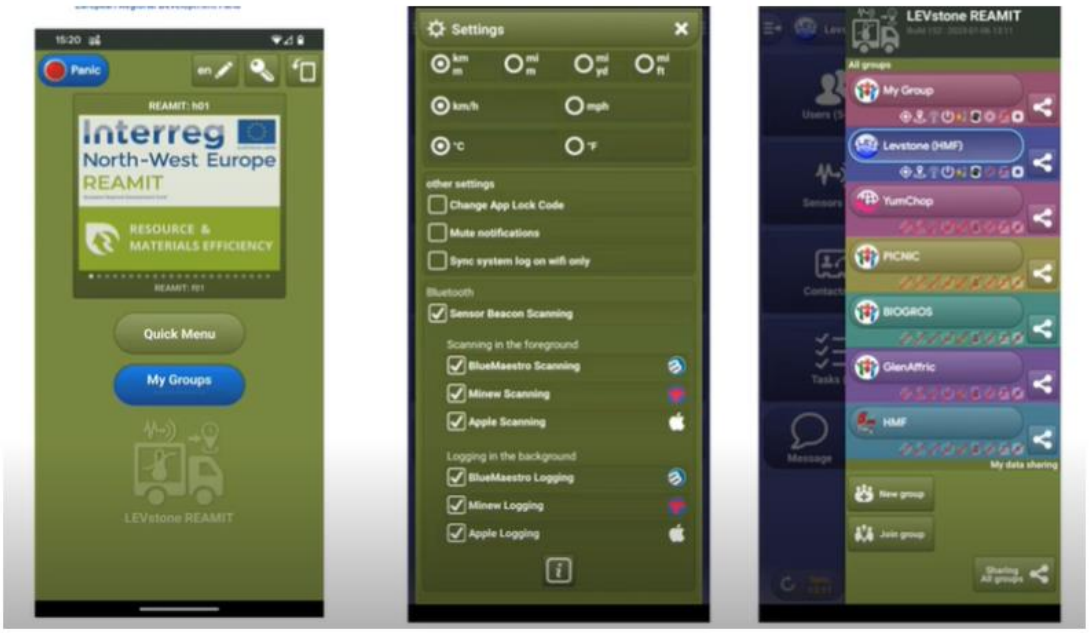
Second database of potential buyers, e.g. food charities, convenience stores, etc. the route where trucks would travel (Levstone); Meta data and a Smart Phone APP for REAMIT – presentation by Levstone

Levstone presented a diagram outlining the progress made and ongoing work regarding the sensors data pathway. They also announced the development of a new application (APP) called REAMIT, which is currently in testing phase, and will be available to partners once it is ready. The APP is multilingual and allows for the addition of Bluetooth devices. Levstone has also developed Blue Maestro scanning, Minew scanning, and Apple scanning within the APP. Access to the APP will be granted through invitations and users will have the ability to share or un-share information such as GPS, temperature, etc. The APP's interface includes features such as users, the diary, notifications, sensors, and a map. An API for weather information has also been integrated into the APP. REAMIT APP connects to sensors through Bluetooth technology, with a maximum distance of 10 meters for successful connection. Levstone demonstrated how the APP will be integrated with YumChop and MHF.

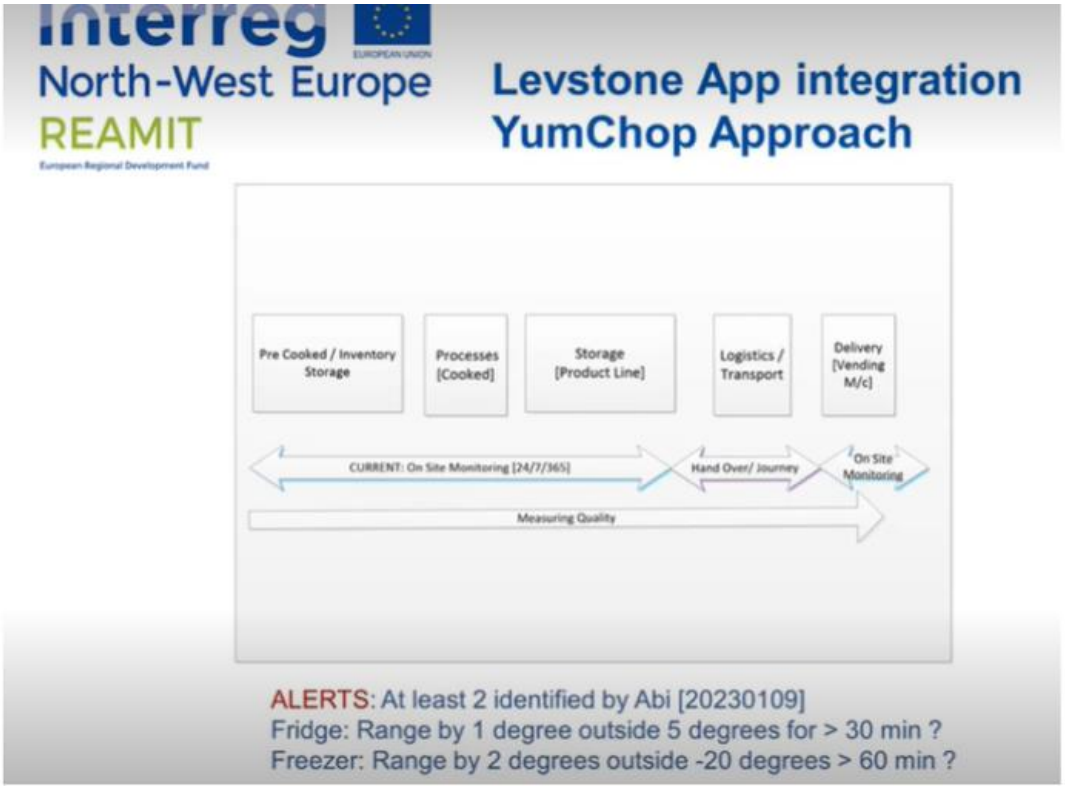
A diagram which represents the application’s development was shown.



Levstone is working on demand based system and also developing Bluethooth based application. Davinder presented a demo and showed the functionality of the APP.



There are two technologies. First, Blue Maestro, which is not reliable, and, another technology seems more robust. Davinder explained some issues related to open API, discussed two approaches and showed how the APP can be used for YumChop and HMF.



The data with GPS is integrated.

Exploring the use of Weather Api to integrate with DB2

1. Open Weather Api and services. *Register with Credit Card.*
2. Many others providing similar services.
e.g. Weatherbit Limitations: 500 per day, not for commercial use, single Api key …
3. Open-Meteo is an open-source weather API with free access for non-commercial use. [www. https://open-meteo.com/en]
Open-Meteo weather forecast APIs uses weather models from multiple national weather providers and combines them to give a more accurate forecast and current weather conditions – To be tested?

Why? Free, Hourly updates, large datasets, for developers: Open Source, easier to access, multiple API services, HTTP based JSON APIs etc..

4. Met – Office : UK best provider – No 'middle' service

A formula for anomaly detection is represented below.

Anomaly score formula

$$S(t) = c_o * max(0, t - t_o) + c_r * max(0, t - c_r)$$

S : anomaly score
t : temperature value
t_o : orange lower threshold
t_r : red threshold
c_o : orange range penalty weight
c_r : red range penalty weight

REAMIT data analysis of each data analysis sub-group

SenX presented the latest updates for both pilot tests: BioGros and Picnic. Two sensors (temperature and trip status) were monitored, the first present in cold store and the second in a vehicle. Only sensors from BioGros were monitored since data was available to Whysor. SenX presented the "anomaly detection dashboard". The aim of this dashboard is to qualify the anomalies (using a specific formula) that can be present in any of the pilot tests. For instance, the temperature can be classified into three categories: 1) RED >8 ºC 2); Orange 5-7 ºC; and 3) Green 1-5 ºC. Regarding the trip status, it can show if the vehicle is moving

or not. The future work will include multiple analysis tools, complete live data integration as well as discussion of pilot tests.

MTU discussed HMF data analysis. The goal is to have an automated instant monitoring system which will monitor the temperature during the milk delivery as well as an alerting system which will alert if temperature is going beyond a threshold value. In addition to the latter, a prediction model will be created to know the maximum journey distance and the time for milk deliveries. REAMIT has provided HMF sensors for monitoring the temperature in individual transport boxes. Also, a system needs to be installed to alert the company of any temperature fluctuations.

So far, the results show the following: ten sensors installed in HMF and data from total 99 journeys are available; type of received data includes: time, battery, temperature, humidity, and the status whether bag is open or closed. An additional data such as external temperature, size of the bag, amount of milk and the actual date and time of the journey and its length. Also, HMF data related to rate of change of temperature during several trips conducted in October and March presented also the factors causing such fluctuations. These factors include seasonal variations, external temperature, amount of milk in the bag and duration of journey. Finally, a multi regression model on all data combined (time, milk temperature, bag size, milk quantity, outside temperature and kind of vehicle) shows that a prediction equation has been obtained. This equation can predict the optimal journey length and duration and can find the impact of various external factors that can affect the milk temperature inside the bag.

Regarding the future work, it might be relevant to address the question of the impact of seasonal variations. At what stage do the bag starts warming up after the journey started? Also, based on this data, can we predict maximum journey time and distance? Can use analysis outputs to provide alternative best routes to driver? Another potential work may relate to new models such as neural networks and implementing Statistical Process Control and Process Capability based analysis for HMF data. Finally, use of new source of data such as real time Weather API, GPS and Traffic data leading may lead to wider and more precise analytics.

James Gillespie presented the updates on data analytics for the pilot study with Musgrave. The data set is from April 2022 to November 2022 and spans 180 days. In total, 49,000 data points were recorded, but some were discarded due to the vans being stationary. The remaining data set is 43,563 data points, which is equal to 3000 deliveries. The initial analysis shows that the mean freezer temperature was minus 3.9 degrees Celsius and the mean fridge temperature was 9.05 degrees Celsius. The data was trimmed and reanalysed to exclude journeys that were still in progress after 35 minutes. The mean freezer temperature was still only minus 5.5 degrees Celsius on average, and the fridge was 7.96 on average. It was suggested that the sensor might not be in the correct location and repositioning the sensors will be explored. Also, we checked battery consumption, and plan to have a longer recording every 5 minutes just in the freezer unit in future.

James Gillespie presented the updates on data analysis for Burns Farm Meats and WD Meats. WD Meats and Burns Farm Meats were monitored for weight, temperature, and humidity data during dry aging. Burns Farm Meats has fixed sensors and has been actively monitoring their cold room since September 2022. The data from Burns Farm Meats is consistent with a cold store, but they do not have any weight data yet. The proposed analysis is to examine the differences in drying processes between the laboratory and companies that use dedicated refrigeration for dry aging. The question is whether using a dedicated room for dry aging will result in enough weight loss to justify the cost. The data from WD meats shows an average 4.1% weight loss from carcasses going into dry age, but similar data is needed from Burns Farm Meats to see how the temperature and humidity profiles affect the carcass weight loss. Future work will include study on how to optimise weight loss using before and after weights combined with temperature and humidity data, and potentially suggesting different locations of the hindquarters to optimise weight loss.

UCD made a presentation about BioGros and Picnic. Following the presentations, there are two parameters including Temperature and Trip Status that are more focused on. However, there are some anomalies detected and a formulation for anomaly detection was represented. The formulation was dependent on anomaly score, temperature value, orange lower threshold, red threshold, orange range penalty weight, and red range penalty weight. The parameters in formulation explained above were considered for anomaly detection.

Action: Data analytics, Levstone and Whysor to develop a system to alert HMF of any temperature fluctuations inside human milk bags.

Action: With regard to Musgrave, UU to arrange a longer recording every 5 minutes just in the freezer unit in future.

14:30 – 15:30 WP T3 Business development of REAMIT technologies (Chair UU)

LCA

Tamiris Da Costa discussed Deliverable 1.2 (life cycle assessment) in two case studies, WD Meats and Burns Farm Meats. Regarding WD Meats, the last collection of LCA data took place on 3 August 2022. We have collected data for dry aging. We were not able to collect data for the other steps since there was not a lot of information. The livestock production that was collected on the Echo England database. There was a gap between these states. We can try to fill in the literature, but for now we are just focused on this stage "the dry engine". The data that were collected concerns: the total weight of carcass that are being stored, the water loss, the storage time, the electricity consumption and the number of sensors. The meat production, mainly the part of farming, the hotspot impacted the risk. The only exception is ionising radiation which is the electricity consumption. The sensors and the big data represent just a small contribution like less than 1%. In order to compensate these additional impacts, we would need to reduce at least 236 kilograms of meat.

Regarding Burns Farm Meats, data was collected on 7 September 2022, at all stages of production to final transportation. Data includes the same elements as for WD Meats. LCA results show that sheep has the highest impact. The contribution of the sensors and the big data is minimal. It is insignificant and it is lower than 1%. To compensate for these additional impacts, we need to avoid at least 215 kilograms of meat per year. If we are able to avoid this amount of food, we would avoid the emission of 43,000 kilograms of CO2.

15:45 – 16:30 WP Communication (chaired NTU)

Usha presented the deliverables that NTU had been working on as part of WP Communication:

- Website launch (by March 2019)
- Social media (by March 2019) – Twitter, Facebook, LinkedIn, YouTube
- Project banners, posters and flyers (July 2022) – these are always updated
- Policy briefs (January 2023)

As for the policy briefs document, Ram and Kate, before the meeting, had shared the ideas on how to improve it. Usha informed that the document was available in the SharePoint and partners could access it and suggest any improvements of the policies.

Regarding REAMIT networking events (December 2022), all of them have been included in the Communication Strategy document. Usha explained that partners were sometimes presenting the project at

events but did not always report it to NTU. She asked partners to do so even if such events were outside of the EU to complete the task on networking events before wrapping the deliverable up in April 2023.

Regarding publishing journal articles (July 2023), Usha explained that the REAMIT team was well ahead of time, with eight papers already published and seven are in a proof reading stage. There were going to be at least 15 research papers ready by July 2023.

Usha further discussed the communication objectives. One of the goals specified in the REAMIT Application Form was to influence agribusinesses to decrease the amount of food waste in food supply chains by 10% by 2023. Usha had already approached Ram and Kate about this issue. The question was: is REAMIT influencing the supply chains to reduce 10%, and if not, what needs to be changed? Usha asked partners to think about it and provide comments.

Ram observed that this has become more complicated as pilot test companies were not sharing the appropriate type of information with REAMIT to make such conclusions. For them, often it was a sensitive type of information. Kate suggested that, with YumChop, perhaps some estimates could be made. Ram made the point that companies would happily talk about how these technologies were helping them avoid waste, but not the specific amounts. Kate proposed to collect testimonials from REAMIT companies, actual quotes from them, so that REAMIT could report that it was a sensitive type of data to share, however, the companies tended to provide this information when directly asked about it.

Action: NTU to collect testimonials from pilot test companies on how REAMIT helps them reduce food waste, given information on actual volume of food waste is often considered sensitive and companies are not keen to share it.

Usha proposed that another approach could be explaining that after installing IoT sensors, REAMIT companies were achieving 0 waste, although that would need to be evidenced. Usha asked if REAMIT could ask the pilot test companies whether they achieved 0 waste thanks to REAMIT. It was then discussed that the REAMIT team could ask the pilot test companies by email to have a written response from them saying whether they had a significant reduce in waste or not.

Action: NTU to lead on approaching pilot test companies and asking them whether they had a significant reduction in food waste after installation of the REAMIT approach (e.g. drafting a template email to have a written response from pilot test companies).

Usha mentioned that she would try to send an email to Abi as she had published a paper with REAMIT team. HMF, Usha added, could also be approached for a testimony. All of that would have to be recorded in our policy document. Usha explained that a background had to be given and explained why the team was creating policies.

Usha asked all authors of journal articles as well as pilot test leads about how REAMIT could create more awareness of the benefits that combining IoT sensor and Big Data technologies could have for agri food companies. It might be another communication objective.

Action: NTU to facilitate a discussion among the REAMIT consortium about how REAMIT could create more awareness of the benefits that combining IoT sensor and Big Data technologies could have for agri food companies. As an outcome, NTU to produce a brief document with input to the final REAMIT project report.

Also, REAMIT was trying to convince agribusiness users of the value of REAMIT's technologies (aimed at reducing risk) and increase their knowledge, and, most of the companies have already become more conscious of the benefits.

Action: NTU to develop a document listing the benefits for agribusiness users from using the REAMIT's approach and technologies, based on input from pilot test companies. Infographics can be used as starting point. This will serve as input to the final REAMIT project report (closure report).

Usha shared with partners the policy brief document and asked to provide their inputs. She explained that the document was aimed at the beneficiaries of the policy.

NTU identified three different policy opportunities. First, Policy for food producers and manufacturers – Usha mentioned YumChop and BioGros as examples. This policy was further divided into: Sourcing; Diversification and Redistribution – at the start of REAMIT, the aim was, if the food was going to be wasted, to redistribute it. However, REAMIT had not explored/worked on this path, as Usha noted; Data analytics for smart organisation and efficiency; Optimised manufacturing and inventory conditions; and Waste management and redistribution.

Usha explained that, for the work on policy briefings, she was trying to make use of other examples, from other projects or businesses outside of REAMIT.

Second, Policy for food distributors and retailers – some examples were given. This includes: Enhanced traceability via IoT and transparent database solutions, which is possible by optimised warehouse and logistics conditions; and Use of IoT for real-time data driven decisions.

Third, Policy for local authorities. Usha explained that this objective was the most challenging and she was looking forward to inputs from partners. She tried to check in the Nottingham city council for relevant documentation, but there were no such policy briefs. Usha asked partners if they had any policy briefing related to their local council, to share with her. Similarly, searching on Google did not yield many results. She wondered if these types of documents were normally available for public.

Tahmina stated that she had worked with Central Bedfordshire Council in the area of environment. If Usha could forward the questions, she could try to contact them, Tahmina suggested. Also, Joan explained that the business school at UU was involved in secular economy strategy development in Northern Ireland, if that was useful, she could make contact and retrieve some information. Ram explained that he had submitted a document to parliament.uk/business, which would sometimes contain a set of questions they would be seeking to develop policies.

Action: Tahmina to contact Central Bedfordshire Council regarding policy areas where REAMIT could contribute to.

Usha explained that she had talked to a PhD student (Zantia) who was working for a food company but they also reported that they had no policy available.

Ram suggested to develop policies using information from all Interreg projects.

Usha went over some points to clarify with the REAMIT team:

- Is there any policy briefing document? (this question had been asked to JS as well)
- Where is it to be communicated and what themes REAMIT want to focus on – role of technology or something else?

Ram explained that the policy briefings were primarily for reporting purposes unless there was an external request for them, and that the document should be shared with REAMIT's stakeholders. If possible, the team could prepare papers or briefings to circulate along with the newsletter, but that it was not possible to send it to real policy makers unless they asked REAMIT to do so.

Kate observed that one of the goals of Interreg's projects is influencing policy-making at the highest level. All of the policy makers are members of committees, Kate explained, and they would be having one on food waste reduction at some point in the future. Kate was going to be sharing the link of the European Commission website as it would be a great opportunity if REAMIT was involved in their meetings.

Action: Kate to share the link to the European Commission website on food waste reduction policy.

Usha commented on the fact that the REAMIT team mentioned that IoT was going to be decisive in the future in REAMIT papers, however this was not going to happen unless there was policy in this direction, she observed. She raised a few questions. First, is this document a public document or will be kept only to the REAMIT team and the funder? Second, can we try to formulate the wording of the policy proposal with our REAMIT and other projects alone? Also, who is the audience for this policy proposal and how they will be approached by the REAMIT team to learn about this policy proposal?

Usha asked whether the team should look beyond these projects (outside of Interreg). Kate observed that the team did not know these projects and we did not have access to all the necessary information about them to develop a policy document. From Kate's perspective, it was a matter of identifying a gap in the policy. For example, by speaking with Abi (YumChop), REAMIT learned there was a gap related to refrigeration requirements. Kate added that to propose a policy document, the team could prepare 3 or 4 sentences which would discuss a particular policy gap. Similarly, HMF was also a strong case for proposing a policy. Both Natalie and Gillian were consultants with ministries across the world, for instance. Kate explained that a map regarding human milk banks across Europe, showed several countries with no official regulation. As for audience, Kate said that it was very targeted, e.g. in the second example, policy would be aimed at human banks.

As a conclusion, Ram proposed to conduct a separate meeting in the future with Kate, Joan, Usha, and others to address these points carefully.

Action: NTU to organise a meeting on how REAMIT can influence policy making. Invitees Usha, Joan, Kate, etc.

A final remark by Kate was that the work on policy influencing can be very beneficial for REAMIT: once REAMIT is recognised by the big actors as a serious contributor to policy documents, they may be invited to policy making networks, which could include for instance, being informed of the latest developments in a given area, which may stimulate ideas for future projects.

Sasha (NTU) shared with the partners the infographic that had been developed. The work was almost completed but some points still need to be further discussed. Sasha showed some of the items on the timeline, for example: January 2019 – project start; In March there were the first pilot tests in France: Rothiau, STEF, Pescanova. Sasha asked for a list all pilots that had ever started with REAMIT, for example: IGRECA. Ali explained that IGRECA initially showed an interest in Raman but after some time, they became unresponsive; the pilot never really took off.

There were also a few pilot tests that only lasted a limited time and Sasha was not sure whether to include them or not. Sasha explained that all of the photos were linked so they relate to newsletters or relevant documentation on the website.

Some more items on the timeline included:

- The German pilot test Weyers GmBh - which needed to be updated
- The Levstone App - launched in September 2020
- The second symposium hosted by Valorial in November 2020
- 4th RAC meeting online hosted by UCD (January 2021)
- Launch of the Whysor Dashboard (February 2021)

Usha asked partners to inform if there were any events missing on the timeline, and if that was the case, to let the NTU team know. Sasha reminded the REAMIT team that she needed all partners to confirm if all dates were correct.

This work, Sasha explained, would be embedded on the home page of the project's website, aimed at showing the journey and it would consist of an interactive document that people could click through.

Sasha asked whether Pescanova or Blue Skies should be mentioned. Ram observed that all companies that REAMIT approached and said yes to a pilot test should be included, even if they cancelled afterwards.

Imke explained that with Weyers (Germany), they actually said no, even though there were talks and discussions at the beginning but ultimately they decided to not participate in the pilot test. Imke said that the infographic should be mentioned that REAMIT had a contact with a German company instead, without including their full name, keeping it anonymous. Ram agreed on this point as well and added that the idea was to show who the REAMIT team approached and committed to pilot testing.

Sasha would be sending partners the link to the infographic and sharing it also in SharePoint.

As for the last part of the infographic, Sasha presented suggestions for graphs to be included: The number of stakeholders REAMIT reached in each country; number of efficient natural and material resource solutions implemented and tested; and amount of events that REAMIT partners presented at (already up to date in the infographic).

Kate added that the infographic could show which type of actors these stakeholders were (as in the reports in eMS), that information already specifies whether they were national public authorities, local public authorities, academia, business development agencies, etc. Kate could provide this data and use it to create this graph.

Action: NTU to work with Kate on types of stakeholders approached by REAMIT.

Kate made the point that the interactions with Inflow (an SME in America), could be added to demonstrate that REAMIT approached actors outside Europe too.

Sasha presented the work on the website, which was regularly updated. She explained that, previously, the website had been hosted by Squarespace, but that it had been moved to GoDaddy which would allow to the website to be live even after the project ended (until November 2027).

Another success relating to the website was that the 4th REAMIT Symposium was broadcasted live on REAMIT's YouTube platform which allowed to increase the number of website views during the period. Sasha showed the analytics regarding the views: 1. on the date of the symposium, there was a notable peak during the live broadcast, and a total of 298 views where achieved for the whole of December; 2. for the period July – December 2022, the website had accumulated 923 visits, which was an 85% increase from the previous period.

Ram reminded the team to keep posting on social media channels as much as possible to help increase visibility of the project. Sasha added that it might be good to try sharing newsletters through university channels and local news outlets.

Action: Partners to keep communicating about REAMIT through social media channels to help increase the visibility of the project.

Sasha also mentioned that the newsletter subscription platform had seen a 4.3% increase. The next newsletter would be in March 2023, which would be the final or second to last.

The development and publishing of case studies was also mentioned. Ram observed that partners should try to publish more and there were case studies that could still be developed: 15 papers should not be the end of REAMIT's research.

Action: Partners to develop more case studies and publications inspired by REAMIT.

Sasha presented the updates on project banners, posters and flyers. A new brochure had been developed for the symposium. Also, five new pilot tests videos were available on YouTube.

The documentary would be made available on YouTube. There were three versions of it: a short 6- minutes versions, a 22-minutes version and a 38-minutes version. Sasha urged partners to help decide which of them was best. Ram asked Sasha to send the links to partners to watch them.

Action: NTU to send links to REAMIT videos to partners.

Sasha mentioned the new posters developed in the period July – December 2022: Musgrave and Burns Meats. Also, a new roll-up had been developed for that RAC meeting. All materials were available in SharePoint. Recent events REAMIT partners had participated in and presented had been included in the strategy communication document. The NTU team was also creating a new press release together with NTU's media department. Sasha encouraged partners to follow a similar path and make press releases as well and using the available videos.

Action: Partners to follow NTU's example and develop press releases about REAMIT.

Gautam asked about the possibility of including information on each partner of the team (a 'meet the team' sort of section) on the website. It was concluded that that was a section that could be developed in the near future.

Action: NTU to develop 'meet the team' section on the REAMIT website.

Action: All partners to access and suggest any improvements of the policy briefs document.

16:30 – 17:30 REAMIT Steering Committee (RSC) meeting (Chair BED)

Ram Ramanathan reviewed the minutes from the previous meeting. Usha Ramanathan made the argument that there were items in the minutes that may need to be corrected. Ram asked Usha to communicate it to him at a later stage for inclusion in the minutes.

Action Log: Actions resulting from RAC/WP/RSC meeting July 2022.

Date	Minute/ Item	Action identified	Responsibility	Status: Confirmation of completion or reasons for non-completion
19/01/2022	22.04.04	Whysor to document all the experience with the pilot test with Picnic in a story telling format to be used in future publications.	Whysor	BioGros is ongoing. The deadline is March 2023 Some drafts need to be sent. GlanAfric stopped.
19/01/2022	22.04.06	Whysor to document all the experiences with the pilot test with Biogros in a story telling format to be used in future publications.	Whysor	Ongoing
19/01/2022	22.04.07	NTU to document all the experience with the pilot test with Glen Affric in a story telling format to be used in future publications.	NTU	Stopped as the pilot test has been discontinued.
19/01/2022	22.04.09	UU to document all experience in the Clostridium Bacteria pilot test with WD Meats in a story telling format to be used in future publications.	UU	Ongoing
19/01/2022	22.04.10	UU to document all the experience with Musgrave pilot in a story telling format to be used in future publications.	UU	Completed and published as a paper in the special issue.
19/01/2022	22.04.11	BED to document all the experience with YumChop pilot test in a story telling format to be used in future publications.	BED	Completed and published.
19/01/2022	22.04.12	UCD to document in a story telling format how ideas at UCD developed for fresh box and proof of concept pilot tests; how these ideas evolved and what actions were taken to implement them. Please include names of all companies that have been approached to participate in these experiments.	UCD	Stopped.

19/01/2022	22.05.03	BED, Whysor, Levstone and data analysis partners to determine whether a separate manual is needed on how the Whysor server is connected to REAMIT Big data server.	BED, Whysor, Levstone	Ongoing
19/01/2022	22.05.04	Levstone and pilot test leads (HMF, Picnic, Musgrave, etc.) to meet and discuss if the Blue maestro system proposed by Levstone would be beneficial for them.	Levstone, Whysor, BED and Ulster	Stopped.
19/01/2022	22.05.06	UoN to make sure that data from the Raman pilot test is transported to the Big Data server at BED.	UoN	Data is coming to the server. Connectivity issues. Completed. Ali to check it. RR suggested an additional analysis. Sahar and Joy to confirm this.
19/01/2022	22.05.09	Data analytics partners to go beyond time series analysis and move to predictive analytics (rather than descriptive).	BED, MTU, SenX, UU	Ongoing
20/01/2022	22.08	NTU to present policy brief examples from other projects supported by Interreg NWE Programme.	NTU	Completed
20/01/2022	22.08	NTU to present ideas for policy briefs in REAMIT.	NTU	Completed
20/01/2022	22.08	NTU to advance work on 5/6 case studies.	NTU	2 from NTU published. BioGros ongoing. Musgrave is published. Picnic, WD Meats/Burns Meat are ongoing.
20/01/2022	22.08	NTU to explore and implementing a new functionality on the REAMIT website: add a log in button to access the Big Data server.	NTU	Stopped.

20/01/2022	22.08	PPs to communicate about REAMIT through social media platforms.	PPs	Ongoing RR is encouraging everyone to support REAMIT communication team and activities
20/01/2022	22.11	All PPs to include minutes from internal meetings in Project Handbook in SharePoint.	PPs	Ongoing All minutes should be put in the SharePoint for all WPTs
06/07/2022	22.14	All pilot test leads to fill in the template for pilot test story telling.	BED	Linked to 22.08 above.
06/07/2022	22.15	Whysor to install sensors at VHG, start measuring the pressure, create a poster, write the pilot test storytelling, and analyse data.	Whysor	Stopped
06/07/2022	22.15	Whysor to complete the pilot test storytelling of VHG.	Whysor	Stopped
06/07/2022	22.15	Whysor to link the data received from Picnic to the data that is coming from the sensors to see if it is possible to recognise a trip in the data.	Whysor	Ongoing
06/07/2022	22.15	BED, MTU and SenX to start the analysis of data for Picnic.	BED, MTU, SenX	Ongoing
06/07/2022	22.15	BED, MTU and SenX to determine a cooling profile for cool box.	BED, MTU, SenX	Ongoing
06/07/2022	22.15	NTU to produce Picnic poster and the video.	NTU	Poster is completed. No need for a video.
06/07/2022	22.15	Whysor to complete the pilot test storytelling of Picnic.	Whysor	Ongoing
06/07/2022	22.15	Whysor and data analytics partners to define the thresholds in which the temperature is correct for each part of BioGros warehouse.	Whysor and data analytics partners	Completed

06/07/2022	22.15	Whysor to complete the pilot test storytelling of BioGros.	Whysor	Ongoing
06/07/2022	22.15	UoN to complete the pilot test storytelling of Raman Spectroscopy.	UoN	Paper published. Story telling document is ongoing.
06/07/2022	22.15	UoN to conduct stage 3 of the pilot test in real life conditions in a truck.	UoN	Ongoing
06/07/2022	22.15	UU to perform two more runs of tests with WD Meats when different combinations of temperature and humidity parameters will be tested to try to reduce the dark facings.	UU	One has been completed and another is ongoing.
06/07/2022	22.15	UU and BED to determine whether Clostridium Bacteria pilot will be analysed further under the REAMIT project or outside it.	UU, BED	Completed
06/07/2022	22.15	UU to discuss with UoN whether and how Raman spectroscopy can be used for this type of analysis. UU to send some samples for testing at UoN.	UU, UoN	Ongoing
06/07/2022	22.15	UU to complete the pilot test storytelling of Clostridium Bacteria.	UU	Ongoing
06/07/2022	2.15	NTU to recover equipment installed at Glen Affric.	NTU	To send a letter for change of ownership with recorded delivery.
06/07/2022	2.15	NTU to complete the pilot test storytelling of Glen Affric.	NTU	Stopped but NTU to write about storytelling with experience with GlenAffric.
06/07/2022	2.15	BED to complete the pilot test storytelling of HMF.	BED	Completed
06/07/2022	2.15	BED to complete the pilot test storytelling of YumChop.	BED	Completed

06/07/2022	2.15	UCD to complete the pilot test storytelling of Burns Meats Farm.	UCD	Ongoing
06/07/2022	2.15	UU to complete the pilot test storytelling for 3DF sensor.	UU	Ongoing
06/07/2022	2.16	Levstone to send any extra data parameter required for the app development as it may differ from modelling data requirements.	Levstone	Completed for Bluetooth and ongoing for Whysor virtual sensors.
06/07/2022	2.16	JE to arrange a meeting with GS and tech team to ensure consistent data labels.	JE	Completed
06/07/2022	2.16	Levstone to develop REAMIT specific App.	Levstone	Completed for Bluetooth and ongoing for Whysor virtual sensors.
06/07/2022	2.16	Levstone to develop a second database for potential demand points.	Levstone	Ongoing
06/07/2022	2.16	SenX and data analytics partners (and Whysor) to integrate SenX system for data analytics with Whysor API approach.	SenX and Whysor	Real time part is yet to be completed.

All of the actions had been reviewed. Ram informed that no feedback was received from Advisory Committee members (Anne Marie had attended an earlier session and gave positive feedback).

Plans for the next RAC meeting hosted by Essex, 22-23 March Colchester, UK

On 22 and 23 March 2023, the final RAC meeting will take place in Colchester at the Wivenhoe house hotel. There were 15 rooms still available if partners were interested. Ram informed that the Essex/BED team would be sending the details on booking the hotel or others nearby.

END OF DAY 1

Day 2. Thursday 12 January 2023 – Morning Session

09:00 – 10:30 WP Project Management (Chair BED)

Kate (KP) reminded the reporting deadlines. The project progress report 4.1 for January – June 2022 has not yet been processed and will be processed in the first quarter of this year. KP mentioned that some partners submitted their reports as late as December 2022, so this caused a delay. Every partner needs to arrange one on the spot audit. On the spot audit of report 4.1 will take place at BED and Essex on 23rd February 2023. The money for the period January – June 2022 should be paid around April 2023.

Report 4.2 for July to December 2022, partners should be talking to their auditors to arrange their audits now. Partners should finish their reporting by March2023. Final deadline for submitting partner reports to LP is Friday 3 March 2023.

REAMIT target groups: partners need to report in eMS the specific target groups they have contacted, for reporting purposes.

Report 5.1 will be the final project report. It will cover the period from 1 January 2023 to 9 July 2023.

RR suggested end of March as the latest date for partners to submit any financial claims, as they will be closing off the project. Make your FLC aware of any charges closer to the deadline, try not to make any claims after March 2023, RR stated. Staff costs will be covered until 9th of July 2023. Only staff costs should be the exception after March until July.

Regarding Programme Manual, KP advised on all aspects of the final project appraisal. A preliminary questionnaire will be sent out to the LP (6 Months before end date) to collect information on outputs and results. These will be returned with the final project progress report. The final payment will take place once the secretariat has completed the final appraisal and final monitoring report, providing there are no issues. Partners are required to keep records of all documents, electronic copies to be stored securely for up to 10 years.

DB recommended partners should store files encrypted and secure drive with whatever is included in SharePoint.

RR spoke about how we can carry on REAMIT's legacy and suggested that a UK organisation will not be able to lead but UCD or any other partners can choose to lead a similar project.

RR spoke about setting up an ESRC centre in Essex focusing on food waste reduction. RR is going through this process to develop a project proposal to set up this centre.

Action: All partners: for each work package lead to ensure all information on SharePoint is up-to date and correctly ordered by the end of January 2023. Order the folders by WP and deliverable.

Action: All partners should be talking to their auditors to arrange their audits of report 4.2 and they should finish their reporting by March and submit it to LP.

10:30 – 10:50 Tea/Coffee Break

10:50 – 11:20 WP Long Term (Chair BED)

Kate said: Yesterday, we hosted Anna-Marie from the East-Netherlands Enterprise Agency. Today, she sent us an email asking if we can present to partners 'Step 1' proposal that they have submitted to Interreg North Sea Region Programme. They are looking for partners/associate partners to help them develop a full proposal, so this is only an expression of interest. Interreg North Sea Region Programme covers regions in dark green – Whysor is the only partner present who is eligible for the funding. The project proposal falls under priority of green transformation circular economy. The project is called F2F value and will create more resilient agri-food supply chains by encouraging and supporting 40 SMEs in the value chain of vegetables, dairy and marine products to maximise the value of feed stock and thereby minimising food waste. They want to create a business model and support for technological solutions. Duration is October 2023 – September 2027. If interested, Kate can forward the presentation and contact details. They are a

business development agency in the NL and they are looking for ideas from enterprises for the development of their WP T3 (business models and technological support). The Dutch agency will be leading the project.

Ram said that we have to create an agreed framework for sharing the impact of REAMIT technologies for reducing food waste. Ram believes this framework will be based on the LCA case studies – we need to link the estimated reduction in carbon emissions to the number of alerts sent, so we can state that our solution results in some amount of food waste reduction. Ram has requested the LCA team work to produce this new estimation based on the number of alerts sent.

We have already done four REAMIT networking events which were expected to be part of the project. NTU has already presented their policy briefing. Additionally, Ram has submitted a policy briefing document exclusively on what we are doing in the REAMIT project to the UK government. UK policy makers are currently reviewing it. If they are happy with it, they will then publish it on their website. If anyone wishes to take a look at what Ram has sent, he is happy to send it to the relevant partner.

Cross sector briefings: Ram is making a presentation at an international conference next month where he is going to highlight that tracking temperature in the cold chain can be useful outside the food sector, for example vaccine supply chains. This is an example of how REAMIT ideas can be used outside of food industry. Kate said that, in general, health, and paper (James explained that Andy Keery had used a cold store to preserve water damaged paper for an insurance company), flowers are the industries which could be interested in the REAMIT solutions. Ram requests if there will any other ideas, we can include them in this document too.

Network prospectus. It is about what different networks that we have created beyond this group. We will derive this deliverable and its contents from our target audiences reached.

There is a separate point on presentation of updates including the 4th REAMIT symposium. Ram noted that we have not received a report on the symposium yet. Ram asked Gael if he can contact Memona for this report.

Action: Valorial to share the report from 4th REAMIT Symposium.

Kate asked: What do we do with sensors and equipment currently with pilot companies at the end of the project?

Ram explained that we back everything and keep it at University of Bedfordshire. We change the ownership of equipment to the pilot companies and let them do whatever they want – for example, the company can approach Whysor or other individual IoT companies to connect the equipment to the cloud and continue receiving alerts. As suggested by Marcel, the company may wish to coordinate with a reseller rather than companies directly. We could create a spinoff who will coordinate the activities of the existing pilot test companies and work with Whysor to continue their work. Again, this requires a company.

Ram has already contacted Joan about this. UU (led by Joan) already has a spinout created, ActionSense (an associate partner on the REAMIT project), which could be used as the middleman. Using ActionSense would reduce the logistical burden of setting up another university spinout. Joan and Ram are going to discuss this option further. Joan, Marcel, Kate, and Ram will organise a meeting about this.

Action: Joan, Marcel, Kate, and Ram to organise a meeting about ActionSense being a link between pilot test companies and Whysor after REAMIT closure.

James asked if there was an issue in companies retaining equipment for auditing purposes (i.e. option 2). Ram said that we will keep a record of where all equipment has been distributed to if this is the option chosen.

Davinder said that hardware is normally a write-off on these projects so should not cause an issue.

Ram asked Whysor to push data to the Bedfordshire cloud until 9 July 2023. After that, there is no obligation since we will not have Joy or Sahar to perform data synchronisation.

Kate asked how we could keep the data flowing after 9 July 2023. Ram said that after 9 July 2023, it has to be paid for by the pilot company.

Marcel has sent an example pricing strategy to Ram for what maintaining equipment and connection to the Whysor cloud would cost. If a middleman company is involved (e.g. ActionSense), they can charge more than Whysor to the company (e.g. double) so they can make a profit.

After the meeting with Joan and ActionSense, companies can be approached and told how much it will cost them going forward to maintain connection to the Whysor cloud and services. If they are not interested, the ownership of the equipment can be changed to a) the company and they can find their own supplier, or b) to the UoB and equipment returned to the UoB.

Example prices are €16 per month for WD Meats, or > €70 per month for BioGros.

11:20 – 12:00 Research studies from the REAMIT project (Chair BED)

Ram opened the session by gratefully acknowledging all the partners contributions to the REAMIT-led MDPI *Sustainability Journal* special issue *New Multidisciplinary Approaches for Reducing Food Waste in Agribusiness Supply Chains.* From an initial idea of two – three papers, a list in June 2022 was produced with 22 potential ideas for publication. Ultimately, 13 papers exclusively documenting research from the REAMIT project were submitted to the journal and one paper on the legal and accounting side of food waste which was partially funded by Essex and partially funded by the REAMIT project.

So far, including one acceptance received this morning, ten papers have been accepted and 8 of these are already published online. The remaining papers, except one, are under multiple stages of review at present. We have therefore already reached the minimum target of ten papers for preparing a book from the special issue, which is the plan from this work.

Ram thanked all colleagues who were contributing to the article processing charges of the journals. Out of the 15 articles, we received fee waivers for 8, 50% discount on 5, 30% discount on one, and one at full price. Thanks to Joan and Fionnuala for already stepping in to cover some of these charges. UoN has already paid their APC.

Thanks to work carried out for this special issue, the name REAMIT will be etched into records permanently, and because it is an open issue anyone can see it. Ram is confident we will receive a large number of citations in the coming years.

However, our project activities are still ongoing which means research is still being done regularly, so please do not stop planning and writing articles. For example, there should be one paper on WD Meats and Burns Meats study, as well as new analytics which could become a publication – linking temperature with weight loss / dark facings. Ram is interested in Jean-Charles' new metric, which he has defined for anomaly

detection. He believes if we can validate the new measure, it would be a very good contribution to the literature.

Additionally, variations in temperature using the reference demand model framework could be a very good work. As we need to complete at minimum 5 LCA's (currently we have four), additional LCA publication works may also be possible. As usual, Ram needs the groups cooperation to complete any additional journal articles although he is happy to contribute.

Action: Partners to complete a paper on WD Meats and Burns Meats study, as well as new analytics.

Action: All partners to create an agreed framework for sharing the impact of REAMIT technologies for reducing food waste (based on the LCA case studies).

END OF DAY 2.

Actions resulting from RAC/WP/RSC meeting on 11-12 January 2023, Dublin

Date	Minute/Item	Action identified	Responsibility	Status
11/01/2023		Whysor with support from university partners (UEssex) to develop a case study document on the pilot test with Picnic.	Whysor and UEssex	
11/01/2023		Whysor to install ten new sensors in Picnic in January 2023, to define trips for which we want extra data from Picnic for analysis, and to define cooling profile and look for anomaly detection.	Whysor	
11/01/2023		Whysor and BED to gather information on the prices of various components that were purchased. This could help to calculate the costs associated with the use of technologies (in addition to the environmental cost calculation).	Whysor and BED	
11/01/2023		Kate to share with partners a research publication on costs-benefits analysis of using IoT technologies by companies.	BED (KP)	
11/01/2023		Whysor, the REAMIT analytics team and writers of the case study will meet with BioGros to further discuss other relevant issues that need to be explored and gather some additional information.	Whysor	
11/01/2023		Whysor and the REAMIT analytics team will continue to work on defining the anomalies.	Whysor	
11/01/2023		UoN will test the portable Raman sensor-based system in journey in February 2023.	UoN	

11/01/2023		UoN will further explore the possibility to collaborate with Vivo Group and will discuss installing Raman sensor-based technology on their premises to test quality of sea food before/during transportation to other customers.	UoN	
11/01/2023		UoN to develop the Storytelling (Deliverable 3.3) and user manual (Deliverable 3.2).	UoN	
11/01/2023		BED to prepare a story telling document on YumChop.	BED	
11/01/2023		Whysor and the HMF team to resolve the issue of connectivity between sensors and the cloud as well as the communication breakdown, and alarming.	Whysor	
11/01/2023		BED to purchase new sensors for HMF.	BED	
11/01/2023		Whysor to improve the dashboard by adding new features such as configuration for binary sensors.	Whysor	
11/01/2023		Once WD Meats provide start and end weights for trials that took place in April and August 2022, James will try to perform one more iteration with different structuring of carcass's/sensors or different temperature and humidity parameters for the refrigeration unit.	UU (James)	
11/01/2023		UU to help WD Meats with calibration/benchmarking.	UU	
11/01/2023		UU to complete a technical report on Clostridium results.	UU	
11/01/2023		UU to prepare new controls for WD Meats and ensure that their	UU	

		lab can replicate the same results as UU lab.		
11/01/2023		UU to move the sensor to 'air on' of the refrigeration unit inside the Musgrave van and to see if more accurate ambient temperature data is available.	UU	
11/01/2023		UU (James) to document a key objective of the pilot test with Andy Keery Refrigeration and to discuss the potential advantages of the technological deployment to his company.	UU (James)	
11/01/2023		UCD to visit BMF to install binary sensors (door open/closed) in order to improve the alerting system.	UCD	
11/01/2023		UCD to improve the alerting system in Burns Farm Meats pilot test.	UCD	
11/01/2023		UCD to visit BFM and deploy a new Eagle logger with humidity probes and binary sensors.	UCD	
11/01/2023		UCD and data analytics team to ask BFM for weight data from at least one cycle of dry aging process as this would allow to propose restructuring of beef carcasses if differences are observed, and to compare results from WD Meads and BFM.	UCD	
11/01/2023		Data analytics, Levstone and Whysor to develop a system to alert HMF of any temperature fluctuations inside human milk bags.	Levstone and Whysor	

11/01/2023		With regard to Musgrave, UU to arrange a longer recording every 5 minutes just in the freezer unit in future.	UU	
11/01/2023		NTU to lead on approaching pilot test companies and asking them whether they had a significant reduction in food waste after installation of the REAMIT approach (e.g. drafting a template email to have a written response from pilot test companies).	NTU	
11/01/2023		NTU to facilitate a discussion among the REAMIT consortium about how REAMIT could create more awareness of the benefits that combining IoT sensor and Big Data technologies could have for agri food companies. As an outcome, NTU to produce a brief document with input to the final REAMIT project report.	NTU	
11/01/2023		NTU to develop a document listing the benefits for agribusiness users from using the REAMIT's approach and technologies, based on input from pilot test companies. Infographics can be used as starting point. This will serve as input to the final REAMIT project report (closure report).	NTU	
11/01/2023		Tahmina to contact Central Bedfordshire Council regarding policy areas where REAMIT could contribute to.	BED (Tahmina)	
11/01/2023		Kate to share the link to the European Commission website on food waste reduction policy.	BED (Kate)	

11/01/2023		NTU to organise a meeting on how REAMIT can influence policy making. Invitees Usha, Joan, Kate, etc.	NTU	
11/01/2023		NTU to work with Kate on types of stakeholders approached by REAMIT.	NTU	
11/01/2023		Partners to keep communicating about REAMIT through social media channels to help increase the visibility of the project.	PPs	
11/01/2023		Partners to develop more case studies and publications inspired by REAMIT.	PPs	
11/01/2023		NTU to send links to REAMIT videos to partners.	NTU	
11/01/2023		Partners to follow NTU's example and develop press releases about REAMIT.	PPs	
11/01/2023		NTU to develop 'meet the team' section on the REAMIT website.	NTU	
11/01/2023		All partners to access and suggest any improvements of the policy briefs document.	PPs	
12/01/2023		All partners: for each work package lead to ensure all information on SharePoint is up-to date and correctly ordered by the end of January 2023. Order the folders by WP and deliverable.	PPs	
12/01/2023		All partners should be talking to their auditors to arrange their audits of report 4.2 and they	PPs	

		should finish their reporting by March and submit it to LP.		
12/01/2023		Valorial to share the report from 4th REAMIT Symposium.	Valorial	
12/01/2023		Joan, Marcel, Kate, and Ram to organise a meeting about ActionSense being a link between pilot test companies and Whysor after REAMIT closure.	Joan, Marcel, Kate, and Ram	
12/01/2023		Partners to complete a paper on WD Meats and Burns Meats study, as well as new analytics.	PPs	
12/01/2023		NTU to collect testimonials from pilot test companies on how REAMIT helps them reduce food waste, given information on actual volume of food waste is often considered sensitive and companies are not keen to share it.	NTU	
12/01/2023		All partners to create an agreed framework for sharing the impact of REAMIT technologies for reducing food waste (based on the LCA case studies).	PPs	

Approved minutes from the 8th meeting of REAMIT Advisory Committee, Work Packages and Steering Committee meeting, 11 – 12 January 2023
Hosted by University College Dublin, Ireland

Attendees:

Name	Institution	Name	Institution
Ram Ramanathan (RR)	Essex	Jean-Charles Vialatte (JV)	SenX
Katarzyna Pelc (KP)	BED	Fionnuala Murphy (FM)	UCD
Sahar Ahmadzadeh (SA) online	BED	Shane Ward (SW)	UCD
Tahmina Ajmal (TA)	BED	Tamiris Da Costa (TC)	UCD
Gael Maugis (GM)	I&R	Xavier Cama (XC)	UCD
Davinder Bola (DB)	Levstone	Omar Dib (OD) online	UoN
Gautam Samriya (GS)	MTU	Imke Hermens (IH)	Whysor
Usha Ramanathan (UR)	NTU	Marcel Steegh	Whysor
Sasha Bennett (SB)	NTU	Tom Verstraten (TV)	Whysor
James Gillespie (JG)	UU	Herve Rannou (HR)	SenX
Joan Condell (JC)	UU	Ali Assaf (AA)	UoN
Trevor Cadden (TC) online	UU	Elaine Ramsey (ER) online	UU

Day 1. Wednesday 11 January 2023 – Morning Session

11:00 - 11:30: REAMIT Advisory Committee meeting (Chair BED)

Kate presented the progress of REAMIT project in the past 6 months: July – December 2022. She made the overview of progress across all Work Packages.

WP T1: the aim was to establish connections with a minimum of five companies, and this goal was exceeded because a total of nine companies were successfully contacted. Ten functional prototypes have been developed, with nine utilising temperature and humidity sensors, and one utilising Raman spectroscopy. Furthermore, there is an additional Bluetooth sensor currently in the development stage. However, there have been some difficulties with the implementation of some pilot tests, mainly staff changes at Picnic and no personnel at Ruthiau dedicated to the Raman pilot test, which challenged communication with pilot test companies.

WP T2: Whysor developed a dashboard to monitor the temperature and humidity. It used the automatic data transfer.

WP Communication: a brochure, a new REAMIT timeline, four new posters, a documentary, six short videos, six posters and six case studies were all made. The policy brief document is still work in progress. A few public events were organised. In December 2022, Valorial, with the support of Images et Réseaux and the REAMIT partners, prepared and hosted a symposium in Nantes (France). Also, partners jointly completed 14 journal articles and, further, submitted them in November 2022 to the special issue of *Sustainability Journal.* P

WP Management: Project Handbook has been updated with the minutes from all the meetings. It is available in SharePoint. Minutes of the recent RAC meeting hosted by Whysor in July 2022 as well as action log have been shared with all partners. When it comes to intermediate work package coordination, BED and University of Essex facilitated over 30 online meetings and supported work package leads. BED is currently working on Project progress report 4.1 and 4.2. The Joint Secretariat has approved a permission for small budgetary changes in the REAMIT AF for MTU and BED. LP partner was informed that we have a new project officer at JS of Interreg NWE Programme since December 2022. Her name is Maelle Lebon.

One risk has been, mainly that NTU partners have experienced challenges with obtaining back REAMIT IoT equipment from Glen Affric, who decided to disengage from the REAMIT pilot test.

WP Long Term: REAMIT partners (MTU and UU) have approached four new business organisations. Valorial organised 4th REAMIT Symposium in Nantes, France. Ram (University of Essex) has initiated a discussion on the legacy of the REAMIT project with some ideas for developing REAMIT 2 project proposals. Finally, Ram developed a successful pitch for a spin-off company inspired by REAMIT and won £8000 from Essex Investment Fund to further develop ideas inspired by REAMIT.

Also, during the RAC meeting, Annemarie Van Vilsteren, as a guest speaker, presented their proposal on the reduction of food waste and invited REAMIT partners (from the eligible area) to join the team developing that project. The project proposal, which will be submitted to Interreg North Sea Region Programme, has three main objectives: to mitigate food waste in the supply chain for vegetable, dairy, and marine products; to promote collaboration and innovation within the food industry; to conduct research on tools that can be utilised during food production to identify areas for optimisation, with the goal of not only reducing food waste but also making the food industry more competitive. The project proposal foresees submissions from up to 30 projects, with at least two or three companies working together.

11:30 – 13:00: WP T1 Pilot Tests (Chair I&R): Adapting and pilot testing sensor technologies in agri-food supply chains

Gael started by presenting an overview of the deliverables that Images et Réseaux have already submitted. First, publication of open call (March 2023) (D1.1). Second, it organised a partner workshop on sensor and Big Data (June 2019) (D2.1). Third, it worked on a test roadmap (March 2023) (D2.2). Finally, it recruited minimum five companies from agri-business supply chain for pilot tests (July 2020) (D1.2).

By March 2023, Images et Réseaux aims to submit a few other deliverables (as per the extension, to be completed by 17 March 2023). This includes working prototypes using sensor technology (D3.1), user manual for each pilot test (D3.2), and report on the pilot test and development of the sensor prototypes (story telling template) (D3.3).

Gael shared the link to access the document regarding the above-mentioned deliverables. He encouraged everyone to access the document and add their contribution in the document before mid of March 2023.

Gael explained also that he exchanged several emails with partners regarding the above-mentioned deliverable. If something still seems unclear to partners, they are welcome to approach him, although, as he believes, partners should have some more clarity now.

Partners presented updates on the pilot tests.

1) Picnic (NL)

Imke from Whysor started a presentation on pilot test with Picnic (NL). As she explained, Picnic is an online supermarket that delivers groceries to the costumer's home. They use trucks to transport groceries from their fulfilment centre in the Netherlands to local hubs and from the hub to the customers' homes. Picnic started with four delivery vehicles in 2015 and now there are over 1000 vehicles in the Netherlands and they deliver groceries in 120 Dutch cities and villages.

As Imke explained, they faced several challenged during the pilot test with Picnic. First, there was a problem with real-time data reporting/monitoring during transportation; second, sustainable sensor housing; third, the personalised cooling profile; and, fourth, easily maintainable equipment. Eventually, Whysor applied the REAMIT solutions to resolve these issues. The team at Whysor installed 20 Elsys EMS sensors (temperature, humidity and acceleration) in Picnic food crates and established a system facilitating real time transmission of data having temperature, humidity and acceleration information from the food crates in delivery journey to a Whysor cloud-based database where further data analysis can be performed.

After the installation of sensors in 2021, data were coming in fine, however, within a few weeks all the sensors stopped sending data. The sensor housing appeared to be not solid enough to withstand the force of heavy groceries. As a solution, flexible rings were 3D printed to protect the housing of the sensor and 20 new sensors were purchased and installed. Few months later, Whysor noticed that all these sensors broke down again, which means that the sensor housing is probably still not strong enough. This experience from the pilot test with Picnic allowed drawing a few conclusions. First, technical specifications of the sensors meet the expectations. Second, protection of the sensor is challenging. Finally, we need to track broken sensors.

Deliverables that have been submitted for this pilot test include:

- Poster – done
- Case Study – not started
- Working prototypes (3.1)
- User manual (3.2)
- Story telling (3.3)

Imke mentioned that the deliverables 3.1, 3.2 and 3.3 are currently in progress. In past few months, Whysor has not been hearing any communication from Picnic despite having tried many times. However, just before Christmas 2022, Picnic got in touch with Whysor. Picnic updated Whysor that they were having organisational movements of staff and, thus, our initial point of contact in Picnic no longer worked in the same department. Picnic expressed a desire to continue and complete the pilot test with REAMIT. Whysor discussed with Picnic a possibility of installing 10 new sensors with new housing in January 2023. Picnic agreed, but they also emphasised that they would have to first look internally for the relevant personnel in Picnic to be in charge of the pilot test. Picnic also agreed to share extra data for some trips that Whysor could identify or define. Based on this, next steps in the Picnic pilot test include installation of ten new sensors in January 2023, defining trips for which we want extra data from Picnic for analysis, and defining cooling profile and looking for anomaly detection.

Ram commented that it is a good development and expressed happiness that Picnic wants to complete the pilot test with us. Ram also mentioned that with further progress on the pilot test in coming days, University of Essex can work together with Whysor team on the Picnic case study. He also welcomed contributions or inputs from other partners for the case study. Imke also expressed willingness to work together further on the case study. He mentioned that they are working with three types of protective rings for sensor housing too, but Whysor is unsure about the longevity and lasting capability of these protective covering of sensor. Ram asked if Whysor is planning trips in coming days. Imke replied that they would plan trips in summer months as the observations are more interesting and relevant then, compared to the winter time.

Ram added that apart from establishing sensing and monitoring system, finding personalised cooling profile and estimating amount of cooling ice packs for the food crates is an important objective of this pilot test. For this purpose, Ram mentioned that finding temperature gradient during delivery journey seems important and he seeks support from other partners to look into it based on incoming data. Ram thanked Imke for her presentation.

Elaine asked if we are capturing the cost of technology used in the pilot test. She commented that it will be important from a business perspective and for cost benefit analysis of using these technologies for the company.

Ram commented that although not actual cost, but through work in LCA we are capturing cost equivalents in terms of environmental impact of using these technologies. He also suggested Tamiris to work further on capturing the actual costs along with environmental cost equivalent. During the discussion, the group commented that we could calculate the costs associated with technologies without much difficulty as we know prices of various components purchased. Ram asked Kate if she could help with it as she has already dealt with ordering sensors and other components. Tahmina also emphasised the need to capture cost related to battery usage and server.

Kate made the point that we need a systematic approach or template to do such cost benefit analysis. She also added that she recently came across an interesting paper regarding cost and benefit of using IoT technology in companies. She said that a cost benefit analysis can be made with pilot test companies, such as HMF, by doing interviews with them and capturing the benefits and challenges they faced. Kate would share the research paper with partners. The group then made an observation that having such template and systemic approach though very useful from business perspective, is a big task in itself.

Action: Whysor with support from university partners (UEssex) to develop a case study document on the pilot test with Picnic.

Action: Whysor to install ten new sensors in Picnic in January 2023, to define trips for which we want extra data from Picnic for analysis, and to define cooling profile and look for anomaly detection.

Action: Whysor and BED to gather information on the prices of various components that were purchased. This could help to calculate the costs associated with the use of technologies (in addition to the environmental cost calculation).

Action: Kate to share with partners a research publication on costs-benefits analysis of using IoT technologies by companies.

2) BioGros (Luxembourg)

BioGros is a wholesaler of high-quality organic and biodynamic foods in Luxembourg. BioGros is a company with a complete supply chain. They have fresh vegetables such as celery, lettuce and mushrooms

produced by organic farmers from the cooperative. The products are transported from the farmer to the BioGros warehouse by vehicle trucks. The vegetables are packaged and then transported to retail in small village shops, etc. BioGros sometimes experiences quality issues in transporting fresh foods, and they wish to gain insights into climatic conditions there. The goal of this pilot test is to gain insight into climatic conditions like temperature and humidity in the complete supply chain and then, particularly, regarding several fragile vegetables like mushrooms, onions, potatoes, and celery roots. The company also would like to have more information on fruit and vegetables ripening inside the warehouse.

Whysor faced several challenges during the pilot test with BioGros. The first issue related to real-time data reporting/monitoring during transport. Second, real-time data reporting/monitoring during warehousing. Third, alerting system in case of anomalies. Fourth, alerts should not be sent when trucks are stationary. Fifth, easily maintainable equipment.

The REAMIT solution involved setting up architecture includes installing sensors at BioGros grower, warehouse and inside the trucks. The sensors selected are digital meter Eagle loggers with temperature and humidity sensors. Data is transmitted from the Lori to the Whysor cloud. Whysor tested connectivity in Luxembourg at two locations and found it to be fine. Whysor also tested battery life and used trip detection algorithm to enhance battery life. The initial conclusions from the pilot test demonstrated that technical specifications of sensors meet expectations, the system is robust and false alerts are avoided.

Deliverables for the pilot test and their status are the following:

- Poster – already done
- Case study – work in progress with NTU
- Working prototypes (3.1) – work in progress
- User manual (3.2) – work in progress
- Story telling (3.3) – work in progress

The next steps for this pilot test include two aspects. First, Whysor will meet with BioGros, the REAMIT analytics team and writers of the case study for discussion and brainstorming for additional questions to be asked and looked into, as well as additional information needed. Second, we are working on defining the anomalies with analytics team at REAMIT. They already held two such meetings and the next meeting is planned this month (January 2023).

Action: Whysor, the REAMIT analytics team and writers of the case study will meet with BioGros to further discuss other relevant issues that need to be explored and gather some additional information.

Action: Whysor and the REAMIT analytics team will continue to work on defining the anomalies.

3) Pilot test with Raman Spectroscopy with Routhiau, IGRECA, ADRO in France (UoN)

Omar (University of Nantes – UoN) started presenting progress update on Raman spectroscopy-based pilot test at UoN. The main aim of the pilot test is to test the use of a portable Raman spectrometer inside food delivery trucks as a means to continuously measure and monitor the quality of food samples in the delivery trucks, as well as alerting the truck drivers/stake holders in case of food quality getting degraded during the road trip.

The pilot test has been divided into three stages.

- Stage 1 – Lab development (test the system in lab and develop the required scripts)

- Stage 2 – Transitioning between lab and company (portable system placed in refrigerated chamber in trucks mimicking real transport conditions)
- Stage 3 – Test in real conditions

The Stage 1 included setting up Raman sensors in lab and testing on food samples. It then involved analysing the observed data using Matlab scripts and uploading the results and scripts to the server. The Stage 1, including all the sub-activities, has already been completed.

The Stage 2 included all the activities of Stage 1, and, additionally, the activities related to system modification, automatisation, simulation as well as validation. All the activities of Stage 2 have already been completed.

Omar demonstrated the results of Stage 2. The system was able to monitor the change in quality of meat samples as we go from Day 0 to Day 30 during our observation period. The system was able to distinguish between high quality and low-quality food samples. The system was also able to detect when the first shift in quality of food samples took place. In addition, the system was also able to detect the molecules that were impacted during change in food quality. For example, the system was able to detect impact on molecules of Tyrosine and Amide 1, which are good indicators food quality.

Stage 3 (test in real conditions) has been divided into two activities. During the first activity, UoN team tried to contact industry such as Routhiau company for testing in real conditions. However, they did not hear back further from them, thus, the team engaged with the other activity – renting a truck. UoN team rented a truck and placed portable Raman sensor-based system in the truck for taking the measurements. The system was installed with foams to protect it from shocks and held tight using rope and the system was tested. The next phase of this activity will be to test the system in journey, and this is planned to take place at some point in February 2023.

Omar also emphasised that they exchanged communication and, eventually, got an interest from Vivo Group (in France) to install Raman sensor-based technology on their premises. The REAMIT team visited Vivo Group during the REAMIT Symposium in December 2022. Their concern is to test quality of sea food before/while transporting it to other customers. UoN plans to discuss it further with the company.

UoN has also published a research paper on Raman Spectroscopy Application in Food Waste Analysis in a special issue of *Sustainability Journal*. Moreover, UoN is preparing a poster for a conference on Raman Spectroscopy which will take place in Brest (France) in January 2023. Omar shared the draft of the poster. UoN is also working on developing the Storytelling (Deliverable 3.3) and user manual (Deliverable 3.2).

Ram commented that the opportunity for using Raman spectroscopy-based food quality analysis with Vivo Group, which has already had a sophisticated technical system in place, seems like a good development, because it strengthens the usability of Raman spectroscopy for such use case.

Devinder asked Ali how long it takes for Raman spectrometer to detect quality of food sample. Ali explained that it measures the quality in less than a second, but we need to measure spectra at multiple locations on the food sample. Ali made the point that using baseline spectra, they can compare spectra of sample in real time and can generate alert for the operator if the spectra indicate change in food quality. Ali also added that Raman spectroscopy works better in cold temperature because noise is reduced in low temperature. Thus, it could be very useful for cases such as Vivo Group. Ali made the argument that Raman spectroscopy can also be used for fruits, vegetables and other food items in addition to meat, chicken, fish and seafood products.

Action: UoN will test the portable Raman sensor-based system in journey in February 2023.

Action: UoN will further explore the possibility to collaborate with Vivo Group and will discuss installing Raman sensor-based technology on their premises to test quality of sea food before/during transportation to other customers.

Action: UoN to develop the Storytelling (Deliverable 3.3) and user manual (Deliverable 3.2).

4) Pilot test with YumChop (UK)

Sahar from the University of Bedfordshire (BED) shared the updates on the pilot test with YumChop in the UK. First, she gave a brief overview of YumChop as a company. YumChop is a British-based family-owned company specialising in producing ready-to-eat frozen meals with African flavour sold through self-serviced automated vending machines. YumChop also delivers directly to customers' homes through purchases made on website, and also to retailers and large organisations.

Sahar updated that REAMIT team visited the company and installed sensors at various locations in YumChop such as different zones, freezers, cold rooms, vending machines and kitchen fridges. Sahar explained the system requirements for YumChop, in particular, types and number of sensors and gateway used during installation. There have been ten sensors deployed in the pilot test, and one sensor has been deployed per fridge/freezer. The acceptable temperature threshold defined by the company is -18 degrees Celsius in a freezer. If the temperature exceeds this threshold, alerts need to be sent to company owners. A proposed analysis that we are working on is early anomaly detection model.

Sahar explained that team is looking into the factors that could potentially affect the temperature of raw materials or processed food in a fridge. The danger zone refers to the temperature range in which bacteria grow most rapidly on food. The maximum temperature should be 5 degrees Celsius. For consumer foods, generally, if the food is exposed to temperature range above 5 degrees Celsius for more than 90 – 120 minutes, the food should be disposed due to the growth of pathogens. Some other causes of food degradation could be that food not cooked or reheated to the temperature required, or hot food is not cooled properly before being placed in cold storage, the fridge is not cooling as per the requirements to keep the food in safe zone. Thus, it is important to check the temperature regularly. Other aspects that we can look into include the impact of seasonal variations and using it for benefit. For example, there could be an increase in energy consumption during summer period as compared to winter. Also, with increased temperature monitoring, we can look for optimising the energy cost by avoiding scenarios such as desired temperature cut-off is -20 degrees Celsius, but food is kept in -30 degrees Celsius, causing extra consumption. We can also carry out a time series analysis of food waste in YumChop, before and after sensor installation.

Some of the plans that we are currently investigating are to optimise routes for reaching a set of vending machines, optimising the journey lengths, correlation between maximum journey lengths and outside temperature, alternative routes based on traffic information as well as the amount of ice packs/dry ice needed in trucks. Other updates can be provided in WP T2 section.

Action: BED to prepare a story telling document on YumChop.

5) Pilot test with Human Milk Foundation (BED)

Sahar (BED) presented updates related to HMF (https://humanmilkfoundation.org/) pilot test. First, she gave a brief overview of HMF. Human Milk Foundation, founded in 2017 in the UK, is a charity working to help more families feed their babies with human milk.

The goal of the pilot test is to monitor temperature in which human milk is transported between a donor, human milk bank, hospital and home; and send alerts if these conditions change. Optimal temperature for transportation of human milk is -20 degrees Celsius. In general, there are 30 – 50 donors per day. For milk deliveries, generally a few bottles of milk are transported per trip in a motorcycle or a car. We have prepared a poster for HMF pilot test highlighting collaboration of REAMIT with HMF. Sahar showed draft of poster. Sahar then gave a brief overview of sensor installation infrastructure deployed for the pilot test. Sensors monitor the temperature and send the data to cloud database where data is analysed. Whysor has built a dashboard for displaying data from HMF sensors. There were some challenges faced during the pilot test. There was an issue related to the connectivity between sensors and the cloud, as the sensors move from one location to other of varying connectivity, sensors loose connection with the cloud. Whysor is working with HMF team to resolve this connectivity issue. Also, another connectivity issue was due to communication breakdown. There were also some challenges related to alarming.

We are analysing the data coming from the sensors and we are monitoring temperature fluctuations over a period of time. Data analytics partners are also looking into the issue if we need other data also for the pilot test apart from regularly analysing the available data. BED also plans to purchase new sensors for HMF. The Whysor team is also working towards improving the dashboard by adding new features such as configuration for binary sensors.

Action: Whysor and the HMF team to resolve the issue of connectivity between sensors and the cloud as well as the communication breakdown, and alarming.

Action: BED to purchase new sensors for HMF.

Action: Whysor to improve the dashboard by adding new features such as configuration for binary sensors.

5) Pilot test with WD Meats (Dry aging chamber) in the UK (UU)

James from UU presented updates related to the pilot test with WD Meats for dry aging. WD Meats wanted to optimise the dry aging process that they deployed on their premises. Dry aging beef is a premium technique used for the flavour development and to tenderise the beef. It involves hanging beef carcasses or hindquarters in a refrigerated room uncovered and left to age for several weeks or even months at a controlled temperature, relative humidity, and airflow. It is costly because of high aging shrinkage, trim loss, risk of contamination, and the requirements of aging conditions and space. REAMIT project is interested in reducing trim loss, which is a phenomenon that occurs when too much moisture is extracted from beef resulting in unusable dark facings (which needs to be trimmed and disposed of before the sale of the meat). UU is trying to reduce the dark facings and, thus, trim loss, by tuning the environmental parameters of the refrigeration setup.

The REAMIT team deployed four LoRaWan sensors and a LoRa gateway in four zones of the dry aging chamber to monitor and record the temperature and humidity data. The equipment selected includes a multi-tech Lora Gateway, and four Ursalink UC11 temperature/humidity sensors. Two sensors were installed at the front of a large, refrigerated lorry container with all the hindquarters hanging up, and two were installed at the rear of the lorry.

The team performed three dry age trials, two of 14-day cycle and one of 21-day cycle in July 2021 (three weeks), March 2022 (three weeks) and August 2022 (two weeks). Normally, the dry aging process lasts three weeks.

James presented some results from the trial. A histogram of temperature values of left placed sensors was presented to look for most recurring values of temperature. Also, the temperature profile of dry aging chamber from front to back, over a period of 14 days. Since July 2022, one more dry aging cycle was performed and it lasted 14 days.

For next steps, James is waiting for Marco to provide start and end weights for April and August 2022 trials. The plan is to ideally perform one more iteration with different structuring of carcass's/sensors or different temperature and humidity parameters for the refrigeration unit after results from the baseline trial will be suggested. There are two questions to explore: (1) Does airflow affect dark facings? Airflow depends on how many carcasses are located in the trailer and also the structure. (2) Are there more optimal parameters which exist for the temperature and humidity which would minimise the dark facings while avoiding harmful bacteria formulation? Another idea is to compare this study with Burns Farm Meats pilot test data, this will be discussed in WP T2.

Action: Once WD Meats provide start and end weights for trials that took place in April and August 2022, James will try to perform one more iteration with different structuring of carcass's/sensors or different temperature and humidity parameters for the refrigeration unit.

6) Pilot test with WD Meats (Clostridium Bacteria) in the UK (UU)

James provided a background of the pilot test. This pilot test has proven to be tricky to kick off, partly due to the need of highly specialised knowledge of microbiology and some logistic issues. Clostridium is an anaerobic spoilage-causing bacterium found on farmyard or animal hide and has a high prevalence in abattoirs. It is a multi-billion-dollar problem because it produces non-toxic gases which spoil products early. In addition, it can spread easily and only grows once the products are packed.

Currently, WD Meats do swabbing with PCR in a lab based at the University of Bristol, which takes at least 48 hours and sometimes 72 hours. As WD Meats are processing tons of meat per time, they are hoping to find a quicker way of detecting it so that they can clean up the factory quicker, which means fewer products are affected. The trial plan is to investigate alternative methods of detecting the bacteria using a trace source of Clostridium using DNA sequencing. The goal is to find a faster method of detection, allowing for immediate clean-up of surfaces when detected that will inevitably reduce the beef waste in abattoirs, retailers and homes.

James provided an update about the current progress in the pilot test. UU met with Marco and Victoria (lab technician at WD Meats) on 3 May. They have purchased their own PCR machine (Genesig), which processes samples in approximately three hours rather than 48 hours, what WD Meats had experienced before. However, they had some issues with calibration. UU will help them with calibration/benchmarking and device validation using positive Clostridium DNA strains and comparing results between their lab and UU lab PCR machine to ensure their machine is functioning correctly. James Dooley also prepared ten samples of positive/negative Clostridium DNA and delivered to WD Meats on 4 August 2022.

WD Meats ran those ten Clostridium samples and sent their results. UU ran the Clostridium samples but only three rather than ten. We are awaiting for James Dooley to write a technical report which would further explain these results. The results between these two runs should match. WD Meats are having recurring issue with their positive/negative controls for Clostridium. James Dooley is going to investigate this and see if he can produce new controls for them to use in their Genesig machine. However, James updated that James Dooley has been very busy in past six months and it has been difficult to contact him and to progress further on this since past six months. Thus, we may need to redo another set of experimentation. James showed results of sample runs by WD Meats and UU. James Dooley shared his initial comments on the results and mentioned results of UU were along expected lines, however, more insight on these is needed.

For the next steps before the end of the project, we have to complete a technical report on Clostridium results. We also look to prepare new controls for WD Meats and ensure that their lab can replicate the same results as UU lab. James Dooley also wants to perform a DNA sequencing study to identify the source of the Clostridium. Marco is very interested in this research because he suspects that a lot of Clostridium is coming from imported cattle and WD Meats brings in a lot of their beef from the UK, and he would like to identify the exact suppliers and farmers for where these issues occur. DNA sequencing could help in proving that this is the case and then WD Meats can change the supplier.

Action: UU to help WD Meats with calibration/benchmarking.

Action: UU to complete a technical report on Clostridium results.

Action: UU to prepare new controls for WD Meats and ensure that their lab can replicate the same results as UU lab.

7) Pilot test with Musgrave in the UK (UU)

James gave a brief background of Musgrave pilot test. Musgrave is the largest wholesaler of groceries in Northern Ireland. They supply one in every four homes. Musgrave deliveries of chilled food produce are performed to various small businesses, fast food restaurants, etc., within approximately 15-mile radius from Musgrave's warehouse, using their own logistics network. Vans performing deliveries are refrigerated, but at present, there is no way of knowing in the cab or the office if the refrigeration units are currently correctly functioning. Breakdowns with refrigeration units can cost the wholesaler full vans of spoiled food. Therefore, they would prefer an alerting system that would let them know of any issues which should be available to both the driver and the logistics staff in the head office, so the van could be redirected back to base loss, minimising the risk of food spoilage.

The sensor system was deployed in the vans of the company to monitor and track temperature and humidity and trip detection algorithm was also implemented. For the current updates on the pilot test, the IoT anomaly detection system was deployed with `Musgrave Marketplace in April 2022 in three delivery vans operating in the greater Belfast area. The system monitors both the frozen and fresh produce refrigeration areas of each van in 5-minute intervals while deliveries are being performed. Logistics staff at the warehouse has been given access to the Whysor dashboard for real-time monitoring of the vehicles and has been added to the alerting service. When no trip is detected, recordings are made and uploaded to cloud every 12 hours. As of now, the batteries have needed replacement once after 180 days in one logger.

For the steps to be completed before project end, the ambient temperature monitoring, results suggest there are problems with the cooling profile of the vans. However, Musgrave have not flagged any issues. We are also looking into the question whether there might be a better sensor location to monitor the ambient temperature. James added that he spoke with a refrigeration specialist who advised placing sensors to monitor ‘air on’ at the refrigeration unit, which is where air is drawn into after circulating the entire van. He believes this is the most accurate representation of ambient temperature. We would try moving the sensor to ‘air on’ of the refrigeration unit and see we could get more accurate ambient temperature data.

Action: UU to move the sensor to ‘air on’ of the refrigeration unit inside the Musgrave van and to see if more accurate ambient temperature data is available.

8) Pilot test with Andy Keery (Rent - a - Fridge & Andy Keery Refrigeration) in Northern Ireland & Ireland (UU)

James updated that in the past two months, he started a small pilot test with Andy Kerry who is CEO of Rent-a-Fridge and Andy Keery Refrigeration in Northern Ireland and Ireland (https://www.rent-a-fridge.co.uk). Andy Kerry Refrigeration rents fridges and cold storage to customers in Ireland and Northern Ireland. He is very popular during festival seasons. He works with supermarkets too. Andy is a contact that we got through Musgrave, for whom Andy works on refrigeration units. Andy manufactures his own portable cold stores and rents them to various clients.

The problem with the company is that there is a potential for food waste in cold storage if equipment failure occurs. James deployed sensors for humidity and temperature & Digital Matter Eagle IoT logger in the company. The company wishes to have a dashboard for remote temperature monitoring in real time and text alerting system to warn if food is at risk of spoilage.

First pilot with the company was at Belfast Continental market between 19 November – 23 December 2022. On 19 November, James installed one Digital Matter Eagle logger with two temperature probes in one of Andy's rentable fridges, hired to Rocket's (a Dublin based burger company) who had a stall at Belfast's continental market. The cold store stayed at the fixed location for the duration of the market. Since the refrigeration unit runs in the cold store 24/7, the logger was hard wired into the fridge's power supply so that sending recording every five minutes was still possible.

James showed some pictures of the deployment in cold storage as well as data observed during the monitoring. From the data, one observation was there was an anomaly at some instant, indicating sudden rise in temperature. The temperature although was still within the threshold limit. Since, this was first trial, alerting system was not deployed then, but this anomaly provides a use case for having alerting system in place for the company.

Second pilot test with the company is for Artisan click and collect food service. It is planned for January – March 2023. On 4 January, James moved the logger into a second cold store destined for a click and collect artisan food service based in the greater Belfast area. The service is due to commence at the end of January. We will see how the monitoring performs.

For future work, Andy updated that he works with a range of clients, including ones outside of the agri-food sector. His past clients include florists, the pharmaceutical industry and wine storing clients. James has asked Andy about the possibility of monitoring some other produce in the future. As James emphasised, this could help us write our 'Business Development' deliverable, but also for future work. Andy generally only knows his clients a few weeks before the rental starts, so he does not know what is coming up yet. Andy also mentioned that he would like to toggle alerting on and off himself from the dashboard since his units are turned off while not in use.

Ram commented that it is good that we have some additional work with the companies, but we have to update them that the project is wrapping up in July 2023 and we can deliver only accordingly.

James replied that he mentioned that to Andy. Ram highlighted that we need to document a key objective of the work with Andy, so he can also discuss the potential advantages of the technological deployment to his clients.

Action: UU (James) to document a key objective of the pilot test with Andy Keery Refrigeration and to discuss the potential advantages of the technological deployment to his company.

9) Pilot test with Burns Farm Meats in Ireland (UCD)

Xavier from UCD presented the updates on the current status of the pilot test with Burns Farm Meats in Ireland. Burns Farm Meats is an Irish company recruited by REAMIT partners in UCD in February/March 2022. It is a small family-run business located in Sligo, Ireland. They have their own farm, which also works as an abattoir in Sligo (northwest of Ireland). Their operations include an abattoir, processing of organic meats, and delivery of retail orders to the public.
The company carries out dry aging process to deliver tender cut meat. They are interested in monitoring of dry aging process. Despite the increase in the flavour and tenderness of the meat, the dry aging process is still costly for abattoirs because of shrinkage of the meat, trim loss, and risk of contamination. They have two cold storage rooms in their facilities in which they carry out dry aging. They are interested in having the tools to monitor these rooms as they have detected a loss.

The aim of the pilot test is to monitor temperature and humidity in the cold storage rooms to reduce food waste. The problem they face is a loss of meat during dry aging, affecting parts that have been exposed to the environment for the duration of the process and need to be trimmed off as a result. We are sensing temperature and humidity data in the chambers. The goal of the pilot test is to establish and implement an alerting system that can warn BFM if the chambers exceed safe environmental condition values.

We placed ten sensors ELT-2 in the chamber, having internal antenna sensors for temperature and humidity, and a gateway. Data coming from the sensors is displayed on Whysor's dashboard and is stored in BED Big Data hub. We deployed six sensors in a larger chamber – two closer to the door, two in a central position and two close to the refrigeration unit. 4 sensors are deployed in a smaller chamber – two closer to the door and two close to the refrigeration unit. Xavier shared a screenshot of data display on Whysor's dashboard for temperature and humidity. Some glitches observed in temperature could have happened due to door opening and closing in their regular operation, though it can be due to some anomaly as well, for which alerting system could be useful.

The humidity sensor seems to have a problem as the readings shown by it are too high. The reason behind this might be that moisture is building up in the internal antenna sensors. We plan to validate its readings. From an analytical perspective, the priority is to ask for weight data from at least one cycle. This would allow to propose restructuring of beef carcasses if differences are observed, and to compare results from WD Meads and BFM.

We also need to work on improving the alerting system. The current system sends alerts also when BFM are working in the chamber (loading, unloading or cleaning) and it is not of help to them. The deployment of binary sensors (door open/closed) will be carried out to improve the alerting system. This would link door status to temperature and humidity readings. Also, there is potential for linking the readings with the Warp10 platform – and incorporate anomaly detection, seasonality analysis and other algorithms.

Next, we are planning to visit to BFM in the next few weeks and deploy a new Eagle logger with humidity probes and binary sensors. An additional Eagle logger will be deployed with a humidity probe (T9602). Two binary sensors will be installed as a means to improve the alerting system. This means that we will use that a more complex and optimised alerting logic.

Ram commented that although having sensors deployed is fine, sour final outcome should be to understand the factors that cause the meat to lose weight or get wasted. How are we planning to link meat loss with the temperature and humidity? Xavier replied that their priority was to first establish the monitoring and alerting system in place. However, we plan to suggest them to measure and share with use weight of trim loss and meat and link it with the temperature and weight loss.

Ram agreed that establishing a link between trim loss/waste in meat and the temperature and humidity is important.

Xavier made a presentation about Burns Farm Meats (BFM). BFM Ltd is a family-owned company located in north Sligo, Ireland. Their main activities include farming, operation of an abattoir, processing of organic meats, and delivery of retail orders to the public. BFMs are especially interested in the monitoring of the dry aging process. Despite an increase in the flavour and tenderness of the meat, dry ageing is still costly for abattoirs because of shrinkage of meat, trim loss and risk of contamination.

They have two cold storage rooms in their facilities in which they carry out dry aging. They are interested in having tools to monitor these rooms as they have detected a loss. Also, REAMIT pilot/scenario including the aim of the pilot, problem, data, and goal was explained to the company.

The aim of the pilot is to 'monitor temperature and humidity in the cold storage rooms to reduce food waste'. The problem was defined as 'a loss of meat occuing during the dry-ageing process, affecting parts that have been eeposed to the environment for the duration of the process and need to be trimmed off as a result'. Also, the data includes temperature and humidity sensor data. The aim is to establish and implement an alerting system that can warn BFM if the chambers exceed safe environmental conditions values.

The equipment selected is presented as follows:

- Tektelic Kona Micro IoT Gateway (Tektelic, Canada)
- 10x ELT-2 Internal Antenna sensors (Elsys, Sweden)
- Bedfordshire Big Data Hub
- Whysor dashboard for real-time data visualisation and alerting

The six sensors in the dry aging chamber were shown. There are six sensors in the large dry aging and four sensors in the smaller chamber. The designed dashboard was presented. There is some anomaly detected and there is an alarming system. 3D representation shows temperature fluctuations.

Pilot current status summary. Humidity reading values have been slowly, but steadily, increasing over time for all sensors. The reason may be that moisture is building up in the Elsys ELT-2 internal antenna sensors. There is a need to validate these readings.
From an analytical perspective the priority is to ask for weight data from at least one cycle. This would allow to propose restructuring of beef carcasses if differences are observed and to compare results from WD Meats and BFM.

Regarding the improvement of alerting system, the current system sends alerts also when BFM are working in the chamber (loading, unloading, or cleaning) and it is not helpful. The deployment of binary sensors (door open/closed) will be carried out to improve the alerting system. This would link door status to temperature and humidity readings. A visit is going to be organised. Also, the goal is to install binary sensors. Jean is working on anomaly detection system.

The next steps for this pilot study include a visit at BFM in the next few weeks and deployment of a new Eagle logger with humidity probes and binary sensors. Also, an additional (Eagle) logger will be deployed with a humidity probe (T9602). Two binary sensors will be installed as a means to improve the alerting system. James Gillespie and Marco Kull worked on a template forr Elsys ELT-2 that can decode binary sensors. The better controlling of the environment, the bigger amount of food waste to be reduced.

Action: UCD to visit BMF to install binary sensors (door open/closed) in order to improve the alerting system.

Action: UCD to improve the alerting system in Burns Farm Meats pilot test.

Action: UCD to visit BFM and deploy a new Eagle logger with humidity probes and binary sensors.

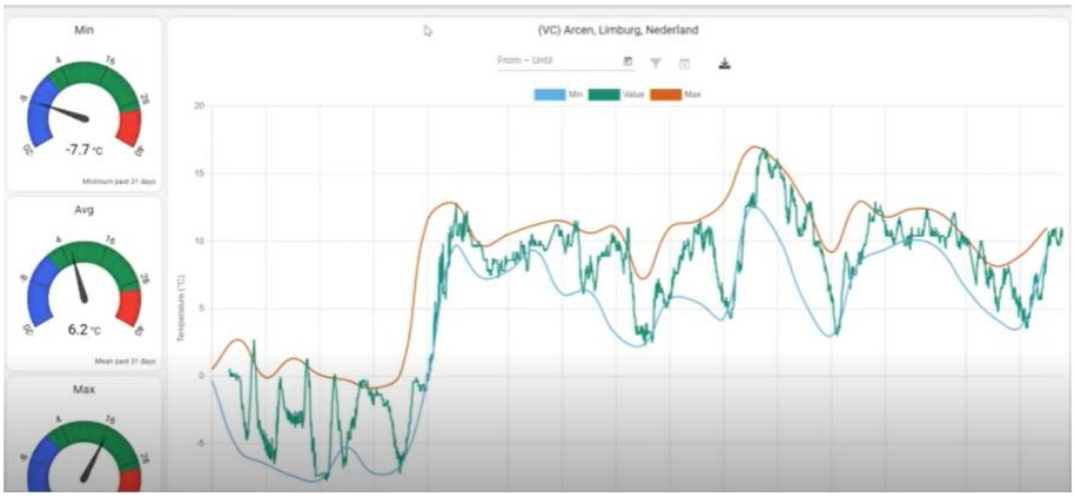
Action: UCD and data analytics team to ask BFM for weight data from at least one cycle of dry aging process as this would allow to propose restructuring of beef carcasses if differences are observed, and to compare results from WD Meads and BFM.

13:00 – 13:45 Lunch break

13:45 – 14:30 WP T2 Big Data integration and application to reduce food wastage

Whysor dashboard, graphical data and new features – presentation by Tom Verstraten, Whysor

TV discussed and demonstrated the new features Whysor is developing for the Whysor dashboard. The designed dashboard can show information of temperature in each selected day.



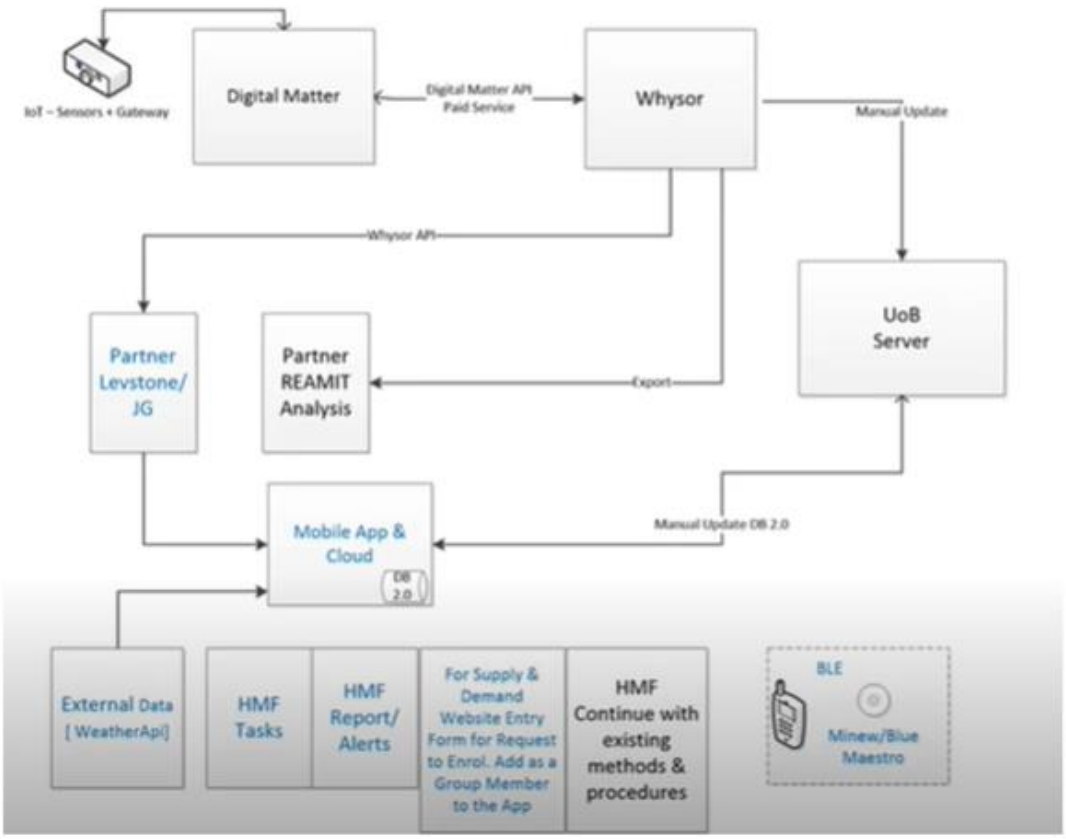
The designed dashboard can show information of temperature in each selected day.

Tom demonstrated also another dashboard and explained that Whysor is working on the data traffic to make it smoother. Tom added grouping data to make it more scalable and improve it. Also, Whysor is working with SenX data and with a new logger (its battery is chargeable).

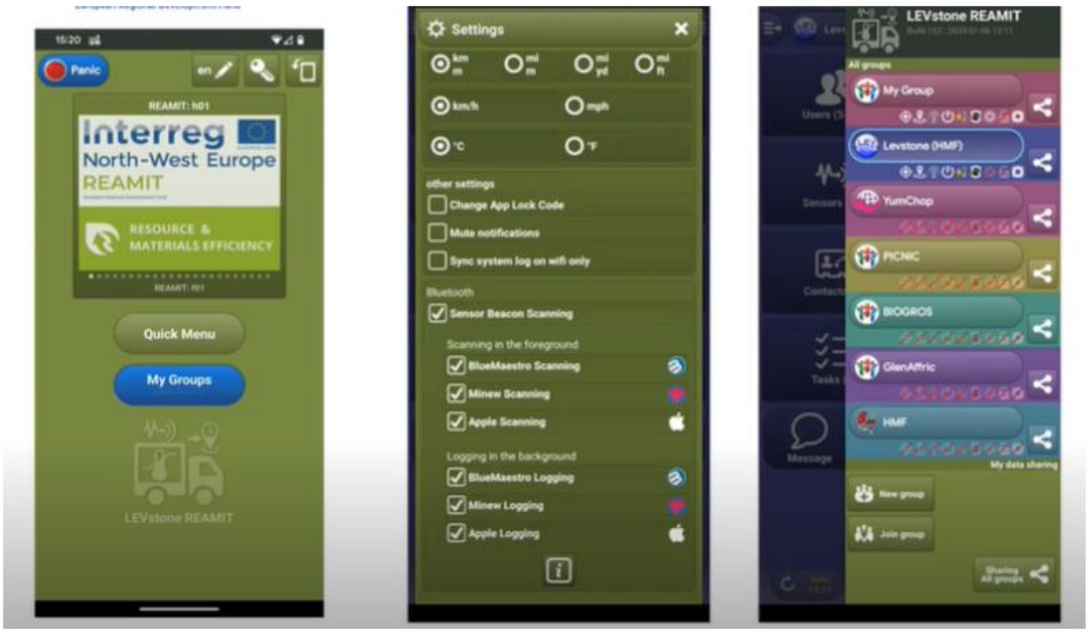
Second database of potential buyers, e.g. food charities, convenience stores, etc. the route where trucks would travel (Levstone); Meta data and a Smart Phone APP for REAMIT – presentation by Levstone

Levstone presented a diagram outlining the progress made and ongoing work regarding the sensors data pathway. They also announced the development of a new application (APP) called REAMIT, which is currently in testing phase, and will be available to partners once it is ready. The APP is multilingual and allows for the addition of Bluetooth devices. Levstone has also developed Blue Maestro scanning, Minew scanning, and Apple scanning within the APP. Access to the APP will be granted through invitations and users will have the ability to share or un-share information such as GPS, temperature, etc. The APP's interface includes features such as users, the diary, notifications, sensors, and a map. An API for weather information has also been integrated into the APP. REAMIT APP connects to sensors through Bluetooth technology, with a maximum distance of 10 meters for successful connection. Levstone demonstrated how the APP will be integrated with YumChop and MHF.

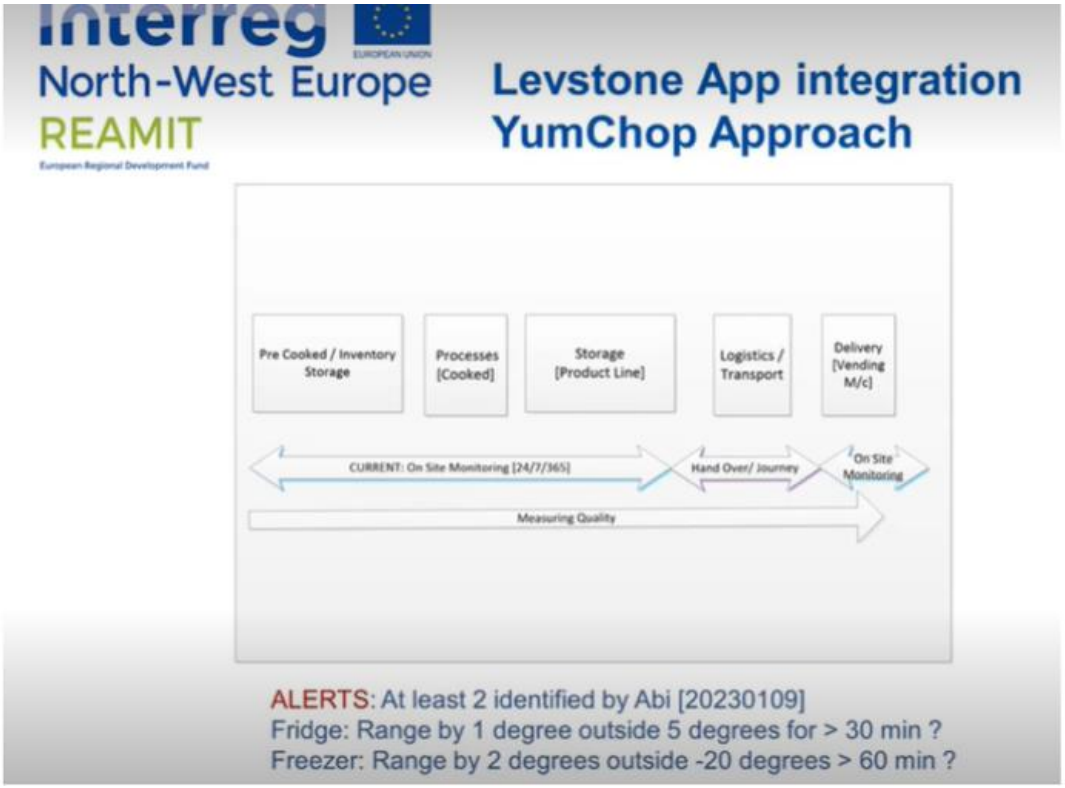
A diagram which represents the application’s development was shown.



Levstone is working on demand based system and also developing Bluethooth based application. Davinder presented a demo and showed the functionality of the APP.



There are two technologies. First, Blue Maestro, which is not reliable, and, another technology seems more robust. Davinder explained some issues related to open API, discussed two approaches and showed how the APP can be used for YumChop and HMF.



The data with GPS is integrated.

Exploring the use of Weather Api to integrate with DB2

1. Open Weather Api and services. *Register with Credit Card.*
2. Many others providing similar services.
e.g. Weatherbit Limitations: 500 per day, not for commercial use, single Api key …
3. Open-Meteo is an open-source weather API with free access for non-commercial use. [www. https://open-meteo.com/en]
Open-Meteo weather forecast APIs uses weather models from multiple national weather providers and combines them to give a more accurate forecast and current weather conditions – To be tested?

Why? Free, Hourly updates, large datasets, for developers: Open Source, easier to access, multiple API services, HTTP based JSON APIs etc..

4. Met – Office : UK best provider – No 'middle' service

A formula for anomaly detection is represented below.

Anomaly score formula

$$S(t) = c_o * max(0, t - t_o) + c_r * max(0, t - c_r)$$

S : anomaly score
t : temperature value
t_o : orange lower threshold
t_r : red threshold
c_o : orange range penalty weight
c_r : red range penalty weight

REAMIT data analysis of each data analysis sub-group

SenX presented the latest updates for both pilot tests: BioGros and Picnic. Two sensors (temperature and trip status) were monitored, the first present in cold store and the second in a vehicle. Only sensors from BioGros were monitored since data was available to Whysor. SenX presented the "anomaly detection dashboard". The aim of this dashboard is to qualify the anomalies (using a specific formula) that can be present in any of the pilot tests. For instance, the temperature can be classified into three categories: 1) RED >8 ºC 2); Orange 5-7 ºC; and 3) Green 1-5 ºC. Regarding the trip status, it can show if the vehicle is moving

or not. The future work will include multiple analysis tools, complete live data integration as well as discussion of pilot tests.

MTU discussed HMF data analysis. The goal is to have an automated instant monitoring system which will monitor the temperature during the milk delivery as well as an alerting system which will alert if temperature is going beyond a threshold value. In addition to the latter, a prediction model will be created to know the maximum journey distance and the time for milk deliveries. REAMIT has provided HMF sensors for monitoring the temperature in individual transport boxes. Also, a system needs to be installed to alert the company of any temperature fluctuations.

So far, the results show the following: ten sensors installed in HMF and data from total 99 journeys are available; type of received data includes: time, battery, temperature, humidity, and the status whether bag is open or closed. An additional data such as external temperature, size of the bag, amount of milk and the actual date and time of the journey and its length. Also, HMF data related to rate of change of temperature during several trips conducted in October and March presented also the factors causing such fluctuations. These factors include seasonal variations, external temperature, amount of milk in the bag and duration of journey. Finally, a multi regression model on all data combined (time, milk temperature, bag size, milk quantity, outside temperature and kind of vehicle) shows that a prediction equation has been obtained. This equation can predict the optimal journey length and duration and can find the impact of various external factors that can affect the milk temperature inside the bag.

Regarding the future work, it might be relevant to address the question of the impact of seasonal variations. At what stage do the bag starts warming up after the journey started? Also, based on this data, can we predict maximum journey time and distance? Can use analysis outputs to provide alternative best routes to driver? Another potential work may relate to new models such as neural networks and implementing Statistical Process Control and Process Capability based analysis for HMF data. Finally, use of new source of data such as real time Weather API, GPS and Traffic data leading may lead to wider and more precise analytics.

James Gillespie presented the updates on data analytics for the pilot study with Musgrave. The data set is from April 2022 to November 2022 and spans 180 days. In total, 49,000 data points were recorded, but some were discarded due to the vans being stationary. The remaining data set is 43,563 data points, which is equal to 3000 deliveries. The initial analysis shows that the mean freezer temperature was minus 3.9 degrees Celsius and the mean fridge temperature was 9.05 degrees Celsius. The data was trimmed and reanalysed to exclude journeys that were still in progress after 35 minutes. The mean freezer temperature was still only minus 5.5 degrees Celsius on average, and the fridge was 7.96 on average. It was suggested that the sensor might not be in the correct location and repositioning the sensors will be explored. Also, we checked battery consumption, and plan to have a longer recording every 5 minutes just in the freezer unit in future.

James Gillespie presented the updates on data analysis for Burns Farm Meats and WD Meats. WD Meats and Burns Farm Meats were monitored for weight, temperature, and humidity data during dry aging. Burns Farm Meats has fixed sensors and has been actively monitoring their cold room since September 2022. The data from Burns Farm Meats is consistent with a cold store, but they do not have any weight data yet. The proposed analysis is to examine the differences in drying processes between the laboratory and companies that use dedicated refrigeration for dry aging. The question is whether using a dedicated room for dry aging will result in enough weight loss to justify the cost. The data from WD meats shows an average 4.1% weight loss from carcasses going into dry age, but similar data is needed from Burns Farm Meats to see how the temperature and humidity profiles affect the carcass weight loss. Future work will include study on how to optimise weight loss using before and after weights combined with temperature and humidity data, and potentially suggesting different locations of the hindquarters to optimise weight loss.

UCD made a presentation about BioGros and Picnic. Following the presentations, there are two parameters including Temperature and Trip Status that are more focused on. However, there are some anomalies detected and a formulation for anomaly detection was represented. The formulation was dependent on anomaly score, temperature value, orange lower threshold, red threshold, orange range penalty weight, and red range penalty weight. The parameters in formulation explained above were considered for anomaly detection.

Action: Data analytics, Levstone and Whysor to develop a system to alert HMF of any temperature fluctuations inside human milk bags.

Action: With regard to Musgrave, UU to arrange a longer recording every 5 minutes just in the freezer unit in future.

14:30 – 15:30 WP T3 Business development of REAMIT technologies (Chair UU)

LCA

Tamiris Da Costa discussed Deliverable 1.2 (life cycle assessment) in two case studies, WD Meats and Burns Farm Meats. Regarding WD Meats, the last collection of LCA data took place on 3 August 2022. We have collected data for dry aging. We were not able to collect data for the other steps since there was not a lot of information. The livestock production that was collected on the Echo England database. There was a gap between these states. We can try to fill in the literature, but for now we are just focused on this stage "the dry engine". The data that were collected concerns: the total weight of carcass that are being stored, the water loss, the storage time, the electricity consumption and the number of sensors. The meat production, mainly the part of farming, the hotspot impacted the risk. The only exception is ionising radiation which is the electricity consumption. The sensors and the big data represent just a small contribution like less than 1%. In order to compensate these additional impacts, we would need to reduce at least 236 kilograms of meat.

Regarding Burns Farm Meats, data was collected on 7 September 2022, at all stages of production to final transportation. Data includes the same elements as for WD Meats. LCA results show that sheep has the highest impact. The contribution of the sensors and the big data is minimal. It is insignificant and it is lower than 1%. To compensate for these additional impacts, we need to avoid at least 215 kilograms of meat per year. If we are able to avoid this amount of food, we would avoid the emission of 43,000 kilograms of CO2.

15:45 – 16:30 WP Communication (chaired NTU)

Usha presented the deliverables that NTU had been working on as part of WP Communication:

- Website launch (by March 2019)
- Social media (by March 2019) – Twitter, Facebook, LinkedIn, YouTube
- Project banners, posters and flyers (July 2022) – these are always updated
- Policy briefs (January 2023)

As for the policy briefs document, Ram and Kate, before the meeting, had shared the ideas on how to improve it. Usha informed that the document was available in the SharePoint and partners could access it and suggest any improvements of the policies.

Regarding REAMIT networking events (December 2022), all of them have been included in the Communication Strategy document. Usha explained that partners were sometimes presenting the project at

events but did not always report it to NTU. She asked partners to do so even if such events were outside of the EU to complete the task on networking events before wrapping the deliverable up in April 2023.

Regarding publishing journal articles (July 2023), Usha explained that the REAMIT team was well ahead of time, with eight papers already published and seven are in a proof reading stage. There were going to be at least 15 research papers ready by July 2023.

Usha further discussed the communication objectives. One of the goals specified in the REAMIT Application Form was to influence agribusinesses to decrease the amount of food waste in food supply chains by 10% by 2023. Usha had already approached Ram and Kate about this issue. The question was: is REAMIT influencing the supply chains to reduce 10%, and if not, what needs to be changed? Usha asked partners to think about it and provide comments.

Ram observed that this has become more complicated as pilot test companies were not sharing the appropriate type of information with REAMIT to make such conclusions. For them, often it was a sensitive type of information. Kate suggested that, with YumChop, perhaps some estimates could be made. Ram made the point that companies would happily talk about how these technologies were helping them avoid waste, but not the specific amounts. Kate proposed to collect testimonials from REAMIT companies, actual quotes from them, so that REAMIT could report that it was a sensitive type of data to share, however, the companies tended to provide this information when directly asked about it.

Action: NTU to collect testimonials from pilot test companies on how REAMIT helps them reduce food waste, given information on actual volume of food waste is often considered sensitive and companies are not keen to share it.

Usha proposed that another approach could be explaining that after installing IoT sensors, REAMIT companies were achieving 0 waste, although that would need to be evidenced. Usha asked if REAMIT could ask the pilot test companies whether they achieved 0 waste thanks to REAMIT. It was then discussed that the REAMIT team could ask the pilot test companies by email to have a written response from them saying whether they had a significant reduce in waste or not.

Action: NTU to lead on approaching pilot test companies and asking them whether they had a significant reduction in food waste after installation of the REAMIT approach (e.g. drafting a template email to have a written response from pilot test companies).

Usha mentioned that she would try to send an email to Abi as she had published a paper with REAMIT team. HMF, Usha added, could also be approached for a testimony. All of that would have to be recorded in our policy document. Usha explained that a background had to be given and explained why the team was creating policies.

Usha asked all authors of journal articles as well as pilot test leads about how REAMIT could create more awareness of the benefits that combining IoT sensor and Big Data technologies could have for agri food companies. It might be another communication objective.

Action: NTU to facilitate a discussion among the REAMIT consortium about how REAMIT could create more awareness of the benefits that combining IoT sensor and Big Data technologies could have for agri food companies. As an outcome, NTU to produce a brief document with input to the final REAMIT project report.

Also, REAMIT was trying to convince agribusiness users of the value of REAMIT's technologies (aimed at reducing risk) and increase their knowledge, and, most of the companies have already become more conscious of the benefits.

Action: NTU to develop a document listing the benefits for agribusiness users from using the REAMIT's approach and technologies, based on input from pilot test companies. Infographics can be used as starting point. This will serve as input to the final REAMIT project report (closure report).

Usha shared with partners the policy brief document and asked to provide their inputs. She explained that the document was aimed at the beneficiaries of the policy.

NTU identified three different policy opportunities. First, Policy for food producers and manufacturers – Usha mentioned YumChop and BioGros as examples. This policy was further divided into: Sourcing; Diversification and Redistribution – at the start of REAMIT, the aim was, if the food was going to be wasted, to redistribute it. However, REAMIT had not explored/worked on this path, as Usha noted; Data analytics for smart organisation and efficiency; Optimised manufacturing and inventory conditions; and Waste management and redistribution.

Usha explained that, for the work on policy briefings, she was trying to make use of other examples, from other projects or businesses outside of REAMIT.

Second, Policy for food distributors and retailers – some examples were given. This includes: Enhanced traceability via IoT and transparent database solutions, which is possible by optimised warehouse and logistics conditions; and Use of IoT for real-time data driven decisions.

Third, Policy for local authorities. Usha explained that this objective was the most challenging and she was looking forward to inputs from partners. She tried to check in the Nottingham city council for relevant documentation, but there were no such policy briefs. Usha asked partners if they had any policy briefing related to their local council, to share with her. Similarly, searching on Google did not yield many results. She wondered if these types of documents were normally available for public.

Tahmina stated that she had worked with Central Bedfordshire Council in the area of environment. If Usha could forward the questions, she could try to contact them, Tahmina suggested. Also, Joan explained that the business school at UU was involved in secular economy strategy development in Northern Ireland, if that was useful, she could make contact and retrieve some information. Ram explained that he had submitted a document to parliament.uk/business, which would sometimes contain a set of questions they would be seeking to develop policies.

Action: Tahmina to contact Central Bedfordshire Council regarding policy areas where REAMIT could contribute to.

Usha explained that she had talked to a PhD student (Zantia) who was working for a food company but they also reported that they had no policy available.

Ram suggested to develop policies using information from all Interreg projects.

Usha went over some points to clarify with the REAMIT team:

- Is there any policy briefing document? (this question had been asked to JS as well)
- Where is it to be communicated and what themes REAMIT want to focus on – role of technology or something else?

Ram explained that the policy briefings were primarily for reporting purposes unless there was an external request for them, and that the document should be shared with REAMIT's stakeholders. If possible, the team could prepare papers or briefings to circulate along with the newsletter, but that it was not possible to send it to real policy makers unless they asked REAMIT to do so.

Kate observed that one of the goals of Interreg's projects is influencing policy-making at the highest level. All of the policy makers are members of committees, Kate explained, and they would be having one on food waste reduction at some point in the future. Kate was going to be sharing the link of the European Commission website as it would be a great opportunity if REAMIT was involved in their meetings.

Action: Kate to share the link to the European Commission website on food waste reduction policy.

Usha commented on the fact that the REAMIT team mentioned that IoT was going to be decisive in the future in REAMIT papers, however this was not going to happen unless there was policy in this direction, she observed. She raised a few questions. First, is this document a public document or will be kept only to the REAMIT team and the funder? Second, can we try to formulate the wording of the policy proposal with our REAMIT and other projects alone? Also, who is the audience for this policy proposal and how they will be approached by the REAMIT team to learn about this policy proposal?

Usha asked whether the team should look beyond these projects (outside of Interreg). Kate observed that the team did not know these projects and we did not have access to all the necessary information about them to develop a policy document. From Kate's perspective, it was a matter of identifying a gap in the policy. For example, by speaking with Abi (YumChop), REAMIT learned there was a gap related to refrigeration requirements. Kate added that to propose a policy document, the team could prepare 3 or 4 sentences which would discuss a particular policy gap. Similarly, HMF was also a strong case for proposing a policy. Both Natalie and Gillian were consultants with ministries across the world, for instance. Kate explained that a map regarding human milk banks across Europe, showed several countries with no official regulation. As for audience, Kate said that it was very targeted, e.g. in the second example, policy would be aimed at human banks.

As a conclusion, Ram proposed to conduct a separate meeting in the future with Kate, Joan, Usha, and others to address these points carefully.

Action: NTU to organise a meeting on how REAMIT can influence policy making. Invitees Usha, Joan, Kate, etc.

A final remark by Kate was that the work on policy influencing can be very beneficial for REAMIT: once REAMIT is recognised by the big actors as a serious contributor to policy documents, they may be invited to policy making networks, which could include for instance, being informed of the latest developments in a given area, which may stimulate ideas for future projects.

Sasha (NTU) shared with the partners the infographic that had been developed. The work was almost completed but some points still need to be further discussed. Sasha showed some of the items on the timeline, for example: January 2019 – project start; In March there were the first pilot tests in France: Rothiau, STEF, Pescanova. Sasha asked for a list all pilots that had ever started with REAMIT, for example: IGRECA. Ali explained that IGRECA initially showed an interest in Raman but after some time, they became unresponsive; the pilot never really took off.

There were also a few pilot tests that only lasted a limited time and Sasha was not sure whether to include them or not. Sasha explained that all of the photos were linked so they relate to newsletters or relevant documentation on the website.

Some more items on the timeline included:

- The German pilot test Weyers GmBh - which needed to be updated
- The Levstone App - launched in September 2020
- The second symposium hosted by Valorial in November 2020
- 4th RAC meeting online hosted by UCD (January 2021)
- Launch of the Whysor Dashboard (February 2021)

Usha asked partners to inform if there were any events missing on the timeline, and if that was the case, to let the NTU team know. Sasha reminded the REAMIT team that she needed all partners to confirm if all dates were correct.

This work, Sasha explained, would be embedded on the home page of the project's website, aimed at showing the journey and it would consist of an interactive document that people could click through.

Sasha asked whether Pescanova or Blue Skies should be mentioned. Ram observed that all companies that REAMIT approached and said yes to a pilot test should be included, even if they cancelled afterwards.

Imke explained that with Weyers (Germany), they actually said no, even though there were talks and discussions at the beginning but ultimately they decided to not participate in the pilot test. Imke said that the infographic should be mentioned that REAMIT had a contact with a German company instead, without including their full name, keeping it anonymous. Ram agreed on this point as well and added that the idea was to show who the REAMIT team approached and committed to pilot testing.

Sasha would be sending partners the link to the infographic and sharing it also in SharePoint.

As for the last part of the infographic, Sasha presented suggestions for graphs to be included: The number of stakeholders REAMIT reached in each country; number of efficient natural and material resource solutions implemented and tested; and amount of events that REAMIT partners presented at (already up to date in the infographic).

Kate added that the infographic could show which type of actors these stakeholders were (as in the reports in eMS), that information already specifies whether they were national public authorities, local public authorities, academia, business development agencies, etc. Kate could provide this data and use it to create this graph.

Action: NTU to work with Kate on types of stakeholders approached by REAMIT.

Kate made the point that the interactions with Inflow (an SME in America), could be added to demonstrate that REAMIT approached actors outside Europe too.

Sasha presented the work on the website, which was regularly updated. She explained that, previously, the website had been hosted by Squarespace, but that it had been moved to GoDaddy which would allow to the website to be live even after the project ended (until November 2027).

Another success relating to the website was that the 4th REAMIT Symposium was broadcasted live on REAMIT's YouTube platform which allowed to increase the number of website views during the period. Sasha showed the analytics regarding the views: 1. on the date of the symposium, there was a notable peak during the live broadcast, and a total of 298 views where achieved for the whole of December; 2. for the period July – December 2022, the website had accumulated 923 visits, which was an 85% increase from the previous period.

Ram reminded the team to keep posting on social media channels as much as possible to help increase visibility of the project. Sasha added that it might be good to try sharing newsletters through university channels and local news outlets.

Action: Partners to keep communicating about REAMIT through social media channels to help increase the visibility of the project.

Sasha also mentioned that the newsletter subscription platform had seen a 4.3% increase. The next newsletter would be in March 2023, which would be the final or second to last.

The development and publishing of case studies was also mentioned. Ram observed that partners should try to publish more and there were case studies that could still be developed: 15 papers should not be the end of REAMIT's research.

Action: Partners to develop more case studies and publications inspired by REAMIT.

Sasha presented the updates on project banners, posters and flyers. A new brochure had been developed for the symposium. Also, five new pilot tests videos were available on YouTube.

The documentary would be made available on YouTube. There were three versions of it: a short 6- minutes versions, a 22-minutes version and a 38-minutes version. Sasha urged partners to help decide which of them was best. Ram asked Sasha to send the links to partners to watch them.

Action: NTU to send links to REAMIT videos to partners.

Sasha mentioned the new posters developed in the period July – December 2022: Musgrave and Burns Meats. Also, a new roll-up had been developed for that RAC meeting. All materials were available in SharePoint. Recent events REAMIT partners had participated in and presented had been included in the strategy communication document. The NTU team was also creating a new press release together with NTU's media department. Sasha encouraged partners to follow a similar path and make press releases as well and using the available videos.

Action: Partners to follow NTU's example and develop press releases about REAMIT.

Gautam asked about the possibility of including information on each partner of the team (a 'meet the team' sort of section) on the website. It was concluded that that was a section that could be developed in the near future.

Action: NTU to develop 'meet the team' section on the REAMIT website.

Action: All partners to access and suggest any improvements of the policy briefs document.

16:30 – 17:30 REAMIT Steering Committee (RSC) meeting (Chair BED)

Ram Ramanathan reviewed the minutes from the previous meeting. Usha Ramanathan made the argument that there were items in the minutes that may need to be corrected. Ram asked Usha to communicate it to him at a later stage for inclusion in the minutes.

Action Log: Actions resulting from RAC/WP/RSC meeting July 2022.

Date	Minute/ Item	Action identified	Responsibility	Status: Confirmation of completion or reasons for non-completion
19/01/2022	22.04.04	Whysor to document all the experience with the pilot test with Picnic in a story telling format to be used in future publications.	Whysor	BioGros is ongoing. The deadline is March 2023 Some drafts need to be sent. GlanAfric stopped.
19/01/2022	22.04.06	Whysor to document all the experiences with the pilot test with Biogros in a story telling format to be used in future publications.	Whysor	Ongoing
19/01/2022	22.04.07	NTU to document all the experience with the pilot test with Glen Affric in a story telling format to be used in future publications.	NTU	Stopped as the pilot test has been discontinued.
19/01/2022	22.04.09	UU to document all experience in the Clostridium Bacteria pilot test with WD Meats in a story telling format to be used in future publications.	UU	Ongoing
19/01/2022	22.04.10	UU to document all the experience with Musgrave pilot in a story telling format to be used in future publications.	UU	Completed and published as a paper in the special issue.
19/01/2022	22.04.11	BED to document all the experience with YumChop pilot test in a story telling format to be used in future publications.	BED	Completed and published.
19/01/2022	22.04.12	UCD to document in a story telling format how ideas at UCD developed for fresh box and proof of concept pilot tests; how these ideas evolved and what actions were taken to implement them. Please include names of all companies that have been approached to participate in these experiments.	UCD	Stopped.

19/01/2022	22.05.03	BED, Whysor, Levstone and data analysis partners to determine whether a separate manual is needed on how the Whysor server is connected to REAMIT Big data server.	BED, Whysor, Levstone	Ongoing
19/01/2022	22.05.04	Levstone and pilot test leads (HMF, Picnic, Musgrave, etc.) to meet and discuss if the Blue maestro system proposed by Levstone would be beneficial for them.	Levstone, Whysor, BED and Ulster	Stopped.
19/01/2022	22.05.06	UoN to make sure that data from the Raman pilot test is transported to the Big Data server at BED.	UoN	Data is coming to the server. Connectivity issues. Completed. Ali to check it. RR suggested an additional analysis. Sahar and Joy to confirm this.
19/01/2022	22.05.09	Data analytics partners to go beyond time series analysis and move to predictive analytics (rather than descriptive).	BED, MTU, SenX, UU	Ongoing
20/01/2022	22.08	NTU to present policy brief examples from other projects supported by Interreg NWE Programme.	NTU	Completed
20/01/2022	22.08	NTU to present ideas for policy briefs in REAMIT.	NTU	Completed
20/01/2022	22.08	NTU to advance work on 5/6 case studies.	NTU	2 from NTU published. BioGros ongoing. Musgrave is published. Picnic, WD Meats/Burns Meat are ongoing.
20/01/2022	22.08	NTU to explore and implementing a new functionality on the REAMIT website: add a log in button to access the Big Data server.	NTU	Stopped.

20/01/2022	22.08	PPs to communicate about REAMIT through social media platforms.	PPs	Ongoing RR is encouraging everyone to support REAMIT communication team and activities
20/01/2022	22.11	All PPs to include minutes from internal meetings in Project Handbook in SharePoint.	PPs	Ongoing All minutes should be put in the SharePoint for all WPTs
06/07/2022	22.14	All pilot test leads to fill in the template for pilot test story telling.	BED	Linked to 22.08 above.
06/07/2022	22.15	Whysor to install sensors at VHG, start measuring the pressure, create a poster, write the pilot test storytelling, and analyse data.	Whysor	Stopped
06/07/2022	22.15	Whysor to complete the pilot test storytelling of VHG.	Whysor	Stopped
06/07/2022	22.15	Whysor to link the data received from Picnic to the data that is coming from the sensors to see if it is possible to recognise a trip in the data.	Whysor	Ongoing
06/07/2022	22.15	BED, MTU and SenX to start the analysis of data for Picnic.	BED, MTU, SenX	Ongoing
06/07/2022	22.15	BED, MTU and SenX to determine a cooling profile for cool box.	BED, MTU, SenX	Ongoing
06/07/2022	22.15	NTU to produce Picnic poster and the video.	NTU	Poster is completed. No need for a video.
06/07/2022	22.15	Whysor to complete the pilot test storytelling of Picnic.	Whysor	Ongoing
06/07/2022	22.15	Whysor and data analytics partners to define the thresholds in which the temperature is correct for each part of BioGros warehouse.	Whysor and data analytics partners	Completed

06/07/2022	22.15	Whysor to complete the pilot test storytelling of BioGros.	Whysor	Ongoing
06/07/2022	22.15	UoN to complete the pilot test storytelling of Raman Spectroscopy.	UoN	Paper published. Story telling document is ongoing.
06/07/2022	22.15	UoN to conduct stage 3 of the pilot test in real life conditions in a truck.	UoN	Ongoing
06/07/2022	22.15	UU to perform two more runs of tests with WD Meats when different combinations of temperature and humidity parameters will be tested to try to reduce the dark facings.	UU	One has been completed and another is ongoing.
06/07/2022	22.15	UU and BED to determine whether Clostridium Bacteria pilot will be analysed further under the REAMIT project or outside it.	UU, BED	Completed
06/07/2022	22.15	UU to discuss with UoN whether and how Raman spectroscopy can be used for this type of analysis. UU to send some samples for testing at UoN.	UU, UoN	Ongoing
06/07/2022	22.15	UU to complete the pilot test storytelling of Clostridium Bacteria.	UU	Ongoing
06/07/2022	2.15	NTU to recover equipment installed at Glen Affric.	NTU	To send a letter for change of ownership with recorded delivery.
06/07/2022	2.15	NTU to complete the pilot test storytelling of Glen Affric.	NTU	Stopped but NTU to write about storytelling with experience with GlenAffric.
06/07/2022	2.15	BED to complete the pilot test storytelling of HMF.	BED	Completed
06/07/2022	2.15	BED to complete the pilot test storytelling of YumChop.	BED	Completed

06/07/2022	2.15	UCD to complete the pilot test storytelling of Burns Meats Farm.	UCD	Ongoing
06/07/2022	2.15	UU to complete the pilot test storytelling for 3DF sensor.	UU	Ongoing
06/07/2022	2.16	Levstone to send any extra data parameter required for the app development as it may differ from modelling data requirements.	Levstone	Completed for Bluetooth and ongoing for Whysor virtual sensors.
06/07/2022	2.16	JE to arrange a meeting with GS and tech team to ensure consistent data labels.	JE	Completed
06/07/2022	2.16	Levstone to develop REAMIT specific App.	Levstone	Completed for Bluetooth and ongoing for Whysor virtual sensors.
06/07/2022	2.16	Levstone to develop a second database for potential demand points.	Levstone	Ongoing
06/07/2022	2.16	SenX and data analytics partners (and Whysor) to integrate SenX system for data analytics with Whysor API approach.	SenX and Whysor	Real time part is yet to be completed.

All of the actions had been reviewed. Ram informed that no feedback was received from Advisory Committee members (Anne Marie had attended an earlier session and gave positive feedback).

Plans for the next RAC meeting hosted by Essex, 22-23 March Colchester, UK

On 22 and 23 March 2023, the final RAC meeting will take place in Colchester at the Wivenhoe house hotel. There were 15 rooms still available if partners were interested. Ram informed that the Essex/BED team would be sending the details on booking the hotel or others nearby.

END OF DAY 1

Day 2. Thursday 12 January 2023 – Morning Session

09:00 – 10:30 WP Project Management (Chair BED)

Kate (KP) reminded the reporting deadlines. The project progress report 4.1 for January – June 2022 has not yet been processed and will be processed in the first quarter of this year. KP mentioned that some partners submitted their reports as late as December 2022, so this caused a delay. Every partner needs to arrange one on the spot audit. On the spot audit of report 4.1 will take place at BED and Essex on 23rd February 2023. The money for the period January – June 2022 should be paid around April 2023.

Report 4.2 for July to December 2022, partners should be talking to their auditors to arrange their audits now. Partners should finish their reporting by March2023. Final deadline for submitting partner reports to LP is Friday 3 March 2023.

REAMIT target groups: partners need to report in eMS the specific target groups they have contacted, for reporting purposes.

Report 5.1 will be the final project report. It will cover the period from 1 January 2023 to 9 July 2023.

RR suggested end of March as the latest date for partners to submit any financial claims, as they will be closing off the project. Make your FLC aware of any charges closer to the deadline, try not to make any claims after March 2023, RR stated. Staff costs will be covered until 9 July 2023. Only staff costs should be the exception after March until July.

Regarding Programme Manual, KP advised on all aspects of the final project appraisal. A preliminary questionnaire will be sent out to the LP (6 Months before end date) to collect information on outputs and results. These will be returned with the final project progress report. The final payment will take place once the secretariat has completed the final appraisal and final monitoring report, providing there are no issues. Partners are required to keep records of all documents, electronic copies to be stored securely for up to 10 years.

DB recommended partners should store files encrypted and secure drive with whatever is included in SharePoint.

RR spoke about how we can carry on REAMIT's legacy and suggested that a UK organisation will not be able to lead but UCD or any other partners can choose to lead a similar project.

RR spoke about setting up an ESRC centre in Essex focusing on food waste reduction. RR is going through this process to develop a project proposal to set up this centre.

Action: All partners: for each work package lead to ensure all information on SharePoint is up-to date and correctly ordered by the end of January 2023. Order the folders by WP and deliverable.

Action: All partners should be talking to their auditors to arrange their audits of report 4.2 and they should finish their reporting by March and submit it to LP.

10:30 – 10:50 Tea/Coffee Break

10:50 – 11:20 WP Long Term (Chair BED)

Kate said: Yesterday, we hosted Anna-Marie from the East-Netherlands Enterprise Agency. Today, she sent us an email asking if we can present to partners 'Step 1' proposal that they have submitted to Interreg North Sea Region Programme. They are looking for partners/associate partners to help them develop a full proposal, so this is only an expression of interest. Interreg North Sea Region Programme covers regions in dark green – Whysor is the only partner present who is eligible for the funding. The project proposal falls under priority of green transformation circular economy. The project is called F2F value and will create more resilient agri-food supply chains by encouraging and supporting 40 SMEs in the value chain of vegetables, dairy and marine products to maximise the value of feed stock and thereby minimising food waste. They want to create a business model and support for technological solutions. Duration is October 2023 – September 2027. If interested, Kate can forward the presentation and contact details. They are a

business development agency in the NL and they are looking for ideas from enterprises for the development of their WP T3 (business models and technological support). The Dutch agency will be leading the project.

Ram said that we have to create an agreed framework for sharing the impact of REAMIT technologies for reducing food waste. Ram believes this framework will be based on the LCA case studies – we need to link the estimated reduction in carbon emissions to the number of alerts sent, so we can state that our solution results in some amount of food waste reduction. Ram has requested the LCA team work to produce this new estimation based on the number of alerts sent.

We have already done four REAMIT networking events which were expected to be part of the project. NTU has already presented their policy briefing. Additionally, Ram has submitted a policy briefing document exclusively on what we are doing in the REAMIT project to the UK government. UK policy makers are currently reviewing it. If they are happy with it, they will then publish it on their website. If anyone wishes to take a look at what Ram has sent, he is happy to send it to the relevant partner.

Cross sector briefings: Ram is making a presentation at an international conference next month where he is going to highlight that tracking temperature in the cold chain can be useful outside the food sector, for example vaccine supply chains. This is an example of how REAMIT ideas can be used outside of food industry. Kate said that, in general, health, and paper (James explained that Andy Keery had used a cold store to preserve water damaged paper for an insurance company), flowers are the industries which could be interested in the REAMIT solutions. Ram requests if there will any other ideas, we can include them in this document too.

Network prospectus. It is about what different networks that we have created beyond this group. We will derive this deliverable and its contents from our target audiences reached.

There is a separate point on presentation of updates including the 4th REAMIT symposium. Ram noted that we have not received a report on the symposium yet. Ram asked Gael if he can contact Memona for this report.

Action: Valorial to share the report from 4th REAMIT Symposium.

Kate asked: What do we do with sensors and equipment currently with pilot companies at the end of the project?

Ram explained that we back everything and keep it at University of Bedfordshire. We change the ownership of equipment to the pilot companies and let them do whatever they want – for example, the company can approach Whysor or other individual IoT companies to connect the equipment to the cloud and continue receiving alerts. As suggested by Marcel, the company may wish to coordinate with a reseller rather than companies directly. We could create a spinoff who will coordinate the activities of the existing pilot test companies and work with Whysor to continue their work. Again, this requires a company.

Ram has already contacted Joan about this. UU (led by Joan) already has a spinout created, ActionSense (an associate partner on the REAMIT project), which could be used as the middleman. Using ActionSense would reduce the logistical burden of setting up another university spinout. Joan and Ram are going to discuss this option further. Joan, Marcel, Kate, and Ram will organise a meeting about this.

Action: Joan, Marcel, Kate, and Ram to organise a meeting about ActionSense being a link between pilot test companies and Whysor after REAMIT closure.

James asked if there was an issue in companies retaining equipment for auditing purposes (i.e. option 2). Ram said that we will keep a record of where all equipment has been distributed to if this is the option chosen.

Davinder said that hardware is normally a write-off on these projects so should not cause an issue.

Ram asked Whysor to push data to the Bedfordshire cloud until 9 July 2023. After that, there is no obligation since we will not have Joy or Sahar to perform data synchronisation.

Kate asked how we could keep the data flowing after 9 July 2023. Ram said that after 9 July 2023, it has to be paid for by the pilot company.

Marcel has sent an example pricing strategy to Ram for what maintaining equipment and connection to the Whysor cloud would cost. If a middleman company is involved (e.g. ActionSense), they can charge more than Whysor to the company (e.g. double) so they can make a profit.

After the meeting with Joan and ActionSense, companies can be approached and told how much it will cost them going forward to maintain connection to the Whysor cloud and services. If they are not interested, the ownership of the equipment can be changed to a) the company and they can find their own supplier, or b) to the UoB and equipment returned to the UoB.

Example prices are €16 per month for WD Meats, or > €70 per month for BioGros.

11:20 – 12:00 Research studies from the REAMIT project (Chair BED)

Ram opened the session by gratefully acknowledging all the partners contributions to the REAMIT-led MDPI *Sustainability Journal* special issue *New Multidisciplinary Approaches for Reducing Food Waste in Agribusiness Supply Chains.* From an initial idea of two – three papers, a list in June 2022 was produced with 22 potential ideas for publication. Ultimately, 13 papers exclusively documenting research from the REAMIT project were submitted to the journal and one paper on the legal and accounting side of food waste which was partially funded by Essex and partially funded by the REAMIT project.

So far, including one acceptance received this morning, ten papers have been accepted and 8 of these are already published online. The remaining papers, except one, are under multiple stages of review at present. We have therefore already reached the minimum target of ten papers for preparing a book from the special issue, which is the plan from this work.

Ram thanked all colleagues who were contributing to the article processing charges of the journals. Out of the 15 articles, we received fee waivers for 8, 50% discount on 5, 30% discount on one, and one at full price. Thanks to Joan and Fionnuala for already stepping in to cover some of these charges. UoN has already paid their APC.

Thanks to work carried out for this special issue, the name REAMIT will be etched into records permanently, and because it is an open issue anyone can see it. Ram is confident we will receive a large number of citations in the coming years.

However, our project activities are still ongoing which means research is still being done regularly, so please do not stop planning and writing articles. For example, there should be one paper on WD Meats and Burns Meats study, as well as new analytics which could become a publication – linking temperature with weight loss / dark facings. Ram is interested in Jean-Charles' new metric, which he has defined for anomaly

detection. He believes if we can validate the new measure, it would be a very good contribution to the literature.

Additionally, variations in temperature using the reference demand model framework could be a very good work. As we need to complete at minimum 5 LCA's (currently we have four), additional LCA publication works may also be possible. As usual, Ram needs the groups cooperation to complete any additional journal articles although he is happy to contribute.

Action: Partners to complete a paper on WD Meats and Burns Meats study, as well as new analytics.

Action: All partners to create an agreed framework for sharing the impact of REAMIT technologies for reducing food waste (based on the LCA case studies).

END OF DAY 2.

Actions resulting from RAC/WP/RSC meeting on 11-12 January 2023, Dublin

Date	Minute/Item	Action identified	Responsibility	Status
11/01/2023		Whysor with support from university partners (UEssex) to develop a case study document on the pilot test with Picnic.	Whysor and UEssex	Ongoing by UEssex, make it anonymous one on last mile delivery.
11/01/2023		Whysor to install ten new sensors in Picnic in January 2023, to define trips for which we want extra data from Picnic for analysis, and to define cooling profile and look for anomaly detection.	Whysor	Ongoing, due to low response from Picnic
11/01/2023		Whysor and BED to gather information on the prices of various components that were purchased. This could help to calculate the costs associated with the use of technologies (in addition to the environmental cost calculation).	Whysor and BED	Ongoing with BED
11/01/2023		Kate to share with partners a research publication on costs-benefits analysis of using IoT technologies by companies.	BED (KP)	Completed. Preliminary draft of the duality paper is being been prepared.
11/01/2023		Whysor, the REAMIT analytics team and writers of the case study will meet with BioGros to further discuss other relevant issues that need to be explored and gather some additional information.	Whysor	Met in January, waiting for response from Biogros. There could be language issues here.
11/01/2023		Whysor and the REAMIT analytics team will continue to work on defining the anomalies.	Whysor	Meeting with Biogros completed.
11/01/2023		UoN will test the portable Raman sensor-based system in journey in February 2023.	UoN	Completed.

				Two tests have been done and documented.
11/01/2023		UoN will further explore the possibility to collaborate with Vivo Group and will discuss installing Raman sensor-based technology on their premises to test quality of sea food before/during transportation to other customers.	UoN	Discussions with Viva group ongoing. Will be presented in Day 2.
11/01/2023		UoN to develop the Storytelling (Deliverable 3.3) and user manual (Deliverable 3.2).	UoN	Completed
11/01/2023		BED to prepare a story telling document on YumChop.	BED	Ongoing
11/01/2023		Whysor and the HMF team to resolve the issue of connectivity between sensors and the cloud as well as the communication breakdown, and alarming.	Whysor	Ongoing
11/01/2023		BED to purchase new sensors for HMF.	BED	Stopped
11/01/2023		Whysor to improve the dashboard by adding new features such as configuration for binary sensors.	Whysor	Imke to check with Marco/Tom.
11/01/2023		Once WD Meats provide start and end weights for trials that took place in April and August 2022, James will try to perform one more iteration with different structuring of carcass's/sensors or different temperature and humidity parameters for the refrigeration unit.	UU (James)	Some data received and more data being collected.
11/01/2023		UU to help WD Meats with calibration/benchmarking.	UU	Ongoing.

11/01/2023		UU to complete a technical report on Clostridium results.	UU	Ongoing.
11/01/2023		UU to prepare new controls for WD Meats and ensure that their lab can replicate the same results as UU lab.	UU	Ongoing.
11/01/2023		UU to move the sensor to 'air on' of the refrigeration unit inside the Musgrave van and to see if more accurate ambient temperature data is available.	UU	Completed.
11/01/2023		UU (James) to document a key objective of the pilot test with Andy Keery Refrigeration and to discuss the potential advantages of the technological deployment to his company.	UU (James)	Completed.
11/01/2023		UCD to visit BMF to install binary sensors (door open/closed) in order to improve the alerting system.	UCD	Partially completed.
11/01/2023		UCD to improve the alerting system in Burns Farm Meats pilot test.	UCD	Ongoing.
11/01/2023		UCD to visit BFM and deploy a new Eagle logger with humidity probes and binary sensors.	UCD	Ongoing
11/01/2023		UCD and data analytics team to ask BFM for weight data from at least one cycle of dry aging process as this would allow to propose restructuring of beef carcasses if differences are observed, and to compare results from WD Meads and BFM.	UCD	Ongoing
11/01/2023		Data analytics, Levstone and Whysor to develop a system to	Levstone and Whysor	More developments are

		alert HMF of any temperature fluctuations inside human milk bags.		needed for the App.
11/01/2023		With regard to Musgrave, UU to arrange a longer recording every 5 minutes just in the freezer unit in future.	UU	Stopped.
11/01/2023		NTU to lead on approaching pilot test companies and asking them whether they had a significant reduction in food waste after installation of the REAMIT approach (e.g. drafting a template email to have a written response from pilot test companies).	NTU	To be taken from testimonials/video transcripts.
11/01/2023		NTU to facilitate a discussion among the REAMIT consortium about how REAMIT could create more awareness of the benefits that combining IoT sensor and Big Data technologies could have for agri food companies. As an outcome, NTU to produce a brief document with input to the final REAMIT project report.	NTU	See the policy support document and the CS document.
11/01/2023		NTU to develop a document listing the benefits for agribusiness users from using the REAMIT's approach and technologies, based on input from pilot test companies. Infographics can be used as starting point. This will serve as input to the final REAMIT project report (closure report).	NTU	Available in the CS document.
11/01/2023		Tahmina to contact Central Bedfordshire Council regarding policy areas where REAMIT could contribute to.	BED (Tahmina)	Stopped

11/01/2023		Kate to share the link to the European Commission website on food waste reduction policy.	BED (Kate)	Completed
11/01/2023		NTU to organise a meeting on how REAMIT can influence policy making. Invitees Usha, Joan, Kate, etc.	NTU	Completed
11/01/2023		NTU to work with Kate on types of stakeholders approached by REAMIT.	NTU	Completed, part of the infographic.
11/01/2023		Partners to keep communicating about REAMIT through social media channels to help increase the visibility of the project.	PPs	Ongoing
11/01/2023		Partners to develop more case studies and publications inspired by REAMIT.	PPs	Discussed today at the Research session
11/01/2023		NTU to send links to REAMIT videos to partners.	NTU	Completed
11/01/2023		Partners to follow NTU's example and develop press releases about REAMIT.	PPs	Completed
11/01/2023		NTU to develop 'meet the team' section on the REAMIT website.	NTU	Completed
11/01/2023		All partners to access and suggest any improvements of the policy briefs document.	PPs	Ongoing
12/01/2023		All partners: for each work package lead to ensure all information on SharePoint is up-to date and correctly ordered by the end of January 2023. Order the folders by WP and deliverable.	PPs	Completed

12/01/2023		All partners should be talking to their auditors to arrange their audits of report 4.2 and they should finish their reporting by March and submit it to LP.	PPs	Completed
12/01/2023		Valorial to share the report from 4th REAMIT Symposium.	Valorial	Completed
12/01/2023		Joan, Marcel, Kate, and Ram to organise a meeting about ActionSense being a link between pilot test companies and Whysor after REAMIT closure.	Joan, Marcel, Kate, and Ram	Completed
12/01/2023		Partners to complete a paper on WD Meats and Burns Meats study, as well as new analytics.	PPs	Ongoing
12/01/2023		NTU to collect testimonials from pilot test companies on how REAMIT helps them reduce food waste, given information on actual volume of food waste is often considered sensitive and companies are not keen to share it.	NTU	Completed
12/01/2023		All partners to create an agreed framework for sharing the impact of REAMIT technologies for reducing food waste (based on the LCA case studies).	PPs	Ongoing

Approved minutes from the 9th meeting of REAMIT Advisory Committee, Work Packages and Steering Committee meeting, 22 – 23 March 2023
Hosted by University of Essex, Colchester, United Kingdom

Attendees:

Name	Institution	Name	Institution
Ram Ramanathan (RR)	Essex	Jean-Charles Vialatte (JV)	SenX
Katarzyna Pelc (KP)	BED	Fionnuala Murphy (FM) online	UCD
Sahar Ahmadzadeh (SA)	BED	Shane Ward (SW)	UCD
Tahmina Ajmal (TA) online	BED	Tamiris Da Costa (TC)	UCD
Gael Maugis (GM) online	I&R	Xavier Cama (XC)	UCD
Davinder Bola (DB)	Levstone	Omar Dib (OD)	UoN
Gautam Samriya (GS)	MTU	Imke Hermens (IH)	Whysor
Usha Ramanathan (UR)	NTU	Ali Assaf (AA)	UoN
Sasha Bennett (SB)	NTU		
James Gillespie (JG)	UU		
Joan Condell (JC) online	UU		
Trevor Cadden (TC) online	UU		

Day 1. Wednesday, 22 March 2023

11:00 – 11:30 RAC

Kate presented an overview of the progress of the project. Her presentation is saved in the SharePoint. Kate provided an update on each of the six REAMIT work packages.

WP T1 – adapting and pilot testing sensing technologies in agri-food supply chains:

- Deliverables DT1.1.1, 1.1.2, 1.2.1 have been completed.
- DT1.2.2 (Test roadmap), DT 1.3.1 (Working prototypes using sensor technology), DT1.3.2 (User manual for each pilot) and DT1.3.3 (Report on the pilot test and development of the sensor prototypes) are each still ongoing.

- REAMIT continues to work with nine companies (and ten working prototypes) and there has been progress with most of them.
- At UoN, the Raman spectroscopy stage 3 has been completed and deliverables for WP T1 have been finalised. Stage 3 involved renting a truck and installing the Raman system while conducting field testing in Nantes. Observations included vibrations coming from bumps affected the signal, and that the sample holder shape needed updated according to the various product. UoN have also produced a video documenting the trial. UoN are working with SenX on analytics for this trial.
- At WD Meats (UU), a new lab scientist at UU has been helping with the Clostridium identification. UU hope to perform two more iterations of the dry age trial before the end of the project to allow for comparative study between WD Meats and Burns Farm Meats data.
- At Yumchop, on 24 March 2023, there is a planned installation of a sensor in a vending machine at Victoria Coach Station in London. Abi asked REAMIT if they could install sensors in a delivery truck being used to deliver Yumchop food to Sainsbury's and for a second vending machine. However, REAMIT will not be able to provide any more sensors to Yumchop because of the closure of the project. Abi is approaching universities to see if she can install kiosks in these campuses. Ram noted that Yumchop has recently installed a freezer at the UEssex campus at students' union. Usha is going to try to get NTU to agree to Yumchop's freezer installation too.
- At HMF, Trevor from UU has carried out a qualitative interview with HMF. Natalie would like to see smaller and lighter sensors installed in human milk bags, however, like Yumchop, the project will not be installing new sensors. Natalie would like to see the mobile APP which has been created by Levstone and is available on SharePoint. Kate has started a research study on duality of technology and impacts on companies, which will involve HMF.
- At Musgrave, the sensor location has been changed in two of the vans and batteries have been replaced. Ambient temperature values have improved since, however there are still ongoing issues. Tamiris plans to do an LCA with Musgrave as the 5th study required for REAMIT.
- At Burns Farm Meats, a binary sensor has been installed on the doors to improve alerting criteria. Trim loss weights have been provided. An Eagle logger was installed to help validate humidity data but did not connect to the network for communication. JG has proposed building a small sensor setup to validate the humidity values for Burns.
- For the 3DF trial at UU, JG has performed experimentation (with his colleague at UU) on the detection of quality deterioration of milk. The work is ongoing.
- An email has been sent to pilot test leads and forwarded to most pilot test companies enquiring about preference for sensor ownership after the project ends. Three options were presented:
    - the sensor could be returned to the pilot lead (partner of the REAMIT project)
    - the sensor could be kept by the company and they find their own cloud system to avail of the sensor functionality
    - the sensor could be kept by a pilot test company and a sub-partner on REAMIT (Action Sense) could handle the interaction between the pilot company and Whysor so the company can continue to use the sensors and dashboard in their current format (approx. €10 per sensor per month)
- REAMIT partners received feedback from 2 pilot test companies: Burns Farm Meats would like to maintain ownership without the subscription, while Yumchop would like to continue with the subscription service. We have not received any further subscription request so far.

Action: Usha (NTU) to try to get NTU to agree to Yumchop's freezer installation at NTU campus.

WP T2 Big data integration and applications to reduce food wastage include the following:

- Development of the smartphone app has been finalised by Levstone and uploaded to the SharePoint. It is now ready to be tested by partners. Blue Maestro development has stopped.

- As for analytics, there are six working groups on data analytics lead by different partners (Picnic and BioGros by SenX, Yumchop by MTU, Musgrave by UU and MTU, WD and Burns by UU and MTU, Raman by SenX and UoN). Further updates will be provided on the progress of these groups later in the meeting.

WP T3 Business development of REAMIT technologies:

- Updates on this work package will be provided later in the meeting.

WP Communication:

- NTU has been leading on communicating about the documentary, producing the newsletters in February and April.
- Usha noted that there will be one further newsletter produced in June.
- For research, there are five planned papers, they will be discussed in further details later during the meeting. Ram noted that this includes also the quantitative study led by Yan and the qualitative study led by Trevor.

WP Management:

- The project handbook is being constantly updated – the latest version is on SharePoint. It is currently over 1000 pages long.
- The minutes from the previous REAMIT meeting in January 2023 have been completed and shared with partners. They will be discussed later.
- Over 20 online meetings of different groups took place in the past 3 months.
- New risks will be discussed during the RSC meeting.
- BED is still in the process of the on-the-spot audit.
- Partners will need to prepare for the audit of report 4.2 and the final audit of report 5.2.
- REAMIT officer at the joint secretariat has sent closure paperwork to BED/UEssex. There is a planned meeting on 16 May 2023 in person in Luton, UK – a final appraisal meeting with the REAMIT officer at founder's organisation.
- MTU, UoN, and UCD still need to complete their on-the-spot audit.

WP Long Term:

- No updates to be presented now.

11:30 – 12:30 Research Studies

Ram thanked all partners who submitted papers to the special issue of *Sustainability Journal*. 15 research papers were submitted, and 12 were accepted and published. Almost all had one round of review, three or four had two rounds, one had three rounds, and the one that is still under consideration has gone to the 5th round of review. One paper has been declined. Ram hopes that the one at the 5th round is published soon as the last revision was very minor. Ram intends to produce a book from the journal after the 5th review round paper has been accepted. The book will be printed for five editors and will be available online for others.
RR notes that what was published was the situation 6-8 months ago and the project has progressed since. Hence, Ram would like to see more papers published documenting the additional work carried out by the partners. Each partner presented their publishing plans.

Ulster University
Ulster is currently focused on producing a paper on the qualitative study entitled "The Role of IoT Sensors in Achieving Increased Sustainability Practices & Performance – The Moderating Role of a Data-driven

Culture" being led by TC with support from his PhD student, Emmet. The target for paper completion /submission is the end of July to a good 3 rated journal on operations and technology.

Currently, UU is at the data collection stage. The goal for the work is to include six interviews focused on REAMIT pilot companies. At least one other interview has been completed with an agri-food company that is external to REAMIT. So far, four interviews have been completed with REAMIT companies: Musgrave, Burns Farm, HMF, and BioGros. There are plans to interview Yumchop and WD Meats in April. There was no response from Picnic.

Emmet has proposed working with Lakshmi (UEssex) on the literature review for the paper, and they have already exchanged emails related to this work. NVivo, a qualitative data analysis software, which allows thematic analysis, will be used for data analysis.

Ulster are planning a comparative study between WD Meats and Burns Farm Meats. Unfortunately, the data collection phase for this study is still underway so there is not a clear timeline on when this paper could be completed by. It will take until the end of May at least until the necessary weight data is collected. Xavier collected trim loss data on site at Burns Farm in February, which ideally, we would add to as the current dataset is rather small.

UU had one paper submitted to *Sustainability Journal* reviewing sensing technologies for minimizing beef waste – it received one round of revisions before going to the editor who decided it wasn't enough. They, however, encouraged re-submission after a month. Ram confirmed that if submitted, it would still be eligible for the special issue. JG mentioned a new researcher who has joined UU – Leigh Johnston – who intends to look at this paper and see if additional literature on quantitative reporting can be added to the article for re-submission.

Ram reminded partners that REAMIT should be acknowledged including its reference number as source of funding for any future journals which are published. A request was also made to ensure the communication team is aware of any additional publications produced.

University College Dublin

The goal is to produce a comparative study between the two abattoirs (Burns and WD Meats) as JG already mentioned. Currently, we do not have enough data collected. Some data was collected on 22 February 2023, and the plan is to revisit it in the next few weeks so that more data can be recorded. A draft of the paper has been started. However, since the weight data is lacking, currently the paper is focused on LCA, provided by Tamiris. The idea is that we can incorporate the weights from WD Meats to a bigger paper. Expected timeline: it will be completed by July 2023. Ram suggests that data collection should be completed by the end of the project, but writing could happen after that if required. Tamiris is working on a dynamic LCA paper which has already been drafted and needs some minor revisions. She hopes to complete the work in the next 1-2 months.

University of Nantes

AA has contacted University services and there may be a patent on the results of the Raman spectroscopy, with the goal of a Raman platform used for quality monitoring during transportation. AA will have a meeting with the university next week. RR congratulated AA and noted this is a great result and would be the first patent from the project.

OB has been working with UU testing the fresh detect. JG has started testing with milk, and the plan is to expand this testing to other products, for example olive oil as it is known to produce more peaks. Afterwards, the plan is to build a model to predict the quality of food and present it as an article in the next four months.

Ram believes that this will be a good work because we have already demonstrated that we made some progress with fluorescence spectroscopy. Ram requested that UU takes responsibility to ensure the FreshDetect is returned to Matthias at the end of the project.

SenX

JC presented his analytics on BioGros using an anomaly score which could be published in the article. The anomaly score indicates if the transportation was carried out with good temperature control so that the quality of the transportation can be assessed. Ranges of temperature are used and for each range a penalty weight exists. These are combined to output a score and from this score we can say if good conditions were met or not. If the anomaly score was high, the transportation was not good. The anomaly scores can also be forecast in the future. While the analysis has been performed with regard to BioGros, it could be applied to any pilot test with temperature sensors.

Plan for a research paper includes: Novel anomaly score for assessing food transportation; comparative analysis of this score with classical anomaly detection; application as a standalone metric on a single sensor; application of the aggregate of each score on a full transportation route; strategies for incremental update of penalty weights; and relation with basic artificial neuron motel.

Ram asked JC if he was working with any of the academic institutions on this article. JC replied he was not. RR stated that it was very important that an academic collaboration was sought. Tahmina volunteered to help JC. Ram also said he would help. Ram said if JC provides the data and results, they can write a paper. Usha has also recruited a new member of staff who will join next month and has expertise in various algorithms. This new staff member may also be available to help write the paper.

Kate asked JC if he would be available to continue work on this publication after the project finishes. JC however said he thinks he should be able to do most of the work in April.

MTU

Statistical process control paper (SPC) was submitted to the special issue based on Picnic dataset. However, the reviewers asked some questions which required more data to answer. The comments also asked data to be collected over the summer period, however the dataset did not have any of this. One reviewer also noted that the work was not novel which GS disagreed with. Based on the comments and available data, the plan is to tweak the scope and purpose of the paper and re-submit it again. GS hopes to re-submit it in the remaining time he has at MTU. Ram notes that he is confident the paper is still publishable, and that the differences between the April and August dataset compared in the paper should be drawn upon. Ram believes the deadlines for this special issue have been missed but it could go to other journals. Tahmina suggested she could support Gautam, and he is happy to collaborate with Tahmina and Jean-Charles on a joint, mixed paper with SPC paper and anomaly detection.

Ram proposed that some of the story telling documents prepared for WP T1 could be turned into publishable case studies. Ram asked if any efforts are being made for this. Usha said she has started preparing a case study for BioGros. This will be published in the case centre, not in a journal.

Action: NTU to led work on turning some of the story telling documents prepared for WP T1 into publishable case studies.

BED

YD is working with RR and Lakshmi on the quantitative paper. The aim is to target a 3 rated journal based on the model testing result. Yan thinks sector specific journals like food policy with descriptive analysis as ICT adoption journals are sometimes difficult. Yan aims for a draft before May.

KP is working on a paper entitled "Dual effects of the internet of things (IoT): Benefits and risks of IoT adoption in agri-food supply chains – learnings from two case studies in the UK." Seen as an extension to the agri-food sector based on the REAMIT work conducted here on a paper on the dual effects already in the literature. The learnings would be from 2-3 case studies: HMF, Yumchop, and Musgrave as KP has been involved in the qualitative interviews with these companies. What are the benefits, risks, organizational conditions, and consequences of IoT adoption. Data collection will be through participant observation. One challenge Kate sees with the paper is that it the data collected may not be detailed enough and may require other technology adoption data like linking the mobile APP to the alerts to be implemented. Ram encouraged Kate to continue pursuing this idea and there is a lot of data from the project that could be used to inform the research work.

13:30 – 14:30 Work Package Long Term and RSC Meeting

Three points were discussed in WP LT: policy briefings, cross sector briefings and network prospectus.

1. Policy briefings

Usha stated: We started this documentation six to eight months ago. It was discussed in detail in our RSC meeting in January 2023 and some of you have commented on how to proceed with a policy brief. In the meantime, Ram's Office at the University of Essex has developed two different policy documents. Ram has prepared a policy document (REAMIT-related) which was further submitted to the UK Parliament in response to their call for evidence. It was shared with everyone.

Based on REAMIT, the policy is renamed as Policy Support document rather than policy document because we are not creating any policy based on REAMIT. We are trying to support the policy developments in the UK and European countries. The document is tweaked in terms of different stakeholders' viewpoint, what policy they consider based on the examples from REAMIT. So that was already developed, and I uploaded it to SharePoint. The document was shared with everyone.

The second policy document was prepared by Usha. This document is based on the question: *what policy can be incorporated within the REAMIT stakeholders*. That means we cannot take all IoT sensors in all good supply chain. Only certain things can be possible for example: how it can be incorporated locally to make food waste reduction as well as carbon emission reduction. Those things are classified under different headings.

The third policy document was prepared by Ram.
Ram noted: The first document that I submitted to the UK Parliament in response to their call about for evidence like the climate change, sustainability, etc. I submitted a document saying that while we do a lot of wonderful things in the UK about the climate change and sustainability, the focus on food waste could be somewhat cheap way of addressing much of a big problem, because saving food from becoming waste is a much cheaper way of saving carbon emissions compared to more capital-intensive ways of reducing carbon. My university suggested that I submit another such policy briefing, Labor Policy Forum. Every Labor Party member is looking for what to focus the next few years. They are looking for relevant policy choices that they must start working on and they have called for, not necessarily from Labor Party members, but also from wider public. In both documents, the first and the second, I stressed the two important points. The first point is basically saying that saving carbon emissions by saving food from becoming waste will be much cheaper compared to any other ways of reducing carbon emissions. The second point is that all companies should be rethinking about food waste reduction in their system.

Ram suggested that companies should be forced to measure their food waste to help them reduce it. Ram also suggested using IoT technology to monitor and reduce food waste. Additionally, Ram suggested that

incentives could be used to encourage companies to reduce food waste but measuring it should be the starting point.

Feedback on Ram's policy briefings:
Shane Ward from UCD, discussed the issue of food waste in the food industry, stating that companies internalize their losses and use tactics like marketing ploys to sell produce that they know they won't be able to sell, resulting in waste at the consumer level. He also mentioned the issue of supply contracts with farmers and how farmers may have to discard produce that doesn't meet strict criteria, even if it is edible and nutritious. He added that looking at the system, as a whole, it is necessary to address the problem of food waste, estimating that 30-50% of food produced is wasted globally. He criticized the use of food banks as a solution to food waste, stating that it's not a sustainable solution.

2. Cross sector briefings

Ram asked partners to collect all the deliverables that were created in a single place in SharePoint.

Sahar presented progress of deliverables in WP Long Term.

Deliverable 1.1. Network prospectus

Deliverable 1.2. REAMIT networking events 2019, 2020, 2021 and 2022– completed and a report from each event has been uploaded in SharePoint.

Deliverable 2.1. The agreed framework for measuring the impact of REAMIT technologies on food waste. A paper that is published by Ram Ramanathan about the motivations and challenges for companies and using IoT sensors for reducing food waste, which also includes insights and a road map for the future research – completed.

Deliverable 3.1. Policy briefings– completed and uploaded to SharePoint.

Deliverable 4.1. Cross-sector briefings – ongoing (cross sector briefings PPT need to be saved in SharePoint. All four papers need to be inserted in a new sub-folder (deliverable 4.1) in SharePoint.

REAMIT Steering Committee meeting

The minutes of 8th RSC meeting (11-12 January 2023) will be confirmed, and partners will be asked to report their activities as per the minutes. For the list of actions please refer to the draft minutes.

Draft Minutes from RAC WP RSC meeting Dublin (11-12 January 2023) document was sent one week ahead of this RSC meeting in Colchester (22-23 March 2023).

1. Risks in REAMIT:

- NTU partners have experienced challenges with obtaining back REAMIT IoT equipment from Glen Affric, who decided to disengage from the REAMIT pilot test. UR confirmed that eventually Glen Affric returned to NTU all the IoT equipment.
- IH from Whysor confirmed that long waiting time for reimbursement of funds is a risk for small companies such as Whysor.

2. Action Log: Actions resulting from RAC/WP/RSC meeting on 11-12 January 2023, Dublin, Ireland.

Date	Minute/Item	Action identified	Responsibility	Status
11/01/2023		Whysor with support from university partners (UEssex) to develop a case study document on the pilot test with Picnic.	Whysor and UEssex	Ongoing by UEssex, make it anonymous one on last mile delivery.
11/01/2023		Whysor to install ten new sensors in Picnic in January 2023, to define trips for which we want extra data from Picnic for analysis, and to define cooling profile and look for anomaly detection.	Whysor	Ongoing, due to low response from Picnic.
11/01/2023		Whysor and BED to gather information on the prices of various IoT sensors components that were purchased. This could help to calculate the costs associated with the use of technologies (in addition to the environmental cost calculation).	Whysor and BED	Ongoing with BED
11/01/2023		Kate to share with partners a research publication on costs-benefits analysis of using IoT technologies by companies.	BED (KP)	Completed. Preliminary draft of the duality paper is being been prepared.
11/01/2023		Whysor, the REAMIT analytics team and writers of the case study will meet with BioGros to further discuss other relevant issues that need to be explored and gather some additional information.	Whysor	Met in January, waiting for response from Biogros. There could be language issues here.
11/01/2023		Whysor and the REAMIT analytics team will continue to work on defining the anomalies.	Whysor	Meeting with Biogros completed.
11/01/2023		UoN will test the portable Raman sensor-based system in journey in February 2023.	UoN	Completed. Two tests have been done and documented.
11/01/2023		UoN will further explore the possibility to collaborate with Vivo Group and will discuss installing Raman sensor-based technology on their premises to test quality of sea	UoN	Discussions with Viva group ongoing. Will be presented in Day 2.

		food before/during transportation to other customers.		
11/01/2023		UoN to develop the Storytelling (Deliverable 3.3) and user manual (Deliverable 3.2).	UoN	Completed
11/01/2023		BED to prepare a story telling document on YumChop.	BED	Ongoing
11/01/2023		Whysor and the HMF team to resolve the issue of connectivity between sensors and the cloud as well as the communication breakdown, and alarming.	Whysor	Ongoing
11/01/2023		BED to purchase new sensors for HMF.	BED	Stopped
11/01/2023		Whysor to improve the dashboard by adding new features such as configuration for binary sensors.	Whysor	Imke to check with Marco/Tom.
11/01/2023		Once WD Meats provide start and end weights for trials that took place in April and August 2022, James will try to perform one more iteration with different structuring of carcass's/sensors or different temperature and humidity parameters for the refrigeration unit.	UU (James)	Some data received and more data being collected.
11/01/2023		UU to help WD Meats with calibration/benchmarking.	UU	Ongoing.
11/01/2023		UU to complete a technical report on Clostridium results.	UU	Ongoing.
11/01/2023		UU to prepare new controls for WD Meats and ensure that their lab can replicate the same results as UU lab.	UU	Ongoing.
11/01/2023		UU to move the sensor to 'air on' of the refrigeration unit inside the Musgrave van and to see if more accurate ambient temperature data is available.	UU	Completed.
11/01/2023		UU (James) to document a key objective of the pilot test with Andy Keery Refrigeration and to discuss the potential advantages of the	UU (James)	Completed.

		technological deployment to his company.		
11/01/2023		UCD to visit BFM to install binary sensors (door open/closed) in order to improve the alerting system.	UCD	Partially completed.
11/01/2023		UCD to improve the alerting system in Burns Farm Meats pilot test.	UCD	Ongoing.
11/01/2023		UCD to visit BFM and deploy a new Eagle logger with humidity probes and binary sensors.	UCD	Ongoing
11/01/2023		UCD and data analytics team to ask BFM for weight data from at least one cycle of dry aging process as this would allow to propose restructuring of beef carcasses if differences are observed, and to compare results from WD Meats and BFM.	UCD	Ongoing
11/01/2023		Data analytics partners, Levstone and Whysor to develop a system to alert HMF of any temperature fluctuations inside human milk bags.	Levstone and Whysor	More developments are needed for the App.
11/01/2023		With regard to Musgrave, UU to arrange a longer recording every 5 minutes just in the freezer unit in future.	UU	Stopped.
11/01/2023		NTU to lead on approaching pilot test companies and asking them whether they had a significant reduction in food waste after installation of the REAMIT approach (e.g. drafting a template email to have a written response from pilot test companies).	NTU	To be taken from testimonials/video transcripts.
11/01/2023		NTU to facilitate a discussion among the REAMIT consortium about how REAMIT could create more awareness of the benefits that combining IoT sensor and Big Data technologies could have for agri food companies. As an outcome, NTU to produce a brief document with input to the final REAMIT project report.	NTU	See the policy support document and the CS document.
11/01/2023		NTU to develop a document listing the benefits for agribusiness users from using the REAMIT's approach and technologies, based on input from pilot test companies. Infographics can be used as starting point. This will serve as input to the final REAMIT project report (closure report).	NTU	Available in the CS document.

11/01/2023		Tahmina to contact Central Bedfordshire Council regarding policy areas where REAMIT could contribute to.	BED (Tahmina)	Stopped
11/01/2023		Kate to share the link to the European Commission website on food waste reduction policy.	BED	Completed
11/01/2023		NTU to organise a meeting on how REAMIT can influence policy making. Invitees Usha, Joan, Kate, etc.	NTU	Completed
11/01/2023		NTU to work with Kate on types of stakeholders approached by REAMIT.	NTU	Completed, part of the infographic.
11/01/2023		Partners to keep communicating about REAMIT through social media channels to help increase the visibility of the project.	PPs	Ongoing
11/01/2023		Partners to develop more case studies and publications inspired by REAMIT.	PPs	Discussed today at the Research session
11/01/2023		NTU to send links to REAMIT videos to partners.	NTU	Completed
11/01/2023		Partners to follow NTU's example and develop press releases about REAMIT.	PPs	Completed
11/01/2023		NTU to develop 'meet the team' section on the REAMIT website.	NTU	Completed
11/01/2023		All partners to access and suggest any improvements of the policy briefs document.	PPs	Ongoing
12/01/2023		All partners: for each work package lead to ensure all information on SharePoint is up-to date and correctly ordered by the end of January 2023. Order the folders by WP and deliverable.	PPs	Completed
12/01/2023		All partners should be talking to their auditors to arrange their audits of report 4.2 and they should finish their reporting by March and submit it to LP.	PPs	Completed
12/01/2023		Valorial to share the report from 4th REAMIT Symposium.	Valorial	Completed
12/01/2023		Joan, Marcel, Kate, and Ram to organise a meeting about ActionSense being a link between pilot test	Joan, Marcel, Kate, and Ram	Completed

		companies and Whysor after REAMIT closure.		
12/01/2023		Partners to complete a paper on WD Meats and Burns Meats study, as well as new analytics.	PPs	Ongoing
12/01/2023		NTU to collect testimonials from pilot test companies on how REAMIT helps them reduce food waste, given information on actual volume of food waste is often considered sensitive and companies are not keen to share it.	NTU	Completed
12/01/2023		All partners to create an agreed framework for sharing the impact of REAMIT technologies for reducing food waste (based on the LCA case studies).	PPs	Ongoing

3. Feedback from RAC meeting and the decisions of the WP meetings will be discussed and approved after discussion.

Ram said that we did not have any Advisory Committee member talking about it. We have sent reports to them, and if we get any reply, we will work on their comments and suggestions.

4. Reporting

Kate presented the calendar for the remainder of REAMIT project activity and finance report and payment claim. BED is still processing a report 4.1 for the six-month period of January – June 2022. There has been a big delay in processing the report 4.1 due to some partners submitting their reports late. The report 4.1 is subject to an on-the-spot check at University of Bedfordshire, which has been ongoing since 23 February 2023. The auditor has been asking for different documents and clarifications since the start of the project, but they are close to finishing the audit soon. The report will be submitted to the funder, and it usually takes about two weeks for the funder to send the money. The team expects to receive the funds by the end of April, after the Easter holiday.

All partners need to complete the report 4.2 in eMS by 30 April. BED, UCD, Levstone, MTU, SenX and Ulster need to complete audit of partners progress report 4.2.

NTU, UCD and UoN need to complete on-the-spot audits.

Closure timeline

- The team suggests that finance reports be completed by the end of May, giving partners one more month to complete their audits. Regarding closing reports, the team discusses the possibility of anticipating some documents, such as pay slips, to help speed up the process.
- The project will close on 9 July 2023, and the team hopes to have everything completed before then. Activity reports in eMS need to be completed and shared with all partners by 30th April 2023. The deadline for financial reports is end of May to allow for the completion of the audit at BED. Kate needs to close the project on 9 July as her contract will end on the latter date. Partners expressed concerns about getting pay slips in time for the financial report.

- Joan and Usha should be invited to the meeting on 24th of May to discuss important points and issues regarding project closing strategy. Joan and Gael talked about a solution regarding project closure and financial issues that may be faced but it was not recorded.
- On-spot audit – some partners did not start it yet, which may lead to a delay in the final report submission and final payment.

5. REAMIT 2.0 and legacy

Ram mentioned that there are opportunities for the project extension, but it will be tough for UK to take lead or be a part of a big European consortium. The reason being that a UK partner in a consortium could bring more risk to the project as political situations could change and lead to instability. Ram proposed some opportunities using the Horizon Europe programme and there are some coordinated calls that the university wants to engage in. He is keen to bring the REAMIT ideas to the next level and believes that there is a good case to be made in reducing food waste using modern digital technology.

Tamiris and Omar presented an idea for an extension of REAMIT that will be submitted at end of June. It's a small project to reduce food loss and waste in the meat or seafood supply chain, with a duration of 18 months and a budget of up to 200,000 at 800,000 EUR. The project involves using Raman spectroscopy and IoT technology to reduce food waste during transportation and manufacturing, as well as including the consumer stage. The project aims to select one product to focus on, and deliverables include the Raman spectroscopy model, implementation of IoT technology during transportation, real-time data for consumers, and a life cycle assessment. The project is still in the planning phase and potential partners are welcome to join. Project partners are: UCD (lead) and UoN, and they are searching for a third partner.

Tamiris also mentioned a new project which is to expand human milk supply chain across Ireland (just an initial discussion). Kate suggested to bring new partners to the small-scale project. Ram suggested going for CFI for funding to extend REAMIT as REAMIT has top-level university involvement and several industries and has the potential to create a strong consortium.

Action: All partners need to complete the progress report 5.2 on the eMS end of April 2023.

Action: All partners need to complete finance report 5.2 on eMS by end of May 2023.

15:30-17:00 WP T3 Business development of REAMIT technologies (Chair UU)

Meeting agenda includes: an assessment report of REAMIT technologies including a comprehensive systematic review (mapping) of the technical and business landscape in the fresh produce food chain (September 2022); Life Cycle Assessment (LCA) for REAMIT (July 2023); current and identified future REAMIT technology assessment report (September 2022); Market readiness report (July 2023); and Business prospectus (July 2023).

Presentation of updates and results (10 minutes each) took place. It covered the following topics:

- Current and future REAMIT Technology assessment report
- Market readiness report
- Business prospectus
- LCA meat industry – WD Meats and Burns Meats (UCD)
- Quantitative study (BED)
- Qualitative study (UU)

Speaker: James Gillespie (UU), T3 chair

In the previous months, UU had been talking about how the business report of REAMIT technologies was going to be completed at the end of the project as it depended on pilot and data analytic results. James provided a summary on each activity and deliverable.

Activity 1, James discussed D1.1 and D1.2.
D1.1 – assessment report of REAMIT technologies including the comprehensive systematic review of the technical and business landscape in fresh produce supply chains, which was due for September 2022, had been completed and was available on SharePoint.

D1.2 – life cycle assessment system, which will allow environmental impact data to be integrated with REAMIT IoT sensors and big data solutions.

Speaker: Tamíris Da Costa (UCD)

Tamíris presented on D1.2 – LCA and explained that she had been updating and refining the results of the LCA studies, as follows:

For Yumchop, Tamíris showed the (old) LCA inventory and impacts that had already been previously presented, followed by the updated results – that is, how much the REAMIT technologies (IoT sensors) contributed to the environmental impact of the company. Updated results were now based on alerts. Previously, it had been done by taking assumptions into account (a 2% of food waste). James had written a code to estimate the number of alerts for this company. The parameters that were selected, were based on food-spoilage temperature thresholds, and using one year worth of data.

These thresholds needed to be recorded six consecutive times for the affected food to be considered waste. Once a load was considered waste, a two-day period over which temperature abuse was not being checked, was given to allow for stocks to be replaced – with the goal of avoiding counting that waste twice. However, what was available was the total amount of food (not amounts stored separately for each fridge and freezer). Thus, that total amount was divided by the total number of fridges and freezers for calculations. Tamíris showed then the updated results for each freezer/fridge.

The next step was to refine the parameters that were considered for these calculations because thresholds had been considered, but there were some food regulations in place. First, for fridges, it stipulated that they should be set at 5° C or below, and if food has been kept at 8° C or above for more than 4 hours it should be thrown away – that needed to be taken into consideration and update the results. Second, for frozen food, it was considered that food should be safe in a half full freezer for 24 hours without power. Tamíris explained that, for the calculations, only one hour had been considered – this also needed to be updated. Finally, many foods and beverages were safe to refreeze if kept between -17.77 and 4.44° C. Updating this was a further next step. Tamíris also mentioned that trying to get data for each of the fridges versus the total amount would also help refining the results.

For Burns Farm Meats, Tamíris showed the LCA inventory that had been previously developed. Recently, some trim loss data had been collected and thus the amount of waste for each carcass was now known. She then presented the updated, new results (e.g., Kg of CO_2 eq.) for this company. As a conclusion, the total carbon emission avoided by the project had changed substantially compared to the previously reported results. The new total was around 1 Mt of CO_2.

As for future work, the next pilot test that was going to be assessed was Musgrave - pending on receiving the relevant data for the calculations. After the presentation, James and Tamíris agreed that the number of

alerts may had been overestimated, and some of those parameters needed to be tuned. Ram asked Tamíris if the code for estimating alerts could be shared to partners on SharePoint.

Activity 2 will include the future improving of REAMIT technologies.

Speaker: Xavier Cama (UCD)

Xavier started presenting on D2.1 and explained that the current REAMIT technologies report was being informed by the quantitative survey that was performed at the end of 2022, led by both BED and UU. A quick, initial overview of the responses was provided and included: a total of 315 responses had been obtained from the company Survation; 48% of the surveyed companies currently were using IoT sensor technology; and amongst IoT users, a 75% were automatically monitoring temperature and a 72% humidity. Examples of the statistical analysis that had been carried out to date from the quantitative survey results included:

1. Taking company types - processors, retailers, production, logistics, etc - versus IoT usage. In that case, a low correlation and no statistical significance were observed. Graphs plotting one question against the other were shown: it was possible to see that retailer companies had the largest percentage of "no", i.e., they were not using IoT sensors for preventing food waste, while processors had the largest percentage of "yes".
2. In a similar fashion, an analysis using business turnover - approximate turnover in the last financial year versus IoT usage - showed statistical significance, although the correlation was not strong.
3. Two more examples included: future IoT adoption, that is, whether companies declared intention to use them in the future, versus cost perception, i.e., if they thought it was going to increase their equipment costs. This correlation test showed a higher correlation than previous examples and statistical significance. The other, final example was checking for correlation between layered questions (constructs). In that case, averages for two constructs had been obtained and tested for correlation. This showed the highest correlation coefficient of the provided examples and statistical significance. The two constructs used were environmental awareness – a group of questions related to commitment in becoming less environmentally impactful – and future IoT adoption, whether they were going to use it in the future and what benefits/purpose they would accomplish with it.

Usha (NTU) and Ram provided feedback on the analysis and observed that it was lacking a theme behind it, that it needed a purpose or goal in what it was trying to provide an answer for. While it was good work, it needed to be continued and given a stronger direction. Lakshmi (University of Essex) asked to be mindful on how constructs were treated for the analysis.

Elaine found that some interesting insights could be taken from the analysis. She added that besides looking at the turnover of companies, analysing IoT usage by the company's size would be interesting for the project. Turnover did not necessarily represent the size of the company, thus using the size could help understand an important element for REAMIT: it would be interesting to see if smaller companies would be willing to adopt IoT sensor technologies and try to determine how could they be incentivised to implement them, measuring their food waste, and acting upon it. Elaine concluded that this would be an important outcome/legacy of the project.

James confirmed that question no. 3 asked on the company's total number of employees, so that question could be utilised for analysis.

A more comprehensive analysis was available in a spreadsheet developed by Tamíris Da Costa and could be shared with partners.

Xavier presented on the future of REAMIT technologies part of D2.1:

1. To inform this section, quantitative survey responses relating to the future usage of IoT may be used to inform about the future of REAMIT technologies.
2. Ram observed that this (i.e., survey responses relating to the future […]) research question was interesting and that the statistical analysis that had just been presented was well fitted to answer it.
3. Additionally, the systematic review prepared for WP T3 activity 1 may contain useful information to feed this deliverable. Some insights can be extracted as for communication technologies (CT) and sensor parameters. Xavier showed a table extracted from the systematic review, and thus from data available on the literature (N = 59), taking the year that papers were published and the CT that they were experimenting with for their IoT architecture to form a ranking of CT popularity in recent years.
4. Finally, a literature review taking information from research articles, white papers, and news articles would also be conducted to complete D2.1.

The Activity 3 related to Market assessment and included D3.1 (market readiness report, a market analysis and foresight report identifying forthcoming opportunities for REAMIT technologies to be developed into marketable products).

Speaker: James Gillespie (UU)

James presented on D3.1 and showed partners the document that they had been working on over the last few months. The report was divided into the following sections: scope of the study, problems surrounding waste in the food supply chain form "farm to fork", and potential solutions linked to Sensor Technology Options on the market.

These 3 initial sections had already been populated and largely informed by some of the papers published by the REAMIT team in *Sustainability Journal*.

Outline of the Pilot Trial companies – for this section, Osterwalder canvasses were being developed for each of the pilot test companies to provide an overview of their business models. After that, they were looking into the SWOT (Strength, Weaknesses, Opportunities and Threats). According to James, this section was going to be lengthy and could have repetition with other deliverables as they were providing an overview of the company and all the activities that REAMIT carried out with them, e.g., lessons learned through the experience of the pilot test would be included as well, which would be very similar to one of the WP T1 deliverables. As Emmet (UU) was carrying out interviews for the qualitative survey, he would help populate the rest of the business models not yet filled out. James also asked pilot leads to help populate the parts corresponding to their pilot tests.

Future Market Scalability (Readiness). This section was going to inform the market of potential for the technologies to reduce waste, improve quality, etc. There was going to be a wider application/scalability of the technologies employed in REAMIT within and across other business sectors. The first thing they were looking at was the feasibility or key learnings of the REAMIT technologies. This was helped by the motivation paper led by Ram and the review paper led by UU. After this, and as a last part of the document, they were developing a "Market Readiness in the Industry Sector' subsection. For this, UU was expecting to utilise the results/data of the ATOM model as well as data from interviews (as for qualitative survey). The market readiness analysis that was being performed was trying to answer whether the industry was ready for the integration of IoT monitoring systems in the supply chain. The quantitative survey which yielded 315 responses could help inform the market readiness. For instance, when trying to answer if the product or service was solving a real need, it was possible to use survey questions and their corresponding company responses such as the one that asked "we believe that IoT provide us with the following benefits" (5 options were given for companies to choose from). Another analysis could be to study if companies were

currently monitoring food quality parameters and if they were employing IoT to do so, and what would be the benefits of using IoT, among other options.

To help supplement the deliverable, Ram recommended a research paper by Yan (BED) and some of her information science colleagues published in 2019 on the future of information systems – which turned influential in the field. They made some assumptions about the future and proposed solutions while obtaining data from published literature for discussion. Ram explained that he thought of the deliverable containing four or five assumptions/proposed outcomes and the report providing solutions/discussion around these as in the paper by Yan.

Elaine (UU) congratulated the work carried out so far on the deliverable and agreed that it could be a good idea to frame the outcomes in Ram's suggested manner; that it is conveyed that the work carried out in REAMIT has a continuation in the future in terms of reducing food waste and increasing food quality.

James had spoken with Emmet about the development of a paper coming out of the qualitative survey work.

James then started presenting on Activity 4 (*Development of business case)*. In included: D4.1 – business prospectus and D4.2 – business case for achieving 40,000 tonnes of waste reduction.

James informed that not much work had been done so far on these deliverables and it would be good to come up with a plan around it. D4.1 consisted of an outward facing document to be made available to SME technology developers, to potential buyers of technology approaches and investors for the product development. Elaine had proposed a high-level structure for this report utilising the MRL (deliverable from activity 3) report to build upon. They had thought of three headings already:

- Market conditions – current and future. That is the criticality of food waste reduction, which they were hoping to get pilot test companies to help on that, plus the use of the quantitative study.
- Market solutions. The scalability of tech across/within the industry sector and transnationality.
- Funding requirements. A cost/benefit perspective, by which pilot case studies, knowledge as to costs of the IoT sensor implementation coming from WPT1, as well as the quantitative survey could be used. Finally, there was also the need to discuss the risks.

D4.2 was a business case using REAMIT data from continual monitoring of sensor data for identifying potential food waste (FW) and analytics to understand patterns of FW in NWE with justification for saving 40,000 tonnes of FW. James explained that the calculations made by Tamíris should help inform the justification of FW reduction, especially the ones based on the new alerting criteria.

Ram expressed that utilising the number of alerts as an indication for FW reduction was very useful and needed to be built upon.

Elaine asked Ram if there was any strategy for dissemination as for the business prospectus, how to make sure it reached the important people – investors, firms, etc. Ram explained that one approach was the search for new funding to keep on developing related work in the future; another approach was using those outputs that could be relevant for policy making and make them available to policy makers – Ram had tried to produce one for the UK parliament. Ram had been further provided with a list by a team at University of Essex of relevant actors whom to send these outputs, in terms of policy making.

James inquired on the possibility of getting support from the other institutions listed on the deliverable description to complete these reports. Ram offered support and asked James/UU partners to simply communicate what tasks they needed help on.

Lakshmi explained that for their ATOM/MOAT study they had performed a demographics analysis and established a demographic profile. After that, they had studied all the questions in depth to get a higher understanding of them as well as the questions in the form of constructs. They had been testing for correlation between the items, as well as the validity and reliability of the results. They had found that they had to eliminate a few of the constructs and items to obtain higher results in terms of statistical accuracy and validity. A modelling approach to identify the level of variance that dependent variables had based on the independent ones had also been performed. Now, she concluded, they were coming at obtaining a linear model, although future work may include other types of models being developed.

Ram commented further that, at first, the model was very complicated and gave problems in terms of statistical fitting. Therefore, they had come up with a linear model, although simpler than what they originally intended or planned.

Lakshmi mentioned to the group that she would not be using question number 23 of the quantitative results, if other teams could analyse it could provide insightful outcomes.

As a conclusion, Ram observed that a meeting amongst WP T3 members could be held to discuss the model and results and how to progress going forward.

Day 2. Thursday, 23 March 2023

9:00-10:30 WP T1

Gael started his presentation and described the deliverables: 3.2 and 3.3. Gael asked partners to save their contributions to WP T1 in the SharePoint.

Presentation of pilot tests

Picnic
Since there were no updates since January 2023 regarding Picnic, Imke didn't prepare the slide presentation. She contacted Picnic, but it turned out that the company is not interested to continue its collaboration with REAMIT. Several trips to find new data are planned. Imke contacted Frank, but he will not be available in his office until next week. She has a lot of questions, for instance how to proceed. She wants to know if we want extra data and the durability of sensors.

Kate asked Imke what she is expecting from this pilot test. Imke replied that they want to have more data on the sustainability of housing.

An Excel sheet which included some requested data was sent out. Jean Charles is expected to work on this data too. So far, the data is of poor quality. To improve it and to provide a good quality analysis, Jean Charles explained some faulty sensors and there are some problems related to temperature. It is possible to focus on the sustainability of housing within a month in a good condition. In 2-3 months, it can be done.

Usha asked for extra data to be considered for publication purposes. Imke replied that she will contact Picnic next week to ask about some additional data. This data could be even in Excel format or any other kind of data available.

BioGros
Since January 2023 there were two meetings of Whysor with BioGros. Imke asked for the next steps after the end of the project, and she is waiting for their reply. There is a question survey James worked on – it needs to be translated. She thinks that the company doesn't find the benefit of it. So, the company is more

interested in working on sensors, rather than developing the case study and the survey. Jean suggested that it is still possible to generate data and she will email them to find it out.

Raman

Omar started the presentation and explained recent updates on the pilot study run by the University of Nantes. The study that involved Raman started in March 2020 and they worked with different pilot companies. Oman presented the methodologies and showed the video. Four posters, four presentations, and three videos have already been delivered. The methodology that all pilot tests relied on, was divided into three stages. Stage 1 – lab development, stage 2 – transitioning phase, and stage 3 – test in real conditions.

Omar mentioned some of the collaborators and pilot tests such as IGRECA, and Pescanova. They supported the stage 1 until 2021. Vivo is another pilot test (potential) company and a project proposal was developed by UoN. The proposal focuses on the portability of Raman and simplifying the analysis. During the Colchester meeting, UoN received an email that their proposal has been accepted by the funder (regional innovation fund in France managed by French local government). Kate asked a question about the size of the proposal. It is about 60 000 Euros worth, and the length is 18 months. This will be mentioned in the final project report under WP Long Term and 'rolling-out' of the REAMIT approach.

HMF

Kate started the presentation. She mentioned that the sensors are working and the data analysis team is involved. Natalie expressed an interest in new smaller sensors. Marcel said he can install new sensors. Regarding the closure of REAMIT, Ram suggested not installing new sensors. Kate spoke to Tamiris about new proposals involving HMF. This could be founded by the UK and Ireland from the Peace Plus Programme.

Yumchop

Sahar provided an update about Yumchop. She explained that Elsy-ELT-1 sensor that provides analogue and digital signals. Kate met Abi at an event at BED on women entrepreneurship in agri food sector under AWARE project. Abi asked Kate if REAMIT can install 2 sensors in 2 vending machines and one sensor in a van delivering Yumchop's food to Sainsbury's. Kate confirmed that James and Xavier are going to install a new sensor in Yumchop's vending machine at Victoria Coach Station, London on 24th of March 2023. During the Colchester event, REAMIT team visited a shop in the UEssex campus with a freezer filled with Yumchop's frozen meals, sold to students in the campus of the University of Essex.

WD Meats

James started the presentation and explained the steps before the end of the project. This includes: performance of a baseline trial with full weight traceability; performance of the second trail with the parameters of the dry age chamber adjusted; and performance of a comparison study with data collected from Burns Farm Meat.

Related to Clostridium, if there is troubleshooting, they can provide support. There is frequent communication between Caroline and Victoria, and it helps WD MEATS detection of Clostridium.

James visited Musgrave in February and replaced the batteries. The loggers were back online. Also, the sensor location was moved so that the 'air on' was monitored. Andy Keery said it is a good location to monitor the ambient temperature. A new dataset has been captured with 1 month of data. The sensor was attached in a real location. James planned the second pilot called Artisan Click and collect food service, between January – March 2023.

On 4 January, James moved the loggers into a second cold store for a click-and-collect artisan food service based in the greater Belfast area. Andy confirmed that the cold store is going to be moved to Biosearch, a testing lab will be based in Belfast.

James explained that for his future publications, he needs more data and that will be beyond the project.

3DF

The pilot data consists of 3DF technology to reduce food waste-2* FreshDetect BFD-100. 3DF sensors can be used to make determinations of total bacterial count on products or liquids. So far, a few steps were made. First, a proof concept study was run at UU in February 2023 to see if the FreshDtect could be used to detect quality degradation in milk. Second, data were collected on three samples of full-fat pasteurized milk over a period of 7 days. Five scans were taken each day. Next, the milk was left unrefrigerated in a warm laboratory to encourage bacterial growth.

Before the project closure, Omar will assist with analysis of milk data and determine if the FD has been able to identify any peaks outside of signal intensity decrease. Also, Omar now has the second FD device. Omar and UU will collaborate on this study.

Burns Farm Meats

Xavier started his presentation and provided a quick overview of BFM, and the sensors and gateways. Xavier presented the diagram of the architecture and showed the big chamber with six sensors and their locations. The additional four sensors were installed in the smaller chamber. Temperature and humidity sensor data were successfully recorded on 7 September 2022. Humidity readings consistently give values higher than expected and there is a lack of some information to link temperature/humidity to food loss during the dry aging process too.

The ongoing Eagle logger couldn't be deployed due to network issues. There is a need for alerting system that takes into consideration their cleaning, loading, and procedures. A switch/binary sensor was installed and attached to one of the already existing sensors in a large chamber. The Eagle logger could not be successfully configured. There is a need to deploy new sensors to use the Eagle logger offline. Weight data and water loss were recorded.

Ten sensors were deployed and Imke suggested Xavier asking for the connectivity of sensors. Davinder asked Xavier to send him the organizational IDs. Yan asked about how data have been achieved. Usha explained that Ram decided about discontinuity after March/April and that further investigations can be done in the future.

Kate suggested a new section in a storytelling document to capture the potential next steps for each pilot test. This will be helpful for the final project report and for developing future project proposals.

Action: All pilot test leads to add a section in the Story Telling Document: 'Next steps' for each pilot test.

Guest presentation by Dr Giovanna Bono, Research Development Manager (EU & International), Research Enterprise Office, University of Essex

The presentation focused on funding streams under the Horizon Europe Programme under 'coordination and action'. Materials provided during the presentation by the presenter have been shared with the partners.

11:00-12:30 WP T2

REAMIT data analysis of each sub-group

Raman Spectroscopy by Jean-Charles Vialatte

This section of the meeting started with a presentation on the Raman Spectroscopy pilot by JV. JV commenced by presenting various tables of the raw sample data. JV showed raw sample vs. pre-processed sample data. JV would like to quantify if we can define quality levels using this data? Can we find expert rules to assess the quality level of a sample? These questions were explored during JV's presentation. JV concluded that food quality deterioration can be observed in Raman spectras. Most of this work concurs with the studies carried out by the University of Nantes. We are able to define quality levels and spectra samples can be split between these various levels. Most of the insights are derived from the analysis on the whole spectra but we can refine this analysis by the specific peaks. OD and JV will carry out further work on this assessment model using automisation and on-edge implementation.

AA elaborated on JV's presentation and said this new project they will launch is to have a smart interface, and to automise the processes.

HMF and Yumchop analytics by Gautam Samriya

GS started the presentation with the data requirements of HMF. GS spoke on how REAMIT will address the issue that HMF are having in their transportation and storage processes. GS said REAMIT is helping to optimise the quality of human donor milk and monitor the storage of the milk and logistics involved. GS explored the various stages of the data analytics journey with HMF. Once establishing the data requirements and challenges faced, the data variables was explored such as the quantity of milk stored, weight of the bags etc. The proposed analysis questions and possibilities include:

1. Real time alerting
2. A study of factors that could potentially affect the temperature of milk in bags.
3. Impact of seasonal variations on HMF's operations. How does external weather affect total permissible journey length or time? Predictive model which can provide an estimated total safe journey distance/time given current weather conditions.
4. At what stage do the bags start to warm up?
5. Once sufficient historical data is available, can we predict the maximum time (or distance) once we know the forecasted for a given day?
6. Can we use the data to look at alternative routes? Can we combine with traffic information and better insights on routes?
7. SPC based analysis.

GS said that for each journey, as the temperature changes, we tried to correlate the different factors that are affecting the rate of change in on the temperature sensor data. GS Showcase the machine learning model on JavaScript. As for the Yumchop data, a preliminary alert set up has been created by GS. The shared data is from 10 sensors fitted at Yumchop.

Data analytics on Musgrave by James Gillespie

Informing on the alerting criteria: JG spoke about the analysis of the sensor data collected so far at Musgrave. JG explained that the exploratory data analysis was performed on the full dataset. The freezers are Musgrave previously took 35 minutes to reach optimum temperature. Whereas with the sensor moved, the freezer reaches optimum temperature in 12.5 minutes. JG discovered that once they knew it took 12.5 minutes to reach optimum chill, they trimmed to data to reanalyse any journeys that were still in progress after 12.5minutes. During these journeys, alerts would be sent whenever the temperatures spike past the thresholds. They later discovered there has been a cooling issue with the fridge units inside the vans at

Musgrave, hence the poor performance until it was repaired, hence the multiple alerts they have received from REAMIT. JG would like to see if Musgrave finds a solution for their cooling issue within their fridges and hopefully this will allow for more optimal temperatures and less spikes. Overall, JG is happy with progress and overall reduction of the spikes in temperature.

Burns Farm Meats by Xavier Cama

XC explains that the sensors have detected humidity readings have increased by 100%. The readings have been consistently higher than expected (between 75 – 80% according to literature). The main focuses are temperature and humidity data. XC showed a table of deboned and weighed hind quarter of beef and measured the trim-weight data. XC compared the costs incurred and the weight of the meat losses which clearly showed how the humidity is resulting in huge losses of resources.

Deliverables general progress
Launch of smartphone APP (July 2022).

DB gave a demonstration on the Levstone app integration. The IoT sensors on the ground go through Digital Matter server, which then goes to Whysor and then to Levstone's server. External weather API has been installed into the app which is used through a journey task within the app. The HMF report and form has been integrated into the app. The app's reach has been extended to Bluetooth devices. Although, nothing is currently being used in a real pilot just yet.

DB stated that some of the benefits of the app is that each pilot test company will have use of a single application mobile app to view alerts pilot data in nearly real time. Each group manages their own resources such as their devices, users, tasks etc, access to weather API/Whysor API and other API interconnections to IoT devices. DB then proceeded to demonstrate how to use the app and its features. The plan is to work with HMF to configure the application. DB will examine the pilot data from HMF and agree which data fields need anonymisation. DB has advised there is an 'App Installation and User Guide' uploaded unto REAMIT SharePoint and available for all partners to view before downloading the application.

YD asked for the end user, how easy is it to use this app? Is it user friendly? How flexibility is it for end users to adjust the temperature alerts and make changes. DB responded that tasks can simply be created by the controller. The application has simple steps for the driver to complete during the journey. YD said that there are different users for the app, the service user, service provider etc so it is a complex mission for this to be a efficiently functional app. YD asked if any of the pilot companies have tested the app yet? DB said the app needs to be tested in the field, so the next steps would be to meet up with HMF soon to discuss their usage of the application. DB went on to explain how the app will be presented to HMF in a forthcoming meeting. DB will bring a smart phone or tablet device to the premises of HMF, meet with Natalie and go through the processes.

Action: HMF will need to use the Levstone app as soon as possible so we can get their feedback.

User Manual on launching the interface

SA presented the user manual. She advised this document is completed and uploaded to the REAMIT SharePoint site. SA went through all the various pages of the user manual, to understand how to access your admin rights and how to access the BED Data server. Due to time constraints this was a brief presentation.

Action: SA requested for all data analytics partners to provide some input on deliverable 8.1 and 8.2 – outcomes of your data analysis of your pilot tests.

IH asked what this would mean for each partner involved in WP T2 as there was quite a lot of work put into the deliverables for WP T1, JG agreed he had contributed 40+ pages for WPT1. KP suggested that they recap and look at the deliverables for WP T2 in the REAMIT Application Form. KP sent the REAMIT application form to IH and explored all the WP T2 deliverables listed.

The status of the deliverables under WP T2 are as follows:

Deliverables	**Title**	**Status**
Activity 4	Develop an interface to collect sensor data and send to cloud	Completed
Deliverable 4.1	Creation and launch of interface	" Ask IMKE
Deliverable 4.2	User Manual on launching the interface	" Check with Gael
Activity 5	Development of Big Data infrastructure for analytics of sensor data and for rerouting to minimise food waste	
Deliverable 5.1	A big data platform with capability to collect and store sensors data from all REAMIT corridors	Completed (2 /1pages)
Deliverable 5.2	Reports on Big Data platform performance	Completed (Summary)
Deliverable 5.3	A web-interface with self-enrol facility for enrolment of potential suppliers and consumers of food produce	Ongoing (To work Davinder)
Deliverable 5.4	User manuals for the big data platform and the web-interface highlighted in the two deliverables above	Refer to appropriate sections
Activity 7	Development of smartphone APP for use by truck drivers and warehouses	
Deliverable 7.1	Launch of smartphone APP for linking to food owners, truck drivers and warehouses.	Ongoing by Levstone

Deliverable 7.2	User manual for the use of the APP	
Activity 8	Delivering the integrated IoT/Big Data technology with capabilities on analytics and decision support to help reduce food waste in NWE.	
Deliverable 8.1	Deployment of the integrated IoT/Big Data/analytics/Decision support technology	5-pages on data analytics and 3.2
Deliverable 8.2	A user manual for the integrated IoT/Big Data/analytics/Decision support technology	Refer to user manual [add a section on data analytics]

SA said she added a link JG's paper but was advised to remove this. KP instead suggested to have a document for each of the deliverables and upload to SharePoint. KP said more detail is needed as only 2 pages was presented by SA for the deliverables. The meeting on WPT2 was stopped as a guest speaker came to visit the meeting so the WPT2 Meeting was cut short.

13:30 – 14:30 WP Management

Kate provided updates on the deliverables of work package management and status of various activities:

The project handbook is being constantly updated. The latest version is on SharePoint.

Minutes from the previous REAMIT meeting in January have been completed and shared with partners. Over 20 online meetings of different groups have taken place.

Intermediate work package coordination: ongoing.

Risk register, risk review: Every six months BED and PPs update the risk log. It's in the form of Excel spread sheet.

Project reports: There will be nine in total. Currently BED and PPs are working on 4.1, 4.2 and 5.1.

Finance trainings for partners: Deliverable completed.

Kate presented yesterday the closure timeline of the project. Ram, Kate and Yan are meeting an Interreg officer in May 2023 (date TBC). Kate updated that the officer is coming to Luton for a two-hour meeting to discuss the project closure, deliverables and evaluation. She has sent along documents requesting all the information and all the evidence. This would be the final project meeting.

Yan added that now we are just waiting for the meeting with the Intereg officer. She said that we are hoping it's done before mid of May because otherwise it's too late. That is a critical meeting. She said we could maybe propose at least activity report by end of June (a preliminary report), so that

we could have a free picture as well. She said we didn't discuss our finance difficulties, but we hope to get the reporting activities, deliverable and everything for reporting purposes before we meet the officer. Usha mentioned that we covered everything thanked all for attending the meeting for the project.

Action: All partners to complete on the spot audit before end of the project.

14:30 – 15:30 WP Communication

Usha provided an update on the status of various deliverables in WP C.

Communication Strategy document: Usha explained that it was prepared some time ago and NTU is regularly updating it for every event. This document would be updated with activities regarding this RSC meeting as well, and it will be then considered complete.

Website Launch: Sasha updated that the website has been launched via Squarespace, but currently everything is being moved to over to a new platform called GoDaddy. This should not change much of the layout of the actual website itself, but it will just be a new hosting platform that will keep the REAMIT website live until 2027. The website will be live for a few more years after the project closure, for the legacy of the project, so that people can still visit the website to see the work that we have done.

Social media: Usha emphasized that everyone is aware of the importance of social media. She was happy that most of the partners have joined and contributed to sharing project updates on social media and all the partners have been very active. The number of social media posts in the past two months, from January, has increased threefold. Sasha has prepared a PowerPoint presentation to showcase the numbers related to social media and was excited by such impact on social media. She added that the PowerPoint has been uploaded to Share Point/module.

Posters and banners: in the most recent period, NTU has developed quite a few new things. Sasha highlighted in the last period, NTU did a lot of work for the symposium. They created new pilot test posters, such as for Picnic and Burns Farm Meats. Sasha also mentioned creating all the other posters from the previous period. They also created a new brochure and some print materials, that were made for the symposium. So quite a lot of new materials were made between July to December 2022. In current period (January 2023 onwards), NTU has mostly been working on more digital projects. They have prepared a digital timeline of project, which is basically a timeline of the journey of REAMIT from the beginning of the project until its completion (January 2019 until June 2023).

Sasha has also been working on a new video, which is a new animated video like the interactive timeline. It's a short, animated video (approximately 2 minutes) showing the journey of REAMIT. Sasha highlighted that the new documentary videos have been released too. There are five new pilot test videos, and they are available on the REAMIT YouTube channel, along with different versions of the documentary that have been recently published. These have also been promoted by a press release through Nottingham Trent University. These are available on SharePoint too.

Policy briefs: Usha mentioned that these were already discussed yesterday. These can be seen in the folder against the communication documentation. The documents on these deliverables have already been uploaded.

REAMIT networking events: Usha updated that she has not made a separate report for this yet. She has added it to the CS document. Now, as NTU has got report for every event, they would compile everything and would create a separate document for this other than the CS document. Usha mentioned that herself

and Sasha would work on it and its one of activities for them to be completed in next two weeks. It will also be uploaded on SharePoint.

Journal Articles: this has already been discussed.

Usha added that they have completed all the deliverables.

Action log

Date	Minute/ Item	Action	Responsibility	Update
22.03.2023		Usha (NTU) to try to get NTU to agree to Yumchop's freezer installation at NTU campus.	NTU (Usha)	To be completed.
22.03.2023		NTU to led work on turning some of the story telling documents prepared for WP T1 into publishable case studies.	NTU	To be completed.
22.03.2023		All partners need to complete the progress report 5.2 on the eMS end of April 2023.	PPs	To be completed.
22.03.2023		All partners need to complete finance report 5.2 on eMS by end of May 2023.	PPs	To be completed.
23.03.2023		All pilot test leads to add a section in the Story Telling Document: 'Next steps' for each pilot test.	PPs	To be completed.
23.03.2023		SA requested for all data analytics partners to provide some input on deliverable 8.1 and 8.2 – outcomes of your data analysis of your pilot tests.	PPs	To be completed.
23.03.2023		HMF will need to use the Levstone app as soon as possible so we can get their feedback.	Levstone	To be completed.
23.03.2023		All partners to complete on the spot audit before end of the project.	PPs	To be completed.