INTERNET OF FOOD & FARM

# D2.5 RECOMMENDATIONS FOR THE OPEN CALLS

## WP 2

May 24th, 2018

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# PROJECT SUMMARY

**The internet of things (IoT) has a revolutionary potential. A smart web of sensors, actuators, cameras, robots, drones and other connected devices allows for an unprecedented level of control and automated decision-making. The project Internet of Food & Farm 2020 (IoF2020) explores the potential of IoT-technologies for the European food and farming industry.**

The goal is ambitious: to make precision farming a reality and to take a vital step towards a more sustainable food value chain. With the help of IoT technologies higher yields and better-quality produce are within reach. Pesticide and fertilizer use will drop, and overall efficiency is optimized. IoT technologies also enable better traceability of food, leading to increased food safety.

Nineteen use-cases organised around five trials (arable, dairy, fruits, meat and vegetables) develop, test and demonstrate IoT technologies in an operational farm environment all over Europe, with the first results expected in the first quarter of 2018.

IoF2020 uses a lean multi-actor approach focusing on user acceptability, stakeholder engagement and the development of sustainable business models. IoF2020 aims to increase the economic viability and market share of developed technologies, while bringing end-users' and farmers' adoption of these technological solutions to the next stage. The aim of IoF2020 is to build a lasting innovation ecosystem that fosters the uptake of IoT technologies. Therefore, key stakeholders along the food value chain are involved in IoF2020, together with technology service providers, software companies and academic research institutions.

Led by the Wageningen University and Research (WUR), the 70+ members' consortium includes partners from agriculture and ICT sectors and uses open source technology provided by other initiatives (e.g. FIWARE). IoF2020 is part of Horizon2020 Industrial Leadership and is supported by the European Commission with a budget of €30 million.

# EXECUTIVE SUMMARY

IoF2020 project being focused on demonstrating the effectiveness of IoT solutions in a large spectrum of different agricultural domains and applications, has carefully selected 5 trials comprising of 19 Use cases (UCs), covering wide thematic and different regions in Europe.

The main goal of this document is to provide recommendations for the Open call (OC), based on the results of the implementation of each UC recommendations for further expansion of Trials that will be compiled in terms of involvement of new end users and implementation of new IoT solutions.

The methodology adopted in this report is a mix of qualitative and quantitative methods, enabling further exploration of the collected data. In order to get proper and meaningful results, currents state of the UCs was analysed, as well as first-hand impressions and suggestions made by UCs representatives at the Stakeholder and partner event in Almeria, Spain.

Based on all data gathered, it has become apparent that with the Open call, greater benefits of the future growth and IoT technology expansion with regards to the European food and farming sector will be achieved.

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# 1. INTRODUCTION

In order to demonstrate the effectiveness of IoT solutions in a large spectrum of different agricultural domains and applications, IoF2020 has carefully selected 5 trials comprising 19 Use Cases (UCs), set in different regions of Europe. This is a key aspect to reflect the diversity of the agri-food domain, and to perform evaluations in conditions which are close to real scale and operational ones.

The project is following and supporting the Use Cases in order to reach certain level of solution matureness and market take-up. The first step was to carefully plan and set-up the Trials. The planning was followed by initial deployment of the systems for demonstration at pilot sites and training the end-users. Next, a spiral approach similar to lean start-up concept that entails feedback collection and performance monitoring followed by technical improvement of the solutions is in implementation phase. Once the solutions reach satisfying level of development and technology readiness (TRL8) dissemination of results through Scale-up demonstration activities will take place. All conducted activities are described in the set of deliverables, at the moment covering the following: Trial implementation plan, Installation, customization and integration report and Annual performance and performance monitoring report. Public versions of deliverables are shortened versions, nonetheless all interested applicants can approach individual Use Case using IoF2020 web presentation.

IoF2020 already has well-structured UCs, with a wide thematic coverage, but has also planned to extend the number of UCs in order to meet future needs and developments. This will be achieved by launching an Open Call (OC) around the project mid-term to be able to involve new regions and sectors, develop additional innovative applications, as well as to re-use results from the current UCs through new sites or new connected devices, and complementary assessment of the acceptability of the UCs.

In that way, IoF2020 is preparing an OC that will allow new teams to join the journey within the Internet of Food and Farm to enlarge the IoF2020 ecosystem and create more impact in the European food and farming sector.

IoF2020 is looking for proposals that will present in a convincing way a high impact on the supply chain, a high level of technical feasibility & innovation as well as a strong economic sustainability. Proposals should be supported by a coherent team of stakeholders that represent the entire IoT supply chain (technology providers, service integrators, end-users, etc.) following the multi – actor approach.

The IoF2020 project is aimed at making precision farming a reality and to take a crucial step towards a more sustainable and transparent food supply chain. To this end, engaging more teams to join the journey within the Internet of Food and Farm to enlarge the IoF2020 ecosystem will create more impact in the European food and farming sector and increase the scale of the initiative. This will be capitalized with the implementation of the Open Call (OC) which will be focused on:

- Extending the technological and business model dimension with aspects that are currently not addressed;
- Leveraging and re-using current Use Case (UC) work and knowledge (which will be detailed below);
- Enhancing current achievements based on the most recent developments with respect to the state of the art in IoT technology and business processes in food and farming.

In this context, launching the OC will result in more market-ready IoT innovations that will be validated and demonstrated in new regions as well as post-farm IoT applications.

This report describes the current state of the UC and based on that provides recommendations for the OC, structured in 4 distinct chapters as follows:

- Chapter 1 provides introductory information with respect to the IoF2020 project, the context in which this report has been elaborated as well as its structure.
- Chapter 2 outlines the approach and methodology of this report.
- Chapter 3 outlines the results of this report.
- Chapter 4 gives the final conclusions on the recommendations for the OC and its benefits.

# 2. APPROACH & METHODOLOGY

In order to provide relevant data and information for the OC recommendations, an analysis on the current state of UC is provided, all based on the IoF2020 project first year's progress. Also, impressions and suggestions presented at the IoF2020 event in Almeria, Spain were taken into account, producing **reliable and meaningful results** to fuel the next steps of the project.

The utilized approach provided us with the opportunity to more comprehensively explore and study results from a variety of diverse UC, capitalizing on the full potential of the OC. At the same time, it enabled us to gain ample insights into the needs of the current UC and pin point how and where OC can provide and create more impact for the project, as well as on the European food and farming sector.

All UCs' analysis was conducted based on their progress during the first year of IoF2020 project and their input on good practices, challenges and possible improvement. IoF2020's innovative lean multi-actor approach combines the multi-actor approach and lean start-up methodology that overcomes major barriers to adoption of IoT technologies in European agriculture. It does this by fostering co-creation of technology. Results from a small step in product development are tested and measured in the operational environment to guide the next step, scaling up to a wide variety of productive

environments and consulting with all stakeholders to address acceptability. The resulting products and services are appropriate for European societies, lower environmental footprints, and have a good fit into target markets

# 3. RESULTS

## 3.1. CURRENT STATE OF THE USE CASES

In the first year, the IoF2020 project has established an initial community with diverse European stakeholders, developing innovative IoT-based solutions for the European food and farming industry. 19 UCs are organized in five trials (arable, dairy, fruits, meat and vegetables) which are developing, performing and testing the IoT solutions in their respective fields, expecting to produce higher yields and better-quality products, using less amount of environmentally harmful products.

In order to provide recommendations and gain an overview of the current state of the UC, we have conducted an in-dept analysis of the UCs, which provided us with plethora of information for the future activities to increase the economic viability and market share of developed technologies. At the end of the first year of the project, UCs provided their own remarks and impressions regarding the progress in their respective trials. They also gave suggestions on how to expand the ecosystem so that the impact created by the project is far greater when it comes to the European food and farming sector.

By analyzing the collected Progress reports of the UCs, which constitutes a part of the Deliverable 2.4, we were able to understand and examine technical and business aspects of UCs, evaluate their progress and determine future needs. To summarize these needs for potential improvements given by UCs at the end of the first reporting period:

- Extend the coverage of IoF2020 UCs across the EU ecosystem, since some parts of Europe are less covered, encouraging to build on the existing UCs, re-using IoT innovations that UCs have already developed and tested.
- Several UCs consider that including more end-users and/or new demonstration sites would allow them to increase the number of experiments and/or to have more trustworthy validation of their technologies.
- Including and engaging partners which a focus on post-farm activities, as well as consumer aspects, and expanding the current layout of use cases which are mostly targeting farm activities.

## 3.2. CONCLUSIONS FROM THE ALMERIA STAKEHOLDERS' EVENT

At the IoF2020 Stakeholder and partner event in Almeria, Spain, which was held from 26th of February until 2nd of March 2018, joint sessions with UCs were held, where further recommendations for the OC were given by their representatives, all aligned with the IoF2020 project framework and objectives.

Use Cases representatives were encouraged to share their experiences and good practices compiled during the first year of the IoF2020 project, providing viable prerequisites for this Open call.

The most important suggestions by the Use Cases were:

- In order to extend the impact of the IoF2020 project, pave the way for the expansion to new sectors and new areas, as this would be beneficial in terms of accessing fresh knowledge and good practices from new regions;
- Give attention to the entire supply chain, considering complementary areas to the UCs, such as: logistics (after-farm logistics), processing, retail and end-consumer (getting feedback from end-consumer regarding their products), as well as increase of production; this would also include practical test cases;
- Include more channels for testimonials from direct end-users;
- Possibly include translation of the IoT technologies which already exist in different sectors to new products. The proposed product or service ought to consist of an innovative, credible IoT concept which brings a significant use of data;
- These proposed IoT solutions should aim at interoperability, replicability and reuse of the anticipated results.

There were also two sessions regarding the Open Call and the structure itself, easing the way of applying and securing transparency and comprehensibility. During the lively interactions, recommendations were made, which are listed below:

- Secure clear programme evaluation criteria for the applicants to have a good understanding regarding the eligibility and selection criteria; this will also have an impact on the reachability to the greater audience;
- Indicate a clear definition of scoring as well as provide specific topics/issues that will be addressed in the Open call, for the applications be considered as contributions to the wider ecosystem;
- Indicate that the verified business application idea for the applicants is needed, as well as planned scalability in the future. This should also incorporate a way for IoT to reach a large number of end-users, most importantly in regions with serious growth potential.

## 3.3. USE CASES' PLANS FOR IMPROVEMENT

IoF2020 embraces a demand-driven methodology in which end-users from the agri-food are actively involved during the entire development process with a value-proposition for end-users: e.g. improving safety, efficiency, quality, lowering difficulty, variability and costs. IoF2020`s innovative approach, the lean multi-actor approach tests market and technical assumptions in real bottlenecks of end-users in their operational environment and value chain stakeholders. Feedback is translated into technical improvements that better meet end-user needs and better fit into the production environment and the value chain. Through this cycle, the technology is altered with a new set of features and a new minimum viable product (MVP) compared to the beginning of the process. The choice of features is directly influenced by end-users and value-chain stakeholders, translating into a new and improved MVP (MVP 2) compared to initial deployment (MVP 1), delivering higher value for the end-user. This cycle is repeated again with the first release to test the new set of features and fine tune them to deliver higher value to the end-user, better fit into the existing production processes and satisfy food-industry standards. The result will be the second release, wherein the cycle will be repeated again. Engaging the large group of end-users to demonstrate the technology in a wide array of productive environments: different types and sizes of farms across a wide geographic area of Europe; once again, technical aspects will be fine-tuned using feedback from a large set of end-users. Finally, large-scale demonstrations will complete and qualify technologies. The products and services resulting from this iterative multi-step process will deliver value identified by end-users and fit into production processes of the value chain – thus demonstrating economic viability. Moreover, it helped us analyse which type of activity(ies) or action(s) will help enhancing the UC performances that could be seized by the Open Call. All the input from the Use Cases is shown below:

**Use Case 1.1 Within-field Management Zoning**

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| **Step(s) towards MVP2** | 1. To demonstrate wireless connectivity between stand-alone sensors and the KPN network<br>- We need to develop software / acquire generic enablers to visualize the sensor data of the different sensors in a way that we can compare the data and use the data in management decisions and FMIS.<br>- We will implement the sensors and connectivity on the second location in 2018.<br>- We will finalize the movie in 2017<br><br>2. To demonstrate biomass monitoring and yield prediction using satellite images, crop growth models and yield sensors on harvesters in potato.<br><br>- We will repeat the 4 methods to map yield potential and predictions<br>- We will evaluate the quality of the data and study correlation, aiming to integrate them in DSS and FMIS<br>- We need to give extra effort to extend the yield/mass mapping system on the harvester to be able to make good quality net yield maps. On clay soil, we are hampered by presence of variable |

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| | and too many cloths of soil in the data.<br><br>3. To demonstrate use of VRA maps in potato crop management.<br><br>- We need to check on the soil map processing<br>- We need to improve the process of sending VRA maps to farm machines (planters, sprayers, spreaders). Still too many software packages are involved.<br>- We need to develop tools to retrieve as-applied maps from farm equipment into the FMIS.<br>- We need to include variable yield expectation maps into the fertilizer advisory DSS.<br>- We like to have support from WP3 on the STRIDE risk analysis on flow of soil map ordering to application of task maps (planting density, soil herbicides) and optimize the flow, including storage as applied map.<br><br>4. To develop a tracking system of potatoes stored in bulk.<br>- We need to extent efforts to develop the track and trace system for storage in the bulk storage facility<br>- We need to add the potato quality sensor system (measuring dry matter content of tubers) to the storage line. |
| **Noticed gap(s) in technology** | |
| **Need for more end-user(s)** | |
| **Need for additional deployment site(s)** | |
| **Other** | |

**Use Case 1.2 Precision crop management**

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| **Step(s) towards MVP2** | - Deployment of hybrid connectivity (LoRa+2.5) sensors<br>- Data fusion with SENTINEL2 data<br>- Integration of data in crop models for improved services with others IoF2020 use cases should be evaluated and tested<br><br><u>Preparation of the cloud infrastructure for long term sustainability</u> |
| **Noticed gap(s) in technology** | - Finalize implementation of LoRa in the IoT system. Orange proposed Bosch to evaluate the design and the implementation of the antenna on the communication module.<br><br>Finalize IoT system energy management and LoRa connectivity. |
| **Need for more end-user(s)** | Not for year 2 |
| **Need for additional** | To be discussed with UC 1.1 |

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| **deployment site(s)** | |
| **Other** | |

**Use Case 1.3 Soya Protein Management**

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| **Step(s) towards MVP2** | Implementation in DSS demo version of Variable Rate prescription map for Planting, Fertilizing and Irrigation based on soil map analysis previously carried out for each field. |
| **Noticed gap(s) in technology** | Data gathering of prescription map only will be carry out only where there is the possibility to communicate with a standard format of file and where company machine support our project with open data gathering for this purpose. |
| **Need for more end-user(s)** | Training in PA technology and software to farmers involved in the project. In the specific: how to read data on line from sensor network and how to use technology to collect data in a correct way during the operations in the fields (for example yield map during harvesting time) |
| **Need for additional deployment site(s)** | Additional technology for VR techniques has to be implemented where the machines is available for this kind of farming for planting and fertilization.<br>Evaluating according on water availability, the implementation of precision irrigation with drip system able to work in automatic mode by following a prescription map provide by DSS. |
| **Other** | Italy: evaluating the collaboration with Kverneland to investigating a data gathering system for prescription map during planting operation |

**Use Case 1.4 Farm machine Interoperability**

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| **Step(s) towards MVP2** | MVP1 will be tested in 2018.<br>- MVP2 should convert the off-line file transfer into on-line communication.<br>– MVP2 should be real-time data communication |
| **Noticed gap(s) in technology** | ADAPT Plug-in are based on Microsoft technology. Although not a concern for the use case, it might be an issue for other platforms. |
| **Need for more end-user(s)** | No, we're fine with the collaborations and do not have a need to extend at this point. |
| **Need for additional deployment site(s)** | No, we're fine with the number of farms to demonstrate the interoperability use case. |
| **Other** | It would be great if we could also involve the manufacturers that are not in IoF2020 yet. Having all machinery connected will make the |

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| | dashboard to monitor the farm useful. |

**Use Case 2.1 Grazing Cow Monitor**

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| **Step(s) towards MVP2** | MVP2 is formed by the combination of the installed system with indoor-outdoor detection algorithms that allow to define whether a cow is indoor or outdoor, and for how long. Based on the test data obtained during year 1, these inside/outside determination algorithms will be developed to determine the inside or outside location of the cow. This will be done using the positioning data that has been logged with the installations performed in year 1, and with the logbook data of cows being inside or outside the barn. For the ILVO barn, data derived from selection gates at the exit and entrance of the dairy barn will be used to verify whether the cow was inside or outside the barn. The algorithms will be developed to first extract at which times a cow is indoor or outdoor. Consecutively, these timestamps will be used to extra the time that a cow spent outdoor for individual monitoring, and to extract the total time during which the barn was empty (i.e. all cows were outside). |
| **Noticed gap(s) in technology** | There are some disadvantages to the used technology that may limit the possibilities to use it for other purposes in agriculture. As a first, the area in which the technology is used should be covered with the Sigfox network. If the coverage is not sufficient, the technology will not work as the data cannot be sent to the cloud. The Sigfox network is currently still being implemented in various regions around the world, hence areas where coverage is currently still a problem may become covered in the future. A second disadvantage is that the data transmission rate is legally limited, meaning that the frequency of position updates is limited. This could be a problem if this technology would be considered for use in applications that require a much more frequent position update. |
| **Need for more end-user(s)** | In the first test trial, only limited feedback from farmers was gathered. Hence, more end-user feedback is necessary to evaluate the developed technology and application, and to allow taking farmer's preferences into account during technology development. More feedback will be gathered from farmers during the rest of the use case duration, but especially during the long-term trial and the demonstration on five farms. Also, more feedback from dairies could be helpful to determine how the technology or its application could be further improved. For example, diaries may be interested in accessing grazing monitoring reports remotely, thus eliminating the need for a farmer to send reports to the dairy. |
| **Need for additional deployment site(s)** | For the long-term trial, five dairy farms are needed. The first farm will be the ILVO research farm (deployment site 1). The second farm (commercial dairy barn used in the test trial, deployment site 2) will be contacted to cooperate next year, but it is uncertain whether the farmer will still cooperate. If not, four new farms will need to be searched. Farms will be searched in Belgian and The Netherlands. Several partners will try to locate farms that want to cooperate in the project: both ILVO and Inagro will address their existing contacts. Possibly, collaboration with UC 2.2 will be investigated to see whether it is possible to install technology on the same farms. Finding farms |

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| | may be challenging, as only dairy farms that perform pasturing are useable in the project. |
| **Other** | |

**Use Case 2.2 Happy Cow**

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| **Step(s) towards MVP2** | There are a couple of steps to get to MVP2. The first one is to gather the farmer feedback. When a farmer agrees with our insight/alert, we can not only measure our KPIs, but also improve the system. This self-learning feedback loop allows the system to get better over time in terms of Estrus.<br><br>In terms of health we gather what disease the farmer found on inspection. This feedback allows us to change our models to pick up on specific diseases and warn the farmer about those. This will be a platform/model improvement.<br><br>As for bias in training, getting more farms over Europe is important to train and measure in such a way that we have multiple types of climates/farmers/barns/cows etc. |
| **Noticed gap(s) in technology** | Farmers request integration with farm management systems. While this is easy for us, the often-outdated platforms on which they are built make this hard. Farmnet365 is a good example of a new platform that would be feasible to integrate with, so this is something we look forward to.<br><br>As for the technology, we noticed the farmer is not interested in IoT, AI & Big Data, they want the system to work. In that sense the technology is not a gap, but there is a gap in understanding what it does. This can be difficult in communicating to the farmer why we think something is up. Sometimes the system makes a decision that is correct but visually cannot be discerned from a healthy cow.<br><br>Bot gaps can be solved by deep integration and understanding of farmers and their knowledge. For the current farm we are working on a integration with the farm management software, and also on how we communicate something is up with the cow. |
| **Need for more end-user(s)** | When you have a self-training system, the more users you have the less Bias you get. Also, the knowledge level of the user is important to make sure the system is trained properly. In that sense it would be useful to have experts verify our data. This is something we are looking into.<br><br>As far as new farms, this also brings new end users, and there by more feedback and less bias. So, from a farmer perspective this is already in the pipeline. |
| **Need for additional deployment site(s)** | Due to training the system is it useful to have more farms in new locations. By spreading the farms geographically, you remove bias on climate, barns, cows and farmers. This is thus necessary to make sure the system is trained in such a way that it can handle different markets/locations and farmers. |

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| **Other** | |

**Use Case 2.3 Herdsman +**

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| **Step(s) towards MVP2** | Location based indication on collar. Strong interaction with UC2.1. |
| **Noticed gap(s) in technology** | Location and integration of all on farm databases. |
| **Need for more end-user(s)** | No. |
| **Need for additional deployment site(s)** | One further farm is being investigated to serve as backup or future expansion. |
| **Other** | N/A |

**Use Case 2.4 Remote Milk Quality**

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| **Step(s) towards MVP2** | Identification of opportunities for the AQA approach with individual cows, at farm level and in transport between dairy farms and dairy plants. Some ideas are:<br>- Safeguarding AQA with use of IR spectrometry with automated milking systems. Developments of the technology for this purpose are well underway. Adequate surveillance on performance is required to arrive at an optimal output.<br>- Assuring test results from DeLaval Herd Navigator measurements.<br>- Assuring Milkguards (logging temperature history and cleaning of herd bulk milk tanks) and combining with IoT technology for sending alerts to initiate adequate and timely action in case of problems.<br>- Faster gathering of results from fast tests on antibiotics from milk collection trucks. This may invoke possibly required action at an earlier stage and through this reduce loss of milk and costs.<br>Together with experts from WP3 a meeting will be planned to discuss Phase 2. Main question will be “How IoT can be integrated in MPV1 to develop MPV2 and how IoT can play a role in identified opportunities on farm or transport. |
| **Noticed gap(s) in technology** | IoT elements are missing in current Use Case. |
| **Need for more end-user(s)** | - |

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| **Need for additional deployment site(s)** | - |
| **Other** | Qlip will shortly start investigation for implementation motion and temperature sensors on its control and calibration samples to be able to verify whether the samples are handled (shaken) and heated according to protocols. We will be more than happy consider lessons learned from other IoFF2020 Use Cases. |

**Use Case 3.1 Fresh Table Grapes Chain**

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| **Step(s) towards MVP2** | The field installations didn't cover the whole growing period of table grapes in Greece and in Italy due to the delayed shipments of the parts of the IoT systems that are coming from abroad. Additionally, a second campaign of IoT systems installations is scheduled for the 2018 period in Greece for installing automatic irrigation in the field trials. These will include flow meters and control of the solenoid valves and the pumping systems through the internet-based platform of Synelixis for automatic irrigation. Also, leaf wetness sensors will be installed for disease forecasting for identifying the right time for crop protection products application. |
| **Noticed gap(s) in technology** | The current UC case is missing information regarding tractor operations. Crop spraying is the most frequent agricultural operation in table grapes. Based on this, data collection for defining if there was proper application of crop protection products is of high significance. Moreover, a technology like that would help in:<br>– the assessment and selection of the appropriate crop protection products by type of application and of pest and disease<br>– the definition of the appropriate volume of application based on crop protection products<br>– the protection of the environment due to better scheduling of the crop spraying operations<br>– the traceability of crop protection products<br>– the marketability of the final product<br>– the crop spraying scheduling when coupled with weather data and leaf wetness data |
| **Need for more end-user(s)** | / |
| **Need for additional deployment site(s)** | / |
| **Other** | / |

### Use Case 3.2 Big Wine Optimization

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| **Step(s) towards MVP2** | None during this reporting period. |
| **Noticed gap(s) in technology** | None during this reporting period. |
| **Need for more end-user(s)** | None during this reporting period. |
| **Need for additional deployment site(s)** | None during this reporting period. |
| **Other** | None during this reporting period. |

### Use Case 3.3 Automated Olive Chain

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| **Step(s) towards MVP2** | Next reporting period will be ready. |
| **Noticed gap(s) in technology** | Farmers have not got any IoT devices installed. These types of technologies improve the fields and crops management. |
| **Need for more end-user(s)** | There are farmers and agronomist, no more end-users are necessary. |
| **Need for additional deployment site(s)** | There are enough demo sites, no more demo sites are necessary. |
| **Other** | Not applicable |

### Use Case 3.4 Intelligent Fruit Logistics

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| **Step(s) towards MVP2** | – Clarification of the end user needs through the refinement of the specification document “IoF2020-UC3.4-IoT-Device-Specification”<br>– Based on the priority of the different functionalities defined in the specification document, MVP2 will be defined<br>– Technical study to choose the best technology compromise to achieve MVP2<br>– Implementation and validation of MVP2<br>– Deployment of MVP2 |
| **Noticed gap(s) in technology** | We have to modify the prototype one or change the Network to create a prototype two which will be able to have a higher accuracy to solve the customer needs. |
| **Need for more end-user(s)** | At the moment there is no need. |
| **Need for additional deployment site(s)** | At the moment there is no need. |

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| **Other** | N/A |

**Use Case 4.1 City Farming Leafy Vegetables**

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| **Step(s) towards MVP2** | We are in the process of deploying a first prototype version of our IoT sensing, data, and control platform at our laboratory test facility.<br><br>Next to this we are converting the growth system from an ebb-and-flow system to a shallow water system.<br><br>Once completely deployed, the performance of the IoT platform and new growth system will be evaluated. Based on the outcome of the evaluation, it will be decided how to proceed.<br><br>It is not unrealistic to assume that the performance some sensor modalities will require further attention.<br><br>It is also clear that in a next step more attention needs to be paid to making the system more robust and food-safe. |
| **Noticed gap(s) in technology** | N.A. |
| **Need for more end-user(s)** | So far, there is no need for more end-users. There is a desire though for knowledge institutes to participate in the operational aspects of the commercial city farm at Staay Fresh Care. Such institutes could for example be Aeres University of Applied Sciences and Wageningen University & Research (WUR). Students from such institutes with a plant physiology background could be of great help by using the IoT platform and the new growth system to improve the operational efficiency of the city farm. Also, by using it, they can evaluate the performance of the IoT platform and new growth system and suggest improvements or new functionalities. |
| **Need for additional deployment site(s)** | So far, there is no need for an additional deployment site. |
| **Other** | |

**Use Case 4.2 Chain-integrated greenhouse production**

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| **Step(s) towards MVP2** | The strategy for the second MVP is to expand our solution to the rest of the stakeholders inside the tomato value chain, commercial greenhouses, the handling industry, and the handling companies. The FIWARE platform created allows to the UC 4.2. members to include the rest of the deployment places included in the work plan including six different commercial growers, two handling and one transport companies. The data-sharing is explained in the Work Plan completed in May and it have a total of 95 different variables which will be included in the Context Broker and save in Cygnus data base (Mysql). Benefits are delivered in terms of data access, synchronization, storage and cost to the farmer and cooperatives. The IoT platform will be integrated to obtain information about handling, vegetables quality parameters, safety and Quality Standards application in two main parts |

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| | of the value chain comprising farms and cooperatives (when applicable). IoT technology will be used in order to save all the data generated in this process. Information of the output of the farm, cooperatives and transport will be available to consumers to make them aware of quality, origin, sustainability and traceability issues. |
| **Noticed gap(s) in technology** | At the moment, The UC 4.2 is working well with the technology proposed. The IoT platform is being developed in FIWARE cloud services where all the data which come from sensors, soft sensors and actuator is collected by the FIWARE Context-Broker to relate the different data sources in order to see the information in real time. For the persistence of the data, we are using Cygnus which we made a subscription to one of the entities notifying a change in the data, for its subsequent persistence in the database. The solution was divided in two parts: front-end and back-end for security issues inside the application, since it does not have any data access to database, although it has also used encrypted passwords and a token which is generated and checked when requesting data from the Back-End, in such a way that if it is not correct, it would not give an answer. Another reason is to lighten the client in such a way that the Back-End will be in charge of managing the heavy tasks of the application. In addition to the aforementioned, since we have a REST API available, we can integrate with any other Front-End that we decide to use in the future.<br><br>The only gap that the UC 4.2 can have in the use of this technology is the access to community accounts in FIWARE, the UC tried to get one account for the four years of the IoF2020 project duration, but anybody gave us a solution, the UC got a community account until the first day of 2018. The members of the UC are looking for a solution for this, so asking a solution to the IoF2020 leaders. |
| **Need for more end-user(s)** | The members of the UC 4.2. thinks that the End-Users included in the UC 4.2 are more than enough to help in the project evaluation. In this UC, farmers, agricultural engineers, production planners, handling company manager and transport manager are included as End-Users of the different solutions proposed in the UC 4.2 which help them as decision support systems in the different task included in the proposal like climate and irrigation control during the primary production or traceability issues to get a system more sustainable with the environmental increasing the water, pesticide, and energy use in the whole value chain. |
| **Need for additional deployment site(s)** | In the UC 4.2. Work Plan were established ten deployment sites, as commented before, six commercial greenhouses, one experimental greenhouse, two handling industries and one transport company which are included in the data-sharing of the UC 4.2. cloud service and will be the End-Users of the first solutions designed. This deployment sites are considered enough for the UC interest and the members don't consider any other deployment site for the future. Many growers and handling companies has been interested in the project and have shown their interest in taking part as deployment site inside the IoF2020, but in the UC 4.2. solution is represented member of the all the steps of the value chain included in the project: farms, handling and transport. |

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| **Other** | It is difficult to say what activity or action can enhance the UC 4.2. development. At the moment, the most important issue for the UC members is to get a community account in FIWARE for the rest of the project duration. FIWARE cloud services has provided a community account until the first day of 2018 and the UC did not receive any response about expand this account until, at least, the end of the project IoF2020, 2020/12/31. Other actions that can help in the develop of the project is the incorporation of new stakeholders that can supply data to the FIWARE platform like commercial farmers interested in the technologies developed and a software company which can help us about improving the different solutions created for this project in FIWARE lab. This company can help us to expand the platform to a many farmer and handling companies which are interested in the incorporation of this kind of technologies to improve the production or the system efficiency. Also, the creation of a IoT server in the University of Almeria with the incorporation of FIWARE technologies is an interesting option to develop a greenhouses data-sharing infrastructure which help the UC to improve the services and the data collection. |

**Use Case 4.3 Added Value Weeding Data**

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| **Step(s) towards MVP2** | No plans for improvement in this period. |
| **Noticed gap(s) in technology** | |
| **Need for more end-user(s)** | |
| **Need for additional deployment site(s)** | |
| **Other** | |

**Use Case 4.4 Enhanced quality certification system**

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| **Step(s) towards MVP2** | Complete MPV1 at the beginning of 2017. |
| **Noticed gap(s) in technology** | |
| **Need for more end-user(s)** | |
| **Need for additional deployment site(s)** | |
| **Other** | |

### Use Case 5.1 Pig Farm Management

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| **Step(s) towards MVP2** | MVP2 will include more data and more analytics with higher performance than MVP1. |
| **Noticed gap(s) in technology** | The following technologies would be very beneficial to the pig farming sector and the use case:<br>- A reliable digital water meter for pen level measurements<br>- A reliable weighing system for individual level measurements<br>- Reliable environmental sensors such as CO2 and ammonia meters |
| **Need for more end-user(s)** | To increase the impact of the solution, and potentially also indicate new business models (not only value for the farmer), additional partners in the chain could be added to the use case. This includes:<br>– Veterinarians<br>– Feed suppliers<br>– Genetics firms<br>– Additional slaughterhouses<br>– Farm advisors<br>– FMIS<br>– Sensor companies |
| **Need for additional deployment site(s)** | At the moment one organic farm is still needed, and potentially also a conventional farm as back-up should one of the now selected farms drop out during the project.<br><br>Additional farms in diverse farming systems will also increase the applicability and impact of the solution. With more diverse is meant other regions, but also other types of sensors, other sensor suppliers, other types of feeding or housing, etc. |
| **Other** | / |

### Use Case 5.2 Poultry Chain Management

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| **Step(s) towards MVP2** | Mainly, two more activities are going to be held during second year:<br><br>– Improved sensors:<br><br>– more capabilities of environmental monitoring (adding to first phase temperature, humidity and luminosity CO2 and ammonia sensors)<br><br>– Dynamic scales: These scales will be wireless and with any cables, being able to be deployed in several places of the farm during the day to gather wight of information from different places of the farm. Current scales cannot be moved from fixed places<br><br>– Analytic models: Thanks to the continues gain of knowledge, the models will be improved. Besides, the deployment of the improved sensors in the second phase will allow the models to improve their performance due to a gain of surrounding knowledge |
| **Noticed gap(s) in technology** | No gaps identified till now, but LORA/SIGFOX technology for transport may need to be considered. |

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| **Need for more end-user(s)** | No need. |
| **Need for additional deployment site(s)** | No need. In the second phase two more farms are going to enter in the project. |
| **Other** | |

**Use Case 5.3 Meat Transparency and Traceability**

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| **Step(s) towards MVP2** | The MVP of constitutes of a transparency system, component for data capture and component for data access (query and presentation). The transparency system (which is cloud-based shared application system) is available. The two required elements towards MVP2 are data capture and data access (query and presentation) components. To realize these two steps are required: 1) making agreements with participants of the use case, 2) realizing collaboration agreements with system providers, for instance, providers of FMIS. These two steps have already been started. Use case 5.3 is actively engaging potential stakeholders and the use case also have approached collaboration partners during the recent WP/WP2 conference. |
| **Noticed gap(s) in technology** | The gap in technology is shown in red in the following image, which is part of the architectural design document of the use case. |
| **Need for more end-user(s)** | The use case focuses on pig farmers. Ideally, realizing a transparency system requires engaging with all actors of a supply chain, i.e. farmers, slaughterhouses, and retailers (butchers). The use case currently aims to fulfil the minimum requirement, i.e. provide a transparency to farmers; but, the use also attempts to engage with entire supply chains. |
| **Need for additional deployment site(s)** | The use case has yet to deploy at the first site. |
| **Other** | |

# 4. CONCLUSIONS

The insights derived from the Use Cases Progress report, as well as impressions and responses by the representatives of the IoF2020 Use Cases, clearly indicate that full potential of the IoF2020 project is not yet reached. In order to achieve greater impact and wider outreach of the IoF2020 project, propositions for the expansions have been made, taking into account good practices and knowledge gathered so far by the Use Cases. With this in mind, the benefits of future growth and expansion, in terms of enhancing IoT technology capacity and potential collaboration and addressing the needs of Use Cases, becomes evident. In this respect, the Open call and its advantages, such as wider outreach to include other parts of Europe, inclusion of other sectors and post-farm activities, proves to be aligned with natural progression of the IoF2020 project, and essential to its greater impact.