D3.8 - SUCCESS STORIES FROM IES – V2

WP 3

21.04.2022

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement № 818182

DOCUMENT IDENTIFICATION

Project	SmartAgriHubs
Project Full Title	Connecting the dots to unleash the innovation potential for digital transformation of the European agri-food sector
Project Number	818182
Starting Date	November 1st, 2018
Duration	4 years
H2020 Call ID & Topic	DT-RUR-12-2018: ICT Innovation for agriculture – Digital Innovation Hubs for Agriculture
Website	smartagrihubs.eu
File Name	D3.8 – Success stories from IEs
Date	21.04.2022
Version	2.0
Status	Final
Dissemination level	Public
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LIST OF ABBREVIATIONS

Abbreviation	Explanation
API	Application Programming Interface
EXPAND OC	EXPAND the SmartAgriHubs Community Network
FIEs	Flagship Innovation Experiments
IEs	Innovation Experiments
FMIS	Farm Management Information System
IoT	Internet of Things
MVP	Minimum Viable Product
MQTT	Standard messaging protocol for the IoT
OCs	Open Calls
RCs	Regional Clusters
RESTART OC	RESTART the European Agri-Food Economy after the COVID-19 Crisis
RESPOND OC	RESPOND to the Covid-19 crisis
SAH	SmartAgriHubs
WPs	Work Packages

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PROJECT SUMMARY

Digital technologies enable a transformation into data-driven, intelligent, agile and autonomous farm operations, and are generally considered as a key to address the grand challenges for agriculture. Recent initiatives showed the eagerness of the sector to seize the opportunities offered by ICT and in particular data-oriented technologies. However, current available applications are still fragmented and mainly used by a small group of early adopters. Against this background, SmartAgriHubs (SAH) has the potential to be a real game changer in the adoption of digital solutions by the farming sector.

SAH will leverage, strengthen, and connect local DIHs and numerous Competence Centres (CCs) throughout Europe. The project already put together a large initial network of 140 DIHs by building on its existing projects and ecosystems such as Internet of Food and Farm (IoF2020). All DIHs are aligned with 9 regional clusters, which are led by organizations that are closely related to national or regional digitization initiatives and funds. DIHs will be empowered and supported in their development, to be able to carry out high-performance Innovation Experiments (IEs). SAH already identified 28 Flagship Innovation Experiments (FIEs), which are examples of outstanding, innovative, and successful IEs, where ideas, concepts and prototypes are further developed and introduced into the market.

SAH uses a multi-actor approach based on a vast network of start-ups, SMEs, business and service providers, technology experts and end-users. End-users from the agri-food sector are at the heart of the project and the driving force of the digital transformation.

Led by the Wageningen University and Research (WUR), SAH consists of a pan-European consortium of over 160 Partners representing all EU Member States. SAH is part of Horizon2020 and is supported by the European Commission with a budget of €20 million.

EXECUTIVE SUMMARY

Deliverable 3.8 - Success stories from IEs, delivered in M36 is the first iteration of the report. This report is perceived as one of the outputs of Task 3.2 - Coordination, Monitoring & Evaluation of Innovation Experiments, implemented under Work Package 3. This deliverable gathers and presents some of the best practices, success stories, and most important lessons learned from the project beginning until M36, from both Flagship Innovation Experiments (FIEs) and Innovation Experiment (IEs) resulting from the Open Calls (OCs).

Information presented within this report is a result of regular status meetings of WP3 with FIEs, IEs, and Regional Clusters (RCs), as well as information gathered from the most recent progress reports submitted by:

- 28 initial FIEs
- 26 IEs resulting from the OCs:
  - RESPOND1 to the COVID-19 Crisis (Here and after: RESPOND1 DIHs) – 13 projects;
  - RESPOND2: SAH2SMEs (Here and after: RESPOND2 SMEs) – eight projects;
  - EXPAND the SmartAgriHubs Community Network (Here and after: EXPAND) – three projects;
  - RESTART the European Agri-Food Economy after the COVID-19 Crisis (Here and after: RESTART) – two projects.

Success stories, lessons learned, and best practices are collected from 54 experiments. Each of them has different objectives, as these projects are a result of specific OC requirements - from solutions that are responding to Covid-19 crises in the Agri-food sector, to hackathon type of activities responding to the effect of Covid-19 crisis, hackathon type of activities that will contribute to the RESTART of the European Agri-Food Economy with short and medium-term impact to mitigate the effects of the COVID-19 crisis, and support to the realization of IEs by DIHs trough services. Therefore, their success stories are closely related to developed solutions or conducted hackathon-like events, nevertheless, some common conclusions can be drawn from all projects.

One of the key success enablers reported by the majority of the experiments relates to good communication flow, between consortium members, project partners, end-users. Use of various communication channels allowing direct and fast communication is highlighted as a crucial element within the project implementation process.

Another element tightly related to the successful implementation of project activities concerns thorough planning and good organization. Most IEs that have organized and conducted hackathons and challenges reported that their dedication to the event organization led to an overall IE success story.

When it comes to reported technical success stories, each experiment reported specific examples that are closely related to their solution/prototype/product. But the ability to provide a proof-of-concept, in most cases at a reasonable price, and the ability to overcome technical difficulties related to different data standardization or poor internet connection, is perceived as a success.

The first chapter of the deliverable provides information on the approach and the methodology which were used for the collection of valuable data from project coordinators.

All gathered lessons and examples of best practices and success stories are presented within Chapter 2 – Results. They should be treated as recommendations, which should be further translated into examples of good practices available to all SmartAgriHubs (SAHs) actors and

IEs resulting from the upcoming OCs. Also, we believe that these experiences will be of use to other interested parties and new IEs, beyond the SAHs project.

Finally, within the last chapter of the document, general conclusions are presented, drawn from FIEs' experiences. The second iteration of the deliverable envisaged in M48 will present best practices arising from the third reporting period, including new OC projects implemented as of M36.

1. APPROACH & METHODOLOGY

As WP3's primary role relates to monitoring and evaluation of FIEs and OC IEs, identification of best practices from IEs was naturally within the scope of its work. The monitoring mechanism applied within WP3 includes monthly meetings with FIEs, IEs, and RCs, periodic reporting, data collection, and one-on-one meetings with FIEs and RCs, based on specific needs. This approach allows prompt reactions of the WP3 team and the project as a whole, where and when needed, and regular interactions with FIEs and RCs.

While the focus of the previous reporting period was mainly placed on the establishment of FIE structures and technology development, the second reporting period is characterized by numerous learning experiences from which it was also possible to extract best practices, success stories, but also lessons learned within the process. This content presents valuable material not only for the SAH project but also for other interested parties, thus this report is naturally classified as a public document.

Collecting and presenting all relevant data regarding IEs progress, in this case – IEs success stories, best practices, and lessons learned was possible through FIE and IE progress reports. The second version of the FIE progress report template was modified and expanded after the first reporting period to reflect the specificities of the second reporting period. Questions related to overall and technological success stories within each FIE, good practices, and lessons learned were incorporated in the new version of the template.

On the other hand, OC IE progress report questionnaires were created at the beginning of each OC reflecting their specificities and objectives, while taking into account specific needs from other WPs. Questions related to identified success stories were integrated into each OC template. More precisely, report templates for OCs Respond for SMEs and Respond for DIHs, had a question on Lessons learned, while reporting template for Expand and Restart OC included questions on IE specific lessons learned and success stories.

Results presented in the following chapter will showcase collected achievements, results, and lessons learned, allowing us to learn from their experiences, better understand the technological context of each FIE, but also regional perspectives and consequences of global crisis, such as Covid-19.

2. RESULTS

The focus of the SAH project is on developing and supporting Agricultural DIHs. DIHs are supporting digitizing farmers and agricultural communities at local level by offering a variety of services (technical, business, funding, ecosystem). In the SAH project the Innovation Experiments have a specific function related to develop the DIH's. In each IE at least one DIH is involved to provide one or more services. Apart from the IE objectives in terms of developing innovative digital applications, the most important SAH objective is to develop, test and apply DIH services.

In analysing the IEs we noticed that there are a lot of lessons learned and progress in the IEs is made but also quite some actions and results that are missing or could be improved. As most of the SAH partners, especially those working in the WPs have been involved in the IoF2020 project we surely see the shortcomings in supporting the IEs on technical issues, business development, user involvement and ecosystem involvement. The SAH project is designed in a way that IE support will be provided by DIHs and not by the WPs. Interaction with IEs in SAH is indirect by providing support to DIHs that support the IEs. For direct support and collecting specific details in the IEs there is no capacity reserved in the WPs for supporting the 80 IEs. A lesson learned after 3 years SAH is that we overestimated the

capacity and maturity of the DIHs. It is now obvious that most of the DIHs are not yet ready to provide full support on all kind of issues that IEs need support on.

We learned that regarding the role of the DIHs we started the project too optimistic. Now we need to be more realistic and recognize that most DIHs need to develop and mature the different supporting services, you can say we made a start with that.

2.1 SUCCESS STORIES, BEST PRACTICES AND LESSONS LEARNT FROM FLAGSHIP INNOVATION EXPERIMENTS

Prior to providing information on the best practices, success stories and lessons learned arising from each initial FIE for the reader it is important to understand the background of each FIE. Without going into details, the table below demonstrates a brief overview of each FIE.

FIE1	**Farm Sustainability Audit** Identifying key sustainability metrics to develop and implement a sustainability audit for dairy farmers and sharing the gathered data with consumers.
FIE2	**Sustainability Tool for Remote Assessment and Management of Farmland -STREAM** Applying digital technologies to simplify the production of farmland habitat reports through an online application.
FIE3	**Digitizing farm machinery produced by SMEs** Advising farmers on business plans and the digitisation of their machinery through expert-led workshops, to improve competitiveness and reduce energy consumption.
FIE4	**Adopting digital technologies by farmers** Improving the technology adoption on farms by assisting end-users in identifying optimal production processes enabled by digital technologies.
FIE5	**Valued Grain Chain** Technology to identify grain lots, defining quality and record cultivation history to improve business models of Nordic arable farmers.
FIE6	**Co-creation of Value and Innovations in Horticulture – Agrifarmlab** Upscaling existing initiatives and accelerating the proliferation of innovative solutions on farms by identifying technology providers best suited to respond to each individual challenge which participating farmers' encounter.
FIE7	**Information System and DSS tool for Cereals Cultivation – DIGI-PILOTE** Delivering strategic advice to wheat farmers through a mobile application which processes information from the cloud and data from IoT solutions.
FIE8	**Decision Support Tool for Digifarmers - STRATE-GEEK**

	Creating a Decision Support Tool which assesses the consequences of decisions in order to support the strategic decision-making by farmers.
FIE9	**Deep Learning and Hyperspectral Imaging - AI 4 AGRICULTURE** Gathering data on crop status by using deep-learning analyses of hyperspectral imaging to improve spray operations.
FIE10	**Smart Data Use on Arable Farms – FarmCube** Digitising decision-making processes by storing data gathered from remote sensing applications and translating it into tailored advice for end-users.
FIE11	**Pig Health Assessment Based on Applied Sensors - SmartPigHealth** Leveraging digitised sensors and prediction models to predict diseases among pigs early on and providing transparent information to all stakeholders.
FIE12	**Improving Responsibility in Livestock Production - DIG-ITfarm** Using data collection to predict early-stage diseases in order to lower the use of antibiotics in swine rearing and disseminating the best-practices.
FIE13	**Ammonia Emission Monitoring Network – AEMON** Implementing an ammonia emissions and climate monitoring tool in animal shelters to improve animal welfare and overall sustainability.
FIE14	**Mower-robot for Vineyards** Achieving precise mowing between grape vines by implementing an autonomous mowing robot system.
FIE15	**Precision farming in agricultural practices on small-scale farms** Developing a mobile application which connects to in-field data-gathering sensors to make precision farming technologies and solutions accessible to end-users.
FIE16	**E-services using drones for quantity buyer** Developing business strategies and testing drone mapping to catalyse the wide adoption of drone-based e-services.
FIE17	**On-line DSS for optimizing fertilizers – PULS for Fertilisers** Creating an online Decision Support system for farmers which processes data from sensors and integrates image analyses to improve both yield quantity and quality.
FIE18	**Autonomous Greenhouses - Smart Micro Farming and Large-scale Production** Combining AI and IoT technologies to establish an automated greenhouse management system able to monitor climatic conditions and carry out robotic crop treatments.
FIE19	**Bee monitoring and behaviour prediction** Collecting data on environmental factors and processes surrounding the beehive through IoT sensors, and training AI with these observations to improve predictability in beekeeping.

FIE20	**Ground Water and meteo sensors** Developing a web-based system for agrometeorological and groundwater measurements to ease the transfer of information between different farm applications and smoothen the uptake of precision agriculture.
FIE21	**SAIA – Sensoring, Artificial Intelligence Algorithms for early detection of crop disease symptoms** Using digital technologies to produce risk maps so as to facilitate the early detection of plant pests.
FIE22	**Iberian Irrigation Portal** Developing an irrigation web portal to improve irrigation management, crop productivity, profitability and the efficient use of water.
FIE23	**Data-Intensive Dairy Production** Digitalising steps of the early dairy production chain to improve forage production, feed mixture and management, stable operations, and resource efficiency.
FIE24	**Implementation of ICT in Aquaculture - AquacultuER4.0** Department of Chemical and Pharmaceutical Sciences Using ICT and IoT technologies to deliver precision fish farming which controls water quality and executes operational routines in order to bolster sustainable aquaculture.
FIE25	**Data-Driven Vineyard Precision Management = VINPREC** Promoting the uptake of precision strategies in viticulture by developing an application for growers which provides decision-making support for routine operations based on sensors attached to machinery.
FIE26	**Digitising Open-Field Vegetables** Deploying drones, satellites and IoT devices to figure out the right harvesting time and discover weed patches, thereby enhancing the production of organic open field vegetables.
FIE27	**Tracking Animal Movements and Health Records** Developing an online tool for the entire value chain tracking animals' movements through IoT technologies, in order to improve animal welfare.
FIE28	**Decentralised Trust in Agri-Food Supply Chains - Tracelabs** Implementing blockchain technology to integrate data from stakeholders across the dairy and poultry supply chain to improve traceability of products.

Table 1 - List of FIEs

Throughout this reporting period, FIEs documented different overall and technical successes stories and lessons learned, which will enable process improvement in further experiments implementation.

Within **FIE1 overall success** story relates to valuable feedback collection from farmers and industry partners and ongoing communication about the project. Farmers were open-minded about improving their sustainability on farms and through the project they saw the opportunity to be the leaders with the Irish dairy industry by being able to effectively reduce their carbon footprint by identifying good and bad practices on their own farm. The industry is also enthusiastic about the project, the national farm survey is interested to collaborate at the end of the project and to re-use some of the processes that FIE has put in place to streamline their auditing process and labor requirements.

On the technical side, the development of the database with multiple different files, coming from many different sources, was received as a **great success story**. Each file in the base had to be individually mapped for each farmer. The water and electricity files were all configured differently as it depends on the way the farm is organized. For example, one farm might have the drinking water coming from the main well and another farmer might have the drinking water coming from a separate well. This would require different mapping to be carried out for each farm to ensure reliable accurate results. All data is now flowing automatically into the newly integrated database where information is securely stored.

The Ingenera company was formally removed from the project. For FIE1, this was a valuable **learning experience** as they have learned about the importance of following protocols.

Within **FIE2**, establishing a good working relationship among partners is an **overall success story.** The FIE **learned** that data requests from state agencies can take significantly longer than expected. Having this in mind, the information management system of the FIE, which helped to organize data collection, transfer, and reporting, is reported as a **success story** of the FIE. This system was successfully applied to a subset of 300 of the ~1000 participating farms in the National Farm Survey. In recent years, the National Farm Survey has expanded the scope of its data collection activities to include an increasing amount of data collected specifically for the purpose of measuring the sector's environmental impact. This data is used to explore a range of issues relating to greenhouse gas and ammonia emissions and water quality; the work of FIE2 now makes a compelling business case for Teagasc to expand this pilot with 300 farms to include data on habitat biodiversity for all participating farms in the National Farm Survey. On the technical side, the development of the application which facilitates the download and transfer of farm photos has been another **success** for this FIE. This help is providing a tangible and realistic insight into the types of farms that the experiment is dealing with and transforms a dry and text-heavy document into one that an individual farmer can relate to and be proud of the biodiversity features on their farm. Although FIE2 has conducted this specific activity before, the ability to determine broad habitat types from satellite imagery (FERS) is a **key success factor** in reducing the logistical effort, time, and cost of the habitat surveys. As the **best practice** within FIE2, early development of software (by CodePlus), which was the key enabler of multiple iterations and important feedback via project meetings and meetings with the Teagasc, and the right combination of different skill sets across FERS, CodePlus, and Teagasc, has been highlighted.

Good practice of **FIE 3** relates to the creation of the form of datalink offering farmers a solution where they can document the spraying in the fields. This creates for the farms a value in the form of obtaining regulatory relief e.g., allowed to use pesticides. However as this is not regulated by law, the demand is currently not as expected. Data standardization is highly important since it would benefit SMEs who would like to get going with data-sharing in the future. This **lesson was learned by FIE3**, as they realized it was more difficult than initially expected to create the datalink from one company to another. In both Sweden and Denmark, it was possible to make the technical upgrade for both the Danfoil Sprayer and the Cameleon machinery, being a **great technical success** for this FIE. The collaboration

between the partners in both countries has been very good, which is an overall success story. Also, the partnership between the two leading DIHs (SEGES and AgroVast) has worked very well.

FIE4 learned that being part of a large EU project like SAH brings great opportunities, including good networking opportunities throughout Europe. Unfortunately, the COVID-19 pandemic had a negative impact on networking between the project partners, since physical meetings were cancelled. Nevertheless, a good collaboration with organizations like SEGES and LUKE was made within this project and provided a broader network for the future of FIE4, which is reported as an **example of good practice**. In Denmark, **valuable lessons were learned from farmers**: they usually have employees who can make equipment work, and if they get good help to start, it will not be long before they join, even if the financial gain is not so clear. Many farmers already have GPS features in their machinery, but this feature is not used in most cases, since farmers are not familiar with how it works. The main reason for this is the lack of technical knowledge in the classical agricultural advisory in Denmark. Equipment dealers have too little knowledge about setting up precision equipment, so the farmer can't learn from them when buying the new equipment, so the link between the agricultural advisors and the technical knowledge is a good match in this case. **On the technical side,** the development of the final functionality of the Pig Scale product, after a long struggle with algorithms and data collection structure, has been perceived as **a great success.** The system is now finalized, and it is being used.

Ecosystem building based on federated software infrastructure is new in the sector. Since there were no existing examples to follow, it took time for all partners to study and learn the new model for collaboration and how to play their part in practice. Resulting in slower experiment development than planned initially. In the end, the new collaboration was seen as interesting and the way to continue, which is a **great example of good practice for FIE5.** As a **technical success story**, FIE5 reported automatic data exchange between FMIS providers, GrainSense, and AgroIntelli through the ValueNet service, but as **an overall success** -proving that farms can increase profitability or monitor their carbon footprint by utilizing digital tools, was highlighted.

The most valuable **lesson learned from FIE6** is related to real demands from farmers to be integrated into the innovation development process. Building the agriculture of the future without listening to the farmers has already been done before, and with partial success. This implies that **the best practice** for this FIE was enabling SMEs and farmers to meet each other again and build together the agricultural future and digital innovations. On the other hand, one of the best **success stories** for FIE6, which is quite contradictory, is the delay of the SME Open Business Agriculture for their software Baoba. The timeline for the software development was changed, in order to take into account real farmers' needs for developing new functionalities. In the initial version, those needs were only partly responded to. Their delay is proof that it's never too late to gain relevancy in the development of an innovative product, and that a complete and deep understanding of the market and customers' needs is mandatory.

FIE7 highlighted the importance of good communication flow inside the project, as one of the most important **lessons learned**. Open communication during monthly meetings and within the SharePoint group was of great help to the coordinators to follow the FIE advancements. During the current reporting period, the development of a data query and display platform is reported as a main **technical success**. The platform is currently under construction, and two partners got involved in its development: ARVALIS and ACTA DS. An **overall success story** of this FIE relates to the organization of a national webinar, which involved all partners and reported on the results obtained during the project. This conference gathered nearly 100 participants and allowed them to share a common goal with all partners.

The importance of setting up weekly meetings, to debrief on bugs, and arbitrate on priorities in order to finalize developments, is the **main lesson learned within FIE8**. In terms of **technical success**, the most significant was the FIEs' change of strategy, due to the change of business model of a partner (Api Agro) that no longer met the initial needs. Initially, the API-Agro platform was identified to expose and deploy APIs. On the other hand, one of the **greatest overall successes** during this period was the actions taken between the two Competence Centers (ACTA Arvalis & Acta Digital service) to meet the deadlines for the delivery of the SYSTERRE® tool in web format, and the development of the APIs and associated screens. During the course of the project, it became clear that the development of the tool has been initially underestimated. The numerous interdependencies between the screens required, on the one hand, to specify the specifications and, on the other hand, to work in close collaboration between the experts and the IT developers in order to ensure that the tool met the needs. Daily meetings made it possible to speed up the correction of bugs in order to achieve the iso-functionality of the tool. The involvement of people in this action as well as the mobilization of testers was a determining element in achieving the objectives of this task.

For FIE9, both technical and overall success story is the successful integration of very new technology (5G) in the pipeline, which is successfully leveraging the power of AI to the agriculture industry.

FIE11 learned that extensive information on barn climate criteria, in 24/7 hourly mode, is able to support the decision-making of the farm management. Also, models learn heavily from historical clinical assessments and not from sensor and management data. Therefore, **valuable lessons were learned** about farmers' behaviour and their lack of interest in finding out about European developments. Farmers were not much interested in exchanging ideas with other FIEs and had a language barrier in communication with the SAH network since they usually don't speak English. But still, farmers expected their service providers to provide them with the information and technology needed to remain competitive. On the technical side, the development of MQTT, which provided that all data gets transferred, even after a power failure or internet failure, was reported as a **success**.

FIE 12 learned that the training of the farmers is a key element for the application of sensor technologies. This also means that the farmer is equipped with knowledge allowing him to contact the service provider once the concern arises. This is **perceived as a success** since farmers are really familiar with the use of digital technologies.

FIE13 was able to provide a proof-of-concept of an emission monitoring system at a reasonable price, which is the most **important technical success**. This was a challenging task, especially for ammonia, as even expensive state-of-the-art ammonia analysers have many prerequisites to function properly. First of all, the cheap sensor components included in the nodes are very fragile and sensitive to the barn environment. For Van Mierlo, the partner in charge of developing the sensor nodes, adapting the design of the nodes to the harsh environment was especially challenging. At the same time, each individual sensor reacts differently to the ammonium concentration in the barn, while there were multiple cross-sensitivity problems, where the sensor components would detect ammonium, while none is present. To amend this, a complicated statistical model was necessary, so the differently reacting sensor components could be linked to each other. To account for cross-sensitivity an additional low-end ammonia sensor was coupled. The resulting system can now provide information on the local trend (rising, lowering) of the ammonia concentration as well as a mean value, which is more or less representative for the barn compartment continuously, especially in mechanically ventilated barns. Given how difficult it is to measure ammonia in a continuous way and the low budget for the sensing components, this is a great

result. Due to the current issues on nitrogen pollution, the topic of agricultural contribution to these issues has been pushed higher on the political agenda.

As a result, FIE13s' nodes have gathered interest outside of the SAH project, which is reported as an **overall success story**. If the system can be improved further, this can be a future way for farmers to improve decisions making process, where their tacit knowledge no longer suffices, as well as a way for them to prove that they are making efforts in reducing emissions. The integration of the different components is more limited than expected, but the FIE has shown that a smart barn climate control system that also takes emissions into account is certainly possible in the future.

The separate sensors (e.g. CO2, NH3, temperature, relative humidity, etc.) included in the sensor nodes are not expensive (in contrast with other climate sensors), though the developed sensor nodes with sensor network and installation is expensive. The NH3 sensor can measure trends for NH3, but spatial differences were detected. It is unclear whether these spatial differences are due to the spatial differences in concentrations in the barn or due to inter-sensor variability. This will be further investigated in a follow-up project. The measurements of trends will already enable the farmer to assess the barn climate as it allows the detection of a worsening climate for animal health.

The first **technical highlight for FIE14** was at the time of powering the drive motors for the first time. Components were purchased, special parts were designed in 3D software and printed in-house on a 3D printer. Tracks replaced the wheels for stability reasons, and these caterpillar tracks were developed and built by the company itself. The developed mower system shall cut the grass between the plants. Therefore, the whole robot or just the cutting component of the robot was moved in the appropriate position. FIE14 decided to use non-GPS navigation. This has the advantage that radio shadows have no influence. A Lidar is used to scan the environment. A rather simple solution was developed using 3 piles (plants) and orienting the mower parallel to the piles with a defined offset. The navigation algorithm is further optimized in parallel to the mower unit. Regarding the **overall success of the project**, one of them is the creation of new contacts, mainly in the scientific community. Another very **important success** is the empowerment of people. Two students of the Bachelor program "Agricultural Technology and Digital Farming" completed their internship and their associated Bachelor-thesis within the framework of this FIE. Their individual work is well documented and can be used as a reference for further development. As modern agriculture and agricultural technology are often associated with the exploitation of nature, FIE14 identifies its **positive impact** within this topic as a **success**. Digitization in agriculture and smart farming is sometimes associated with the exploitation of nature, but with the new method of cutting grass instead of applying chemicals to regulate the growth of grass in orchards and vineyards, smart agricultural technology is moving into a new perspective of sustainable, organic agriculture. After completion of the IE, further developments and continuous improvement of the platform are planned in cooperation with partners, which is another success of this FIE.

FIE15 reported on **several technical success stories**. One of them is the implementation of a real-time caching and tracking strategy, that supports instant access to a large amount of data with an optimal access time. This approach improves usability and allows scaling to a global market since the satellite data from the ESA Copernicus program is available all over the world and enables precision farming at reasonable costs. Besides the real-time monitoring of crops, another technical success is the ability to statistically analyse the satellite data of multiple years and provide stable zones which are not only the basis for fertilization but enable to optimize crop production starting from tillage and seeding. Precision farming awakes from a field of research and becomes mature to be used by a broad community of farmers. FIE15 sets out to introduce precision farming to small-scale farms

and lower the barrier to entry. Identified **learned lessons**, such as to immediately present a user's success, minimize the interactions and ease the usability with pre-filled values have been considered in the newest version of the solution. The integration to the Farmdok FMIS was the method of choice to demonstrate the success of the implementation. Farmdok customers with a high-end license, including precision farming span the range from small farms with 17ha up to more than 1000ha. This shows the feasibility of precision farming and the awareness of farmers to optimize agricultural management from an ecological and economical point of view, which can be considered as an **overall FIE success**.

One of the **lessons learned within FIE16** concerns the difficulty to provide drone flight plan services in a short period of time, with weather restrictions and closed flight zones. The key problem to solve was not technical but rather organizational. Another **lesson learned** relates to the issue of choosing the target group - clients for these services. In the beginning, the FIE assumed the selection of clients (end-users) as individual farmers. During the experiment, it turned out that the most important target groups could be user groups. These are groups of agricultural producers, local governments, and associations of producers. Such farmers can order services jointly, which will make the price and availability of services for a single farmer much better. This is the key that will allow achieving the goal of the experiment, which is to provide advisory services using drones for small and medium-sized farms**. The technical team** involved in the experiment already had experience in similar projects. Nevertheless, the FIE faced the problems of assembling maps in a way that would be useful for agricultural advisors who compile agricultural advice on the basis of drone data. The field tests of the equipment took place over two seasons. During the first season, a large part of the tests required technical refinement. These were, for example, problems with memory cards, limits of counters in the camera, shifting photos from cameras of various types - most often 2 cameras were used on one drone - standard for visible light and multispectral light. There were also problems with the configuration of control tablets - both Android and iOS systems were used. Flights at different altitudes were also tested. Folding maps and accessing flight test results presented a challenge as well. After many trials of different versions of the software, a solution was adopted, which is reported as the **overall technical success of the FIE.** In the adopted solution, the agricultural advisor has access and works on a remote desktop with a local version of the software, in order to take advantage of the better computational performance of local servers. Development of the detailed plans of activities to be performed with each service has been identified as an **overall FIE success**. Drone services are difficult to implement in case (risk) of closed air zones and unfavourable weather conditions for flights. The service design team had to take these difficulties into account, and the end recipient, the farmer, cares only about the short delivery time- mapping fields for damage must be done within a few days, biological protection must be carried out within one week of identifying the risk of the pest. By developing the plan mentioned above, all these issues were covered.

The core **lessons learned within FIE17** addressed the challenges encountered by the restrictions caused by the Covid-19 pandemic. Lack of F2F meetings and events took its toll on implementation outcomes. Unfortunately, not all activities can be replaced by online methods, and establishing smooth cooperation between partners in a difficult communication situation was another valuable lesson for FIE17.

During the timeline of the SAH project, **FIE18 learned several valuable lessons**, regarding the planning and implementation of project activities. The first lesson addresses the planning of the budget more carefully since it can prevent losses caused by unexpected situations (the COVID-19 pandemic). Limited access to materials, consequently, lead to an increase in prices, which can influence the planned budget. Another lesson learned concerns the importance of maintaining connections with all actors of the project. The FIE was in constant

contact with end-users and organizations supporting Agriculture 4.0, and promoted solutions related to the automation of processes in agriculture, which attracted many institutes which started following the SAH project and other FIEs. Finally, a valuable lesson was learned about constant communication with end-users, which enabled the improvement of the technical solution, by listening to the users' needs. One of the **greatest overall successes** was to find and encourage end-users to take an active part in the FIE, especially during the pandemic. Conducting trainings and subsequent workshops in this difficult period required many supporting activities and protecting the health of their employees and end-users. Another **great success story of this FIE** is getting familiar with new opportunities on developing the next generation of autonomous robots for greenhouse. Thanks to the cooperation with end-users, which are research institutes dealing with research on plants in greenhouse crops, the FIE developed new research challenges that will improve cultivation conditions, reduce the use of water, fertilizers, and pesticides. They will also automate the entire process and relieve researchers from routine agrotechnical activities. **On the technical side**, preparation of API for data exchange between the robot platform and the ATMESYS data platform has been **reported as a success**, together with launching and testing the algorithm for building task sets depending on the type of crop, date, growth phase, monitoring and the necessary list of treatments, environmental conditions. Implementation of the algorithm to determine the most optimal route of the robot arm movement in terms of the type of plant, growth phase and stable operation of the device in conditions extremely unfavourable for electronics (temperature in the greenhouse above 50°C) are great successful examples from this FIE.

One of the **best practices identified within FIE19** is an excellent transfer of knowledge and experience from different disciplines, between information and communication technology and beekeepers. A good experience was using the AGILE / SCRUM methodology, which in cooperation with beekeepers allowed to develop a solution in short sprints, implement it step by step, and test it. In this way, quickly gaining feedback from the main user and quickly addressing the necessary needs. Short development sprints with exact tasks and milestones were easy to understand for both parties - developers and end-users. In the everyday information technology industry, the analysis of geospatial information is a simple and common use case, but a very high-quality discovery for beekeepers, when planning the location of their holdings and seeing the information that bees can collect here. Enabling the beekeepers with making the right decision on where to place the future, or even move the existing apiary, is identified as a major **technical success story of FIE19.** Starting a negotiation process for a new project proposal, in cooperation with the industry of sensor manufacturers, can be considered as an overall success story of this FIE. Definition and plan of potential cooperation still are vague but in progress. From our side and sensor provider side now is a task to identify the potential of provided sensor use in beekeeping and bee yard protection. Provided sensors are sound monitors able to identify wide spectrum sound frequencies, which may help with a single sensor unit to identify bee behavior, animal and other insect attacks.

Lessons learned during FIE20 implementation were mainly related to the integration of data from various data sources and data producers. The challenge is to integrate sensor observations provided by different APIs and partly by exports in files and provide understandable visualizations to the end-user in form of charts. A standalone chapter was the processing of satellite images to provide analyses based on these data. In the case of Latvia, where clouds are very often presented on images during the growth season, images have to be very detailed and thoroughly analyzed to get correct results. There are important lessons provided by farmers as feedback providers. Designers and developers of the system thought of a clear and usable data presentation and layout of the system, farmers showed a

different point of view of the expected information and expected ways of reading knowledge from data. The importance of different data and the amount of presented information was discussed. Most of the **technical success stories** of FIE20 are mainly in the field of analytical functions. A new analysis "Crop weather risk monitoring and prediction" was developed by Meteoblue and integration of in-situ measurements were prepared. This function combines data from long-time series models, current forecasts, and in situ observations to a common visualization. Another analysis developed for decision support of farmers is the "NDVI Average Daily Change" which provides information on the average change of vegetation indices during the growth season. This analysis supports the decision-making process by providing information about what is happening with crops on the field. The **overall success story** is that FIE20 submitted a proposal to the "FAO-ITU Call for Good practices in the field of digital agriculture in Europe and Central Asia" and in mid of March 2021 was selected as one of 360 projects to the WSIS Prizes 2021 from total 1270 submitted proposals.

FIE21 good timing for demonstration in the Agri sector is important. Being persistent and in their case organizing several campaigns, as one of the most important **lessons learned.** The prediction of pest evolution is recognized as a **technical success** and the market likes the service. It's difficult to sell a service this way, but in this case, the results are very good for the user.

Focusing on irrigation communities, **FIE22 learned** that the identification of the water needs of the irrigators (farmers) in order to determine the methodology of the water distribution and control (programmed irrigation, on-demand, etc.) is very important. The most significant **technical FIE success** is ABOVIGIA, which is the demo site in Portugal. Using the WEB Portal, this irrigation community has improved the irrigation control, offering to the irrigators a DSS for irrigation management and real-time data regarding the water consumption. As **an overall success**, a good collaboration among all the partners and organization of different workshops for opportunities identification has been highlighted.

Throughout the timeline of the SAH project, **FIE23 learned** that data management is very important and that a good business plan is necessary. User-friendly language must be used with farmers, and technical training, skills development, and knowledge transfer activities, targeting professionals in agriculture, are highly recommended. In terms of cooperation between partners and arrival at the main target, a Demo Day organized by FIE23 was identified as a **great success**.

FIE24 learned that fishermen and aquaculture operators are highly motivated in adopting new solutions that can improve their working conditions. Both technologies and training have stimulated operators to develop new skills and know-how to monitor the marine environment. Benefits arising from the use of new technology can increase motivation in attending training courses even more. The most innovative aspect is the inclusion of environment monitoring within the routine and "daily practice of work" as tools to improve production and animal well-being. This represents a profound change of vision, generating the awareness that the quality of products strongly depends on the protection and care of the environment. The experience of FIE24 foreshadows the first step towards an integrated Blue Economy system, in which production is strictly connected to the protection of the marine and coastal environment, a heritage to be safeguarded, both by reducing the undesirable effects of anthropogenic pressure and in relation to effects of climate change (in agreement also with the policy of Emilia-Romagna Region). The ability of aquaculture operators to autonomously employ the sensor network, including their understanding of measured parameters, FIE24 consider as the **main technological and overall success** within this reporting period.

Within the two years of **FIE25** execution, the **most important lessons** were related to interactions with the farmers and the interaction with DIHs. The **lessons learned with farmers** come from a best practice that UCSC has used which is the ongoing sharing of results and the active involvement of end-users in the development of the prototype. In this way, FIE learned that sharing ideas led to the continuous improvement of the prototype addressing not only a solid technical efficiency but also a very good user-friendliness that could be the key to the success of FIE. Continuous interaction between CCs and DIHs led to great advantages from the point of view of sharing results. In fact, thanks to the network provided by DIHs, it has been possible to speed up the operation of dissemination of the IEP results. The most **significant technical success pertaining to FIE25** was to find, within the short duration of the FIE itself (24 months), a solution for relevant dysfunction or damage occurring when TRL 7 had to be achieved. In fact, the excellent outcome from a preliminary trial conducted in the first year under close-to-real conditions (i.e., potted vines grown outside to correspond to TRL6) was not confirmed by the first field trials performed at Malvicini Estate where the performance of the thermal camera, once mounted on a caterpillar tractor, was totally unsatisfactory until the point of physical rupture of some components. Though, it was enlightening assessing that the same camera, once mounted on a newer wheeled tractor performed quite nicely. Though, before testing the system in the third farm (Gavioli), Casella and UCSC partners decided that universality of functioning should have been warranted by the system and so the thermal camera was replaced by a more robust and reliable, yet identically accurate, IR sensor. Test performed at Gavioli allowed to confirm that this latter will represent the final configuration of the ECS sensor. It is a technical success as an IR sensor is much less expensive than any thermal sensor and it contributes to the IoT philosophy of the new ECS sensor pursuing low cost and acceptable accuracy at the same time. Although the field testing and demonstration were not fully satisfactory for reasons explained above, FIE25 identified the perception that the growers (our end users) truly felt comfortable accepting that type of new technology, as **the overall success story**. Mostly for three reasons: 1) ECS is weather independent (runs can be performed under clear or overcast days) and does not require any booking of equipment or permits to be obtained in case a UAV approach is preferred; 2) the sensor is a tractor mounted and works with an "on-the-go" mode. Therefore, the farmer does like the fact that they can master the tractor where the sensor is loaded and, most importantly, the canopy scans can be performed concurrently with any other vineyard operations including sprays, shoot trimming, leaf removal, and others; 3) most importantly, after the end of the row scanning, the grower does not have to "wait" for day or weeks that a vigor or yield map is processed and made available. The post-processing is performed in almost real-time, and, at the end of the day, the grower gets access to the information required, that could either be a prescription map or a warning for starting a given practice (for instance irrigation).

As **FIE26** has reached its **successful finalization**, all procedures, including data collection, cultivation practices, software development, and hardware deployment have generally gone exceptionally smoothly for a 2-year long experiment. During the first months of the FIE, several difficulties were encountered such as the extreme wind speeds, which made UAV flights very challenging in the open fields, while environmental parameters, such as the near all-time-high rainfall recorded during certain days of autumn 2019, made cultivation practices very effortful. However, all the FIE partners managed to overcome these obstacles and end with a result we are highly satisfied with. A major part in this was played by a carefully drafted risk management plan, and an overall risk mitigations strategy, as potential obstacles were identified ahead. Finally, effective and efficient communication between partners is something that might seem obvious but truly holds great importance in this type of experiment, where small delays or misconceptions can potentially damage the entire experimental run. To this end, the collaboration between partners is a key component and a

necessity for **the successful implementation** of such actions. **On the technical side**, FIE25 consider the "integration" of different technologies, such as IoT, remote sensing, machine learning, and big data analytics in the agricultural sector, along with the cooperation of multiple researchers working on these fields in order to tackle a critical world problem (i.e., food security), as something that has never been achieved at a similar scale with SAH. Still, one of the greatest **overall successes of FIE25** was demonstrated through the final online event, where the overall work of FIE25 and the respective outputs were presented. Not only that the engagement of various different stakeholders was achieved, but several direct end-users, such as farmers or agronomists showed great interest in our outputs, indicating that adoption can be greatly supported by efficient dissemination and efficient demonstration. This again might come out as obvious, but user acceptance and adoption interest are something that numerous countries (including Greece) have difficulties in accelerating, while SAH thought its outputs and especially the individual FIEs had the chance to promote new agricultural technologies, showing to the general public how easy it is for end-users to „get started" with Smart Farming.

For **FIE27**, the **most important lesson learned** throughout the SAH timeline is that end-user feedback is invaluable - research and discussions with farmers and transporters facilitated by FCBR and mAgro have been paramount to shaping the functional requirements of the digital infrastructure. **The best practice** extracted from this experience is that user feedback and acceptance testing should be an essential part of every step of the process: ideation, design, implementation, and validation. This makes the process more adaptable to change and more agile. Similar to how digital solutions such as teleconferencing and distributed and collaborative digital document management have come to our aid in successfully finalizing this FIE during these unprecedented times (COVID-19), so can IoT solutions provide benefits to the agricultural domain. Along the way, **it was learned** that, in order to build a feasible IoT solution for agri-business, the following requirements must be fulfilled - a feasible solution must be cost-effective, must speed up and streamline processes, must increase workforce safety, must benefit animal welfare, and must be environmentally friendly. **On the technical side**, one of the greatest challenges that FIE27 faced was that the attachments to animals' ear tags have legal constraints on weight and, as such, required us to research a novel solution for IoT devices where the entire hardware (microchip, PCB, battery holder, and battery) needed to be under 7 grams. The process was quite arduous and required a large number of iterations for choosing the hardware stack, manufacturing the PCB, soldering and assembling the hardware, designing and 3D-printing the casing and the ear tag attach-and-detach mechanism, and putting all of these components together towards implementing an innovative IoT device. The **most significant success** was measuring the KPIs of our end product where we not only reached, but even surpassed our initial target: 0 printed documents, processing time of under 1 minute, and, most importantly, a proximity range of scanning the device of 25 meters (20 meters farther than initially proposed). Moreover, during the experiments, it is noticed that the IoT devices were capable of identifying and tracking animal transports at an 80 km/h driving speed, which poses even greater benefits and use cases for our solution.

Within the current reporting period, **FIE28 learned** that the food is a low-margin item, and the introduction of any kind of technological solutions to the agri-food supply chain must increase the added value enough to cover the costs of implementing such solutions. When providing solutions, it is important to understand the existing business processes and systems in place and to try and work with them, rather than trying to completely replace them. Especially when it comes to large IT or production systems, ripping and replacing what is in place is often too costly to be a viable option for businesses. In this regard, interoperability is key when introducing any new technology to existing business systems.

One aspect of interoperability FIE28 is addressing interoperability with legacy IT systems. Data interoperability is another aspect, addressed by using globally adopted supply-chain and other standards (like GS1 EPCIS, W3C Verifiable Credentials, W3C Web of Things, etc.) for data exchange within the system. The third aspect is interoperability with existing processes. With the implementation of FIEs' technology, this experiment is trying to interfere with existing processes as little as possible and identify touchpoints where the system can be attached to what is already in place. With this approach, FIE28 can streamline the implementation process and limit the burden (financial, HR, timewise) on the users, which is **a good practice. FIE28 had great success** with launching the decentralized provenance application with Perutnina Ptuj, the largest poultry producer in SE Europe, beyond just testing it within the FIE. They have incorporated the application in their ongoing marketing efforts to differentiate themselves on the market and are using it to show the provenance of more than 30 of their products from their Premium Natur line on the Slovenian and Austrian markets. By connecting the decentralized provenance application with data from the Kakaxi IoT device, FIE successfully proved how IoT technology can be used for ensuring greater transparency in agri-food supply chains and for proving this transparency to the end consumers, which can be considered as one of the **most important technological success** stories of this FIE. Another success story is related to the automated trusted dairy payment clearing system, which received recognition and endorsement from the Oracle team, for the use of their Oracle Blockchain Platform in the solution. **In terms of technology**, the most significant breakthrough that FIE has achieved with their solution is successfully integrating permissioned (private) and public blockchain technologies. No other technology provider has been able to achieve this before. This is **an outstanding achievement** that unlocks the new value that DLT can bring to businesses and other organizations across the globe.

2.2 SUCCESS STORIES, BEST PRACTICES AND LESSONS LEARNED FROM THE OPEN CALL INNOVATION EXPERIMENTS

As previously mentioned, the current reporting period is characterized by several OC, however, this deliverable is presenting achievements of those experiments that have submitted either midterm or final progress reports by M36 (October 2020). Lessons learned are collected from 26 IEs and presented below. Also, to comprehend the context of each success story arising from a specific OC, a brief description of each OC is provided below, without going into too many details as *D 2.6-2, Periodic reports on SAHs network expansion by the Open Calls* will look in more details into each OC separately.

2.2.1 RESPOND OC SMEs

Open call organized as a pan-European online Challenge calling for SMEs to RESPOND to the effects of the crisis and use potential opportunities to fight against the CORONA COVID-19 pandemic, from the perspective of how digital innovation can contribute to minimizing the consequences of the crisis to the European agri-food economy. Smart Agri Hubs RESPOND open call focuses on the organization and realization of hackathon type of activities and the proposal of immediate technological solutions that will RESPOND to the effects of the COVID-19 crisis and use potential opportunities to fight against the pandemic. Solutions must be

directly proposed by SMEs and have a clear pan-European added value and well-documented potential for rapid replication.

Eight projects have been approved for financing within this OC. The shortest project lasted for four months, while the longest one was implemented for eight months. All projects have been finalized and shared their lessons learned:

1. **WiziFarm Mission - Matching platform for agricultural skills** project began on the 1st of July 2020 and lasted until the 31st of December 2020. The objective of this project was to improve the recruitment experience in agriculture and in particular for seasonal recruitment in France, by developing a multifunctional platform.

2. **Connecting Food's ROOTS platform - ROOTS** project lasted from July 2020 to the end of December 2020. The aim was to adapt an existing B2B blockchain platform in order to quickly onboard producers and retailers and increase the local sourcing of products. The digital auditing technology will also certify product origins, identifying in real-time anomalies affecting food safety, and reassuring consumers in their local food systems.

3. **SMART FRUIT PACKER ROBOT - ROCKET** project lasted from July to the end of December 2020. Within this project, the end effector – gripper with a double suction area and a new design of flexible adaptor pieces was developed. 3D printed elements of a soft touch to apple and pear fruit pieces and at the same time have a good fixed horizontal grip for high-speed movement and impact for acceleration and stop. The goal is to achieve up to 60 picks per minute (High-speed fruit handling).

4. **FarmSuite - The first farmer-friendly digital platform tailored to organic food systems,** the project lasted from August 14th, 2020, to 31st of March 2021. The main idea was the creation of a platform allowing farmers to become more efficient and effective in managing online sales of their products, which have consistently increased due to the Covid-19 pandemic. The main objectives of our project are:
    - Adaptable, affordable, and ready-to-use toolkit for farmers to enter – or improve their presence in – the online marketplace
    - Develop new sales channels for farmers
    - Give farmers tools to efficiently manage their sales-related workflow
    - Support farmers in developing an effective online communication strategy

5. **Digital transformation of SMEs in agri-food sector - SOSTENIBL.se**, the project lasted from August to the end of December 2020. The main objective of this project was to open digital and direct sales channels for SMEs in the agri-food sector and bring visibility to small farmers and producers, while fostering short and more transparent food supply chains, where end-customers have access to local food and can buy directly from small producers.

6. **Close-Cow-Care - Software that enables the farm vet to closer support dairy farmers in managing cow health and production.** The project lasted from September until the end of December 2020. The main objective of this project was to enable farm veterinarians to get better insight in the actual, today's, situation on a client dairy farm, in order to support the veterinarian in assisting the dairy farm in keeping the herd healthy and productive. This also includes guarding animal welfare.

7. **Cooperative digital platform for farm to fork - CODIPLAF2F** project lasted from July 2020 till December 2020. Within this project, a blockchain technology has been developed, for full traceability of the products. After the end of the project, about 200 farms kept using the platform, as it allows them to sell their products directly to customers, online.

8. **FLOX-cam - Remote visual inspection of poultry farms – improving bird welfare and performance in a post-COVID-19 world** project lasted from September till the end of December 2020. During the project lifetime, 'FLOX-box' edge processors were assembled and deployed, together with overhead cameras, to the farms. The software part of the project was an app that will collect the high-resolution images from deployed hardware and help farmers effectively manage their flock.

2.2.1.1 Lessons learned

WiziFarm Mission identified the importance of being well advised in terms of regulations and legal frameworks, as the main lesson learned during the project lifetime.

Connecting Food's ROOTS platform reported that the biggest lesson learned concerned the importance of keeping continuous communication with all stakeholders, as their needs may change over the project development period. It is best to learn this information immediately, as it allows for decisions and adaptations to be made, instead of developing a product that in the end will not fit their needs.

SMART FRUIT PACKER ROBOT – ROCKET learned that it is highly important to involve growers and inspectors at an earlier stage in the interpretation of the trade standard and that the impact in time for training the neural nets should not be underestimated.

FarmSuite identified an important lesson about how essential is to reflect on what the outcome of the last months of the work was and what is envisioned for the future of FarmSuite. Thanks to the opportunity given by SAHs, this SME embarked on a journey to build a platform that could finally answer the needs of small and medium organic farms in the Italian market. This journey taught the team that they need for digitalization of the Italian organic farming world is very high. Small and medium farms usually don't have an online presence, and even if they do, they rarely have an online store. The few farms that have a functioning online store often rely on expensive solutions that are not specific to food and FarmSuite is the attempt to answer the need for farm-specific and fairly priced solutions to enter the online market. This project fits a larger ecosystem of work carried out by AIAB Srl, aimed at strengthening the organic agriculture sector in Italy; consequently, it is possible to say that the results obtained in this project are only a starting point. The team learned that putting together the software developing world and the agriculture world is a very challenging yet stimulating endeavor. This encounter was proficuous and they are now planning to consolidate on what has been created, to carry on the development of the platform, and to strengthen the network of farms and consumers that is being built up around it. The FarmSuite team also learned that both farmers and consumers need and desire fair, direct, and efficient sales channels; FarmSuite and terre.bio will offer concrete solutions to both producers (who wants to improve their farms) and to consumers (who are looking for certified organic products): as a result, local, ethical and sustainable food systems will be created and strengthened.

Feedback proved to the **SOSTENIBL.se** solution showed that the solution is very valuable and needed by micro and SMEs in the agri-food sector. It became clear that SMEs need support and initiatives to be able to take advantage of the opportunities that the online channel represents. The participatory and user-centric approach applied along with the project, inspired in design thinking methodologies, enabled us to establish a trusted and closer relationship with participant SMEs, and laid the foundations for open collaboration. Their eager participation, their feedback, and inputs benefitted the project greatly. Close contact developed with SMEs in all phases of the project helped to identify key challenges they face, which might present opportunities for innovative solutions to be developed. One topic that remains of critical importance is logistics. Not only it is core for SOSTENIBL.se, but also a barrier for SMEs to access the market directly. This barrier is more pronounced for SMEs located in rural areas. SOSTENIBL.se expressed the will to dig deeper and explore alliances and partnerships to identify innovative logistics models, as well as solutions to enhance logistics coverage in rural areas.

Close-Cow-Care – Software learned that the development of a functional app is a complex process, which must be thoroughly planned ahead.

Automating hub onboarding means hubs can onboard faster. Starting hubs do require some personal guidance with the 'practical' side of things during a start-up. **CODIPLAF2F** underestimated the time required to get this practical side going and will need to find a good way to deal with this in the future.

FLOX-cam learned that it is very important to have a formalized shed mapping process before installation, to outline biosecurity protocols, and to record the obstacles and dimensions of the shed. Another lesson learned is related to the interview methodology with farmers, which had to be improved, in order to facilitate a smooth communication and feedback exchange. The method was updated by firstly preparing loose questions on specific aspects of the system, to provide a loose structure but still leave room for a longer conversation. The second step is filling out the recording table, to ensure that no feedback on any features of the system has been missed.

2.2.1.2 Best practice – Example

Connecting Food's ROOTS platform

Within the SmartAgrihub RESPOND Call, Connecting Food presented a new version of their platform, aimed at producers working with retailers, that wish to prove their product's origins, in order to address consumers', need for fresh and local food, that the pandemic underlined.

The blockchain platform ROOTS by Connecting Food was the winning project of the SmartAgriHubs RESPOND Open Call, as voted as the most innovative project during the 2nd SAH webinar about the Covid-19 crisis, organized in November 2020.

Connecting Food's team stated that they already had an existing transparency platform based on blockchain, and very early on in the pandemic, they saw that supply chains were being very much impacted by COVID-19. They also saw that consumers were even more concerned with food safety than they were before and were seeking out products purchased locally. This motivated the team to think outside of the box and reflect on how the ROOTS platform could be adapted to fit the need of producers and retailers during these challenging times.

They were encouraged by Business France to participate in SAH OC, and they believed it was an opportunity to address the immediate need and respond to SAHs objectives of helping digitize food supply chains, ensure food safety and reassure consumers.
The purpose of this project is twofold: first, to restore consumer confidence in food systems, and second, to enable retailers to showcase where their products are really from and respond to the growing consumer demands for local foods. In general, food supply chains have been so shaken up by the increased sanitary restrictions, that food labelling has become more difficult, and retailers sometimes have trouble identifying which batch comes from which supplier. Using the Roots platform, they will now have that visibility when it comes to tracking the origin of products in their store. In addition, they benefit from the LiveAudit® module, which provides real-time digital supply chain auditing, verifying that products are compliant at every single stage in the production process, and providing immediate alerts if they are not. And of course, the QR codes are a unique way to reconnect consumers with a product's origin and allow them to discover a product's entire journey, from farm to plate.

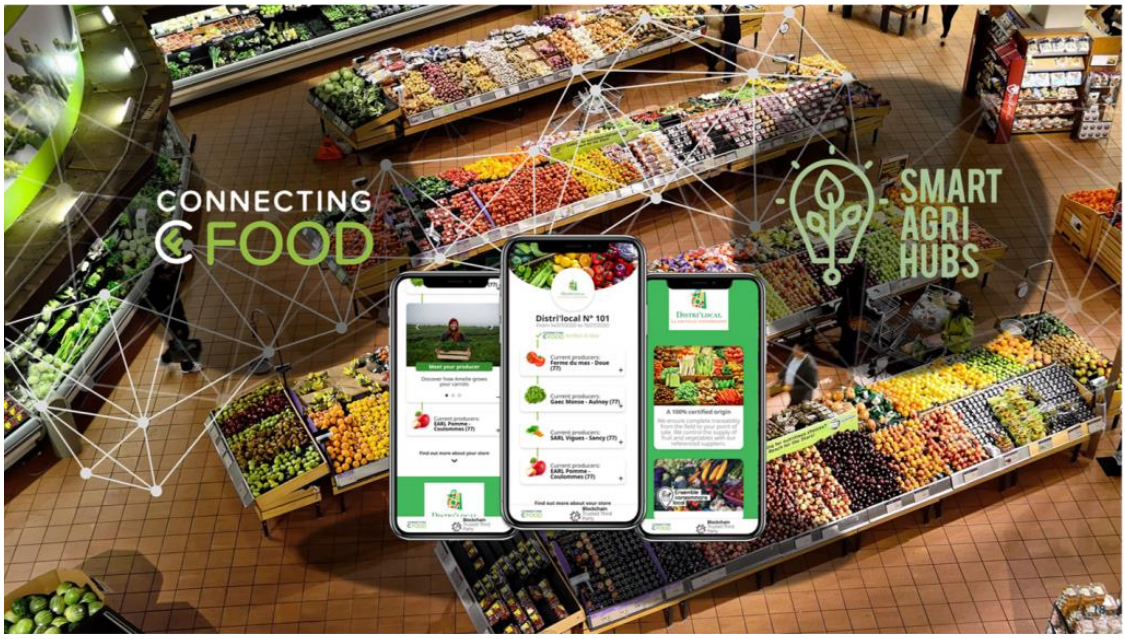

Figure 1 - The winning project of the SmartAgriHubs Call

Connecting Food's team is looking forward to supporting local farmers, reassuring more consumers regarding food sourcing and quality, and helping retailers ensure that 100% of their food sold is traceable. In order to achieve that, as many retailers and their providers as possible must get on board. To attract the attention of the agri-food sector, Connecting Food's platform offers many benefits for agri-food actors, such as:

- **PROVIDE PROOF OF YOUR COMMITMENTS**
  While all brands make promises to consumers on their packaging, very few currently allow them to verify for themselves that these commitments have been kept. Thanks to a QR code on our blockchain-traced products, consumers gain access to a product's entire journey, and can verify that the products have indeed been audited. Connecting Food thus provides direct proof that the product they have in their hands actually does meet its commitments, creating a relationship of trust and strengthening consumer brand preferences.
- **COMMUNICATE POSITIVELY AND PROACTIVELY**

From agri-bashing to retailer-bashing, there is an urgent need today for both sectors need to promote their collective efforts and to highlight the men and women working to feed our planet every day. The Connecting Food web-app provides an ideal tool to reconnect consumers with the producers who actually made the product they have in their hands. We help food brands shift from storytelling to the marketing of truth.

- **STAND OUT FROM YOUR COMPETITORS**
  Growing consumer demands for transparency are impacting the entire industry. In the B2B arena, both retailers and brands are looking for suppliers who can guarantee the origin, traceability, and quality of their products. Product specifications are becoming stricter, and proof of commitments are being required.
- **PROVE THE VALUE OF YOUR PRODUCTS**
  Today, 32% of consumers are willing to pay more for a truly transparent product (PWC study, 2020), particularly regarding origin and manufacturing methods. Connecting Food allows brands to offer total transparency, so that consumers can feel they are making educated choices and meaningful purchases.
- **ENSURE FOOD SAFETY**
  It is never pleasant to hear from a customer that the product delivered did not meet specifications. Yet error is human; unlike LiveAudit®, our audit module, which is 100% digital. By detecting non-conformities as soon as they occur, and alerting you immediately, Connecting Food allows you to improve food safety and product quality.
- **REDUCE PRODUCT RECALLS**
  The numerous product recalls of the past years are in large part responsible for the lagging consumer confidence in the food industry. By ensuring real-time traceability and applying the LiveAudit® module, we allow food brands, manufacturers, and retailers to drastically reduce the risk of a recall.
- **MANAGE YOUR FOOD-CHAINS EFFICIENTLY**
  In order to meet customer product specifications, cooperatives must certify internally that their producers meet certain required criteria. This is why Connecting Food has built a "Contract Eligibility Management" module that allows for real-time verification of a producer's eligibility for a given product specification, and this for hundreds of indicators! This provides both time and efficiency gains in terms of producer management.
- **CONDUCT TRACEBILITY EXERCISES IN SECONDS**
  From raw materials to finished products in-store, the concept of a "batch number" can take on different identities depending on the stage of production and the number of entities involved. This means that during a traceability exercise, teams can take several hours (or even days!) to trace back the exact history of a batch. The Connecting Food platform allows you to do this in just a few minutes, by linking products together and giving you visibility into batch movements throughout all stages of production.
- **REDUCE INDUSTRIAL FOOD WASTE**
  67% of the world's food waste takes place before a product even arrives in store! Issues with the calibre or product appearance, breaks in the cold chain, or damages along the way often cause products to end up directly in the dumpster, instead of being rerouted to other sectors. By identifying the channels for which a product is compliant, Connecting Food allows non-compliant products to be downgraded instead of discarded, thereby reducing industrial food waste.
- **SHARE ADDED-VALUE ACROSS THE FOODCHAIN**
  Consumers often want to know how much of the price they pay is actually paid to the producer. In order to compensate them for sharing their data, the Connecting Food

platform allows farmers to be rewarded for their transparency. Brands can also use the web-app to communicate fair-pay and fair-trade information to the end-consumer.

2.2.2 RESPOND OC DIHs

Open call for DIHs is for hackathon type of activities that will RESPOND to the effects of the COVID-19 crisis and use potential opportunities to fight against the COVID-19 pandemic from the perspective of how digital innovation can contribute to mitigate consequences in the agri-food domain. Such activities can be specifically:

- On-line Hackathons
- Focused Challenges
- Datathons

13 projects have been awarded within this OC. The shortest project lasted for four months, whereas the longest ones were six months. All projects are finalized within the second reporting period, and have shared their lessons learned:

1. **HACK4FOOD - TO FEED THE FUTURE - H4F** – Hack4Food was a 2-day event that took place on October 9th and 10th, 2020. Hackathon was organized by Innovacoop, an Italian DIH, had 84 applicants, 44 selected and divided into 10 teams, 19 stakeholders were involved from the beginning. The Hack4Food initiative aimed at stimulating the development of innovative solutions, based on the application of digital technologies, to tackle the most crucial issues that have emerged in the global pandemic in the Emilia-Romagna agri-food sector. The hackathon focused on ideas to respond to three challenges faced today by the sector:
    - Efficiency, transparency, traceability of food supply chains for safe and quality foods;
    - Prevention of waste in the agri-food chain;
    - Management of food surpluses for the benefit of the most fragile sections of the population.

    Proposals covered topics such as training for small farm holders, low-cost precision agriculture using machinery and robotics, open-source machine learning or urban agriculture. Finally, 3 winners were awarded.

Figure 2 - HACK4FOOD participants (Screenshot)

2. **Solutions that strengthen the supply-demand relationship along the agri-food chain based on circular economy and last mile delivery strategies in times of COVID-19 - Strenght AgriChain –** a challenge event, organized in October and November 2020, by DIH consortium (DIH-ITK + Andalucia Agrotech DIH + Polo of Digital contents of Malaga), with a purpose to tackle a burning topic: Solutions that strengthen the supply-demand relationship along the agri-food chain based on circular economy and last mile delivery strategies in times of COVID-19. A total of 36 ideas have been presented, of which the organizers have selected ten, mainly digital platforms through which buying / selling is encouraged. Finally, e teams were awarded as winners.

3. **Agri-food solutions using island-centred design in three Islands, Canary Islands – Madeira Islands – Azores Islands - Agrisland Hackathon.** This hackathon was dedicated to agri-food solutions using island-centred design in three Islands: Canary Islands, Madeira Islands, Azores Islands. The event was organized by Canary Islands Digital Innovation Hub (CIDIHUB), had 61 registered participants and 13 working solutions developed. The general Challenge was the enhancement of competitiveness through digital solutions that strengthen supply chains within the agri-food sector. Finally, 3 teams were selected as winners.

Figure 3 - Agrisland event (Screenshot)

4. **LONG LIFE TO SAFE FRESH - What to start and accelerate? - LL2FRESH** – a challenge, organized by two DIHs (COTHN-CC - DIH and INESTEC – CC), conducted online through 10 events, with the final event on the 17th of December 2020. LL2FRESH as a co-creation program selected 10 projects that defined a practical approach to reveal new solutions. For 3 months, projects had the opportunity to work together with companies and stakeholders to develop and demonstrate the value of their solutions. The program selected three distinct projects that will receive advisory services and access to an exclusive network of stakeholders and experts, including a lump sum of 2,400 euros.

5. **Hack AgriFood 2020: RESPOND to the COVID-19 crisis - HACK'20 -** International event organized by AgriFood Lithuania DIH, was consisting of two online events: - expert innovators hackathon that took place between October 13 - November 22, 2020, and a two-day beginner innovators hackathon with the period of November 21-22, 2020. A total of 35 teams were selected and invited to partake in the two events - 11 beginner international teams and 24 expert teams selected (101 individual participants). As a result, 6 teams were nominated for the final session and awarded, three from each hackathon event. All the challenges of the hackathon were real problems of AgriFood companies from Lithuania, Latvia, Spain and Austria. For the international online hackathon, the topics were focused on local food supply networks, utilizing production side streams, smart food packaging, solving last-mile delivery.
   For the regional online hackathon, the topics were AI solutions in agri-food, reducing food loss and food waste, crisis-adverse horticulture, mitigating labour shortage, smart animal husbandry, side stream valorisation and boosting local production.

Figure 4 - HACK'20 participants (Screenshot)

6. **The COVID 19 INSPIRE Hackathon 2020 - Plan4All – INSPIRE –** is a hackathon, organized by Plan4all (an NGO) and Czech Center for Science and Society. Both stages of the event – the hacking stage and the final stage – took place in the period between October 15th and November 30th, 2020. Event gathered more than 130 registered participants from 32 different countries, who worked on the following ideas:
    - Best practices catalogue for EBAG (eco-, bio-, agro-, geo-) distance education
    - Atlas of Regional Specialities
    - Citizens Science Network for Peer-to-Peer Maps Sharing
    - Rural Attractiveness Visualization
    - WhiteBoard - Future Collaborative Maps
    - Atlas of the Best Practices - Polirural cases
    - Developing a blockchain technology to enhance tracking and tracing of food items throughout the value chain to ensure food security in Africa
    - Digitalization of indigenous knowledge in African agriculture for fostering food security
    - Production and Agri Logistics chain Cyber Assurance solutions
    - Sustainable solution to chronic diseases like diabetes through organic farming
    - Earth Observation for monitoring of regional food supplies deviations
    - Atlas of Social Enterprises
    - Calculation of agro-climatic factors - potential source of information for forecasting regional food supplies

    Finally, three winners were selected.

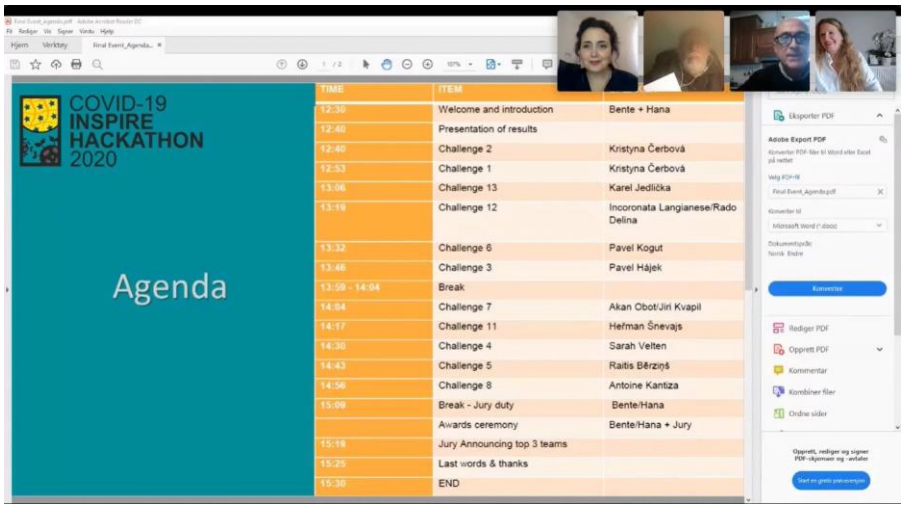

Figure 5 - COVID-19 INSPIRE Hackathon 2020 agenda (Screenshot)

7. **Improve short food supply chains management through digital innovations - FoodLog Proximity**. This maturation workshop had a goal to improve short food-supply chains management through digital innovations, and was organized by Agri Sud-Ouest Innovation (DIH), Digital 113, and We4log. The event was initially planned in Toulouse on the 13th of November, but it was held online due to COVID-19. The members of the consortium composed 6 groups, according to the solutions proposed by the companies, to work together on the following ideas:
    - **Group 1:** Animated by ASOI and "Chambre d'agriculture du Tarn worked on 'Optimization of the farmers' marketplace for the "Chambre d'Agriculture"
    - **Group 2:** Animated by D113 and Minjat worked on a platform for pooling supplies between actors in short food supply chains with shared sourcing.
    - **Group 3:** Animated by We4log and Region Occitanie worked on logistical optimization of the regional purchasing for the collective catering.
    - **Group 4:** Animated by ASOI and "Marché d'Intérêt National" Montpellier worked on the massification, and optimization of food redistribution flows in the Montpellier metropolitan area.
    - **Group 5:** Animated by ASOI and Drive fermier Toulousain worked on the development of a logistical tool to coordinate different collection points as part of a farmer's drive marketplace on the scale of the metropolis of Toulouse.
    - **Group 6:** Animated by ASOI and Consign'up worked on an IT management tool for efficient logistics supporting the return of the consignment in Occitanie.

    Each workshop was animated by a member of the consortium and at the end if the event, three teams were awarded.

8. **Resilience through Automation and Digital Acceleration in Response to COVID-19 – RADAR –** This hackathon was organized by Agri-EPI Centre (DIH) and had two challenges: Digital Diagnosis and Automating Field Operations for Horticulture. The hackathon focused on the horticulture and livestock/veterinary sectors. 48 participants were divided into 12 teams, and had a 12-hour duration of the hackathon, on 23 and 24 September 2020, to come up with proposed technical solutions within their chosen stream. Finally, two teams were selected as winners (one

per challenge), and they will each become the focus of the year-long 'product launch programme' delivered by Agri-EPI.

9. **Hacking sustainable, safe and environmentally friendly food production and supply in SEE as a fight against pandemic scenarios - FARM2FORK HACK**. This hackathon was organized by Innovation Technology Cluster, and during the main event (conducted online on November 24th as a part of the Agrobiznis conference on 5th New technologies in agriculture) 20 pitch presentations were published. The Farm2Fork Hack participation was open for any European solution provider (Startups and SMEs), innovator and enthusiast (working under the legal entity), being able to propose an innovative and implementable solution, which will result in (i) minimizing the negative effects of the COVID pandemic or (ii) increase resilience of the food production and food supply systems in pandemic situations. There were three winning proposals.

Figure 6 - FARM2FORK HACK: presentation of the winning solution (Screenshot)

10. **Cre'active marathon to find solutions to local food chain problems emerging from the COVID-19 crisis - Hack[72h]** was organized by CRAPDL DIH and included two sessions - first online session on the 09th of December 2020, and second session on the 08th of January 2021. 29 people registered for the event, either as participants or as potential team leaders. Their profiles were: entrepreneurs, students, farm advisors and citizens. There was a list of topics to be worked on during the event:
    - **Topic 1**: Consuming locally sourced products: during the first lockdown, we saw an increased interest from the general public for locally source products. how to maintain the attractivity of locally source products? How to encourage local public/private partnerships? How can we optimize the logistics of local food supply chains?
    - **Topic 2:** Diversification and communication: Highly specialized companies and producers with a single outlet found themselves deprived of their preferred market overnight. Events and fairs were cancelled, and other channels had to be set up to maintain networking and allow sales pitches to take place. How to anticipate and manage the crisis? How to assist producers in diversifying their sources of income?

- **Topic 3:** Organisation and well-being: French supply chains include players of very different sizes. In smaller organizations, one individual could have to wear multiple hats, from marketing to production. How can SMEs better manage their work-life balance? How can we help farmers to take some rest, improve their mindset and motivate them?

Four different solutions for initially identified problems emerged from this event, but only two were awarded.

11. **RO AgriFood Hacking – HAR 2020** – organized by APAR (Asociatia Pentru Promovarea Alimentului Romanesc) DIH, took place between 14th and 15th of November 2020. The primary objective of the RO Agri-Food Hacking - HAR 2020 is to generate immediate solutions that will RESPOND to the effects of the COVID-19 crisis and use potential opportunities to fight against the pandemic for the agri-food system. The second goal is to mobilize practical innovative digital solutions that tackle current deficient barriers of the Romanian agri-food environment using technology and software. In the end, 12 innovative solutions were developed.
    During the final event, 10 finalist teams presented 12 solutions, the jury announced three hackathon winners, and one special prize was awarded (Mentors Award).

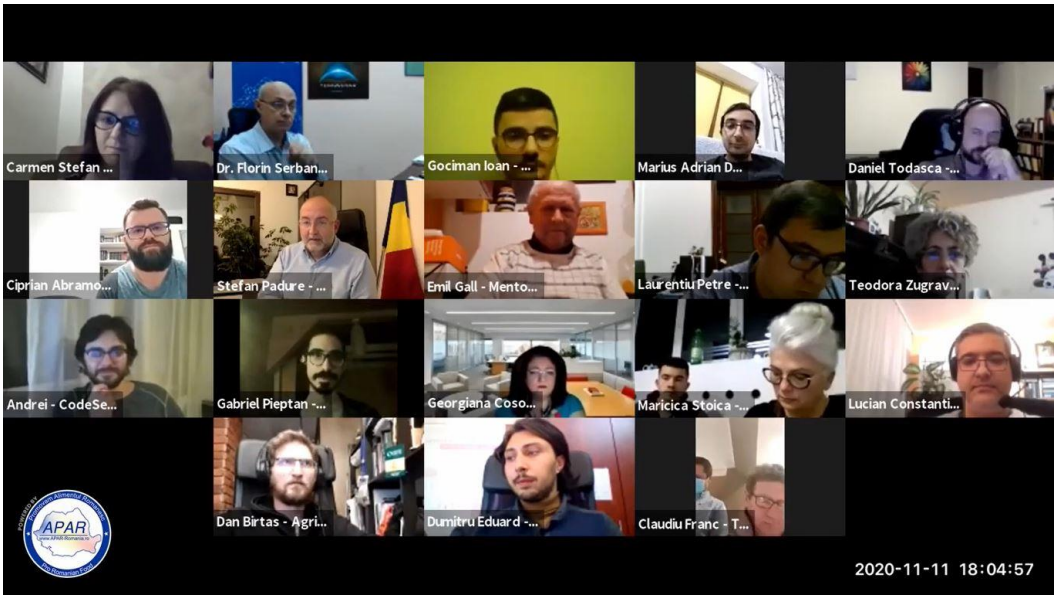

Figure 7 - HAR2020 participants (Screenshot)

12. **Farmhack: Innovations Generated through hackathon – Tackling –** the event "F:IGHT against Corona" was organized by Innovate GmbH, and conducted as an online event, with 79 participants and 4 awarded solutions. The core challenges offered during the hackathon focused on digital solutions designed to address challenges in the agricultural industry in particular: Optimizing hygiene processes in slaughterhouses, staff shortages in harvesting specialty crops, short-term fluctuations in demand for French fries and meat products, and the problem of food waste in the restaurant industry.

13. **The future of farm to fork - 3F –** this hackathon was aiming to provide digital solutions for short food chains. The event was conducted online, on December 4th and

5th 2020, with 4 main challenges identified (it was also possible for the teams to propose their own topic in their application to the competition.:

- The first topic was focusing on transparency and access to information. How can we provide consumers with tools to verify the high quality of delivered products?
- The second topic focused on how to enable consumers to find out about suppliers offering different products.
- The third hackathon topic was to create a new channel for farmers and food producers to reach new target groups.
- The last topic was to connect farmers with customers and customers with farmers, by providing constantly updated offers with the presentation of real products.

Two winners were awarded at the end of the event.

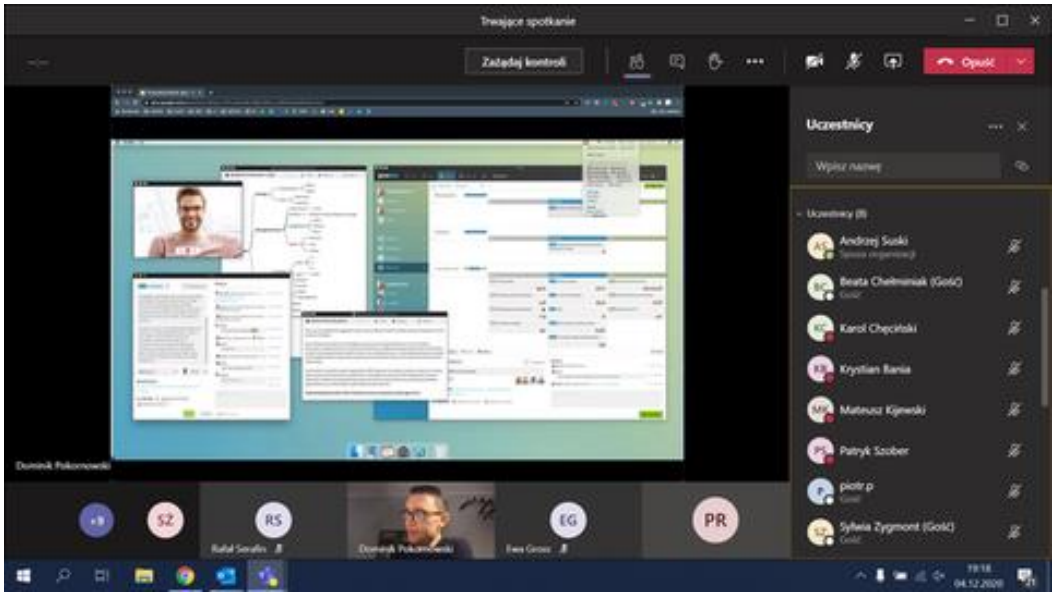

Figure 8 - Showcasing the winners of 3F hackathon (Screenshot)

2.2.2.1 RESPOND DIHs lessons learned

Key lessons learned for **H4F** team, are related to the involvement of different stakeholders. In some cases, it was difficult to attract relevant stakeholders to participate in the hackathon, as the word "hackathon" is not so well understood in traditional fields as agriculture. In addition, the COVID-19 situation didn't allow an intensive and in person activity of matching and knowledge exchange between persons involved, but eventually, stakeholders' response was very good. The main reason is the persistence in explaining and educating the potential stakeholders about the great opportunities that hackathons offer and the knowledge-sharing concept, as a way for improvements.

Strength AgriChain reported several lessons learned during the project. The first one is related to the dissemination of the events – it was learned that the dissemination phase must start long before the challenge begins, as people need some time to comprehend the information.

Another important lesson is related to the website domain - .eu extension requires an official verification, which means the landing page of the website might be temporarily unavailable, while it's being checked.

The last valuable lesson to be highlighted is related to good communication among the consortium members. Usage of different communication channels (even unofficial messengers, like WhatssApp) was very helpful in achieving direct and fast communication, which can be essential for resolving issues in time.

While organizing and implementing the **Agrisland Hackathon**, the most important lesson learned was about the importance of planning ahead. A good plan is the key for successful implementation – the best way is to establish a simple roadmap to follow, and work through the arising issues one by one. If possible, the planning phase should be several months prior to the execution phase, and it should include checking of the planned steps also (double checking of the participation/availability of the experts, setups, issues with audio, internet connection, etc.).

LL2FRESH project learned that it is very easy to involve the stakeholders in defining the challenges, but it is not that easy to capture ideas. The reason for that may be the lack of relevance of the LL2FRESH program theme, which can be improved by giving more visibility to the network. Also, the value proposition of the programme is well understood from the point of view of the internal network, but it is not clear from the external point of view, so designing a way to propose clear relationships, between this kind of initiatives and the activities proposed, is the key solution.

A valuable lesson that was learned from the organization of **HACK'20 hackathon** is related to the creation of guidelines for partners, involved stakeholders and potential event participants in order to establish a common understanding with a large number of international and local partners involved. A significant amount of time and effort is needed to align all involved local and international parties to the same agenda, so early establishment of key procedures, requirements and organizational steps helps substantially in reducing misunderstandings. Clear guidelines must be created both for project partners and participants, at the very beginning of the preparation phase. Questions form expert innovator teams on the IP rights and possible collaboration with the SME's were resolved by creating and posting guidelines on the website.

Pan4All project reported that the key lesson learned from the organization of the event is that hackathons and individual challenges are a great way to bring together people from different disciplines, organisations and cultures to solve a problem together. Especially in the pandemic period, which established some new ways of communication and work as normal. This online way of communication will remain in society for a long time even after the end of the pandemic, and it is possible that many people will not return to face-to-face meetings. Therefore, this way of online communication needs to be developed and improved.
The main lesson learned by the consortium of **FoodLog Proximity** project concerns the difficulty of soliciting different actors (agriculture and digital/ local stakeholders and SMEs) who do not necessarily have the same interests. There was a need for mediation to bring these different sectors together. Each partner of the FLP consortium needed to be very pro-active to communicate about this project towards its members and to create discussions between these actors and to develop projects.
Another lesson is related to the need to involve the challenge providers. In addition to the definition of their needs, they must also be involved in the follow-up of the project and define what they can do in order to ensure the success of the project.

Some of the key lessons learned within the **RADAR project** implementation period, are related to the planning and the implementation of the events, and they include the following:

- heavy promotion of the hackathon outcomes to all relevant stakeholders;
- setting-up regular one-to-ones with each team to ensure continuous support for launching the technology;

- hackathon judges should have first-hand practical experience so they can provide valuable feedback to the participants;
- providing simplified score sheets for the judges and provide them with more time between solution pitches;
- ensuring that there are contingency plans in place for each support activity that is offered to each winning team;
- ensuring that there is a 'kick-off' meeting held with all participants at the beginning of each hackathon day. This will ensure that teams are reminded of the rules and provide focus to the teams around the challenge.

Farm2Fork hack project provided an excellent lesson regarding the importance of collaboration among different actors, such as the hackathon start-ups and SMEs, partners of the project, mentors, expert commissions – evaluators, and a group of people behind the whole process who provided background support on communication, technology, and promotion. COVID-19 pandemic was a major challenge, since it made it more difficult to convince innovators, organizations, enthusiasts to apply to the event. Joint forces of all aforementioned actors were the key for success, as positive feedback from the participants can confirm.

As reported in the mid-term report, the main lesson learned within the first reporting period of **the HACK [72h]** was related to event planning and preparation. Organization of a hackathon session and recruitment of participants requires time. The limited time frame for this project, including the summer period, was a constraint and the initial workplan did not take sufficient care for this. However, the final report confirms that precise timing and preparation of facilitation material, together with sufficient staff to support the participants both on the content and on the online tools access, as well as the inevitable technical mishaps, are essential for having a well-functioning participatory approach for group meetings and brainstorming online.

A key lesson learned within the **RO AgriFood Hacking – HAR 2020** project's lifetime concerns the importance of good collaboration among the consortium partners. Open communication, flexibility and willingness to assist in different situations, are the first condition that must be met for the event to be successful.

While planning and organizing **"F:IGHT against Corona"** hackathon, several important lessons were learned and reported. They are all related to basic planning of the activities, and the importance of good communication and collaboration among the actors:

- Additional personnel capacities should always be planned ahead;
- Schedules need room for adjustment, as interactive parts are difficult to estimate in terms of time;
- it is important to talk to the experts before defining thematic focuses, so that it can be ensured later on that the thematic focus is chosen correctly and that appropriate challenges can actually be generated;
- it is helpful to involve a suitable moderator in the planning at an early stage. Since this moderator is significantly involved in the execution of the hackathon, you can save resources and work in a more targeted manner than if you had to reschedule later;
- the open exchange with partners on topics and objectives of the activities integrates them into the planning at an early stage and ensures valuable support.

Foremost lessons taken from this reporting period of the **FarmHack project**, regard the timing of the event itself and the recruitment process. As hackathon-type events attract mostly young students seeking the opportunity to test their abilities, the communication should have been more student-oriented. It is also reported that the key role for attracting

the participants was played by established partnerships, which confirmed the already existing assumption of the importance of partnership relations in such initiatives.

2.2.2.2 Best practice – Example

The starting point of this project was the creation of a common ground for collaboration between DIHs and Clusters, as opposed to having a competitor approach, as it tends to be in practice. The collaborative approach brought multiple advantages resulting in fruitful collaborations and excellent final outcomes.

Six different clusters, from different regions and fifteen member states were involved within the process, with the participation of 135 end users from the agri-food sector. These results were achieved by clusters engagement to bring SMEs with challenges. Proposals involved a wide range of local and international agri-food sector stakeholders – end-users (farmers, cooperatives, agriculture, and food industry companies, representative organizations), agrifood-focused DIHs and clusters from around Europe, research centers, public agencies, and governmental institutions.

The event was organised online, which was a challenge of its own. The hackathon latest for four months and was organised on two levels:

- on-line expert event connecting mature teams/innovators/experts with SMEs (challenge owners), while working on a specific problem. 24 teams in total (73 individual participants) were selected and invited to partake in the hackathon and were supported during a 6-week period via regular mentorship, workshops, webinars and individual consultations with the help of 32 mentors and jury members. The goal was to create implementable products for real SME challenges. Teams from other non-EU counties also took part.
- beginner innovators hackathon attracting students and early investors was a two-day event (from November 21-22, 2020) with participant teams from Lithuania and neighbouring countries with the aim to solve the most important challenges in the agri-food sector. A total of 11 teams (28 individual participants) were selected and invited to partake in the hackathon and were supported via regular mentorship, workshops, webinars and individual consultations with the help of 32 mentors and jury members.

As a result, participants from ten countries, three continents and six agri-food sector clusters took part.

Teams worked on 27 challenges in total that are related to the Covid19 crisis. At least seven innovative solutions with minimum viable product phase were made and eleven with the conceptual implementation phases.

On November 26, 6 nominated teams, from both events, pitched their finalized solutions during the *AgriFood Forum* to an audience of leading local and international agri-food sector stakeholders (policymakers, business leaders, researchers, innovators, and domain experts), with final rankings and winners announced, and an award ceremony held.

In terms of dissemination and outreach, 1800 participants have seen the final results of the hackathon at the ceremony introducing finalists, winners, and products created. Six teams selected for further acceleration will be supported after the project end, while the organisation is already working closely with three teams that are improving rapidly. The other three teams are working on the product improvements.

Hackathon results have been communicated by clusters that are part of the network, resulting in 1 million unique viewers.

Three different articles were published in national media and two in international media, and one radio interview in the national language.

The event proved that not only short hackathon events can be successful, but also other approaches as demonstrated within this project. Online events are beneficial as they can attract more expert teams and start-ups, while engaging and bringing stakeholders from many different countries. While organisation and preparation of the event, as well as monitoring of teams, is a complex process, it proves to bring results beyond expected.

Figure 9 - HACK'20 winners

2.2.3 EXPAND OC

This OC is for projects that are proposing initiatives of DIHs that propose a thorough strategy to support the digital innovation in their region and facilitate the set-up and realization of IEs, equipped by own investments, and supported by additional public and/or private funding.

Besides the individual set up of IEs, it is considered of utmost importance that such supported initiatives:

- Validate the services offered by DIHs and Competence Centres (CCs)
- Facilitate experience exchange and critical the mass of the European Network of DIHs and CCs.

The funding that is provided by SAHs is exclusively available for developing, maturing, and providing DIH innovation services.

At the time of the deliverable submission, six OC projects have been approved for financing, three projects are at the very early stage, and three projects have delivered their mid-term progress reports. The shortest one is lasting for eight months, while the longest one is being implemented for 18 months. These projects have shared their success stories and lessons learned:

Expand 1 - Smart palletization system for the optimization in winery logistics (IntelWines): started in February 2021 and will last until January 2022. The aim of this project is to reduce uncertainty in all wine producing processes, by exercising greater control over all the determining factors, and setting up an automatic response that minimizes variability in the final product. This goal will be reached with advance research and development in the field of precise viticulture technologies, new models that bring winemaking closer to the demands of consumption, and food safety that incorporate hybrid algorithms of artificial intelligence and Deep Reinforcement Learning.

Expand 2 - Development of "win-win-win" business model for potato ecosystem: this project started in February 2021 and will last until the end of July 2022. Within this project, the new digital innovation hub ODYC will develop and mature its services to support the realisation of a specific Innovation Experiment: a crucial and ready to start Belgian initiative called POTCHAIN (innovation experiment, IE). This IE will finally bring & convince all actors to engage in digitization by creating new digital business models in the potato production sector in combination with a smart harvester.

Expand 4 - Expanding and linking the Farm2Fork network to serve large canteens: the IE is set up in Belgium, Flanders and will run from May 2021 to December 2021. This project is focused on the following:

- Support F2F hubs in gradually setting up a local pilot in three different locations: Ghent with the hub VANIER, Leuven with the hub KORTOM, Brussels with the hub CURIEUSENEUS. The DIH will support the hubs for their F2F logistic supply to local Sodexo canteens.
- Disseminate the learnings and share knowledge to successfully upgrade these pilots to a dedicated Sodexo platform (centralized ordering; decentralized logistics).
- Connect the partners by setting up the first steps for a Warehouse Management System (WMS) and product transformation through social workplaces (vegetable washing and cutting, re-packing of bulk products…) in collaboration with Sociaago.

2.2.3.1 EXPAND success stories and lessons learned

The main success of **IntelWines project** is the possibility to demonstrate that the palletization optimization problem can reach a point of balance between the effort of the workers and the benefit provided by artificial intelligence. Thanks to the EXPAND OC, viticulture workers are being equipped with digital skills, through this new technology – augmented reality applications and mobile devices in their daily work environment.

The lesson that has been learned during the project is that achievements such as the reduction of packaging materials and the improvement of workers' ergonomics at their workstations, can be provided by the application of digital solutions.

Specific lessons learned during the **"WIN-WIN-WIN"** project are related to solution testing – in the R&D lab environment and in the field. The best option would be agile development of the solution, between lab and real-world environment. Another valuable lesson concerns partnerships and the importance of establishing good partnerships and interactions with all stakeholders, since farmers, who are testing the app are providing important feedback for solution improvements.

This project reported on two success stories: the first one is the involvement of the potato industry in the data-sharing economy, and the second one concerns the improvement of the state of the art of sensor techniques able to measure the potato calibre sizes in a cost-efficient manner.

Linking decentralized local farms with a centralized organization, such as SODEXO, is the main success of the **"Expanding and linking the Farm2Fork network"** experiment. By elaborating food safety standards and procedures, or by writing an onboarding procedure for farms, the Farm2Fork sector is getting more professional and reliable, and this upscaling image for Farm2Fork is created thanks to the fact that DIH and large catering groups are involved in the project.

An important lesson learned is that DIH plays a key facilitation role in IE, and that different community building sessions and Peer Exchanges, organised by SAH, are key for the exchange of knowledge.

2.2.4 RESTART OC

The topic of the open call is the organization of hackathon type of activities, that will contribute to RESTART of the European Agri-Food Economy with short and medium-term impact to mitigate the effects of the COVID-19 crisis. The OC is for one or several DIHs, as potential proposers.

The activities can be specifically:

- Online & offline Hackathons
- Focused Challenges
- Datathons

At the time of the deliverable submission, five projects have been awarded within this OC. Three are at the very early stage, one project is finalized, and the final progress report is submitted, while one project is still ongoing, and therefore the mid-term progress report was submitted by the time of this deliverable.

Restart1: Platform "ON:E Agrar" Online-Events for Food & Agrar Innovations is finalized and lasted for five months, from 1.2-30.06.2021. This project worked on the development of a platform to support online events and collaboration between innovative actors in the agri-food domain, allowing interactions during the time of Covid19.

Restart4: StrikeTwo 2021 - Opening the future of food is an ongoing project that has started on 29.03. 2021 and will last for 12 months - until 29.03.2022. This is a four-day accelerator programme focused on the use of technology to secure the future of the food system (and the support activities surrounding this). The three unique traits of StrikeTwo are:

1. Uniting the entire ecosystem

2. Focused on real problems with matching technologies
3. Resulting in collaboration and collective execution.

2.2.4.1 RESTART success stories and lessons learned

The **main lessons learned for the "ON:E Agrar**" experiment are related to the strategic approach resulting in a quick increasement of viewers. Namely, they have learned that well known interview partners are a crucial element to increasing the number of viewers, as their popularity will result in further mobilization of new followers. **On a more technical side**, lessons learned are related to user behaviour – it is reported that attendees will switch off quickly and interact little when the sound is disturbed. Also, it is important to avoid bad/blurry visuals and therefore a rehearsal must be carried out before each show. A good example of a success story relates to the application of inexpensive and simple methods expanding the project scope. Namely, in addition to the creation of a platform for a new digital event experience, a playground for innovations and innovators was developed. Thanks to some very innovative personalities who joined IE presentation sessions, and presented their product and themselves as ideas providers, the motivation behind the invention was understood and understanding large "impact" that it could have.

As reported **by StrikeTwo IE, the most important lesson learned** is related to the planning of the activities and experiment implementation. Unforeseen risks and obstacles can create major issues in the predicted timeline, so it is very important to think ahead. Many adaptions to the planning of StrikeTwo had to be done, since unexpected changes within the team delayed some of the deliverables. Also, COVID-19 pandemics had a big impact on the timeline, making it hard to get potential track owners to commit to owning a track, since they are not clear on what their urgencies and priorities will be in the next period, delaying the announcement of the tracks and the invitation of track participants. Overcoming the aforementioned obstacles is **the greatest success** reported by this IE, since the COVID 19 period was survived with the enthusiasm and hard work of the team, partners and the committee.

3. CONCLUSIONS

After analysing the lessons learned, best practices and success stories reported by FIEs and IEs within the current reporting period, we can identify some common lessons and successes reported by the majority:

Communication

Most of the experiments identified a good communication flow as a key to the successful implementation of all project activities. This concerns the communication:

- **within the consortium**, as it promotes flexibility and in-time assistance in different situations, which is essential for the successfulness of the project itself. It is recommended to use different communication channels, in order to establish direct and efficient communication;
- **with project partners**, preferably through weekly meetings, which are an excellent way to continuously debrief on bugs and arbitrate on priorities in order to finalize developments;
- **with end-users**, since sharing ideas and listening to their practical needs led to the continuous improvement of prototypes and digital solutions, addressing not only to a solid technical efficiency, but also to a very good user-friendliness. It is also important to use "friendly" language with farmers and other end-uses, since not all of them have the technical knowledge, and may not understand all terms. It is strongly recommended to implement an interview procedure for end-users, by preparing specific questions on specific aspects of the solution, to provide a basic structure, but still leave room for a longer conversation.

The majority of IEs noted that efficient communication between partners is something that might seem obvious, but it truly holds great importance in all types of experiments, where small delays or misconceptions can potentially damage the entire experimental run.

Planning and organization

A good implementation plan and well-organized activities are reported by most IEs as crucial for the successful conduction of events, demonstrations and the project as a whole. The most important lessons are related to:

- the **planning of the budget** more carefully, since it can prevent losses caused by unexpected situations (such as COVID-19 pandemic);
- thorough **planning of the project activities timeline**, as they can last longer than expected due to different circumstances. The best way is to establish a simple roadmap to follow, and work through the arising issues one by one;
- **planning of the hackathon or similar online sessions** (such as trainings or workshops) must include a heavy dissemination phase, preferably several months prior to the event, as people need some time to comprehend the information. It is strongly advised to prepare guidelines for partners, involved stakeholders and potential event participants in order to establish a common understanding with a large number of international and local actors involved. Also, it is helpful to involve a suitable moderator in the planning at an early stage, and a well-known interview partner, who can be a crucial element to increasing number of viewers and participants, as their popularity will result in further mobilization of interested individuals.

Most IEs that organized and conducted hackathons and challenges reported that their dedication to the event organization led to an overall IE success story – a successful event.

Technical lessons

Some valuable lessons drawn from the technical side of experiments are:

- when providing digital or physical solutions, it is important to **understand the existing business processes and systems in place** and to try and work with them, rather than trying to completely replace them;
- **agile development of the solution**, between lab and real-world environment, is identified as the best and the most efficient way, since it includes all types of conditions;
- carefully **choose the target group of end-users**. If the target group is not well chosen at the beginning of the development phase, many amendments may be necessary before the finalization of the solution;
- When it comes to reported technical success stories, each experiment reported specific examples, closely related to their solution/prototype/product. An example of this is a successful integration of permissioned (private) and public blockchain technologies, while no other technology provider has been able to achieve this before. An outstanding achievement unlocking new value that the company can bring to businesses and other organizations across the globe. Also, the ability to provide a proof-of-concept, in most cases at a reasonable price, and overcome technical difficulties, related to different data standardization or poor internet connection, is considered a success.

End-user's behaviour

By involving different end-users, such as farmers, growers, fishermen and aquaculture operators in experiments, and students, researchers, legislators in hackathon events, IEs learned valuable lessons on their behaviour:

- In Denmark, farmers showed a **lack of interest in finding out about European developments** and were not interested in exchanging ideas with other FIEs, since they had a language barrier (they usually don't speak English). It is preferred to communicate with end-users in their native language;
- fishermen and aquaculture operators are **highly motivated in adopting new solutions** that can improve their working conditions
- younger growers and farmers truly **felt comfortable accepting the new technology** and innovative digital solutions, if the benefits were clearly showcased;
- virtual event attendees **tend to switch off quickly and interact little** when the sound is disturbed. Also, it is important to avoid bad/blurry visuals and therefore a rehearsal must be carried out before each show

Success stories related to the end user's behaviour, in most cases, concern the mindset switch, once the solution is demonstrated to them. After giving clear proofs on how the solution can contribute to better decision making, or monitoring footprint, or increasing profit or lowering production costs, the majority of farmers/end-users became more open to innovations. Some IEs reported as a success the fact that they managed to train end users to use their solution, even if their initial interest was low.

Other

Besides the lessons categorized above, IEs had different valuable experiences, which were noted and highlighted within their mid-term and final reports:

- for most IEs, being a part of a large EU project like **SAH brought great opportunities**;
- it is highly important to be **well advised in terms of regulations** and legal frameworks;
- not all activities can be **replaced by online methods**, and establishing smooth cooperation between partners in a difficult communication situation;
- **measuring the KPIs** of the end product are very important, since they can identify if the product/solution is developing in a good direction;
- **hackathons and individual challenges** are a great way to bring together people from different disciplines, organisations and cultures to solve a problem together. Especially in the pandemic period, which established some new ways of communication.
- new projects and business opportunities arising for the success achieved within SAHs.

A **great overall success story**, which confirms the above-mentioned importance of being involved in EU projects like SAH, is reported by FIE20. This FIE submitted a proposal to the "FAO-ITU Call for Good practices in the field of digital agriculture in Europe and Central Asia" and in mid of March 2021 was selected as one of 360 projects to the WSIS Prizes 2021 from total of 1270 submitted proposals.

All gathered lessons and examples of success stories, should be treated as a list of recommendations, which should be translated into good practices in the further development of the SAH project, and should be of use to interested parties and new IEs, beyond the SAHs project. The second and the last version of the report is envisaged in M48 when best practices arising from the third reporting period will be presented, including new OC projects implemented as of M36.