D3.4 PERIODIC EVALUATION OF THE IES PERFORMANCE – V3

WP 3

30 November 2022

This is the public version of the deliverable.

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
AP	Action Plan
API	Application Programming Interface
CC	Competence Centres
CO2	Carbon Dioxide
DIH	Digital Innovation Hub
DMP	Data Management Plan
IE	Innovation Experiment
IOF2020	Internet of Food and Farm
IOT	Internet of Things
IP	Innovation Portal
IPR	Intellectual Property Rights
FIE	Flagship Innovation Experiment
EIP	European Innovation Partnership
F2F	Face to face
GIS	Geographic Innovation System
GDPR	General Data Protection Regulation
GHG	Greenhouse gases
IOS	International Organisation for standardisation
KPIs	Key Performance Indicators
LPID	Land Parcel Identification System
MVP	Minimum Viable Product
NGO	Non-governmental organisation
NPPL	National Smart Farming Pilot Project
RC	Regional Cluster
RDI	Research, development, and Innovation
SAH	SmartAgriHubs
SMEs	Small and Medium-Sized Enterprises
TRL	Technology Readiness Level
WP	Work Package

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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

This report is the third iteration of D3.4 - Periodic evaluation of the IEs performance, delivered in M48, preserving the progress of Flagship Innovation Experiments and Innovation Experiments of the Smart Agri Hubs project (SAH).

SAH was characterised by a high number of Open Call projects, 76 in total arising from six open calls: RESPOND SME 8, RESPOND DIH 13, RESTART 7, EXPAND 11, PREPARE 15 and SERVICE 22. All of the project was implemented in line with the predefined objectives, budget and timeline, with some deviations justified and accepted by the project steering group. Within the third reporting period only, 54 OC projects were implemented. Results from the project finalised as part of the second reporting period can be found within the previous iteration of the same deliverable. Nevertheless, the report aims to provide a summary of overall results as well.

Success stories, best practices and lessons learned are part of D3.8-2 (Success stories form IEs), while activities related to maximisation of FIEs market take up are presented as part of D3.7-2 (Report on maximisation of IEs market take up). A section on reusable components is also included within this report, while previously the presentation was made within a dedicated deliverable - D3.5 (IE technology requirements identification). All three deliverables are delivered in M48 by WP3, covering developments within the third reporting period.

The periodic evaluation of FIE performance reports was of crucial importance for WP3 throughout the project, since the main objectives of the WP are the monitoring and evaluation of the FIEs through the previously set KPIs, as well as the advancement of their Technology Readiness Levels (TRLs). With the increased number of the OC projects, the WP3 role also increased. As within the previous reporting period, progress reports from nine Regional Clusters (RCs) were analysed and included to this deliverable as well.

This report is focused on monitoring FIEs, IEs and RC activities, including requirements, outputs, FIEs' progress, challenges and changes in the planned activities and accomplishments. As with the previous reporting period, several FIEs have encountered challenges that were result of COVID-19, resulting in an extension of their work plans, without implications in the final results.

This deliverable also presents the reusable components and digital solutions on the market at the end of the SAH based on input from the Final Progress Reports and "Additional Questions documents" of the (F)IEs. In total, 296 reusable components, 201 technological and 95 non-technological ones were identified. The majority of them (n=206, 70%) are market-ready and 29 others will be at the end of 2022 or early 2023, increasing the rate to 79% (n =235). Already, 40 digital solutions, addressing or circumventing specific agricultural challenges, are on the market. Tools showcasing the outcome of the (F)IEs, the reusable components, and digital solutions, such as the Thing Link tool, IoT Catalogue, and ATN tool are described. They will remain visible and available contributing to the sustainability of the SAH project and its network.

The report presents a wealth of information for a better understanding of the concepts, approaches, activities, and results achieved throughout the project.

This is the public version of the deliverable.

1. INTRODUCTION

The focus of the SAH project is on developing and supporting agricultural DIHs. DIHs support digitising farmers and agricultural communities at the local level by offering a variety of services (technical, business, ecosystem, education, skills and training). In the SAH project, (F)IEs have a specific function related to the development of the DIHs. In each (F)IE, at least one DIH is involved in order to provide one or more services. Apart from the (F)IE's objectives to develop innovative digital applications, the most important SAH aim is to develop, test, and apply DIH services.

The SAH project is designed in a way that (F)IE support will be provided by DIHs and not by the WPs. Interaction with (F)IEs in SAH is indirect by providing support to DIHs that support the (F)IEs. For direct support and collecting specific details in the (F)IEs there was no capacity reserved in the WPs for supporting the 76 (F)IEs. A lesson learned from the SAH is that we overestimated the capacity and maturity of the DIHs, but we could observe improved DIH capacities during the third reporting period and following the assessment of DIHs as received from RCs.

Analysing the (F)IE's, one can observe a wide scope of activities performed by DIHs within the F(IE) development process. At the project level, DIHs involved in the (F)IEs were stimulated via ecosystem, business, and technological services, for the most. Even though most of the DIHs are in their early stage of development and are starting to develop and apply services, activities that were taken during the SAH are already impressive. DIHs were very active within the OC projects, also being project coordinators, and have expressed high interest in improving and further developing their services. We can conclude that many DIHs have made good progress in developing a service toward supporting (F)IES. Regional Clusters additionally stimulated and enhanced interactions between DIHs, (F)IEs, and other actors at the regional, national, and pan-European levels.

OC projects were surely a good mechanism for improving and building DIHs services. Nevertheless, more work should be done on improving DIHs skills and competencies for the provision of full support on all kinds of issues that (F)IEs need support on. That being said, we recognize that most DIHs need to further develop and mature the different supporting services, which have been started by the SAH project.

2. APPROACH & METHODOLOGY

2.1 FIE AND IE PROGRESS REPORTS

The methodological approach applied within the first and second reporting period was applied for the last reporting period as well, including the preparation of FIE progress report templates, which included several additional questions regarding sustainability, additional funding and plans beyond SAH project. These reports were analysed, and the results are presented as part of this deliverable. Regarding progress report templates from the OC project, each had a different set of questions, since each project had a different aim. Therefore, each OC template was adjusted accordingly. FIE and IE progress reports from the third reporting period are part of Annexes 1 and 2.

2.2 DIHS FEEDBACK

As part of WP3 evaluation, the team reached out to DIHs belonging to initial FIEs and asked for their feedback on collaboration with FIE's teams. This line of communication was established and implemented during the third reporting period. A separate template was created for each DIH, containing elements from FIE progress reports, while DIHs were asked to provide their feedback on activities conducted within FIE, including their reflection on the overall collaboration with the FIE. The DIH reports are compiled and presented in Annex 3. The same approach was employed for CCs, and the analysis is presented as part of the WP5 deliverable 5.6 – report on CC good practices.

2.3 RC PROGRESS REPORTS

Similar to the previous two reporting periods, RCs were asked to provide RC progress reports, reflecting on their activities and progress during the third reporting period. The same structure of the template was applied this time, incorporating a question related to Open Call Experiments and their support to them. The template was placed in an online form, via the Innovation Portal and can be also seen in Annex 4.

2.4 REUSABLE COMPONENTS

2.4.1 Data collection

In the first year of the project, FIE coordinators were asked to list both technological and non-technological requirements and their fulfilment in order to support FIE consortia and connect them to appropriate technology providers, DIHs or CCs if necessary. The reusability of these components was assessed by FIE coordinators and Deliverable 3.5 (first version) "Technology components identification" (September 2019) reported on these findings. Whether the components are truly reusable as such is to be validated when used by a number of other systems and users. Very often, this will require modifications, but in essence, the possibilities of reusing the solutions and the willingness to share it is already a good starting point.

The "reusability" related data were again collected in October 2020 and 2021 and described in Deliverable 3.6 "Common challenges analysis and technology reusability exploitation" and Deliverable 3.5 (second version) "Technology components identification II," respectively. A

bigger focus was placed on received and requested support from DIHs and CCs, users and stakeholders, dissemination, promotion and collaborations.

At the end of this four-year project, a final summary is made of all reusable components of the 28 Flagship Innovation Experiments and the 76 OC Innovation Experiments.

The data were extracted from the Final Progress Reports of the initial FIEs from the last reporting period (M37-M48) or earlier submitted reports (M17-M36) if FIEs already ended before M36. The reuse of both technological and non-technological components by others within the timeframe of the SAH project was also investigated.

Five OCs, some with continuous submission rounds, were launched in this project adding new DIHs and CCs to the SAH network. The new IEs, supported by DIHs and CCs, offered the project additional reusable technological and non-technological components. Data for this final summary were derived from several reports of these open calls:

- RESPOND open call for SMEs: IE coordinators had to list the developed components and reusability of them (short questions) in their Final Progress Report.
- RESPOND open call for DIHs and RESTART open call: hackathons were organised by the DIHs and asking for reusable components was not relevant.
- PREPARE open call: coordinators were asked if they were planning to develop reusable components according to the project proposal they developed within the scope of their experiment (Table 1).

Name of reusable component	Component owner	Type of component	Who can reuse this component?	Within which sector/s this components can be reused	Indicate if a component is technological or non-technological

Table 1: Reusable components listed in the PREPARE IEs' Final Progress Report

- EXPAND open call and SERVICE open call: the Final Progress Report contained tables about the reusable components (Table 2) and the reuse by others during the SAH project was also investigated.

	Name of component 1	Name of component 2
Component owner (DIH, CC, company…)		
Type of Component		
How is it reusable?		
When it will be reusable?		
Whom it concerns?		
Support provided by DIH		

Support provided by other party (e.g., CC)		
Reusable component impacted sectors		
Promotion plan		

Table 2: Reusable components listed in the EXPAND IEs' Final Progress Report

The Final Progress Reports can be found in Annex 1. All the data were collected in an Excel spreadsheet and sorted by sector, i.e. animal production, arable, aquaculture, dairy, fruit, novel foods, and vegetable sectors. The reusable technological components were categorised into five groups:

- **Data**: e.g., API, platform, app, data analysis;
- **Drones**: a separate category was made as we received some external questions to list the drone-based cases within the project;
- **Hardware**: e.g., camera, robot, battery;
- **Sensors**;
- **Systems**: e.g., software, AI model, algorithm.

The non-technological ones were divided into three categories:

- **Business models**: a separate category was made as many coordinators requested support for this topic;
- **Network;**
- **Procedures:** e.g., event management, consortium agreement, protocol, service.

2.4.2 Tool

Several tools were analysed, and data visualisation tool "Thing Link"[1] was chosen as the most appropriate platform to showcase the reusable components per sector and per category while adding links to the SAH website. This tool was developed by WP3 and is constantly being updated as the FIEs and IEs have different end dates.

2.5 DIGITAL SOLUTIONS

2.5.1 Data collection

Every FIE consortium included at least one DIH and one CC and several end-users, often farmers. These partners were solving agricultural challenges and developing innovative solutions. The SAH project does not claim to determine the best (non-)technological solutions, but all stakeholders can learn from them. The (non-)technological components and developed solutions are chosen based on the in-house knowledge, experience and tools of the DIHs, CCs and other partners within the FIEs and are further developed and tested within the FIEs. The market readiness status of the developed solutions was listed in the Final Progress Reports of the FIEs from the last reporting period (M37-M48) or earlier submitted reports (M17-M36) if FIEs already ended before M36.

IEs from the OCs were coordinated by at least one DIH. The objectives and outcome of the five OC types were different and more details can be found in Deliverables of WP2.

- **RESPOND open call for SMEs:** IE coordinators listed the developed solutions on the market in an Additional Questions document at the end of the SAH project.

[1] https://www.thinglink.com/

- **RESPOND open call for DIHs and RESTART open call**: hackathons were organised by the DIHs. The market readiness status of the winning solution(s) was asked at the IE coordinator through an Additional Questions document at the end of the SAH project.
- **EXPAND open call**: in the Final Progress Report was asked how close the developed digital solutions are to putting them on the market and if further technical developments are required before being able to do so.
- **PREPARE open call and SERVICE open call**: new proposals were developed, and services were tested and validated within these open calls respectively, no new digital solutions were launched on the market.

The "Final Progress Reports" and "Additional Questions documents" can be found in Annex 1. For an overview of the digital solutions on the market, see chapter 3.1.

2.5.2 IoT catalogue

The digital solutions developed within the FIEs are demonstrated in the IoT catalogue: https://www.iot-catalogue.com/. Coordinators from the RESPOND open call for SMEs and EXPAND open call IEs were also asked if they want their developed digital solutions to be shown in the IoT catalogue. WP3 supported Unparallel, the Portuguese SME developing this catalogue and monitored this task.

2.5.3 ATN tool

The Agricultural Navigator Tool (ATN), created by SAH (WP5), gives CCs the opportunity to increase their visibility and showcase their competences and systems. Technologies, developed within or outside the scope of the SAH project, can be added and linked to projects in the ATN tool. WP3 encouraged CCs to enter their system and competences in the ATN tool and supported them in this process. The progress of this task was monitored by asking in the Final Progress Reports or in the Additional Questions documents.

3. RESULTS

This chapter describes the progress of each FIE throughout SAH. In total, 28 FIEs were supported by 60 DIHs and 70 CCs, within the scope of ecosystem, business, technology and skill-related services.

In addition, 68 DIHs were coordinators of OC projects (EXPAND, SERVICE, PREPARE, RESPOND, RESTART for DIHs).

When combining numbers with IEs from the OCs projects, at the time of the deliverable submission, 40 solutions are launched on the market. SAH solutions were tested on 341,837 farms/test sites throughout four years of project implementation, representing a significant number of test farms/test facilities deployed during the project. A total of 296 reusable components were produced, by the FIEs and IEs, including both technological and non-technological components. This chapter provides a brief overview of FIEs' progress.

For a better visual overview of the projects implemented throughout the SAH, Figure 1 demonstrates the geographical distribution of FIEs and OC IEs throughout Europe while Figure 2 demonstrates a number of projects (of the project coordinators) per participating country.

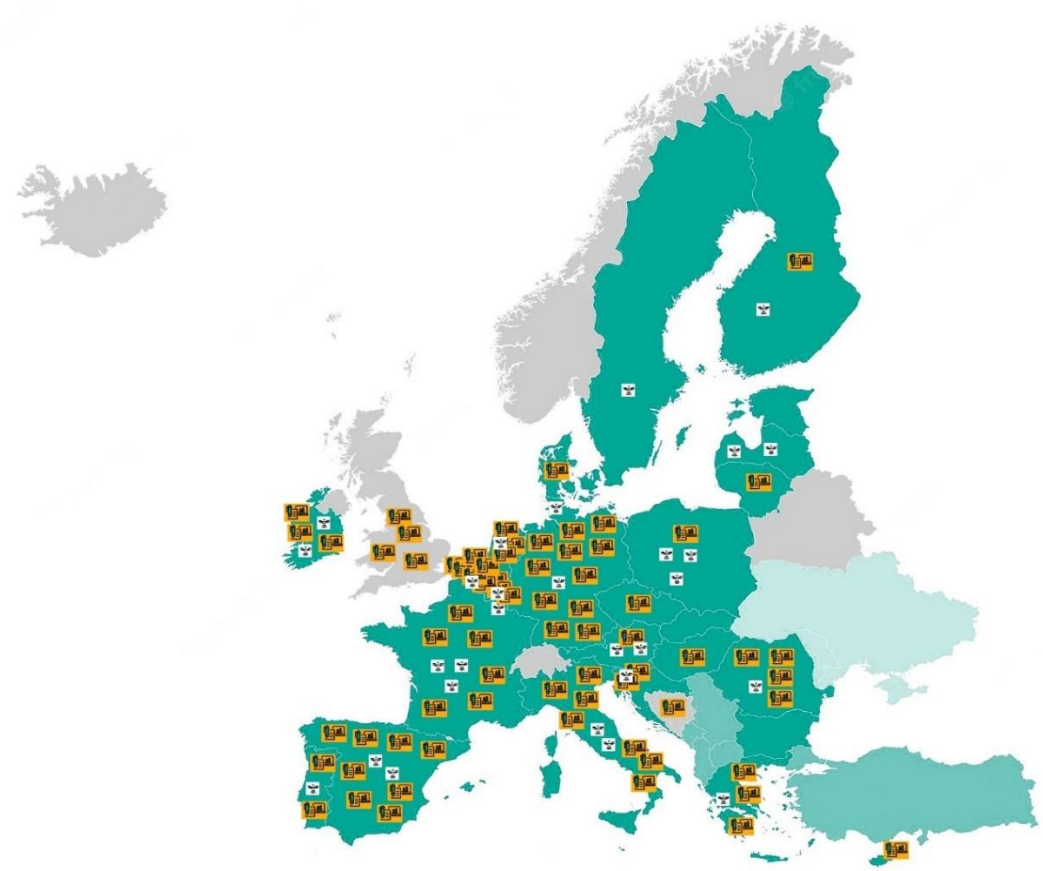

Figure 1 Geographical distribution of FIEs and IEs (orange points are OC projects while the white ones are representing initial FIEs)

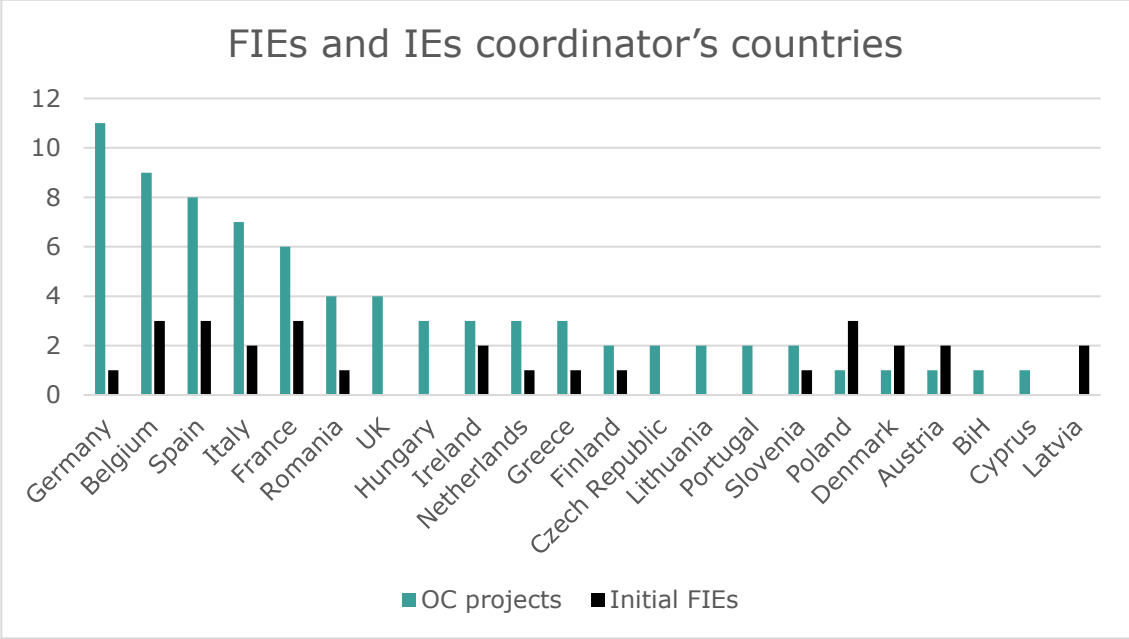

Figure 2 FIEs and IEs coordinator's countries

3.1 FIE PROGRESS M1-M48

This is a public version of the deliverable. Results that are part of this chapter are presented within the confidential version of the document.

3.2 PROVISION OF DIH SERVICES TO FIES

Throughout the project, a collaborative approach within the FIE was a crucial element for the successful finalisation of predefined objectives and goals. An important component in the FIE consortia was related to services delivered by DIHs. Their role was defined at the beginning of the project, within each FIE execution plan. Direct monitoring of the DIH implementation was not envisaged under SAH supervision, nevertheless DIHs were asked during the third reporting period to provide their feedback regarding collaboration with FIEs. Prior to that FIEs were communicating their experience about collaborations with DIHs only. The exercise was targeting 28 initial FIEs and 60 participating DIHs. The feedback was received from 26 DIHs from 19 FIEs. It was concluded that those more proactive DIHs responded to the request. Two of the FIEs ended at the end of October 2022, enabling the team to reach out to their seven participating DIHs and collect feedback. Finally, DIHs from seven FIEs never responded to the WP3 request for the feedback provision and were perceived as DIHs with low activity levels. Once the feedback was collected, WP3 proceeded with the analysis of responses presented within this chapter.

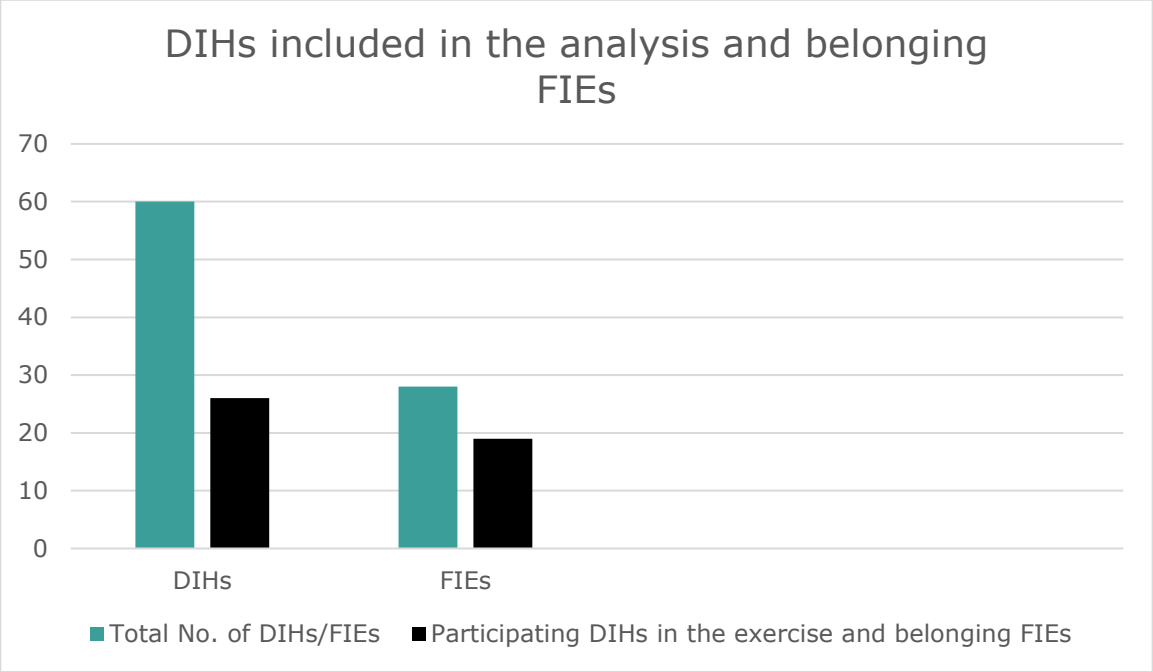

Figure 3 Number of DIHs involved in the exercise vs total number of DIHs

Services related to ecosystem development were by far the most delivered by DIHs – approximately 36 services. These services were related to community building, strategy development, ecosystem learning, representation and promotion, preparation and organisation of demos events. The next most common services were related to the provision of business support – approximately 17 services, followed by technology related services-14 and skills and education – 3 services.

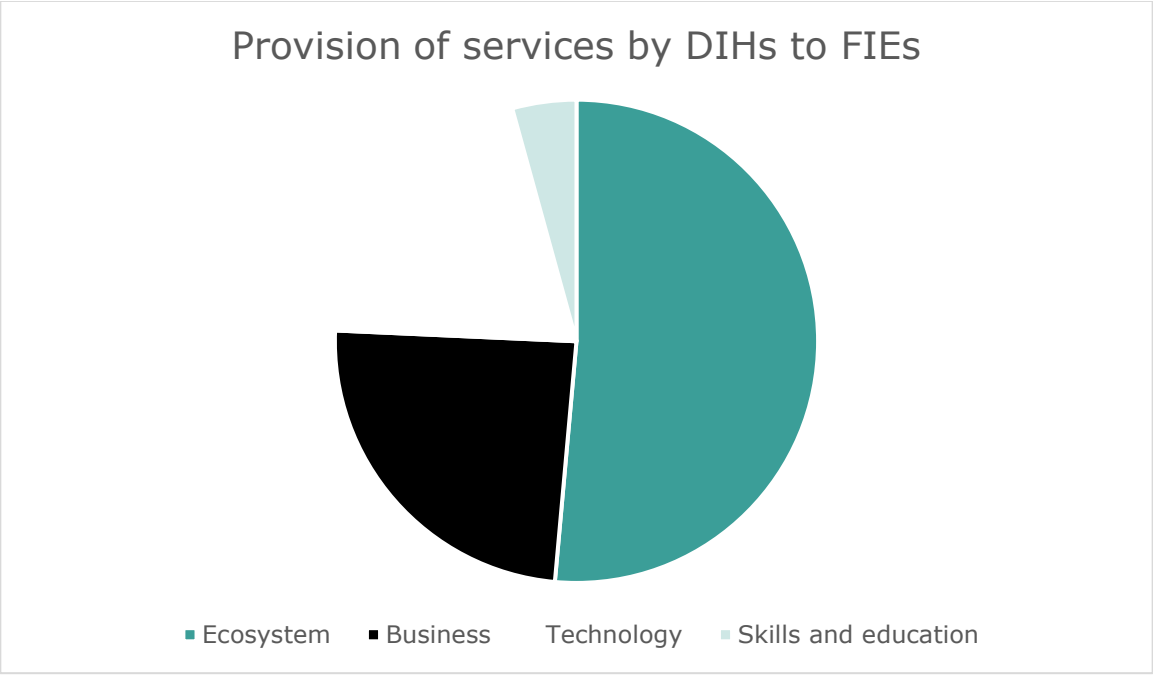

Figure 4 Services provided by DIHs to FIEs

In addition, DIHs were providing support within the development of **reusable technological and/or non-technological components.** An overview of these components is presented in Annex 8. While a brief analysis is presented below.

25 DIHs supported activities towards the development of 29 reusable technological components within 16 FIEs. Example of the support relates to:

- Energy monitoring
- Multi criteria technical, economic and environmental evaluation tool for crop production
- Development of potato crop growth prediction models using field specific data
- Big data management and analytics
- Introduction and testing, consultations
- Assessment, consulting and feedback on the results

Regarding non-technological components, 18 FIEs were supported by 25 DIHs towards 22 components. Some examples of provided support:

- Provision of specific knowledge related to the component - digital solution, agronomic knowledge
- Marching with external experts
- Identification of the solution providers and potential users
- Cross sectorial communication
- Field trials
- Mobilising the network, intervening with the farmers
- Sensor installations
- Promotion of the solution, etc.

DIHs were asked about **services** that they would like to **strengthen** in the near future. Even though the ecosystem services were the most often provided by DIHs, as seen above, 11 DIHs communicated the need to improve ecosystem services, including:

- Dissemination and communication to target audiences
- Ecosystem building
- Use and management of the ecosystem network
- Establishment of regular formal discussions with farmers
- Creation of a broader network of opportunities for innovators and entrepreneurs
- Expansion of farmer's network
- Expand and further grow the network and ecosystem focusing on innovation in agriculture
- Involvement of users with increased use of digital tools and strengthening the open innovation approach in special target groups
- Networking

Eight DIHs expressed interest in improving technology related services, including:

- Establishment of an open lab
- Several DIH's responses concerned the development of a technology based on identified needs or further improving the technology they worked on previously
- Development of data exchange platforms and access to developed AI components
- Development of Life Living Lab for the provision of support to innovative early-stage ideas

Five DIHs expressed interest in further developing business services, including:

- Development of business models
- Provision of needs of plant producers specifically
- Development of a business methodology for the ecosystem
- Work around the placement of the solution on the market

- Funding skills

One DIH indicated that with becoming an eDIH, they will need to improve all services, one DIH indicated the need to further improve digital services and one DIH communicated their need to further improve specific expertise related to the FIE technology as an important element in the provision of support to the FIEs. None of the DIH expressed the need to work on the services related to the skills (training and education).

DIHs were asked to **rate their collaboration with the FIEs** throughout the project. 21/26 DIHs responded to this question. 12 DIHs rated the collaboration as very positive. Three DIHs said that the collaboration was positive, and three DIHs noted that they had more expectations from the collaboration with the FIE, in terms of their involvement in FIE activities. Two of the DIHs noted that the collaboration was challenging but positive and one DIH noted that the collaboration was beneficial.

In general, DIHs will further utilise gained knowledge for further development and collaborations on both national and international levels. DIHs were able to learn from their collaborations with FIEs, expand the ecosystem, shape their services and work towards exploring new ones.

3.3 OC PROGRESS

The SAH project was characterised by a high number of OC projects, 76 in total arising from six OCs. Overview of the OCs with a number of projects finalised per each of the OC is shown in the table below, while al overview of EXPAND, RESPOND, PREPARE and SERVICE projects (including their implementation timeline and belonging sectors) is presented in Annex 10.

Open Call	Total number of projects	No. of projects finalised as part of the 3rd reporting period	No. of projects finalised as part of the second reporting period
RESPOND SME	8	0	8
RESPOND DIH	13	0	13
RESTART	7	6	1
EXPAND	11	11	0
PREPARE	15	13	2
SERVICE	22	22	0
TOTAL	76	52	24

Table 3: Overview of all OC projects

All the projects were implemented in line with predefined execution, with several projects slightly extended (2 months in average) to accommodate new circumstances. Detailed information on the OC dynamics and structure can be found within WP2 reports. Within the third reporting period only, 52 projects were implemented, while 24 were implemented as part of the second reporting period. A total of 18 projects under RESPOND for SMEs and RESPOND

for DIHs open call are presented within the previous iteration of the deliverable as all were implemented as part of the second reporting period.

3.3.1. EXPAND

This is a public version of the deliverable. Results that are part of this chapter are presented within the confidential version of the document.

3.3.2 RESTART

This is a public version of the deliverable. Results that are part of this chapter are presented within the confidential version of the document.

3.3.3 PREPARE

This is a public version of the deliverable. Results that are part of this chapter are presented within the confidential version of the document.

3.3.4 SERVICE

This is a public version of the deliverable. Results that are part of this chapter are presented within the confidential version of the document.

4. REUSABLE COMPONENTS

In total, 296 reusable components were used and/or developed within the SAH project, divided into 201 technological and 95 non-technological ones, indicating a huge increase within the last reporting period (n_{2019}=100, n_{2020}=103, n_{2021}=130) due to the many new IEs from open calls. The SAH project does not claim to determine the best (non-) technological solutions, but all stakeholders can learn from the chosen solutions for the specific agricultural challenges of each (F)IE.

The majority of technological reusable components are part of the system category (n=89), including software, AI models, algorithms, etc. followed by data-related components (n=60) - such as APIs, platforms, apps, data analyses -, hardware (n=31) - such as robots and cameras-, sensors (n=17) and drones (n =4) (Figure 1).

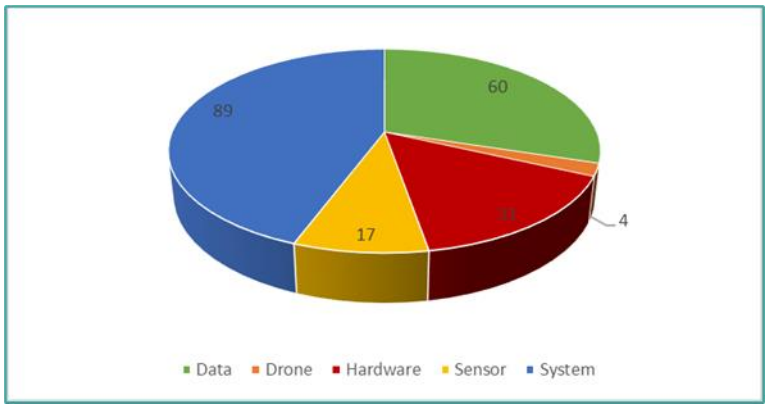

Figure 5: Technological reusable components used and/or developed within the SmartAgriHubs project

Sixty-eight percent of the technological reusable components (n=136) are already available on the market, and 11 will be at the end of 2022 or January 2023. The readiness or availability of the others is unknown, and they only belong to the system, hardware, data or sensor

category from open call IEs who started relatively late in the SAH project or are delivering services to ongoing projects. Some IEs did not give/have this information.

Some FIEs are working in several sectors and a lot of open call IEs cover all sectors. The majority of reusable components are intended to be used in the fruit (n=112), arable (n=107) and animal production sectors (n=95). In the aquaculture sector only 62 components are reusable and all except 2 are developed in cross-sectoral (F)IEs. The technological reusable components per sector are shown in Figure 2.

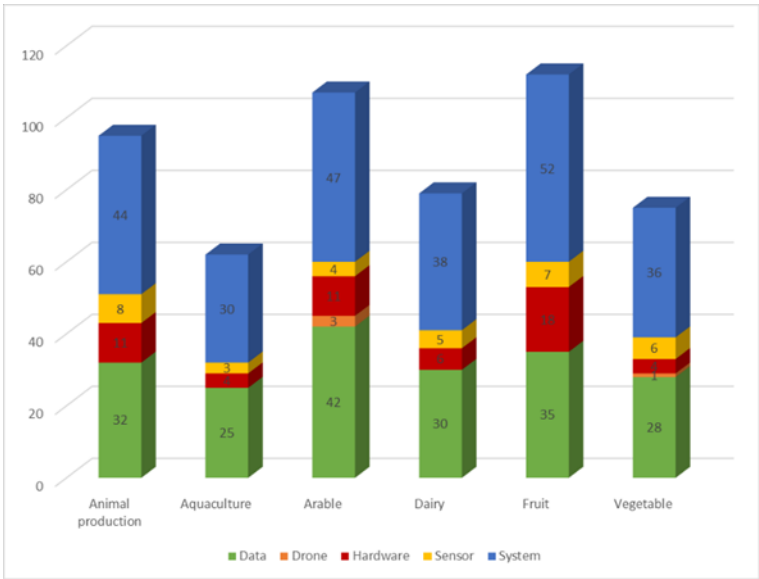

Figure 6: Technological reusable components used and/or developed within the SmartAgriHubs project per sector

The main category of non-technological reusable components (n=82) is the procedure category, including evaluation protocols, services, event management, consortium agreements etc. (Figure 3).

Seventy-four percent of the non-technological reusable components (n=70) are already available and 18 will be available at the end of 2022 or early 2023. The readiness or availability of the others is unknown. These were developed within 2 FIEs and 6 open call IEs.

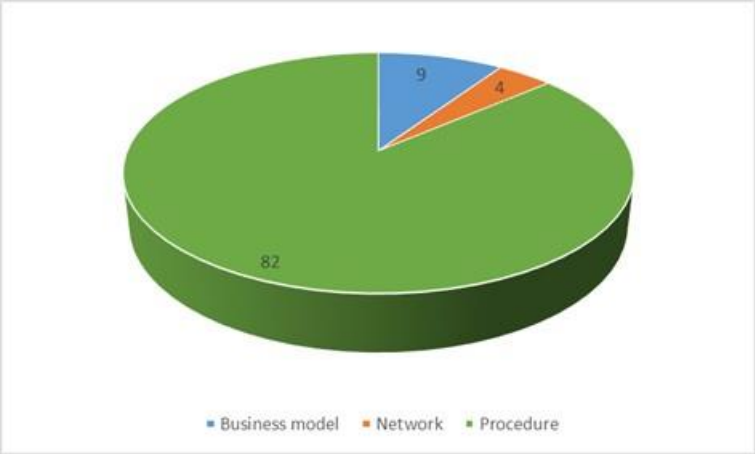

Figure 7: Non-technological reusable components used and/or developed within the SmartAgriHubs project

The non-technological reusable components per sector are shown in Figure 4. The arable sector has the most non-technological components and other ones are equally distributed among the animal production, aquaculture, dairy, fruit and vegetable sector.

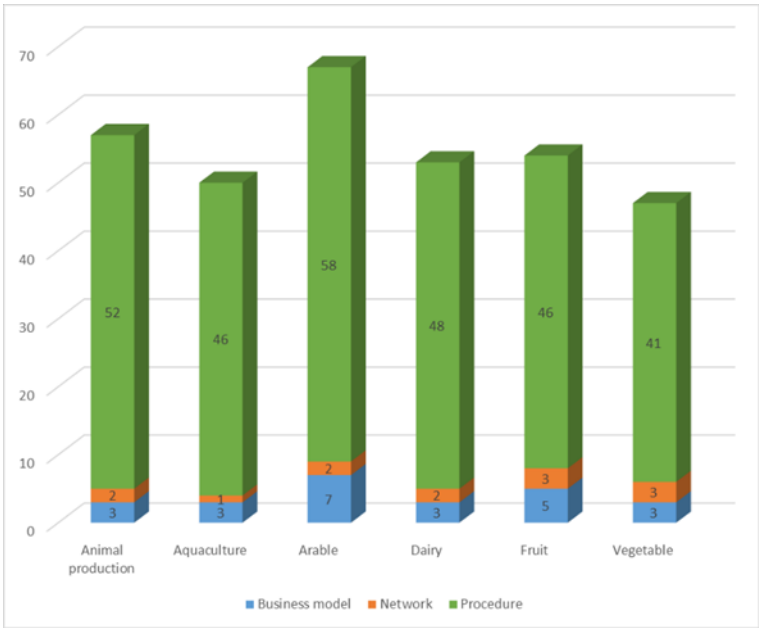

Figure 8: Non-technological reusable components used and/or developed within the SmartAgriHubs project per sector

Four out of 28 FIEs and seven out of 33 IEs (only EXPAND and SERVICE open call coordinators received this question) confirmed that their components were already re-used by others during the lifetime of the SAH project:

- FIE6 AgriFarmLab (RC France): The non-technological component about providing services, community building and strategy development is already used by FIE7 and FIE8 (France).
- FIE8 STRATE-GEEK (RC France): The clustering and continuous integration technics are used in FIE7 Digi-PILOT (France).
- FIE13 Ammonia Emmision Monitoring Network (AEMON) (RC NWE): The modular sensor network is used in FIE11 SmartPigHealth (Germany).
- FIE20 Ground water and meteo sensors (RC NEE): Sensor data management is used by FIE19 Bee monitoring and behaviour prediction (Latvia).
- EXPAND 1 Smart palletization system for the optimization in winery logistics (RC Iberia): 2 APIs have been used in other projecst of Pago de Carraovejas in the wine sector to support the control of all wine production processes and the conditions under which the wine is produced.
- EXPAND 2 Development of win-win-win business model for potato ecosystem (RC NWE): The first camera system prototype was also used in another EU project. The focus was on measuring tare and not on length distribution.
- EXPAND 3 Pooled resource exchange on a platform for innovation program execution (RC NWE): The open innovation cycle framework was bought in by Hansekitchen.
- EXPAND 5: Strengthening cross-regional DIH collaboration in aquaculture innovation support services (RC CE): The developed reusable services, i.e., policy recommendations, dissemination plan, aquaculture support handbook, exploitation strategy and software tool handbook are already being reused by the 4 use cases implemented by each partner of the IE consortium.
- EXPAND 6 Agrihub made in CzechoSlovakia (RC CE): A geospatial metadata catalogue and metadata editing tool, a service for publishing geospatial data on the web, a library and IoT software were already reused by other use cases and by several DIHs (Plan4all, Polirural, SIEUSOIL).
- EXPAND 8 Promoting digital innovation for agri-food cooperatives (RC Italy & Malta): The Copernicus open access hub and USGS earth database are extensively exploited

in research and commercial activities based on remote sensing, not only for agricultural applications. The Precision Farming AI Algorithms owned by Digimat are under development also through other R&D projects, e.g., I-FASENET - Ital-GovSatCom FAcilities SErvices and NETworking project and ODESSA - On DEmand Services for Smart Agriculture project.

- SERVICE 18 Facilitating interdisciplinary teamwork on dairy farms for better transition cow management (RC NWE): The interdisciplinary service model of FITeam was selected as a case study by the European Social Fund (ESF) CHAIN project, in which practical guidelines are developed for service providers to share data across the supply chain. Consultants from the expertise centre Workitects have observed and analysed the FITeam process at the validation farm Biezenhoeve and will use this input to develop recommendations in the CHAIN project.

All reusable components are showcased in the Thing Link tool (Figure 5 and 6): https://www.thinglink.com/scene/1583099841347584003. The Thing Link tool will be placed on the SmartAgriHubs website and remain available to all stakeholders beyond the SAH project timeline.

Figure 9: Thing Link tool presenting the reusable components of the (Flagship) Innovation Experiments per sector

Several synergy workshops were organised to present the collected reusable components and the developed Thing Link tool as well as to show the digital solutions on the market and IoT catalogue:

- online "Sector-based support and synergy workshop", June 1, 2022
- session "Actor of SmartAgriHubs – Technology and lessons learnt", June 22, 2022 (IoT week, Dublin)
- session "Discover how SmartAgriHubs addresses 5 key objectives", September 26, 2022 (SAH final event, Lisbon)
- workshop "Sector-specific developments, challenges and future demands: animal production and dairy sectors", September 27, 2022 (SAH final event, Lisbon)
- workshop "Sector-specific developments, challenges and future demands: fruit, vegetable and arable sectors" September 27, 2022 (SAH final event, Lisbon)

More information can be found in D3.7 "Report on maximization of IEs market take-up."

Figure 10: Examples of the Thing Link tool presentation of the reusable components of the (Flagship) Innovation Experiments per sector

4.1 DIGITAL SOLUTIONS ON THE MARKET

In total, 40 digital solutions are on the market, being developed or validated in 14 out of 28 FIEs, 10 out of 21 RESPOND open call IEs (with 11 of them organising hackathons) and 5 out of 11 EXPAND open call cases (Table 4). The coordinators of the other FIEs indicated that their solution is waiting for an update and will soon be on the market or being further improved in a follow-up project as the total agricultural challenge was not completely solved. All have already separate reusable components on the market. Furthermore, EXPAND open call coordinators are supporting other innovative projects that are often not yet finalised and the RESPOND open call for DIHs contained hackathon organizations and further support of winners who are also still finalizing their digital solution.

Eleven solutions are intended to be used in arable farming, six in animal production, five in dairy farming, three in both vegetable and fruit sector and only one in aquaculture. Two addressed the food processing and organic food sector. Eight can be used in all sectors as it is, for instance, a training program or a sensor, monitoring work and localization of farmers.

Digital solutions and outcomes of the 28 FIEs and five IEs will soon be presented in the IoT catalogue: https://www.iot-catalogue.com/. Draft pages were created by Unparallel (the Portuguese SME developing this catalogue) based on input from the Final Progress Reports and response from the (F)IE coordinators. Currently, pages are being finalised and are expected to be publicly available by the first quarter of 2023. The ATN tool also showcases competences, systems and related technologies of CCs. Examples can be found in D3.7 "Report on maximization of IEs market take-up."

Number (F)IE	Name (F)IE	Regional Cluster	Sector	N of digital solutions on the market	Name digital solution(s)
FIE 2	STREAM	RC Ireland & UK	Animal production & dairy	1	Online application tool, producing farm land habitat reports
FIE 3	Digitizing farm machinery produced by SMEs	RC Scandinavia	Arable	2	Digitized Danfoil Spitfire field sprayer Digitized Cameleon row hoe
FIE 4	Adopting digital technologies by farmers	RC Scandinavia	Animal production Arable	2	Swedish Pigscale Danish arable farm concept with digital upgrades of existing machinery
FIE 6	AgriFarmLab	RC France	All Fruit All All All	5	Aptimiz sensor, following time and localization of farmers and software My Bacchus smart sensor, measuring several parameters in vinification and software MobiProtec camera linked to a movable energetically self-sufficient platform Baoba software for farm management
FIE 7	Digi-PILOTE	RC France	Arable	1	Prévi-lis expertise offer supporting tool implementation for crop monitoring
FIE 9	AI 4 AGRICULTURE	RC NWE	Arable	2	Early weed detection system Early Alternaria potato disease detection system
FIE 12	DIG-Itfarm	RC NWE	Animal production	2	ChickenBoy robot with sensors Soundtalk pig cough monitor
FIE 13	AEMON	RC NWE	Animal production & dairy	2	Indoor climate monitoring sensor nodes Sensor network for dairy cows and pigs for trend monitoring
FIE 15	Precision farming on small-scale farms	RC CE	Arable	2	Precision farming software services
FIE 16	E-services using drones for quantity buyer	RC NEE	Arable	1	Poldrony.pl drone platform
FIE 17	Online DSS for optimizing fertilizers	RC NEE	Arable	1	Online decision support tool platform and services
FIE 22	Iberian irrigation portal	RC Iberia	Arable, fruit & vegetable	1	Irrigation web portal
FIE 23	Data-intensive dairy production	RC Iberia	Arable & dairy	1	Data-driven dairy support system
FIE 28	Decentralized trust in agri-food supply chains	RC SEE	Animal production & dairy	1	Decentralized provenance application
RESPOND 1	WiziFarm Mission	RC France	Arable	1	Workers' recruitment platform
RESPOND 2	ROOTS	RC France	All	1	B2B marketplace and consumer communication tool
RESPOND 3	ROCKET	RC NWE	Fruit	1	Automatic Fruit packer
RESPOND 5	Sostenibl.es	RC Iberia	Other: organic food	1	Marketplace platform
RESPOND 7	CODIPLAF2F	RC NWE	All	1	Onboarding form and wiki for food hubs' short supply chain platform
RESPOND 8	FLOX-cam	RC Ireland & UK	Animal production	1	FLOX poultry camera and sensor system with software and algorithms
RESPOND DIH 1	H4F	RC Italy&Malta	Arable & dairy	1	Hackathton winning solution on the market
RESPOND DIH 7	FoodLogProximity	RC France	All	1	Hackathon winning solution on the market
RESPOND DIH 9	Farm2Fork HACK	RC SEE	All	2	Hackathon winnings solution on the market
RESPOND DIH 10	Hack72h	RC France	All	1	Hackathon winning solution on the market
EXPAND 3	PREPIPE	RC NWE	All	1	Coaching and train the trainer program
EXPAND 4	F2FHUBCONNECT	RC NWE	All	1	Supply system for large canteens
EXPAND 5	AquaHubs	RC NEE	Aquaculture	1	Aquaculture technologies of supported IE (business secret)
EXPAND 7	RAINaDiv	RC NWE	Other: food processing	1	AI model and prototype AI platform
EXPAND 10	WEAVER	RC NWE	Fruit & vegetable	1	Collaborative transport robot WEAVER

Table 4: Overview of digital solutions on the market

5. RC PROGRESS

This is a public version of the deliverable. Results that are part of this chapter are presented within the confidential version of the document.

6. CONCLUSIONS

During four years of the project, 28 initial FIEs and 76 OC projects were implemented. FIEs were supported by 60 DIHs and 70 CCs, within the scope of ecosystem, business, technology, and skill-related services. In addition, 68 DIHs were coordinators of OC projects (EXPAND, SERVICE, PREPARE, RESPOND, RESTART for DIHs).

At the time of the deliverable submission, 40 solutions are launched on the market. SAH solutions were tested on 341,837 farms/test sites. Those (F)IEs that still do not have their

solution on the market are all working further on the development of the solution/services by:

- Actively working with the partners towards solution expansion and improvement
- Applying results in a new project
- Collaborating with interested parties - overall industry, including farmers, milk processors, government, and agri-trading companies
- Collaborating with potential customers
- Actively developing and updating the solution towards market readiness
- Adapting solution to the market needs and redefining their business and marketing strategies
- Searching for new funding opportunities (e.g., PREPARE open call)
- Participating in other innovative projects that are not yet finalized (e.g., EXPAND open call)
- Supporting hackathon winners who are still developing their digital solutions (e.g., RESPOND open call and RESTART open call)

The outcome of the (F)IEs are presented in the IoT catalogue. Technologies, competences and systems of CCs are showcased in the ATN tool as part of the SAH Innovation Portal, strenghtening the searching tool of this portal.

A total of 296 reusable components were produced, by the FIEs and IEs, including both technological and non-technological components. Seventy percent of them (n=206) are market-ready and 29 others will be at the end of 2022 or early 2023, increasing the rate to 79% (n=235). All reusable components are shown in the Thing Link tool and will remain visible and available after the lifetime of the SAH project contributing to the sustainability of the SAH project and its network.

The SAH project was precieved by valuable intervention not only for the developemnt of services and solutions, but also in terms on collaborations. RC, FIEs and IEs all actively contributed towards expansion of the network. EXPAND and SERVICE OCs were specially fruitfull in therms of the service provision, with approximately 328 services developed and improved troughout those 33 projects. SERVICE OC was particularry interesting to DIHs, and all of them expressed satisfaction with the projects outcomes in a short time of implementation. In addition, trough RESTART and RESPOND for DIHs, 20 hackathon-like activities were organised. Most of the DIHs are following up on the winning solutions and all of them agreed that hachathons are a good methodological approach for supporting innovative solutions. Trough PREPARE OC, DIHs worked on the development of 16 proposals engaging Innovation Experiments for developing/strenghtening their services. This information is available also within D3.8-2, Success stories from (F)IEs.

RCs are perceived as an important and useful element in the SAH project. With their prede-fined activities and actions, they were serving as extended support at the regional level. Seven out of nine RCs plan to continue actively with their activities, including:

- Participating in the pan-European innovation projects
- Promoting the concept of SAH’s network
- Sustaining, building and supporting its multi-actor network
- Supporting DIHs and CCs from the region and serving as their national contact point
- Attending the sectorial events
- Serving as a repository for new contacts, news, events and funding schemes
- Identifying links between farmers and technology providers in the region
- Promoting the SAH Innovation Portal
- Providing support in developing and creating national plans and strategies with the results from SAH
- Disseminating digital solutions

RC France stated that at this stage there is no concrete plan for RC sustainability beyond SAH. However, they intend to continue meeting and communicating with actors from the SAH ecosystem on the agrifood tech topics.

For RC Italy and Malta, even though there is no concrete plan put in place, the RC partners will continue to work on current and future projects linked to the agricultural sector within an already established collaboration among them.

The impressive outcomes of the SAH project will serve the network in developing new initiatives, proposals, partnerships, ideas, and collaborations on a global level. The SAH demonstrated the great potential of the network utilising all its elements toward supporting the agri-food sector. This is also well observed also through FIEs', IEs', and RCs' plans to actively work on the concepts, networks, solutions, and collaborations beyond SAH.

7. ANNEX

D3.4-3 Annexes can be found via a link included in the confidential version.

Annex 1 – FIE progress reports M37-48
Annex 2 – OC progress reports M37-48
Annex 3 – Feedback from DIHs
Annex 4 – RC progress reports and Action Plans
Annex 5 – RC collaborations and support
Annex 6 – Overview of services developed and implemented within EXPAND OC
Annex 7 – Other elements arising from the FIE implementation
Annex 8 – DIHs support in reusable components
Annex 9 – Topics of developed proposals under PREPARE OC
Annex 10 – Overview of OC projects – EXPAND, RESTART, PREPARE, SERVICE