Strategic vision, implementation roadmap and thematic priorities for the S3FOOD project

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Abstract
This deliverable summarizes the strategic vision and implementation roadmap that identify the expected input from the collaboration and mutual added value of the S3 partnership ' Smart sensors for agri-food'. Furthermore, the 4 thematic priorities of the S3FOOD project are described. All activities set up in the framework of S3FOOD will be linked to those 4 thematic priorities.

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1 METHODOLOGY AND LINK WITH CONNSENSYS

1.1 METHODOLOGY

To affirm the S3P "Smart Sensors 4 Agri-food" partnership strategy, agree on the implementation roadmap and operational management all partners have been intensely involved to collect and address the feedback and remarks from all involved parties in all regions of the S3P partnership.

Flanders' FOOD has been coordinating the collection of input from all partners and other stakeholders (regional authorities, companies, living labs, etc.). This has been done via various media and at different occasions.

The main sources of input

- Workshop organized by Flanders' FOOD back to back with the semi-annual Working Committee Meeting S3 Partnerships (Bilbao, Spain – 27-28 November 2018)
- Survey results from T1.1in Connsensys and S3FOOD
- Brainstorm meetings organized in each region in T1.2 of Connsensys and T1.2 in S3FOOD (for the partners that are not involved in the Connsensys consortium)
- Workshop organized by Flanders' FOOD at the Central European and Transregional Cooperation in Smart Specialization on the modernization of the Food Industry through Industry 4.0 and digitization with particular focus on developing transdisciplinary competences, skills and demonstration projects workshop (Budapest, Hungary - 20 September 2019)
- The Connsensys Advisory Board
- One-on-one meetings and discussions with the Connsensys and S3FOOD partners
- Expert interviews and interviews with other cluster partnership organizations

1.2 SMART COLLABORATION BETWEEN CONNSENSYS AND S3FOOD

The results presented in this deliverable are a combined effort between the Connsensys and S3FOOD project. The Connsensys beneficiaries collected the input and feedback in their own respective regions, while the scope was broadened by the S3FOOD project to all other S3P partner regions not represented by the Connsensys partners. Furthermore, in S3FOOD the scope of the strategy was opened up to include the entire industry 4.0 conversion of the food sector, whereas Connsenssys focusses specifically on smart sensor systems. Via the smart and efficient collaboration between the Connsensy and S3FOOD the presented strategic document include a broad agreement between all S3P stakeholders and will guarantee long-term success of the S3P partnership.

In the framework of S3FOOD this deliverable presents the following aspects

- Strategy
- Implementation Roadmap
- Thematic priorities of the S3FOOD project

2 STRATEGIC VISION

2.1 CHALLENGES

The agri-food industry is taking its first steps towards Industry 4.0. Some larger enterprises with a broad network, connections with research and technology organizations (RTOs) and international affiliations are up-to-date and aware of the most recent technological developments and its opportunities. However, all over Europe, the agri-food industry is typically a small and medium-sized enterprises (SMEs) driven sector. Even 'large companies' are, relatively speaking (in comparison with other sectors), quite small.

For the agri-food industry, the creation of an IoT environment and introducing big data management is a huge challenge, and we believe that a down to earth, stepwise approach, starting from the challenges and needs of the agri-food companies is needed. Many agri-food companies don't have smart sensor systems (sensors, ICT solutions/platforms, robotic solutions controlled by sensors, monitoring, etc.) installed in their production environment and still rely on manually registered data and data interpretation is done by a few personnel members with specific expertise. This specific expertise and knowledge, built up during years on the job, is in many cases not secured in systems or procedures.

Removing these bottlenecks involves the investment in smart sensor systems, ICT solutions as well as in data analysts (to ensure data collection, management and mining) that have an understanding of food-related issues, ranging from food safety, food quality and traceability. It is of paramount importance to extract the relevant information from the available digital data, understand the data, recognize trends and take preventive measures to ensure a smooth-running production process, predictive maintenance of machinery and so on.

The agri-food system becomes more and more interconnected between different stakeholders (farmer, consumer, retailer, food processing industry, etc.). The need for more and improved tracking and tracing, higher quality standards, prevention of food losses and so on, increase the demand for smart sensor systems, data management systems, etc. Multinationals hire consultants to scan their production and to introduce those systems, for agri-food SMEs it is a lot more difficult to find the right solutions.

2.2 OBJECTIVES AND OVERALL METHODOLOGY

2.2.1 THE ECOSYSTEM

The aim of the S3FOOD project and also the overarching Thematic Smart Specialization Partnership (S3P) is to set-up a platform and supportive business ecosystem between agri-food clusters and clusters representing technology and/or digital solution providers, relevant RTOs and other stakeholders, to lower the barriers for agri-food companies to access and implement the newest smart sensor systems, make them acquainted with and train them in data management and mining, etc. and thus facilitate and enable the Industry 4.0 transition of the agri-food industry.

Making the leap towards Industry 4.0 is the final step of a larger strategy and trajectory involving all aspects linked to digitalization of the agri-food industry, such as data management, blockchain, artificial intelligence, augmented reality, robotics (cobots), cybersecurity, skills development of workers and management, etc.

The collaboration between the clusters (or innovation actors providing similar services) and RTOs will create a trust zone between the involved sectors, companies and also regions.

Agri-food companies have specific requirements for the sensors, related ICT solutions, etc. and also expect the machine producers to integrate these sensors in their equipment/machines/production lines. Via the S3FOOD project, the involved stakeholders will get a better understanding of each other's capabilities/capacities and specific requirements for these technologies.

The ecosystem involved is complex and includes multiple actors with different fields of expertise. We see the following relevant stakeholders in the Industry 4.0 value chain for the agri-food industry (Figure 1):

- Agri-food companies
- Technology providers: including smart sensor producers, etc.
- Digital solution providers
- Machine producers: producers of production machinery for the agri-food industry, producers of robots, etc. These machine producers are very important in relation to the connectivity between the machines of the production process.
- Integrators: can integrate the smart sensors in the production line of the agri-food companies (tailor-made) or collaborate with the machine producers to develop a generic solution for a larger market
- Universities, RTOs, etc. that can provide knowledge, information and guidance to introduce new technologies (not available on the market yet)

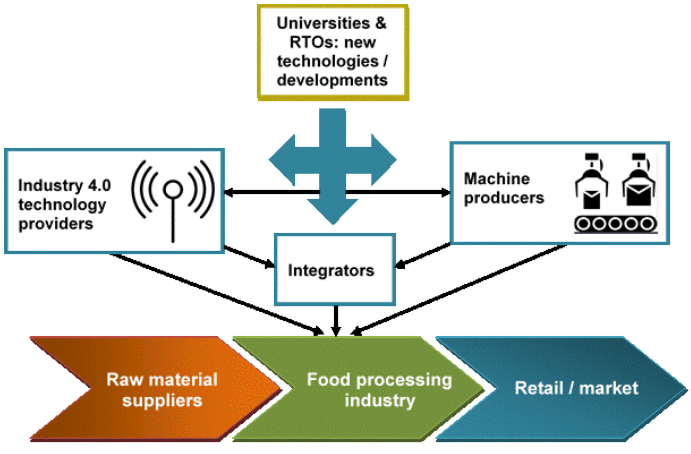


Figure 1Schematic overview of the stakeholders in the Industry 4.0 value chain for the agri-food industry

As backbone of our Strategy we will set-up a network of shared, open access living labs, where smart sensor systems, ICT solutions and other industry 4.0 related technologies can be demonstrated, tested and where relevant training sessions and workshops can be organized. Competition and duplication within EU regions limits the development of critical scale. It is clear that collaboration between complementary EU regions is more effective, efficient and sustainable than competition. Frequent cross-sectoral and interregional meetings and activities, involving all parties of our ecosystem (Figure 1), will be necessary to translate our shared vision into a roadmap, strategic lines and concrete investment projects to accomplish our goals.

These living labs provide a 'safe' environment for agri-food companies to get a first experience with these technologies and digital solutions. We will define and connect already existing, comparable living labs, staffed with competent, multidisciplinary teams, from different European regions.

Starting from the specific needs and challenges of the agri-food SMEs, it is our strong believe that the living labs offer the ideal environment to get introduced to new technologies and experience first-hand the potential, opportunities and added value they have in store for specific applications.

Furthermore, the start-up and scale-up community will be involved in our ecosystem and new tech companies with fresh and innovative ideas and developments will be closely followed-up by our consortium and Partnership.

2.2.2 THE 5 STEP MODEL TOWARD INDUSTRY 4.0 UPTAKE IN THE AGRI-FOOD INDUSTRY

Based on the lessons learned from previous projects and cross-sectorial collaborations, a 5 step model (Figure 2) was developed guiding introduction of Industry 4.0 relevant technologies in the agri-food industry: creating awareness, building a trust zone, evaluation and validation, implementation and leverage creation. The technologies and digital solutions we consider are available at higher TRLs and ready for validation in an industrial environment.

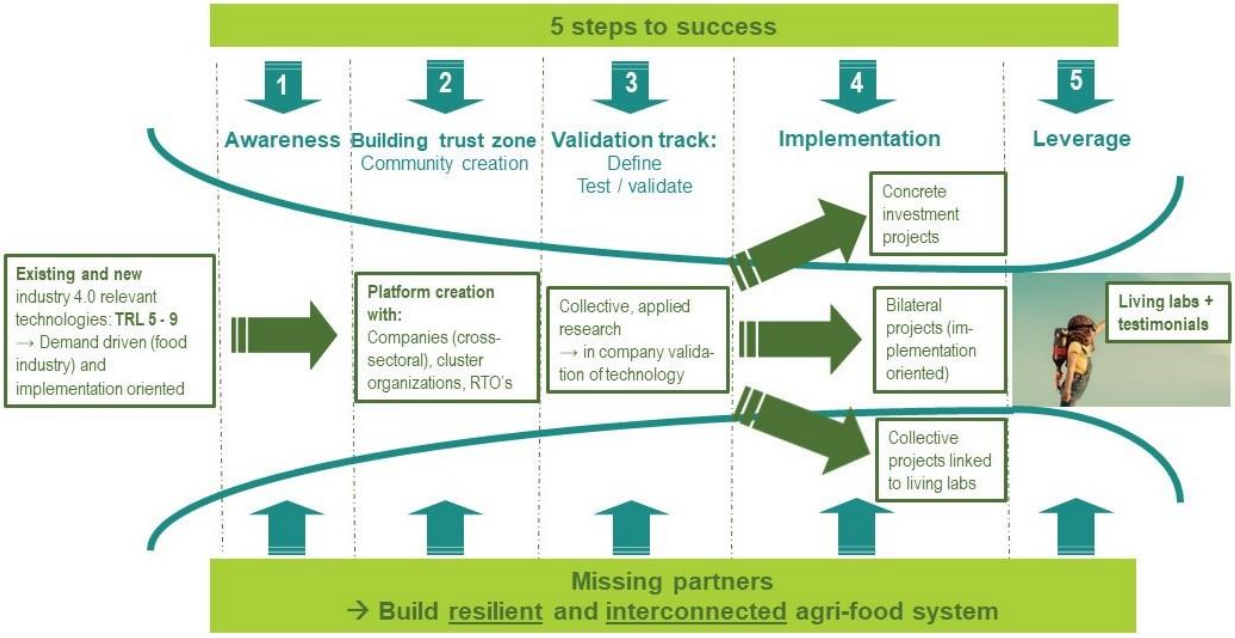


Figure 2 The 5 step model to guide the introduction of Industry 4.0 relevant technologies in the agri-food industry

A detailed description of the focus of each step and the activities that fit in each step is given in the following paragraphs.

STEP 1: CREATING AWARENESS:

Creating awareness is a continuous process during the whole technology integration and implementation process. The key aspects in this process are:

- Identification of specialized clusters and other intermediary organizations (in different regions)
- Inform and convince these organizations to join forces
- Identification of top players (agri-food, technology providers, digital solution providers, etc.) with support of the involved cluster organizations and other intermediary organizations
- Frequent meetings and activities to improve the Strategy and Implementation Roadmap, taking into account new developments and opportunities
- The deployment of our Strategy linked to the Industry 4.0 transition of the agri-food industry calls for the collaboration within the defined ecosystem, as well as with regional authorities and regional and national funding agencies.

STEP 2: BUILDING THE TRUST ZONE BETWEEN THE INVOLVED SECTORS – COMMUNITY CREATION:

The objective of this trust zone and community building is to bring companies and RTOs together in a forum with focus on the digitalization for the agri-food industry and in this way improve and increase the awareness. A trust zone will be built between the agri-food companies and the technology providers, so the agri-food companies know which support and solutions they can obtain and the technology and digital solution providers understand the needs of the agri-food companies.

We want to facilitate this by creating a network of living labs, supported by a cross-sectorial and interregional team, supplemented with specialized and customized business support services for the agri-food SMEs. The network should consist of different complementary partners: RTOs, cluster organizations, agri-food companies, machine producers, system integrators, technology and digital solution providers.

Activities will include the following:

- Screening of needs and opportunities for the agri-food industry
- Technology watch on emerging Industry 4.0 innovations
- Generation and support of innovative ideas, networking and partner matching between agri-food companies, technology and/or digital solution providers
- Via a centralized contact point, services are provided concerning Industry 4.0 technologies that are already available for the agri-food industry.
- Furthermore, a number of thematic seminars, workshops, training courses and demonstrations will be organized to promote knowledge transfer.

Step 3: Evaluation and validation of new technologies and digital solutions

The process to get from awareness to validation is a collaborative work in which common goals between all partners should be reached: demonstrate/test/feasibility checks of new technologies and digital solutions towards concrete investment projects. The process of validation gives insight in the specifications needed for industrial applications.

In the validation track the target groups of the project are actively involved: the agri-food companies as well as the technology and digital solution providers, machine producers and integrators for whom the agri-food industry is an important customer. During validation, which can be partly organized in the living labs or on site in the agri-food companies, RTOs can bring technology to a level that technology providers and integrators can take further to implementation towards end users.

Step 4: Implementation of new technologies and digital solutions

Close collaboration between the agri-food companies and the technology and digital solution providers will result in concrete investment projects in the agri-food companies and collective large-scale SME

group projects linked to the livings labs. When needed, additional partners such as integrators and machine developers will be involved to make the jump from a stand-alone, validated device (demonstrator) to full integration in the production plant.

These projects will be identified, evaluated and implemented and additionally, the technology and digital solution providers can also invest in the living labs, where they can demonstrate their technology and give trainings.

Step 5 Leverage

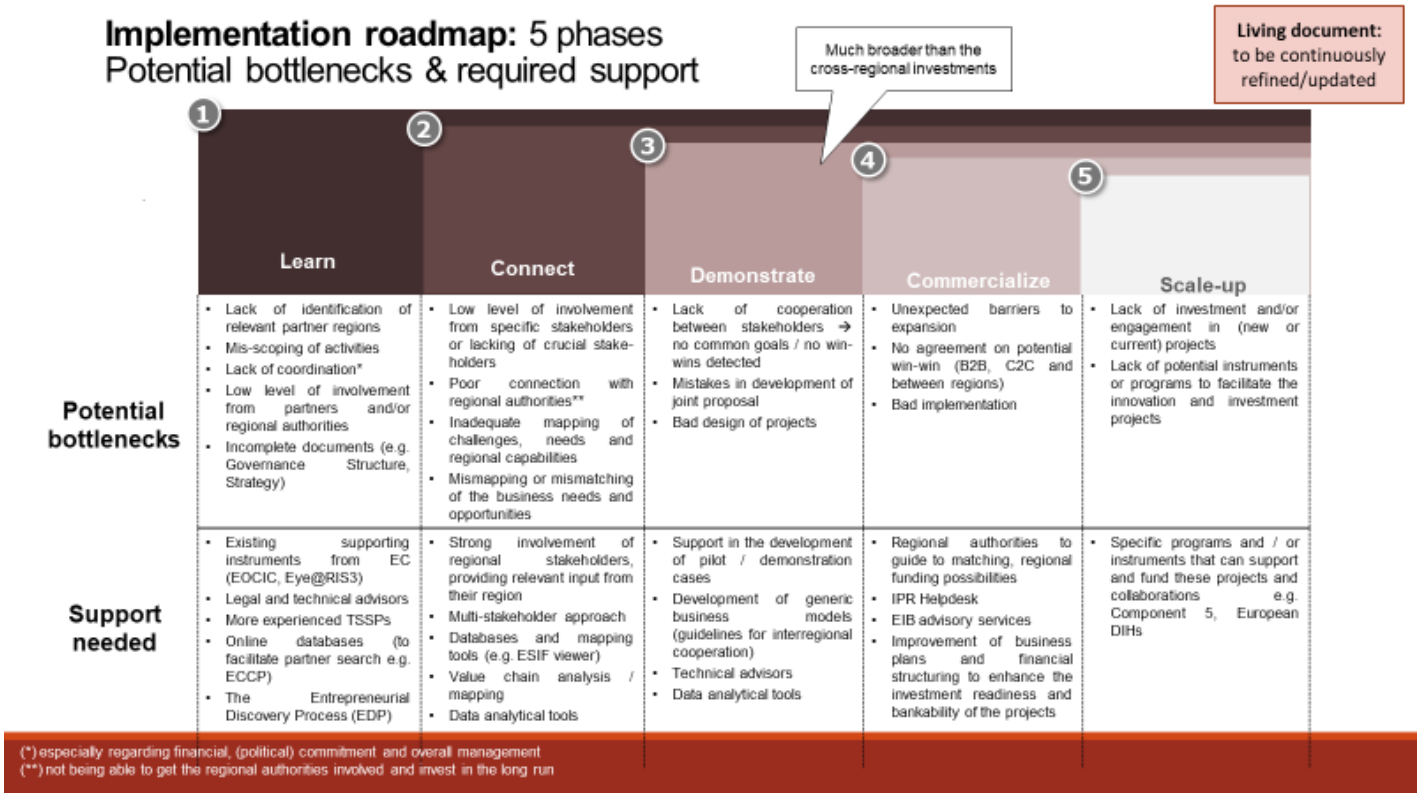
Integration, investments and realizations in the agri-food industry create visibility for all stakeholders and will help to attract new partners for newly defined validation and implementation tracks and new technologies, which is a supporting evolution to reinforce the funnel.

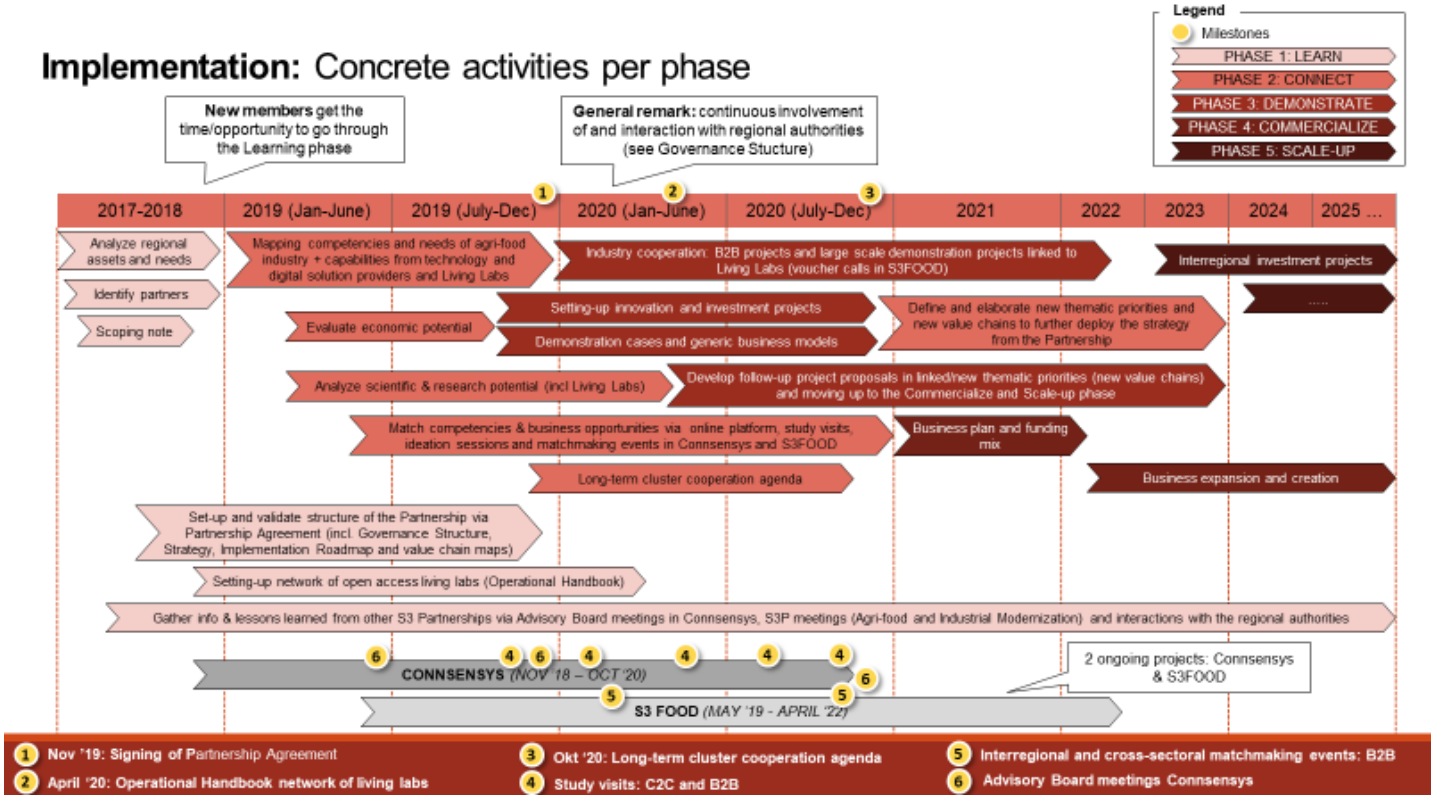
Therefore demonstrations, training programs and study visits in the living labs, RTOs and frontrunner agri-food companies will be organized in collaboration with technology and digital providers. Furthermore, the activities, news, events, testimonials, success stories and concrete results will be distributed and disseminated via newsletters, presentations, etc. This will enable the cross-fertilization and speed up the learning process.

Creating leverage also includes engaging and feeding input to policy makers and managing authorities of regional and European funds, in order to ensure the relevance and the likely translation of our Strategy in practice.

3 IMPLEMENTATION ROADMAP

The implementation roadmap describes how the S3 partnership will exploit synergies and common assets.





4 THEMATIC PRIORITIES FOR S3FOOD

The ongoing digital transformation leads to new ways of producing, new products and new business models. The concepts of Industry 4.0 offer significant opportunities and challenges. Food companies, as an important segment in the process industry, are facing the challenge to become ever more efficient in their production processes, both in the use of resources as in utilizing raw materials as best as possible, but they also need to be able to be flexible enough to respond to fast changing consumer demands. Additionally, they need to work with the additional complexity of the raw materials being biological products, often showing large (seasonal) variations, are being transformed into a wide range of high-quality end products with a complex composition. This production process is influenced by various factors and the final product not only needs to be of high quality but also – and foremost- has to be safe for human consumption. The different stages that can be distinguished in the digital transformation process are illustrated in Figure 3.

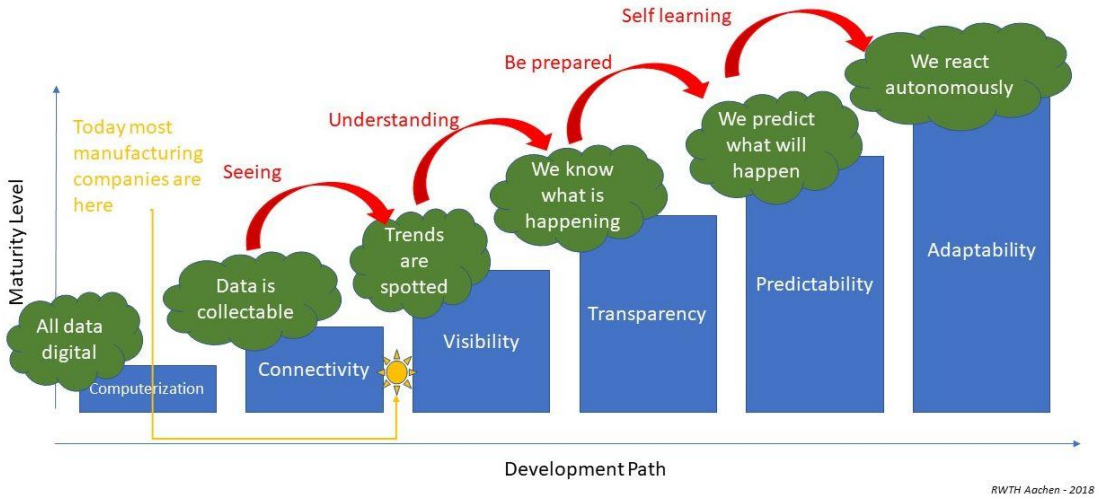


Figure 3 Different stages in digital maturity – steps to take in the digitalization process

Based on the processed information obtained under T1.1 and T1.2 4 thematic priorities were defined that will serve as the framework for all activities that will be deployed in the framework of S3FOOD.

4.1 THEMATIC PRIORITY 1: SENSORS TO MONITOR REAL TIME CRITICAL CONTROL PARAMETERS

To ensure real time monitoring of the quality of the food products during processing it is of crucial importance that not only the machine parameters but also the characteristic of the products itself can be measured. As soon as the critical control parameters are identified, the search for the best suited sensor system can start. For some quality characteristics no suitable sensor system is commercially available yet. Examples are the inline monitoring of consistency and crystallization degree of margarine, the viscosity of dough, structure and functionality of the final product, … In this case the potential of innovative sensor developments (RTO's for instance) need to be explored. Another way is the soft sensor approach where via data-analysis and modelling a parameter that cannot be measured directly is predicted based on a set of measurable parameters for which sensor systems are available. This decision tree for sensor selection is illustrated in Figure 4.

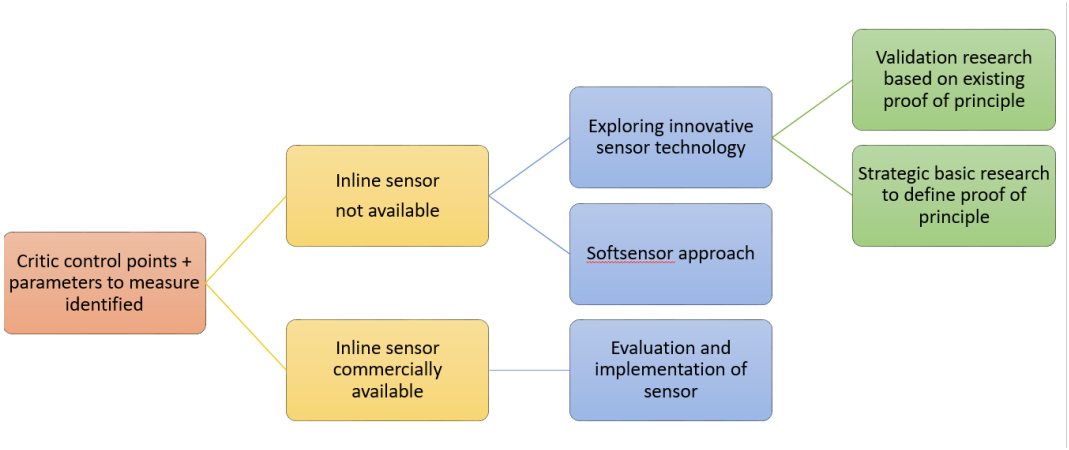


Figure 4 Decision tree for sensor selection.

4.2 THEMATIC PRIORITY 2: SENSOR INTEGRATION AND IMPLEMENTATION

The agri-food companies do not need sensor systems, they need integrated solutions. This means that technology providers and digital solution providers will have to work together to understand and grasp the needs of the agri-food companies and develop smart systems accordingly. These smart systems will have to be implemented in the production chain of the agri-food companies, implying an active involvement of the technology and solutions providers to fully understand the working conditions in the end market. Accreditation and certification to show compliance to all the strict food safety requirements are also necessary. Finally, an integrated solution also means that the smart system seamlessly transfers data from and to the production monitoring systems, the ERP software that is in place and quality monitoring systems.

4.3 THEMATIC PRIORITY 3: SMART DATA MANAGEMENT – FROM DATA TO INFORMATION TO ACTION

Capturing data via sensors is only a first step. Data are only the facts and figures that you measure. By ordering, analyzing and adding context to them, data can be transformed to information. By understanding patterns in information, we can attain knowledge. Knowledge differs from data or information considering the fact that new knowledge may be created from existing knowledge using logical inference. Knowledge allows you to understand how things work and why things happen and as such we can anticipate this. This knowledge can also be used to make machines and processes 'smart'. Digitalization and (big) data analysis – the fast and iterative processing of large sets of data - can turn this into a systematic learning process, with or without human input. Figure 5 illustrates the different steps of data analytics maturity. It shows how data can be used to evolve from describing what has happened to steer what should happen.

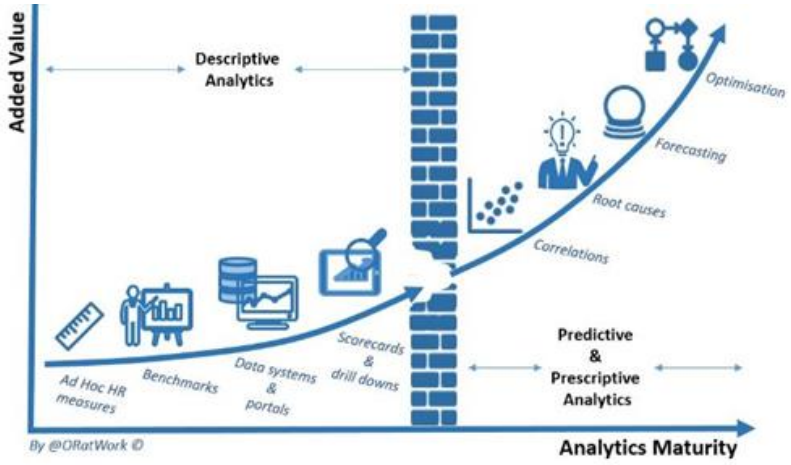


Figure 5 Data analytics maturity model (Gartner)

4.4 THEMATIC PRIORITY 4: CONNECTIVITY IN FOOD COMPANIES AND IN THE FOOD VALUE CHAIN

Capturing and monitoring data from one machine or system is one thing, but it becomes much more interesting if the data from different machines or even different plants can be aggregated, compared or used. Therefore, the smart systems in the food processing industry need the ability to connect to one another and exchange information, most likely through the Cloud. There are still quite some issues that need to be overcome when it comes to communicating monitoring systems. First, there is the lack of standardization in the choice of a communication protocol: should the system use wired communication or wireless? Which technology shall be used? Which data communication protocol? When process data is communicated through the Cloud, there are still huge issues with regards to data security and the risk of the data being tampered. Digital solution providers will have to invest time and resources in implementing rigorous security solutions but also in gaining the trust from the companies in the food value chain.