FOOD PROCESSING COMPANIES' CHALLENGES AND THEMATIC PRIORITIES FOR DIGITAL INNOVATION

INTRO

The challenges and needs of the food processing SMEs with regard to digitalization in the agri-food value chain as well as technical thematic priorities have been mapped in the Innosup-1 project S3FOOD. Both challenges and thematic priorities are summarized below and together they form a crucial pillar of the SS4AF innovation methodology.

CHALLENGES

Food processing companies, as an important segment of the manufacturing industry, are facing challenges to become even more efficient in their production processes, both in the use of resources as in utilising raw materials as best and efficient as possible, but they also need to be flexible enough to respond to fast changing consumer demands and changes in global value chains. Furthermore, they need to work with the complexity of raw materials, being biological products, often showing large (seasonal) variations, and that 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, tasty and competitive but also – and foremost – has to be safe for human consumption. Additional challenges include increasing quality demands, traceability, a wider product variety, a constant pressure on costs and delivery times, personnel costs, difficulties to attract specialised personnel, etc.

The core value of food processing companies is to produce high quality products that are fit for human consumption. Food processing companies are facing several challenges: increasing quality demands, a larger product variety that needs to be produced in a flexible way, traceability of origin, a constant pressure on costs and delivery times, personnel costs, difficulties to attracting specialised personnel etc. It is of paramount importance for the EU food processing companies to maintain or strengthen their local and international competitive position in global value chains and to be able to respond, in a flexible and efficient way, to fast changing consumer demands, the acceleration of the digital transformation and innovation of the processing system. The COVID-19 pandemic further highlighted the need for flexibility and resilience and the importance of a high degree of digitalisation of the agri-food industry, which can help companies to address COVID-19 impacts that have been felt in all segments of the agri-food value chain.

Current challenges the food processing companies are facing and where digital solutions and data driven processing can provide an answer are related to:

- Safeguarding and monitoring hygienic processing and quality control
- Traceability: more and more higher standards are desired on traceability of (food) products. Not only from a food safety point of view, but also from conscious consumers who demand to be able to know where (different parts of) their food comes from. With support of more digitalised processes, it should be easier to enhance the traceability and even use this as a unique selling point.
- Flexibility: the demand of consumers and therefor wholesale and retail changes more rapidly than ever, forcing the food processing industry to become more and more flexible. Not only in volume, but also in products and specifications. Digitalisation

should make it easier to be more adaptive to changing demand. The Covid 19 crisis has put more emphasis on this need for flexibility, not only in relation to demand, but also in relation to resources, both material and human.

- Labour: finding (enough) skilled employees is not easy. Next to that the available labour force is relatively expensive. Through digitalisation some parts of labour where employees are hard to find can be substituted by automated processes. This will probably lead to a shift of labour (from manual processing to managing ICT-driven systems), more than a decline of labour.
- Sustainability: efficient use of resources, limiting food waste and creating value from side streams. Digitalisation can make process 'smart' and providing data on use of resources and allowing for the exploration on how to optimize this.
- Identifying and realizing new business concepts / models (in case the "traditional sales channels" will become ineffective).

All over Europe, the agri-food industry is typically a SME drive sector with 99% of the companies active in food and drink industry in Europe being SMEs. The food processing SMEs, as well as SMEs in other sectors throughout Europe, are struggling, more than large companies, to keep up with the pace of digital transformation. The reasons for this are manifold, but mostly they tend to be uncertain of the business case, lack access to technically skilled employees, as the agri-food industry seems to be a less attractive sector for these technical profiles, and access to repositories of well-structured data. SMEs also fear poor or uncertain return on investments.

Data driven digital solutions are expected to bring numerous benefits to the food industry such as increased efficiency, flexibility and productivity, loss reduction, improved transparency, traceability and overall business performance, more information and added value for their customers, etc. At the same time, these digital solutions have the potential to disrupt the traditional agri-food industry by changing existing business models and potentially crowding out successful ones. For SMEs, which are the backbone of this industry, this poses a particular challenge and requires a step-by-step, sober approach.

The integration of innovative digital technologies throughout the production system and technological developments within the Industry 5.0 context, such as data analysis and artificial intelligence, offer great potential for real-time process and quality control of ingredients/products and an optimization of production processes to transform the production equipment to a flexible, responsive and adaptive system, while also taking into account the human centric aspect that includes training and skills development for workers as 'end users' of the digital solutions. To this end, the adoption and implementation of innovative digital solutions in the agri-food industry will enhance and support the economic resilience and adaptability of this industry.

THEMATIC PRIORITIES

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 1.
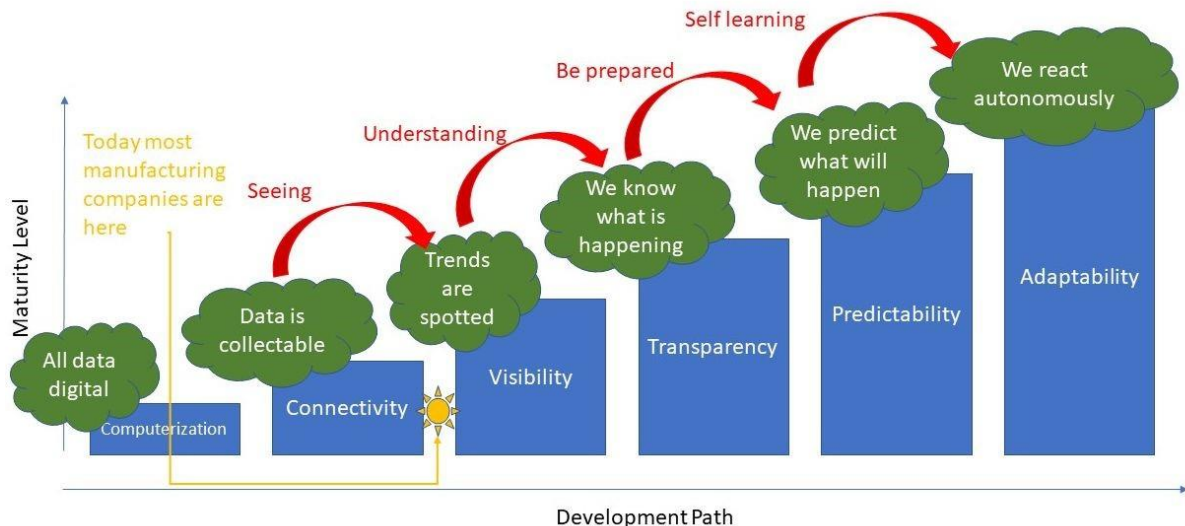

Figure 1 Different stages in digital maturity – steps to take in the digitalization process

In the framework of the Innosup-1 project, this trajectory was split into distinct thematic priorities.

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 2.
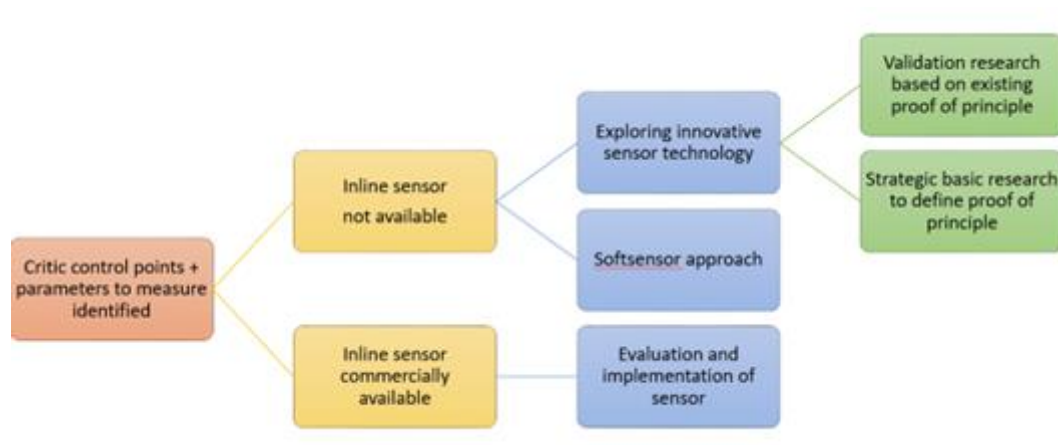
Figure 2 Decision tree for sensor selection.

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.

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 3 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.
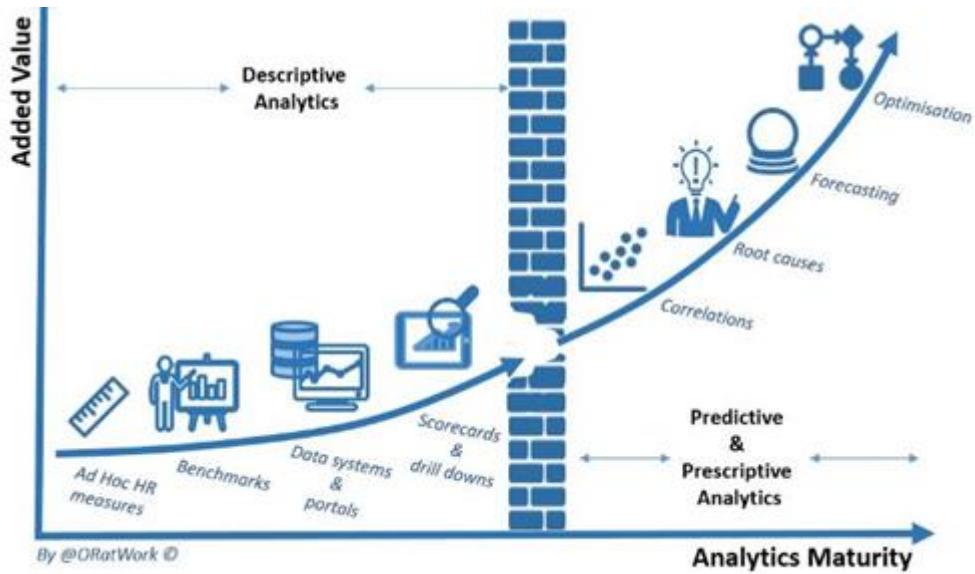
Figure 3 Data analytics maturity model (Gartner)

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.