

Future Internet and the Agri-Food Sector - State of the Art of Future Internet Research -

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Abstract: The agri-food sector is one of the most important sectors of the economy, encompassing agriculture, the food industry, retail, and eventually, all members of society as consumers. With its responsibility of serving consumers with food that is safe, readily available, affordable and of the quality and diversity consumers expect, the food sector needs (1) to be efficient, (2) to build on an appropriate organization and control of processes, and (3) to provide assurance on the safety and quality of its products which consumers could trust. Efficiency, process control and consumer communications are all closely related to the use of information and communication technology. Global networks, the internet, networked devices, sensors, and communication intelligence are of foremost relevance for the sustainability of the food sector in meeting its responsibility. The emerging capabilities of the Future Internet (FI) promise to overcome major barriers of the past and to support the sector in its global activities. However, the utilization of capabilities of the FI can build on a wealth of knowledge from literature, experiments and best practice activities that can provide guidance on how and where to move. Project partners within the EU SmartAgriFood project [SAF11] have collected 110 knowledge cases from various angles that capture a broad variety of different aspects related to farming, logistics, and awareness. The cooperation of 20 project partners in collecting the cases assured the consideration of a broad range of competences. Partners involve groups from research as well as from service providers, system engineering groups, standardization, and industry. The cases are related to more than 60 indicators which should support the identification of cases that might be of relevance for any emerging project scenario. The paper gives a rough overview on the orientation of the cases.

1. Introduction and Overview

The agri-food sector is complex as few other sectors are, with its diversity of products, the deterioration of fresh products, the dependency of agricultural production on weather conditions as well as on the control of diseases or pests, the limitations in the evaluation of quality characteristics at the final customer, the consumer, the relevance of bulk products, the distances between areas of production and areas of consumption, the depend-

ency on cultural backgrounds in production and consumption, the dominance of SMEs, the volatility of markets and many other issues of similar relevance.

Since many years research initiatives have dealt with many of these issues reaching from basic research to experimental field activities and beyond. It is a basis which makes a move from research and experiments to the development of prototype systems and their implementation in the sector feasible. There is a long history of efforts in utilizing information and communication technology for the food sector’s needs. Precision agriculture in primary production as well as tracking and tracing of food products along the food value chain characterize major initiatives in serving the sector’s and consumers’ needs. However, these examples also demonstrate the complexity in issues. The EU looks back at more than ten years of tracking and tracing research while precision agriculture is dealt with in global conference series since many years as well. It is not the least due to deficiencies in the capability of information and communication technology that these initiatives have not reached widespread adoption irrespective of needs. Especially tracking and tracing as a baseline information and communication activity for transparency in the food sector has not reached a level of operation that matches the global network activity of the food sector in sourcing and sales.

Categories	Indicators
Grouping of examples	Study, prototype system, operational system, comprehensive system or service, system component, service component, standards, others
Use case	Farming, logistics, awareness
Focus	Tracking and tracing service, other user services, system design and organization, system operation and management
Functionality	Exchange, sending, receiving, processing, filtering, aggregating, collection, capturing, scanning, searching, selecting, filtering, signalling, assuring data ownership, security, ontologies
Internet	Use of internet, contribution to FI, utilization of FI
Affected groups	Farms, agricultural trade, processing, retail, consumers, system providers, others
FI domains	Semantic web, standards/protocols, internet of things, interoperability, flexible connections, service oriented web, system security
Technology	RFID, networked devices, sensors, communication technology, agents, central databases, distributed data bases, scanners, signalling, multicasting, broadcasting, others
Lessons for system organization, function, operation, management	Mobility, flexibility, autonomy, independence from central management, system efficiency, information availability, communication with target groups, others

Table 1: Indicators used in second stage of analysis

In collecting the cases, the project implemented a two stage approach. In the first stage, the cases were provided by partners using a basic template including information about the background (literature, project, system product, expert experience, other), focus (information needs, information organization, chain communication organization, system organization, process organization, IT components, FI functionalities, other), sector (agriculture, food), source, content, further information, and lessons learned. In the second stage of analysis, the cases were further specified according to a more extensive number of indicators as listed in table 1. They allow a detailed specification and categorization of cases depending on interests and needs. The specifications were provided by the partners who delivered the respective case.

2. Basic Analysis and Evaluation

The cases cover farming, logistics along the food chain, and food awareness. About three quarters of cases deal with farming and logistics with an even distribution among them, about one quarter deals with food awareness. The somewhat lower number of cases linked with awareness is probably due to the development of interests in the utilization of IT technology over time. The initial interest in using IT technology was focused on improving business interaction between enterprises and supporting process efficiency along the food value chain. The provision of information on products and processes towards the final customers in the chain was of secondary interest and received only attention in connection with (1) scandals that created distrust among consumers and business customers and asked for information that could provide some guarantees of food safety or quality, (2) increasing consumer interest in information on food, and (3) the development of quality and environmental management activities which required communication between partners in the chain. Furthermore, it is only recently that technologies are available that allow extensive communication with consumers and the development of communication schemes along the chain that are not devoted to organizational efficiency but on improving information on products and processes.

A detailed analysis of the case studies provided builds on a comprehensive analysis table that is provided to SmartAgriFood partners as an Excel analysis table. It relates all cases to the different indicators and allows project partners to do their own analysis depending on needs. By opening the Excel table one can directly open any case study through links listed in the Excel table for each of the cases. By using an Excel table one could easily sort the case studies according to indicators of interest allowing a focused view and a selected opening of case studies. Some general relationships between cases and indicators are summarized in the following sections.

All cases are initially linked to farming, logistics and awareness. However, they may affect different stages of the food value chain (see table 1). The majority of cases linked to 'farming' do focus on farms, whereas the majority of cases linked to 'logistics' reaches primarily from farms to retail (with an emphasis on processing and retail) and includes, in addition, system providers. In 'awareness' the number of cases is relatively lower. However, within these boundaries, the cases affect quite evenly all stages of the chain including consumers as well as system providers. This highlights the need for cooperation along the chain for best serving information needs at the end of the chain. The organizational focus of cases is captured through a diverse cluster of alternatives. They include information needs, the organizations of information or communication systems, process organizations, IT components, FI functionalities, tracking and tracing services, system design, and system operation and management. Specific interest is in information needs of businesses, information and communication organization, tracking and tracing, system design, and system operation. In discussing various technologies and especially technologies related to networked devices, the provision of cases is primarily directed towards classical networked devices of various kinds and data bases. Agents and broadcasting are emerging technologies that are less considered in the cases but will certainly receive greater attention in the future. Related to issues of the FI the focus of provided cases is on standards, interoperability and the FI in general.

The analysis of cases allows a first basic evaluation of their content. A core element refers to the aspect ‘lessons learned’. Apart from content issues like ‘information availability’ aspects or efficiency as well as mobility, flexibility, and autonomy have been addressed in the cases provided. The ‘lessons learned’ have a close relationship with elements of the FI. However, system security is an exception. It is an issue with limited relevance for prototype systems and project developments where most cases have been derived from and has, as such not yet found appropriate attention in the data base. There is a need for further elaboration of the issue. A related picture is provided when the FI is linked to IT functionalities. The primary focus of cases dealing with elements of the Internet or FI is on data activities including collection, processing, and exchange, i.e. the classical view on IT activities. Little attention in cases has been placed on data ownership, one of the central issues in the organizational feasibility of systems. The same is true for data security and ontologies. Deficiencies in the consideration of these issues have been of major relevance in system failures where the technical system organization was fitting.

3. Summary

This paper presents a broad knowledge base comprised of 110 examples on information and communication use with relevance for the FI and the agri-food sector. The examples are discussed and analysed according to a number of criteria. They relate to farming, logistics and awareness, and cover a wide variety of information and communication systems and technology. The relationships are captured in a selection table which allows focused access to cases which are accessible for SmartAgriFood project partners through the internet. A rough analysis of lessons learned makes it apparent that envisaged capabilities of the FI could contribute substantially to the development of the agri-food sector. Mobility, flexibility, autonomy, efficiency or decentralization are some of the keywords that evolve from analysis. The FI could provide solutions to overcome traditional barriers in these areas. The paper gives a rough overview on the orientation of the cases.

References

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