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Transparency in Food Networks - Where to Go

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ABSTRACT

One of the core requests in assuring competitiveness and sustainability in the food value chain is transparency. Food is a basic human need and as such of paramount interest to consumers. They expect retail to provide guarantees assuring that food is safe to eat and of the quality they request. Increasingly, interests of consumers reach beyond these basic needs but involve environmental or ethical aspects related to the production and distribution of food. The provision of the guarantees is communicated to consumers through claims that are expressed in messages ('food is safe'), signals ('food miles'), labels of various kind, or just clusters of information items (as e.g. 'origin'). Appropriate communication provides transparency to consumers and allowed them to 'make informed decisions' that fit their needs.

The complexity of the sector, the absence of focal players in the field, the complexity in the collection, processing and communication of information, and limitations in information and network technology have made it difficult to find concepts and solutions that could solve the transparency problem at consumers' end. This is where the Future Internet provides opportunities that allowed to meet the challenge and to appropriately address the transparency problem.

This paper introduces into the subject through a detailed outline of the transparency complexity of the food sector and the requirements on concepts and systems that could deal with it. This is followed by a presentation and discussion of a suitable concept, building on network elements of the Future Internet. The concept is based on a range of generic functionalities and system components that provide stability but also assure that the concept could easily be adapted to a broad range of sector scenarios in different product lines and food value chain organizations.

Keywords: Transparency, food networks, information technology, Future Internet

1 Introduction

Consumers' trust in food, food production, the origin of food, and the actors involved is a core requirement for the functioning of European food markets and the competitiveness of industry involved. With the experience of the BSE crises and subsequent food scandals in mind, consumers increasingly expect transparency on which trust can build. Transparency is not meant to know everything but to ***create awareness*** on the issues consumers are interested in, involving information on the safety and quality of products and processes, and increasingly on issues around environmental, social, and ethical aspects.

Trust is a sensitive 'product'. NGOs and other groups are increasingly demonstrating the divergence between claims and reality contributing to the public push towards increased transparency. Claims in this context represent statements on product characteristics (e.g. on quality) that are not directly apparent to consumers upon visual inspection. Many companies have embarked on the bandwagon towards transparency and are putting tremendous efforts in serving this need. However, with the scattered company infrastructure of the sector, the deep integration within the food industry and the importance of commodity products in most food products across the sector, reaching transparency is a sector problem that cannot be tackled by individual companies alone (Fritz and Schiefer, 2009). Furthermore, any scandal is damaging the trust in 'food' in general, distorts markets and cannot be limited to the individual company involved

This asks for sector wide efforts to improve on transparency linked to sales products. However, with the dependency of transparency information on the activities of all actors in the value chain, the design of appropriate transparency systems requires cooperation within the sector and a suitable IT infrastructure on which information can be collected, processed and moved towards retail and the consumer. The IT infrastructure is the critical success factor in the scenario as without its base any further agreements in the sector on the development of transparency is without a realistic chance of implementation.

The baseline for such an infrastructure is the ability to clearly identify products and the link between products and the transparency information. This so-called 'tracking and tracing' ability is the base on which all information and services can build. There are many initiatives by regional or global actors towards the establishment of global tracking and tracing systems that could cover the industry. However they were all doomed to fail (Fritz and Schiefer, 2009) because of a.o.:

a) limitations in past technology that required central management activities the sector was not prepared to accept, and

b) the investment needs especially for SMEs in joining integrated IT solution networks.

With the advent of new and increasingly powerful networked technology and new internet communication opportunities, the picture changes as it opens the way for decentralized solutions building on autonomy in trade units, flexibility, and new functionalities in what is called the Future Internet (Tselentis and Galis, 2010), that allowed easy access to the system and the easy development of transparency services building on a few functionalities with generic base.

It has been demonstrated (see the EU project www.cuteloop.eu) that the information flow can be adequately specified by a few generic functionalities with 'information filters', 'action triggers', and software agents at the core. Filters, triggers, and agents are rule-based system elements. The specification of rules (incl. processing rules) identifies the characteristics of any transparency system. The combination of these core functionalities with input, output and communication functionalities and their organization into generic sequences of functionalities allows a sufficient description of information flows embedded in transparency systems. The mapping of specified functionalities with technology elements as e.g. RFIDs or scanners of advanced levels of sophistication enables the evaluation of the principal capability and efficiency of future transparency systems that fit the needs of the sector. The necessary IT infrastructure is the base on which the content can build. The actual content the services provide is not part of the infrastructure but depending on changing needs of consumers and the ability of the sector to deliver.

Transparency is driven by ***needs***. However it is one of the most complex and fuzzy issues the sector is facing. The complexities are due to complexities in food products and processes but also due to the dynamically changing open network organization of the food sector with its multitude of SMEs (small and medium sized enterprises), its cultural diversity, its differences in expectations, its differences in the ability to serve transparency needs, and its lack of a consistent appropriate institutional infrastructure that could support coordinated initiatives towards higher levels of transparency throughout the food value chain.

Transparency builds on appropriate ***signals*** which integrate available ***information*** and communicate a certain '***message***' to recipients (e.g. 'food is safe'). Transforming information to simple, clear, and easily understandable 'messages' and assuring that messages do build on information that can be trusted are key issues in ensuring transparency and trust. In the selected domain, signals build primarily on information about products, including their composition and characteristics, on information about processes they were involved in or exposed to, and the production environment (including its origin etc.). The provision of information could involve a broad range of alternatives depending on opportunities but also on the ability and willingness of consumers and decision makers to grasp, interpret, and process the information as needed.

For discussions on transparency (content) issues we can refer to results of a European project (www.transparentfood.eu) which aimed at identifying the ***state of the art*** in transparency in the food chain, remaining deficiencies, and ***needs for action***. One has to identify a clear line between the communication infrastructure to be developed and specific information to be carried along for providing transparency in a certain domain. The interest in transparency domains might change on short notice but the infrastructure must be able to easily adjust to such changes. It must be able to carry the relevant information but should not be bound to any specific information. The transparency view is an extremely dynamic field which might change on short notice depending on developments in lifestyles, policy, food scandals, market shortages, etc.

The present paper builds partly on results from the EU project SmartAgriFood (www.smartagrifood.eu) partly covered in Lehmann, et al. (2011) but is being complemented by results from the projects Cuteloop (www.cuteloop.eu) partly covered in Reiche (2011), Transparent_Food (www.transparentfood.eu) partly covered in Schiefer and Deiters (2013), and the ongoing project FIspace (www.fispace.eu). It is divided into 3 parts. The *first part* (chapter 1) provides the basis for the system design in subsequent parts. It introduces into the food scenario 'awareness', discusses opportunities to make the scenario come true, outlines some of the challenges the food system is confronted with and presents some of the emerging issues in transparency domains consumers are interested in. The *second part* in chapters 3 and 4 develops a design framework for a suitable system infrastructure whereas the *third part* (chapter 5) links up with implementation initiatives that employ features of the Future Internet capabilities.

2 A Baseline View

2.1 Overview

Food chain initiatives towards reaching ***awareness*** are focused on serving the information needs of the final customer in the food value chain. The final customer, however, is a complex unit. It is comprised of ***retail***, ***consumers***, and the ***interface*** between them. Retail constitutes the final stage in the food value chain which delivers goods to consumers and provides the information requested by the market, i.e. the consumers. Consumers on the other side link up with retail to receive goods and to request the information they need for making an 'informed decision' (see CIAA, 2005; FoodDrinkEurope, 2013). While the usual understanding of 'retail' refers to retail outlets, the discussion could be extended to other forms of product delivery like home delivery services, caterers, restaurants, or fast food chains, which may be interpreted as specific 'retailers'. There is no difference in the delivery of information to consumers' end, the difference is limited to the 'interface', where the information meets the consumers.

The information exchange can build on a ***push scenario*** where information is provided without explicit request or a ***pull scenario*** where information is requested that was not yet provided. Understanding consumers' information needs is a difficult issue considering the diversity in backgrounds, customs, interests, etc. Retail as their direct business partner is in constant exchange with consumers and might be in the best position to understand its customers' needs. This does not mean that retail is always able or willing to provide to its customers all information they are interested in. However, retail is certainly interested in being always prepared, i.e. have all the information at its disposal which it might not provide in its daily routine but which customers might request with urgency in certain circumstances.

Looking at the interface from both sides one can identify the following principal interests in dealing with needs in transparency (Lehmann et al, 2011). The *consumer perspective* is primarily characterized by *pull situations* as information is usually requested. However, they could be further extended to situations where consumers provide feedback information *pushed* onto retail or other actors in the chain. In this paper we concentrate on the basic pull situations which could involve a broad variety of alternatives. Some are described in the appendix, embedded in reality situations which relate to ongoing project activities. All scenarios have in common that the information needs are serviced at the point of sales, i.e. are provided with the product. Initiatives where information on products could be picked up after sales through internet sites and using the product identification code represent a principal transparency barrier as they require an extra search initiative.

Retail provides the interface between the value chain and the consumer as the final customer. As such it is interested to have all information at hand the customer might want to ask for. Its strength is the ability to deliver, both in products and information. However, beyond the ability to deliver information, retail must also assure that products are safe and of the quality its customers expect. This guarantee is based on:

a) the reception and use of information from producers, suppliers, or from the product itself (if it is able to communicate its status independently from any actor in the chain), and

b) subsequently the elimination of unsafe or unfit products from further sales.

To sum it up, retail needs to receive the information requested by consumers and, in addition, information that allows to eliminate unsafe products or products not matching its own or its customers' expectations. Furthermore it needs it in time. However there is a difference in information dependency. Information to be provided to the consumers is directly linked to the sale of products and has to reach retail on a *routine basis* together with the product. Retail's interest in the assurance of food safety and quality is realized through its business procurement agreements specified at the time of order. As such, retail can expect to receive the products that match its orders. Any additional information is in principle *obsolete* and not part of the deliveries. However, retail might occasionally want:

a) to exercise some *control* involving requests for additional information or

b) to being informed in time if, by any circumstances, shipped deliveries might not match (or no longer match) its order specifications in quality or safety.

Defining quality requirements at order times and requesting that suppliers assure deliveries match requirements (which in turn could reduce communication needs) is a result of the power balance in the chain. With the strength of retail, suppliers have to perform and to deliver the product characteristics requested. The responsibility for analysis is placed on the early stages of the chain. In this case, information provided to consumers could remain quite stable and build on retail's order characteristics.

2.2 Organization and Content

For serving the different scenarios in the consumer and the retail perspectives, one needs to specify:

a) the content of information needs providing '***transparency***' and

b) the structural and technological organization of business services (information services) that can provide the requested information at the time needed, where needed, and in the format needed.

Generally agreed upon under the term '***sustainability***', the content may involve information on economic (including food quality), environmental, social (incl. food safety), and ethical concerns. However, the provision of information is not as straightforward as it may sound. In information content, the relevant and most critical issue is usually not the content as such but understanding the ability of consumers in grasping information and the perception they develop. This is the basis for discussions on transferring information into 'appropriate' ***signals*** that contain the 'message' consumers are interested in (Schiefer and Deiters, 2013).

Considering the many product lines in the food sector, including meat, fish, fruits and vegetables, or cereals, the identification of product specific information items and their linkage with appropriate signals might involve a tremendous task and lead to different system alternatives (Axmann et al, 2013). However, signals that serve transparency needs of consumers do not differ substantially between product lines (e.g. the concept of 'food miles' is product independent as are certain certification schemes). This allows the formulation of signal/information relationships that cut across different product lines.

However, transparency signals are not just those that can be formally communicated or that build on information collected through formal information systems. Cultural background of producers, local customs, or the location of production may provide, if known, strong signals to consumers on the quality of products or the reliability of information. As a consequence, the need for *formal transparency signals* or their content may differ significantly between regions, cultures, etc. To sum it up, to reach transparency, the need for variations in signals between product lines is, in principle, limited the need for differences in signals between cultures is not. A sophisticated example for communicating content and signals is presently the focus of a branding initiative by the REWE retail group aimed at the establishment of a sustainability brand ("Pro Planet"; www.rewe.de) that could serve the mass market.

The approach involves an independent external expert and advisory group which is responsible for identifying a product's eligibility to be incorporated into the sustainability product line. The group evaluates the sustainability of products according to a number of criteria with relevance for various dimensions of sustainability such as climate change, animal welfare, etc. The evaluation involves all the various stages of the supply chain and specifies 'hot spots' for improvements. The consideration of the various stages of the chain assures a fair evaluation according to improvement opportunities and signals in a feedback procedure to supplier companies at each stage (including agriculture) needs for improvements in their production and distribution processes. The evaluation approach is such not only a way of identifying appropriate products but to support suppliers in improving their production towards better sustainability. An example of an evaluation scheme is outlined in figure 1.

The evaluation group calculates an overall sustainability index which is the basis for accepting a product and a supplier for inclusion in the program. By using the index instead of limits for individual criteria, the approach allows flexibility in improvement activities by its suppliers. High level performance in certain sustainability dimensions may offset some deficiencies in others. This approach facilitates participation of farms and food enterprises with different backgrounds and leaves it to enterprises what to emphasize in their efforts towards better sustainability. This is a major difference to the quality and environmental certification schemes active in the sector and better matches the multi-dimensionality in the definition of sustainability.

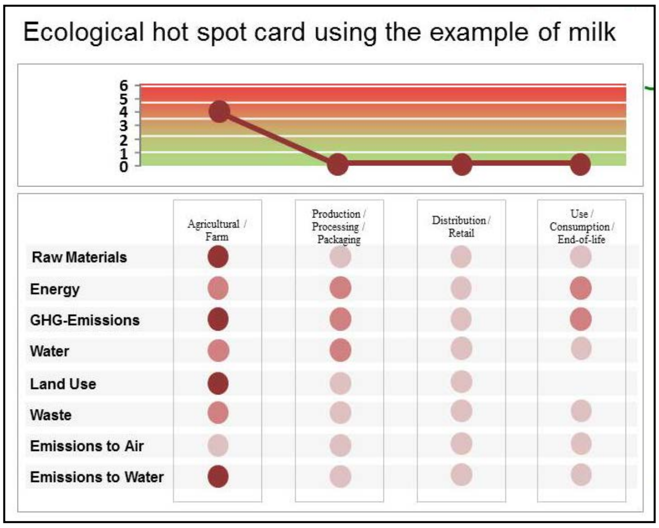

Figure 1. Example of an evaluation card in the program (Rewe, 2014).

The ***organization of business services*** supports the collection and use of information content. It needs to include:

a) ***processes*** for information collection,

b) ***services*** that provide the necessary information for recipients, and

c) specifications of ***activation patterns***, i.e. rules that determine when and how to retrieve the information.

The organization is not just a technological challenge but a challenge that has to take into account issues like data ownership, access to information, information guarantees, or the ability for interactions between actors and systems on the basis of technology, knowledge, resources, exchange rules, and standards. These are major issues that will be addressed in subsequent sections.

3 Making the Scenario Work – an Overview of Principles

3.1 Overview

For getting the necessary information, consumers and retail have to rely on information services that provide a fitting link between the source of information and the use of information at the end. These links involve a.o.:

a) procedures for the collection of information,
b) an information carrier from source to end,
c) the transformation of information into signals, and
d) the activation of information access and use.

The design of services can build on a few generic alternatives in each of the elements. This supports the development of generic organization alternatives for information services for the food sector.

3.2 Information Collection

For serving the different scenarios at consumers' as well as at retail's end, sources of necessary information linked to sustainability in a broad sense involve products, processes, and actors (sites incl. products' origins) that are engaged in production and distribution. It is apparent from the analysis of various food sub-sectors that information can be or needs to be collected:

a) at enterprise premises *before* the product leaves the enterprise premises,

b) at enterprise premises *after the product has left* the enterprise premises, a situation typical for laboratory testing, and

c) on a product's path through the value chain (*monitoring*).

The collection of information may be organized on-site or *in advance*. 'In advance' fits information items that are stable during some time or do not significantly change over time independent of the actual product batch produced. They could be collected any time and with any product batch before use and stored in data bases for later use with subsequent product batches. Examples are e.g. studies on carbon emissions in distribution of apples which would not change as long as the distribution channel remains unchanged. This is an approach presently commonly applied in environmental issues where information is complex to collect.

The further utilization of information that was collected is dependent (if not required by law) on agreement with the collecting enterprise. Data ownership is a difficult issue to deal with. It becomes more apparent with the increase in information needs and the related efforts in data collection. Data access and its value is increasingly becoming a business issue in the economics of trade relationships. One of the approaches presently favored leaves data with the enterprise which allows access in certain circumstances '*on demand*'.

3.3 Information Carrier – the Tracking and Tracing Backbone

The move of information from information providers to information users along the food value chain requires carriers. Traditionally, information is communicated through sales documents. This approach limits information quantity, is slow in the linkage of information across several stages of the chain and has difficulties in the integration of information provided after products have been shipped. State-of-the-art approaches build on the utilization of:

a) communication networks (as, e.g., internet, GSM, or satellite networks) and

b) centrally managed data bases.

In principle, communication systems based on this technology can serve a broad range of communication needs. However, they face resistance in the market place because of their requirements on centrally managed communication systems which requires agreements on system features, finances, and investments across the whole sector and food value chain on a regional and *global scale* to be successful (Schiefer and Fritz, 2008). Actual developments in technology have the potential to change the scenario dramatically in the future. RFID chips involving the capability of computers combined with sensor and communication technology (receiving/sending) allow to attaching information to products. This allowed decentralized communication systems where transparency could be realized without general sector management agreements (CuteLoop, 2011). Efforts in this direction might open the way for solutions that could match the diversity of the global food sector and, in addition, become feasible for the majority of SMEs in the sector.

The communication between enterprises for tracking and tracing activities depends on the universal acceptance of organizational and technical communication *standards* and on agreements for information exchange. For the identification of trade units (product batches) as the very basic tracking and tracing requirement, solution proposals have been formulated by the universal standard committee GS1 ('General Standard One'; www.gs1.org) with its specification of Global Location Numbers (GLN), a universal trade unit identification scheme with the Global Trade Item Number (GTIN), and the development of Electronic Product Codes (EPC) that facilitate the use of electronic identification devices like RFIDs and others. Such agreements have to be complemented by a number of additional agreements (Transparent_Food, 2011) dealing with c*ommunication protocols, Syntax and Semantics*.

3.4 Transformation of Information for Use

The information available at the end develops through communication and transformation of information throughout the chain. It is communicated as 'backpack' on the information carrier as all information is directly or indirectly linked to products, their production or origin. The transformation procedure is not part of a general information infrastructure. It is too much linked to specific needs of individual products and actors involved. However, one could identify generic functionalities on how to easily establish transformation procedures that could build on the tracking and tracing carrier system. In linking information with possible signals, there is a great variety of alternatives that guide the transformation of information on its way through the value chain. However, they all follow a few principle schemes:

Scheme 1: Information is being collected and communicated unchanged throughout the value chain towards the end (*static information scheme*). Examples are information about 'animal welfare' at farm level or the origin of products.

Scheme 2: Information is being collected and changed along the value chain with each actor involved (*dynamic information scheme*). Examples are information about 'food miles' which integrates information related to CO_2 emissions in the production and distribution process or information from monitoring activities of product quality involving e.g. continuous measurements of product temperature.

Scheme 3: Information is being collected from various domains and aggregated into a 'label' that might or might not be part of a certification scheme, in the first case referred to as 'certificate'. The communication item is the label and not the individual information contained.

For 'scheme 2' information activities, Life Cycle Assessment (LCA) and its variations like Social-LCA etc. provide suggestions for suitable transformation activities. It has become the primary tool for such transformation processes. While 'scheme 3' information activities restrict communication to the label, it is evident, that the information used in the composition of a certificate would be available at user's end for individual evaluation and use independently of the label used as 'carrier'. Building on this argument, there is already a multitude of information in the value chain that might be suitable for the formulation of signals at user's end.

3.5 Activation of Access

In the delivery of information in support of transparency one can distinguish between three generic alternatives for activating (*activation patterns*) the necessary information flow (CuteLoop, 2011):

a) 'regular delivery', where information is delivered with the product (in whatever form),

b) 'on demand', where information is delivered on a case by case basis if asked for, and

c) 'exception reporting', where information is delivered, if certain characteristics of products already shipped do not match requested requirements (e.g., in food safety).

Regular information delivery might be linked to legal requirements but also to predefined customer needs within a controlled information environment. It is evident, that potential users of data have an interest in receiving data on a regular basis and not just 'on demand'. There have been attempts in food chains to establish broad based general data transfers from data generating groups (in the food case especially producers and traders) to data users at later stages of the chain. However, such requests meet resistance when data ownership is considered of competitive value.

Information on demand deals with irregular information needs, sampling activities at the users' end, or users' interest in checking the validity of information received. However, it is also an approach that supports the interest of providers of data regarding data ownership and data confidentiality.

Exception reporting is a service that routinely checks (as an automated background query service) if there are irregularities with incoming products that require specific attention by the customer. Exception reporting services are of specific attractiveness as they support the identification of deficiencies without information overload at the user's end.

3.6 Some Food System Complexities with Relevance for System Design

The food sector has to deal with specific complexities that distinguish it from other sectors and make it a challenge to deal with. They are primarily due to its sector organization and the processes involved in food production.

Sector organization. The food sector is a global one as it is based on agricultural products that need different environmental conditions to grow and are bound to the use of land wherever it is available. Together with variability in production, this global view builds on business relationships that cannot be confined to 'closed chains' as in other sectors but builds on a network approach with dynamically changing network relationships. Furthermore, it is characterized by many small and medium sized enterprises (FoodDrinkEurope, 2013a,b), starting with agriculture but also reaching into manufacturing and retail with its many small shops, bakeries or butchers. Both issues have consequences for the system to be developed. The network situation asks for systems that allow easy connection on *short notice* and *without prohibitive investments* on site. The relevance of SMEs asks for the provision of features that make it easy and cost effective for SMEs to participate, i.e. to eliminate the risk of market distortion by non-participating groups.

Process characteristics. They are not relevant for the ***infrastructure design*** but need to be addressed in the 'black box' information processing units that build on the infrastructure and characterize the information transformation process from the source to the final use. As an example, in the movement and processing of food along the food value chain, food may change

a) its inherent characteristics dealing with a.o. safety, quality, or quantity, such as e.g. deterioration during distribution,

b) its material characteristics as e.g. from solid fruits to liquid juice transformation implying changes in units of measurement etc., or

c) its units of trade and its composition which leads to a new 'food item' with its own individual characteristics related to consumer communication.

4 The Organizational View – Moving Towards Generic Solutions

4.1 Overview

The following section (based on results of the EU CuteLoop project (www.cuteloop.eu), see also Reiche (2011)) provides a basic framework for the organizational structuring of IT-based transparency systems that build on emerging technologies and capabilities of the Future Internet. The framework allows to reducing the organizational communication elements to a limited number of system elements of generic nature, i.e., that could support transparency systems in a broad range of food sectors (product lines). The ability to build on a reduced number of system elements is due to the focus on transparency with its information flow between chain actors and the infrastructural approach which does not replace 'applications' but takes up the challenge of providing the basis for their integration.

Enterprises already have systems in place to record, monitor, evaluate and communicate various kinds of relevant information throughout production and trade processes. However these systems are mostly situated in the individual enterprise or encompass only few members of the network. The vision is to employing a combination of communication services (the transparency infrastructure) that can be accessed through open access platforms and which interact with the existing systems landscape. The identification of a generic base of information and communication services that connect actors at various stages within the chain and with consumers builds on the delineation of various generic system components structured within a three layer approach comprised of an 'information service layer', a 'functionality layer' and an 'enabling technology layer' .(Lehmann et al, 2012; Reiche et al, 2012).

4.2 Information service layer

The *information service layer* deals with *services* supporting interaction between actors in the field. All of these services are being initiated according to rules which are referred to as activation patterns. As has been discussed above, there are two types of services which are of a generic nature. They include the provision of information of static nature (*status information*) that is generated once and the realization of a *dynamic view* involving e.g. the provision of information from continuous monitoring of changes in product characteristics during storage, distribution and sales.

The provision of information builds on the principal approach '*Question initiates answer*'. This relationship is not bound to a specific way questions are being asked. They might have been part of a contract or be linked to a certain event. In this context, differences between the first and the second service are limited to the number of process iterations. While the first service is limited to a single iteration, the second service involves a number of iterations with a stop rule and the delivery of an aggregate answer.

The provision of information is usually the base for the initiation of an activity of any kind (e.g. '*eliminate products from shelves in store*'). In the specification of the relationships, the basic information services can therefore be complemented by an activity service which builds on the analysis of the outcome of the basic information services (usually of the kind: '*do results match certain requirements*' (on quality or food safety, etc.)) for initiation of a specified activity.

The initiation of the information services builds on a limited number of distinguished activation patterns distinguished as *regular* information delivery (from source to recipient), where request for information is usually initiated (triggered) by the delivery of goods, information *on demand*, where request for information is initiated (triggered) by chance or by an event, usually at receiver's end (pull approach), and *exception reporting*, where the request is initiated (triggered) by an event, usually at sender's end (push approach).

Despite their differences from an application point of view, all three information activation alternatives, regular provision, provision on demand and exception reporting build, from a system point of view, on a similar *request and delivery* pattern.

4.3 Functionality layer

The *functionality layer* involves functionalities that deal with data elements and data clusters following their path from collection to use. They provide basic services linking data clusters of a certain status with a subsequent cluster of a different status (different location, different view) or with providers and users. For transparency needs we can limit ourselves to the following functionalities referred to as infrastructural elements (*data input* or collection, *data cluster*, *data transfer*, and *data output)*, and operational elements (d*ata filter* which selects or aggregates data, *trigger* (of activity) which analyses data and draws conclusions, and *data search* which locates and identifies data clusters of need).

All of the operational elements are, in principle, rule based systems. Incorporating state-of-the-art software technologies (e.g. agents, expert systems) facilitates the integration and elimination of rules and an easy adaptation of elements to different scenarios. Possible service solutions identify basic combinations of different elements that are integrated with selected technologies and serve defined information service alternatives. As an example, the request and delivery alternative could be served by an element sequence as follows:

<u>Initiation</u> → Input ←→ Filter ←→ Transfer ←→ Trigger → <u>Activity</u>

4.4 Enabling technology layer

The *enabling technology* layer represents a basic grouping of technologies that could serve as enablers for functionalities, which, in turn, could serve as enablers for information service alternatives. In the technology environment of the Future Internet the prime technologies of interest involve technologies subsumed in the following as 'networked devices'. The major alternatives in networked devices with relevance to the chain information and communication requirements include technologies such as RFIDs, scanners, agents and communication networks.

In IT system terms, the services provided through the functionality layer define the generic software modules while the enabling technology layer relates to the basic hardware technologies that allow the transfer of the specified information services into business support. Technology developments are usually characterized by an increase in integration. As an example, an RFID scanner might be confined in present technology environments to a reading (input) activity. In advanced technology environments it might integrate a reading, filter, and trigger element or even reach beyond. For a methodology that allows easy modeling of identified interaction services involving different functionalities and technologies we refer to Reiche (2011) and Lehmann et al (2011).

5 Implementation concept

Newly emerging implementation concepts are being modelled along the line of the '*app store*' philosophy employing features of today's internet capabilities (Future Internet). One of these concepts is being dealt with in the EU project FIspace (www.fispace.eu). Its basic approach is to cut down complex systems (information services) into smaller system elements (sub-services) that (if used together) model the complex system. As an example, an information service that aims at serving information needs of e.g. retail could build on a sequence of sub-services such as 'request for information', 'identification of information source', 'provision of information at source', delivery of information from source to requesting party, 'integration of delivered information into recipient's data base', etc.

All of these sub-services could be implemented as limited in scope stand-alone '*apps*' employing a functionality layer and enabling technology layer as discussed above. The challenges are to

a) activate the apps in an appropriate order and to

b) assure that the outputs and inputs of the different apps match.

The concept employs an internet-based platform where the linkage of apps and the order of their activation is being modelled so as to mirror the information service to be implemented. Whenever an app is being activated it consults with the platform on which app to activate upon its completion. The information service develops based on a number of apps that interact with the platform for assuring their appropriate linkage with other apps requested for delivering the information service. Of course, the approach is based on the assumption the developers of apps for a certain information service have agreed on a common format for linking their inputs and outputs.

With the platform approach, apps could be arranged for serving different information services depending on the process design implemented in the platform. While anybody could develop apps that could be utilized in a complex process design, the EU project FIspace aims at providing a set of apps of a generic nature that could be integrated into all kinds of process designs. The approach is attractive because of its flexibility and its ability to get many different development groups engaged in developing apps of limited scope but with the potential of becoming part of a complex information service. This reduces investment risks, opens the doors for SMEs with limited development capacity and facilitates future system maintenance as individual apps could be easily replaced by new developments in apps without interfering with the complexity of the information service.

In addition to the technological attractiveness, the approach has the potential to overcome the problems of E-readiness (Bui et al., 2003; Fritz and Schiefer, 2010) prevalent in the sector. The structural difficulties within the food sector where large globally active enterprises especially in farm supplies and retail are linked with the many small enterprises that the sector is comprised of (more than 95% according to FoodDrinkEurope, 2013a, b) are paralleled with the differences in the level of IT solutions and IT capabilities present in the sector. These differences were identified as one of the major obstacles in organizing IT based systems that could provide the suitable infrastructure for assuring transparency and appropriate tracking and tracing solutions in the open network approach that characterizes the business relationships in the sector (Schiefer and Deiters, 2013).

6 Conclusion

The discussion on reaching transparency in the food sector has been going on for a long time. Deficiencies are less due to limited engagements of actors in the food sector but in limitations in technology, difficulties in reaching sector agreements on a European and global scale, and major differences in the E-readiness of enterprises in the field. Actors in the chain are aware of the pressures coming from markets to be able to have appropriate information at hand if requested by consumers. This becomes especially apparent if food scandals emerge and market participants and especially retail are not able to react appropriately because of information deficiencies.

New technologies in system development, internet capabilities and network devices open opportunities that could change the situation. They provide flexibility, are suitable for being used within the open network approach of the food system and allow the utilization of development capacities available in the development community and especially the capacities available at SMEs. A cluster of European projects has dealt with this situation and provides a framework on which the new developments could build. The paper summarizes core features of the framework and relates them to the problems inherent in reaching transparency in the sector.

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