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Realising Future Internet Potentials for Food Chain SMEs: A Hierarchy of Needs

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ABSTRACT

The EC funded FI-PPP programme is currently elaborating a large set of enabling technologies that shall help to overcome challenges towards a sustainable networked society of tomorrow. This up-front investment can highly facilitate access to such Internet potentials by food chain SMEs. Nevertheless, SMEs require a systematic support for being able to decide on which technological enablers are relevant at which moment of their business evolution. To characterise a decision reference, a hierarchy of needs of food chain SMEs is presented that can serve as baseline when aiming at the usage of the FI-PPP results in an SME environment.

Keywords: food chain SMEs, information systems, future internet, business collaboration, ICT introduction

1 Introduction

Many research projects in the domain of Information and Communication Technologies (ICT) that are funded by the European Union's Seventh Framework Programme for Research (FP7) are somehow addressing the topic of a "Future Internet" (FI). This movement is based on the idea to join forces to work on challenges and realise potentials the Internet could provide in the future. In the end of March 2008, an initial group of some 63 European Technology Platforms (ETPs) and Research Projects signed the Bled Declaration (2008), which was prepared to be open to existing and future EU Projects that wish to actively contribute. It was specifically calling for action towards the realisation of a Future Internet from a European perspective. The conference in Bled was also the Kick-off of the so called "Future Internet Assembly" (FIA), which was defined as "a collaboration between projects that have recognised the need to strengthen European activities on the Future Internet to maintain European competitiveness in the global marketplace" as stated by FIA (2013).

Subsequently, throughout the FP7 an impressive effort was made that concluded in the Future Internet Public Private Partnership (FI-PPP) programme that is mobilising some 500 million euro, including 300 million euro contribution from the European Commission (EC) for projects that can advance a shared vision for harmonised European-scale technology platforms and their implementation (FI-PPP, 2013).

Within this continuity from the Bled conference in March 2008 until the start of the second phase of the FI-PPP programme in April 2013, a team of researches was specifically following the vision of providing such Future Internet potentials to small and medium sized enterprises (SMEs) that are active in the food chain (Sundmaeker, 2008; Sundmaeker et al., 2010; Verdouw et al., 2012) while specifically addressing the supplies of fruits and vegetables. The main idea was to facilitate the access to produce related information as well as to facilitate the alerting of supply chain actors and even consumers in exceptional cases especially when the consumption of food could damage health of individuals. Therefore, there was a specific view on business collaboration within food chains as well as aiming at the provision of innovations that will be applicable in food supplying networks of dynamically interacting SMEs.

The research results elaborated in those projects are including both business process related innovations as well as technological enablers that shall facilitate the development of solutions towards the realisation of a FI. Nevertheless, a key and pressing question is on how to fully exploit the potentials of such solutions for food chain SMEs. Since it is not just about the adoption of a technological feature in a single SME, but on how to motivate and enable a critical mass of collaborating businesses towards the exploitation of innovative features. At the same time, technological constraints need to be addressed where to name a few, specifically the classical problems of interoperability, security, privacy, and infrastructure maintenance remain. Therefore, a systematic approach is required that facilitates the realisation of the Future Internet potentials for food SMEs.

Within the following sections, the Future Internet initiative is detailed at the European level and specifically with respect to the most recent FI-PPP programme. A hierarchy of needs is presented that was developed to serve as a reference model when aiming at the adoption of innovative technologies by food chain SMEs. It puts the different enablers and steps to be taken for an FI innovation project in a sequential relationship and maps it on the dimension of generic and specific enablers that are being developed in the FI-PPP programme.

Finally, an outlook towards the third phase of the FI-PPP programme is presented that provides some 100 million euro of financial support and specifically targets at an involvement of software developing SMEs for realising FI based innovative solutions that can be adopted by multi-sectorial end-users to generate growth and jobs in the European regions.

2 The European Future Internet Initiative towards a Public Private Partnership

As stated by the Future Internet Assembly (2013), the "*today's Internet was designed in the 1970s for purposes that bear little resemblance to current and foreseen usage scenarios*". Therefore, initiatives on the Future of the Internet were started all over the world and specifically in the US (GENI, 2013; FIND, 2013). The European initiative was specifically kicked off in the beginning of 2008 while a fast growing community was assembling with dedicated conferences enabling a joint work on e.g. architectures, IoT, service offer, trust & identity as well as on the relation of an FI to the socio-economics. The ongoing FIA is targeting at a collaboration of existing research projects, organising yearly conferences and publishing related results. It can be characterised as an open collaboration space that mobilises a critical mass of researchers that are also joining their forces to elaborate on strategic research roadmaps as well as on pre-normative principles, concepts, design, architectures, recommendations and functional specifications of key FI system components and their interfaces.

Subsequently, born out of the needs of the economic crisis for sustainable growth and jobs, the FI-PPP programme was developed that is specifically focusing on the realisation of a European technology base for a Future Internet that can be used by related technology and service industries. Moreover, the idea was to provide an environment for developing and deploying services as well as to accelerate the development of new networked based services for the citizens and consumers. As outlined in November 2009 in the FIA Stockholm by the European Future Internet Initiative and specifically by Kennedy (2009), the purpose of an FI related public private partnership shall be to realise a multi-disciplinary and integrated approach. The FI-PPP shall enable to run massively distributed services and applications over large scale and secure internet infrastructures to deal with the increasing complexity of intertwined application and service demands. The formulated strategy on behalf of the European Technology Platforms was in a certain contradiction to the previous approach of EC research funding within the ICT domain. Since as represented by the individual member projects of the FIA, such specific research projects were addressing the elaboration of innovative research results that are not necessarily leading to cross sectorial applications/services but could lead to stand-alone solutions developed in/ for a single sector. Hence, the idea was to push efficiency and productivity gains that a networked solution(s) will be able to provide and that the market can support.

To achieve this dimension, the FI-PPP programme was published in 2010, calling for some first eleven projects with a total budget of some 136 million euro. In the heart of this programme the project FI-WARE was funded with some 41 million euro by the EU programme to realise a so called "Future Internet Core Platform". The basic idea was to develop and provide so called "Generic Enablers" (GEs) that are representing applications/ services of a general nature and being applicable by multi-sectorial solutions within a Future Internet. For being able to test and validate those GEs from a multi-sectorial perspective, some additional eight so called use case projects were initiated. Those use case projects were equipped with some additional 38.8 million euro funding to elaborate on the needs of different sectors (i.e. food chain, transport and logistics, environment, media content, energy, personal mobility, utility provision and citizen safety). On top of that, those projects were developing initial sector specific solutions (i.e. also

providing sector specific enablers – so called "specific enablers" (SEs)), which made an integral usage of the GEs. At the same time, the programme level management was set-up out of the projects, allowing for a joint work on an overall architecture and governance (i.e. the architecture and steering boards). This new dimension and size of collaboration and coordination in a European RTD programme was further complemented with a programme level support project as well as a project to work on infrastructure support and capacity building.

Those projects represented the first phase of the FI-PPP programme that lasted from April 2011 until March 2013. There was a seamless continuation by a kick off of the FI-PPP phase 2 in April 2013. Some five new use case related projects were started, representing also new sectors like manufacturing and health. However, the idea of realising Future Internet platforms was reinforced that can be used specifically by software developing SMEs for application/ service development at a reduced complexity. At the same time, end-user organisations shall be enabled to reduce their up-front investments in technology as well as to decrease potential risks in specific decisions for a technological solution. Therefore, the available and envisaged GEs and SEs to be developed are representing a comprehensive collection of building blocks that can be reused at a large scale. An overall architectural concept shall assure for a general compatibility, while the open specification shall assure for a sustainable availability of the outcomes of the FI-PPP programme.

The activities in the programme will be exemplified within the next chapter outlining the way from first research with respect to required enablers for food chain SMEs towards the embedding in the overall FI-PPP programme.

3 From Networked Devices to Networked Businesses

As one initiative towards the Future of the Internet, it was researched on the potentials of networked devices. In the area of EU funded projects, a cluster of research projects was established in the beginning of 2007[*]. The work was specifically addressing potentials of networked devices like active or passive RFID tags that can have a permanent or event-triggered connection to other devices or also the Internet itself. Such networked devices can be considered as a key enabler to realise solutions towards an "Internet of Things" (IoT), realising a symbiotic interaction among the real/physical, the digital, virtual worlds and society, as specifically outlined in the first cluster book on vision and challenges for realising the IoT (Sundmaeker et al., 2010), also presenting the cluster's Strategic Research Agenda.

Such networked devices can be quite "simple devices" that possibly cannot do more than just transmit a fixed ID as soon as the RFID chip and its antenna is entering an electro-magnetic field. Therefore, we concluded that just the usage of a certain enabling technology (like RFID, speech recognition, wireless multi-media) within a business environment does not make it kind of intelligent per se that would lead an organisation towards an improved interaction within the organisation or with other businesses. To realise an environment that is responsive to the business needs, assure an effective realisation of processes and optimally support the human actor (HA), the overall ambience of a HA within the business environment needs to become intelligent. Therefore, we worked on an approach based on the paradigm of "Ambient Intelligence" (AI) that can be used for a systemic innovation of industrial working environments in SMEs. As a prerequisite to understand the domain of AI solutions and to contribute to its definition, Stokic, Kirchhoff and Sundmaeker (2006) elaborated a Reference Architecture for AmI systems to serve as a tool for the development of AmI based control systems. Especially the categorisation of the different solution elements can be used to structure both the analysis of a business environment as well as the solution design. This approach was experienced in several business cases, while generally focusing on one business entity. Networked devices (e.g. mobile phones and RFID) were used to offer a context sensitive support of business processes and the involved end-users.

An accompanying methodological support was elaborated that targeted at the support of SMEs, to identify to what extent AmI technologies can create innovation potentials in their business processes. However, SME constraints like limited investment potential, limited staff quantity and qualification often create a strong reluctance to innovation. Therefore, SMEs will not go for a general experimentation of new technologies. They are looking for innovative solutions which can be put into daily operation on a short-term, creating measurable business benefits. As outlined in Kirchhoff et al., 2006, this

[*]The CERP cluster was established under the name "Cluster of European RFID projects", focusing on RFID as key RTD topic. The focus on RFID was enlarged to also reflect the extended view of the member projects that were not just addressing the unique identification of objects, but an extended view on objects to be used under the paradigm of the Internet. Subsequently, the cluster was finally renamed in the IERC cluster, called "European Research Cluster on the Internet of Things", while it elaborated its first Strategic Research Agenda (SRA) in March 2010 that is yearly updated. See also http://www.internet-of-things-research.eu/

methodological support was addressing both:

- The “process dimension”, targeting at the quality, cost and schedule optimisation of the execution of the business processes, supported by an advanced and integrated company-wide ICT system, open for its integration in an Extended Enterprise ICT environment.
- The “human centric dimension”, targeting at the creation of a context sensitive intelligent ICT environment for the human operators involved in the different business processes of the company, based on the potentials of the application of AmI technologies.

Such a methodological support, based on the usage of networked devices, can help to realise an intelligent support of business processes. Therefore, Sundmaeker et al. (2008, 2010) called it Networked Devices Enabled Intelligence. However, the realised solutions were mainly used and introduced by single enterprises, while classical challenges according to Sundmaeker (2004) were still imposing a burden as experienced in other business domains and sectors when aiming at an integrated business process/ entity support:

- Lack of interoperability between systems that generate and provide access to data
- Underlying ICT infrastructure, based on purchased products or custom-built solutions
- Processes, procedures used within the virtual enterprise.

Further studies as presented by Zahariadis et al. (2011) also highlighted problems like (i) lack of data integrity, reliability, provenance and trust; ii) a lack of data integration and federated storage solutions; iii) lack of flexibility and adaptive control; and iv) segmentation of data and control. However, according to Verdouw et al. (2012) the intended development of Future Internet (FI) technologies is promising to overcome such limitation, by pushing the trend towards:

- The on-going industrialization of IT in the form of cloud computing and open service delivery platforms;
- New wireless networking technologies and the deployment of fibre that are paving the way for new (real-time) applications;
- The breakthrough of the Internet of Things, with the vision of ubiquitously connecting intelligent devices and sensors.

Such a fundamental change in the availability of technological enablers could become the next paradigm shift in how organisations can organise their business. As the networked business interaction is already true for the stable interoperation of large business partners, it becomes apparent that also SMEs, which are dynamically interacting in food chains/networks could benefit from these FI technologies.

Sundmaeker (2008) outlined differences between classical ICT solutions and envisaged solutions based on networked devices enabled intelligence. The following Table 1 is continuing this analysis, by mapping the characteristics of solutions based on networked devices enabled intelligence with the envisaged FI support that can be provided by the FI-PPP programme.

Table1.
Enabling characteristics of envisaged FI based solutions.

Characteristic	Solutions based on networked devices enabled intelligence	Envisaged FI support
Amount of Functionality	Specific individual w.r.t. the actors/ group of actors and continuously evolving over time.	Yes, service/ app based features
Location of Functionality	Decentralised, partly mobile and possibly defined at runtime.	Centralised for agnostic features & Decentralised
Usability	Highly customisable, even by users themselves, enabling context based user interfaces taking into account implicit inputs from ambience.	Highly adaptable and customisable
Portability	Solutions are aiming at supporting diverse platforms as well as dynamic and distributed operation.	RESTful services
Maintenance	Open environment, enabling ICT suppliers to maintain solutions from other ICT suppliers.	Yes, open source and/or open services
Interfaces	Dynamic, based on ontology, self-explanatory.	Facilitating legacy system integration
Middleware	Publish-Subscribe relation of peers.	Publish-subscribe, using central platforms for peer interaction
Infrastructure	Evolving infrastructure and continuously changing devices.	Not limited to specific devices
Performance	High performance of servers and centralised not mobile hardware. Limited and even highly restricted performance of mobile, distributed devices.	High performance platforms and customised devices.
Efficiency	Available ICT devices and infrastructure are generally requiring an optimisation of the performance/usage ratio.	Highly scalable platforms and customised clients.
Availability	Processing in accordance to available performance and queuing of requests, required to enable disconnected operation and asynchronous processing.	Service elasticity based on RESTful services
Security	Built-in security (i.e. in devices) and evolving communities of trust with dynamic roles, based on interacting peers and groups.	Platform facilitated security & trust
Privacy	Profile based and individual interaction with centralised and often decentralised data storage, requiring mobile processing of content.	Enabling decentralised storage of business data.
Governance	Independent strategies and policies likely.	Agnostic platform, which are managed by a related entity.

The envisaged GEs and SEs that are/shall be provided by the FI-PPP projects are technological features. Their supported characteristics have the potential to address the challenges for the realisation of a networked business as listed above. However, the simple availability of a technological feature does not determine its proper and managed usage. Therefore, also the realisation of FI based solutions needs related methodological approaches for being able to handle technologies, processes and relations with the human actor. On top of that, one has to identify clear guidelines for an SME type target audience on

which prerequisites need to or can be fulfilled when aiming at the usage of an FI based solution. Those guidelines have also to enable an SME to consider its business objective at all stages of an FI empowered business process innovation. Such an improvement management approach shall assure that the redesign of business processes drives the ICT usage, and not vice versa. This was the idea to further elaborate on a hierarchy of motivational aspect when aiming at the employment of FI services and applications.

4 Towards the adoption of a Future Internet – A Hierarchy of Needs

As outlined above, the Future Internet Public Private Partnership was born in the global economic crisis to aim at creation of growth and jobs. Hence it is even more logical to develop a methodological approach that is empowering specifically food SMEs to take an advantage of such innovation potentials[†]. However, especially SMEs are reluctant in strategic investments that require a certain Return on Investment period and are mostly not able to lead the technological innovation in a sector. More often, they are following general trends and customer's demand. According to Kirchhoff et al. (2004) specifically SMEs require a specific support to overcome their reluctance and are requiring a methodological support that is covering those needs.

Therefore, our research with a focus on methodologies for ICT introduction in SMEs was aiming at a systematic analysis of the FI-PPP offerings and to map the results to different hierarchy levels that need to be subsequently fulfilled before being able to establish valuable business collaboration and go even beyond. For doing so, we considered an SME as a kind of living entity that asks for a fulfilment of its needs. To further classify the motivation of an SME, the theory of Human Motivation according to Maslow (1943) was used as a reference set of needs to elaborate on the hierarchy of SME needs. Furthermore, the envisaged results of the FI-PPP programme were mapped on the different stages (see Figure 1), as baseline to discuss the envisaged needs for involvement of the different stakeholders what is considered as a basic prerequisite beyond individual process organisation and ICT.

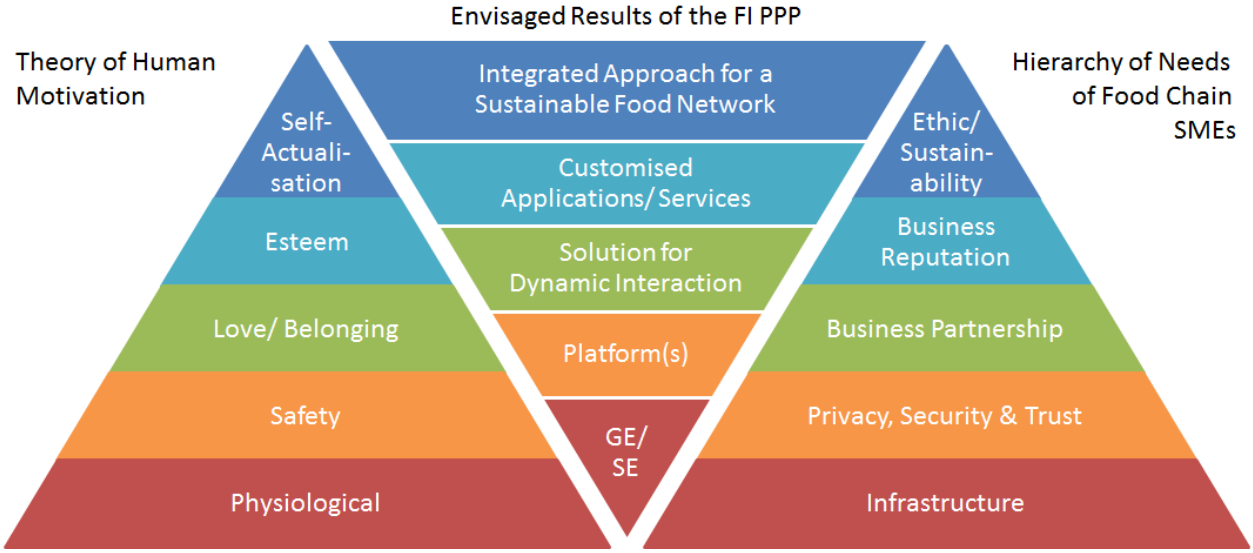

Figure 1. Developing a hierarchy of needs of food chain SMEs when aiming at exploiting the envisaged FI-PPP results, in tyle of the theory of human motivation.

As presented in Figure 1, based on the theory of human motivation, we defined five groups of food chain SME needs that could correspond to the idea of those five levels from a physiological to a self-actualisation point of view. In the following we analysed the available or envisaged results from the FI-PPP projects and aimed at a mapping to those five different levels. Finally, we decided not to make a one-to-one mapping but to map the first levels of the FI-PPP results to two different levels of the hierarchy of needs. We think that this also corresponds to the degree of relative need satisfaction as discussed by Maslow (1943). Generally, for being able to satisfy the needs at a higher level in the hierarchy of needs of

[†]According to FoodDrinkEurope (2013), the food and drink industry was in 2011 the largest manufacturing sector in the EU (14.9% with a turnover of 1,017 billion EUR), employing 4.25 Mio. people, characterised as a fragmented industry with some 287,000 companies in 2010 and finally some 49.3% of SMEs.

food chain SMEs it is not considered as a prerequisite to satisfy the previous level by 100% before the next need emerges. Hence one can assume a relative satisfaction also for SMEs. The hierarchy of needs of food chain SMEs that could be satisfied by the envisaged FI-PPP results is detailed in the following.

- ***Infrastructure:***

  As a human body is in the need for air, water and food (i.e. to group such needs for e.g. oxygen, water, salt, protein content in blood), a food chain SME is in a need for a basic infrastructure that allows for a business operation. Without a sufficient amount of employees, organisational procedures, equipment and buildings there will be no business operation possible. As soon as even one factor is insufficiently available neither a business will start nor survive. All focus will be put on establishing or maintaining the infrastructure as soon as there is any deficiency. The list of such factors also includes the availability of ICT like a telephone or fax machine as very basic needs, while nowadays also email is replacing this to a certain degree. However, the latter is also including the availability of a PC with the related software and an Internet access. Furthermore, one can assume that possibly not all, but a certain amount of food chain SMEs are also requiring more sophisticated software/hardware solutions (e.g. for materials and order management) for being able to operate a competitive business. From a perspective of aiming at the usage of FI-PPP results, one can already assign the GEs from FI WARE as well as the SEs from the other FI-PPP projects to this level. These enablers are providing functionalities that could already satisfy some basic needs within an organisation like for storage of information or communication via pub/sub mechanisms. However, on the first level of basic infrastructure needs, we are not considering an excessive usage of such enablers by end-user type of organisations as it requires more business oriented solution that are generally realised/customised by software developers.

- ***Privacy, Security and Trust:***

  With a focus on realising future Internet potentials we are discussing especially those ICT related aspects, while of course - as the second step - a food chain SME is also in the need for safety with respect to stable customer demand, reliable supplies as well as fair legal environment to name a few. Nevertheless, when analysing the needs and potentials for using FI related enablers in combination with a business ambience that is able to work at a basic level, the end-users are asking solution providers to assure their needs towards privacy, security and trust. As outlined by Krause (1999) it is required to safeguard integrity and non- repudiation of transactions as well as enabling their easy identification, authorisation and encryption before being able to process interactions in the Internet at a larger extent (i.e. this is of basic importance for a business transaction/ collaboration of '2 to n' food chain SMEs what is the focus of our most recent work – it is expected to experience differences when just analysing the SME without interdependencies to its outside world, while this would be just a limited viewpoint). The GEs/ SEs can provide such features, but from a business end-user point of view, as said before, the usage requires an integrated approach that can be offered by the envisaged FI-PPP platforms that shall be specifically developed by the phase 2 usage area projects (i.e. FIspace, FINESCE, fistar, FITMAN, FIcontent). Therefore, it is considered that those FI based platforms will specifically contribute to satisfy those needs towards privacy, security and trust. On top of that, they are compiling features based on business requirements that shall be reusable by groups of organisations. This is highly reducing the software development effort, while assuring business grade required protection.

- ***Business Partnership:***

  An SME business that is up and running searches for beneficial business partnerships that will facilitate the achievement of requirements with respect to quality, cost and schedule. Furthermore, also new partnership strategies are developed. On the one hand, an SME can elaborate on horizontal and/or vertical partnerships in the chain to increase its efficiency and reduce the effort for cooperation. On the other, the SME can work on strategies for its production depth as well as diversification. New markets can be addressed and new products can be realised. With a focus on FI potentials, this is specifically addressing the realisation of innovative business collaboration as well as to offer new services to customers (i.e. specifically combining Internet based services with classical products like to enable the electronic traceability of meat products[‡]). Therefore, the envisaged FI-PPP platforms are offering the critical mass that is required to start such new service environments. As soon as those platforms are basically running - on a next level - new ICT supported business models and solutions will be developed

[‡]Realising ICT based services for a tracking and tracing of products via the Internet. As an example the fTrace solution (http://www.ftrace.com/en/gb) provides added-value services to the classical product. The basic service is handling the provenance of the product, while additional services can be added to e.g. provide further information about the usage of a product or on how to combine it with other products.

that can be offered for dynamic interaction of business partners. As example, already in its basic realisation, the envisaged FIspace platform will be combined with a number of first applications that are targeting at such dynamic interaction for enhanced business collaboration. Those services/ applications will be offered via the FIspace app store. An SME can combine the used service (e.g. for exchanging product quality related data) with such a service that is running at a different SME via the platform (e.g. for receiving product quality data and/or sending feedback). Furthermore, also different services can be combined that are used by one SME or that are used by different SMEs (e.g. one app provides product quality related data and another is analysing relevant risks based on latest incidents that were published most recently). As soon as entering this level of satisfying the needs of food chain SMEs, the continuous and effective support of business processes by FI potentials can be started.

- ***Business Reputation:***
  Successful and long-term business relations are often based on mutual trust and a high evaluation of the organisations. As it is much about the people involved in business collaboration, characteristics of self-confidence, worth, strength, capability and adequacy of being useful and necessary in the world would be assigned to this level of trying to satisfy the need for business reputation. The lack of satisfying this need can lead an SME to situations where the employees are selling products/ services below value or are avoiding to go in challenging competitions with their competitors as they do not trust in their own capabilities. The organisation needs to be convinced and having enough self-assurance for being able to go for new offerings/ innovations as well as to take the risk to invest in new solutions. From an FI-PPP perspective, it is based on solutions for dynamic interactions to go for more customised applications and services. This includes the adaptation to the specific SME needs taking into account both installed business processes and the integration with existing legacy systems. At the same time, a business architect needs to elaborate on the potentials for combining applications/services and on how to most efficiently arrange the business collaboration with business partners. Especially this effort needs to be considered as a joint undertaking of the SME itself representing the end-user of technology in close collaboration with software developers, business architects/ consultants and operators of Future Internet based platforms.

- ***Ethic and Sustainability:***
  The previous hierarchy levels of food chain SME needs were addressing the challenges on how to assure that the organisation will finally survive on the medium to long-term. However, if this situation seems for granted, the innovation does not stand still in a healthy and motivated organisation. New targets are set and often addressing ethical as well as sustainability targets. Organisations are discovering new potentials for e.g. lowering their CO^2 footprint, taking care for animal welfare, reducing the water consumption as well as taking care for fair trade and/or salaries. Of course, one shall also not underestimate the positive impact of such “strategies” they can have on the business success and vice versa on the business reputation. Nevertheless, they cannot be treated as first need to be satisfied. Accompanying, the envisaged results of the FI-PPP can also add large value to the satisfaction of such needs. The realisation of new initiatives can be facilitated by realising sector solutions that are currently being addressed by the use case related projects. Each of those projects is including large scale trials that are thoroughly validating the technological enablers and models for an integrated approach that could also lead the potentials towards a sustainable food network. Those projects are even collaborating and searching for synergies between the different sectors, which are currently being addressed (i.e. food, logistics and transport, health, manufacturing and energy).

Each of those hierarchy levels presented before could be detailed much more. The SME dimension for adopting ICT potentials is not stemming from the FI-PPP initiative, but being elaborated in many other research initiatives as also outlined by Kirchhoff et al. (2004 & 2006) and Sundmaeker (2008). SMEs are requiring clear guidelines that are easy to understand on how to handle innovative potentials. Nevertheless, this large scale initiative of an FI-PPP programme is opening a new dimension of providing required technologies at a large scale that are targeted at a joint objective in realising the potentials of a Future Internet. Therefore, the mapping of the envisaged results can serve for determining the potentials for reuse as well as to facilitate decisions on the appropriate timing on when the programme results can be used in accordance to the current situation of an SME.

5 Summary and Outlook

The paper is summarising the development path of the Future Internet Public Private Partnership programme. It is further highlighting the envisaged basic characteristics of potential FI-PPP results with a reference towards an intelligent support of processes and users. It needs to be considered as a summary

of the manifold results being produced by the overall programme that is funded in total by some 300 million Euros by the EU. For more detailed information there are substantial resources available and the running projects are already in close collaboration with developer groups. On top of that, when starting phase 3 of the programme in April 2014, there are some 100 million Euros available that shall be used for involving an SME type target audience. Especially software developing SMEs can receive a push for developing new solutions and pushing innovation in close collaboration with end-users. It is very likely that this will have a significant impact for food chain SMEs that can benefit from the envisaged solutions to be developed.

Furthermore, the "Hierarchy of Needs of Food Chain SMEs" was developed and mapped on the FI-PPP dimension to analyse on how/ when technology end-users (i.e. the food chain SMEs) can take an advantage of the Future Internet potentials. This uptake of FI potentials as well as models for offering innovative solutions are currently being discussed and developed for its further exploitation in between the organisations involved in the FI-PPP initiatives and future stakeholders (i.e. especially to be grouped in classes of technology end users, app developers, business architects/ consultants and operators of the envisaged platform). The most recent discussion is based on real software development including especially results that can be assigned to the first four FI-PPP levels as presented in Figure 1. The fifth level can be considered as implicitly considered by the architectural approach of the FIspace platform that shall not be limited towards food chain users, but open to general business collaboration in supply-demand networks.

We are continuing our work towards phase 3 of the FI-PPP programme and are inviting software developers and end-users to take advantage from the results that are available to the public audience (www.smartagrifood.eu & www.fispace.eu). Especially the FIspace project will provide a platform for business collaboration that is open to software developers to offer their apps as well as to end-users to facilitate business collaboration.

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