An IoT-leveraged information system for future shopping environments

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Abstract

Internet of Things, as an integral part of Future Internet, covers a wide range of concepts for identification and interoperability among attributes, interfaces and objects from virtual and physical worlds. Those concepts enable a new generation of services that can be used to tackle traditional limitations observed in shopping environments regarding shopping process. The description of products can become as complex as the ingredients and processes involved in their manufacturing process. That complexity affects directly to customers which find difficult to match their preferences with the information displayed on products. Moreover, new shopping trends are emerging and are based on preferences about: health, ingredients, manufacturing, ecological, etc. and there are no specific tools to manage such scattered and heterogeneous types of information. This paper describes the development of a pilot that was implemented in a real supermarket with the aim of fulfilling the shopping process needs of its customers. The pilot manages virtual identities and attributes in a single and extendable information system enriched by Smart Notifications features enabling consumers to request information of specific products using smartphones. Real customers were involved in design and experimentation stages and the results of evaluation are also presented.

Keywords: Future Internet, IoT, M2M, user involvement, information system development, co-creation, customization, HTML5

1 Introduction

Traditionally, shopping sites have been focused primarily on providing customers with an environment that eases the access to products based on marketing techniques in the form of: fidelity cards, design of aisles, shelves layout, proper replenishment, stock management and etcetera. Nonetheless, with the advent of new shopping trends by customers willing to buy only products that match their particular ideological preferences, those shopping sites are facing the need of a revamp process to supersede those old-fashioned techniques where product categorization and information displayed on products are static and lacking of interactivity as they are no longer suitable to support the shopping process and satisfy customers demands. This revamp process takes place within the search for competitiveness in supermarkets [17] and can be achieved by harnessing the power and seamless integration of current service

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paradigms: The Internet of Things and Machine to Machine communications [2] as they are suitable to enable virtual, humane and non-humane participants to actively exchange data and information.

As new products fill the aisles of supermarkets, it becomes more difficult to maintain a minimum knowledge about the features of interest found in all the alternatives available. Traditional shopping behavior where products are selected based on price or marketing campaigns has evolved to demand more information about the process involved in manufacturing, origin of the ingredients, logistics routes and etcetera. In synchrony with the new shopping behavior, new target products have emerged based on topics such as: vegetarian, allergens-free, transgenic, sustainability and so on. The Food Awareness concept [5] takes into account those descriptive topics and defines the foundations of consumers' trust in food by prioritizing the information available about the actors involved in manufacturing and logistics.

In this paper, we extend the work previously done [10] regarding the development of an information system implemented in a real supermarket environment. In this work we analyze the implications of providing some adaptations for the interoperability and interaction with heterogeneous sources of information, geographically scattered across distinct locations and we contribute with an evaluation methodology based on the definition of several sessions (workshops) with customers that constitute an interactive way of retrieving feedback and information of user involvement and satisfaction.

The design, experimentation and implementation steps where supported by using the co-creation model [13] and open innovation concept [3] as customers' opinions were reflected in every stage of the development. The potential of Future Internet technologies remained in the whole process of drafting the resulting solution to guarantee the proper integration of scattered and heterogeneous data and information sources into one service information system. The extensibility was also considered to seamlessly include additional standard information systems such as Electronic Product Code Information Service (EPCIS) [9] as support backend. The web pilot validation was also tested and evaluated in real shopping conditions.

The rest of the paper is organized as follows: Section 2 describes the background regarding information availability for customers in supermarket environments. Section 3 exposes the value of involving users in the development cycle. Section 4 describes the resulting solution that has been developed with the inputs obtained from customers. Section 5 presents the consumers' opinions about the resulting web pilot usefulness. Conclusions are summarized in Section 6.

2 Availability of Information for Customers

The classic approach employed by manufacturers and supermarkets for making information available for customers about the products they sell is mostly based on making envelopes and presentation more attractive and attach some type of information they considered important to show. Nonetheless, the information presented in labels is limited to the dimensions of the label itself which in turn may derive into a lack of certain data that customers might be interested to know. Interactivity is restrained to scan a code or visit a URL address to access a corporative web site in order to search for additional information with no guarantee to find the relevant attributes.

In the light of a future shopping environment where data exchange among all the actors involved is a top matter, the classic approach exposed above bring out a series of limitations that impedes the provision of new services and impacts negatively on every single link of the shopping process:

- Customers must carefully read and analyze every product label and consult external sources to best decide if that product fits their interests. Relevant information is typically scattered across heterogeneous sources: labels, websites, leaflets and etcetera.

- Manufacturers are not able to update or extend the information labeled on their products once

on their way to supermarket. The lack of granulated and specific information may discourage potential customers to consider their products.

- Supermarkets miss the opportunity to engage customer's loyalty by satisfying their shopping needs beyond of fidelity cards and suggesting special offers directed to market groups. Despite the close relationship between supermarket and customers, current approaches make difficult to suggest the most suitable selection of products to customers based on predefined criteria.

The challenges exposed above can be overcome with the implementation of an information system based on the Machineto- Machine communications and Internet of Things approaches. Support for additional requirements from Food-Awareness and future shopping behaviors can also be satisfied with these new approaches.

One of the utmost challenges to be solved is represented by the paramount complexity of dealing with sources of data geographically scattered across distinct locations with distinct maintainers and owners: manufacturers, supermarket and customers (Fig. 1); and the associated difficulty to construct useful information from those data that can be relevant in different stages of the supply and shopping processes.

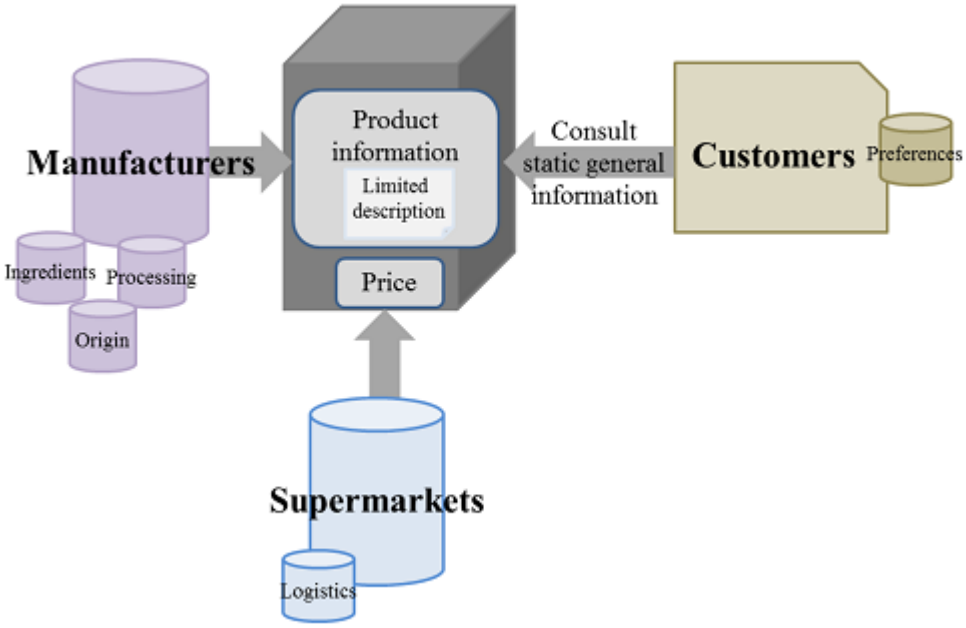

Figure 1: Scattering of information sources

Manufacturers are in charge of maintaining the information related to their products: ingredients, manufacturing processes, origin and etcetera. Only certain amount of this information is published whether on product labels or corporative website and its interpretation might confuse readers.

Supermarkets manage information useful for setting the sale price on their own premises, stock, suppliers, customers' subscriptions, sales records and so on. Most of this information remains private for corporative purposes.

Customers contribute with their preferences and interests. Unfortunately, current approaches do not exploit that valuable information to the maximum as customer preferences are not managed in a proper manner so that profiling of product offers can be directed to particular customers based on updatable consumer profiles.

By surpassing those information management issues, current technology advances enable customers to consult granulated and personalized information about products by using simply using their smartphones to scan QR codes or entering identification codes labeled on products.

Interoperability and interaction with heterogeneous sources of information, devices or virtual objects [11] describe the vision of the future supermarket environment. In order to achieve those goals, some adaptations must be made:

- Supermarket must establish a categorization of features that best describe their products so that can be useful to establish the foundations of customers' profiles which is one of the goals of the Future Internet's platforms [6] and also to reflect their interests: product processing, chemical use, origin, nutritional information, welfare certifications and etcetera. This task can benefit from the knowledge that supermarkets have about their customers and, as a result, an information system can be built to manage these data so that customers can identify with them and select their preferences and eventually update them.

- Setting up an accessible platform where every link of the product value chain is able to collect, store and update the data is managing and producing at every step: new ingredients added, new raw material providers, eventual environmental issues during transportation, new recommendations of use, recipes and so on. The information collected in this accessible platform should be easy to be consumed by friendly and fast interfaces so that no additional software or complex configurations take place in the process which in turn might downgrade the user experience.

The Smart Agri-Food Project [18] is part of the Future Internet Public-Private Partnership (FI-PPP) program [1] and addresses farming, agri-logistics and food awareness use-cases by aiming the boost of application and use of future internet ICTs [6] in the Agri-Food domain. The web pilot described in this paper has been developed as part of this project within the Food Awareness use case by providing internetworking among all the virtual or physical objects and interfaces so that consumers are able to request and retrieve information of a specific product using their smartphone. The information retrieved is matched with the consumers' shopping profiles previously set on the sign-up process.

3 Development Based on Co-Participation

Customers are moving away from traditional roles to become co-creators and consumers of value [13], with this assertion in mind it becomes a quite useful task to involve customers in the development stages of an information service solution for a supermarket with the extended features mentioned above. The proper interpretation of consumer expectations must be based on an iterative communication scheme so that initial and subsequent opinions are validated and used as external ideas that feed the internal ones so that technology selection and development are pushed forward [3]. With this communicative development method, all the needs of co-creation and co-development approaches are fulfilled and it is possible to harness the potential of the external ideas.

To clearly understand the user needs and visualize possible challenges and limitations on certain scenarios it is quite useful to consider the user participation in the development stages. Cooperation applied in the customization of services provides consumers with the ability to communicate in a compelling experience characterized by an intrinsic enjoyment and engagement that is prone to be repeated [14]. When developing a personalized Future Internet [6] information system for shopping environments, user involvement is a must, so that new opportunities could arise:

- for supermarkets and consumers regarding loyalty relationships and thoughtfulness.

- for manufacturers and governments as they benefit from having an service infrastructure where smart notifications and updates can be sent to customers and citizens in case of contamination contingences.

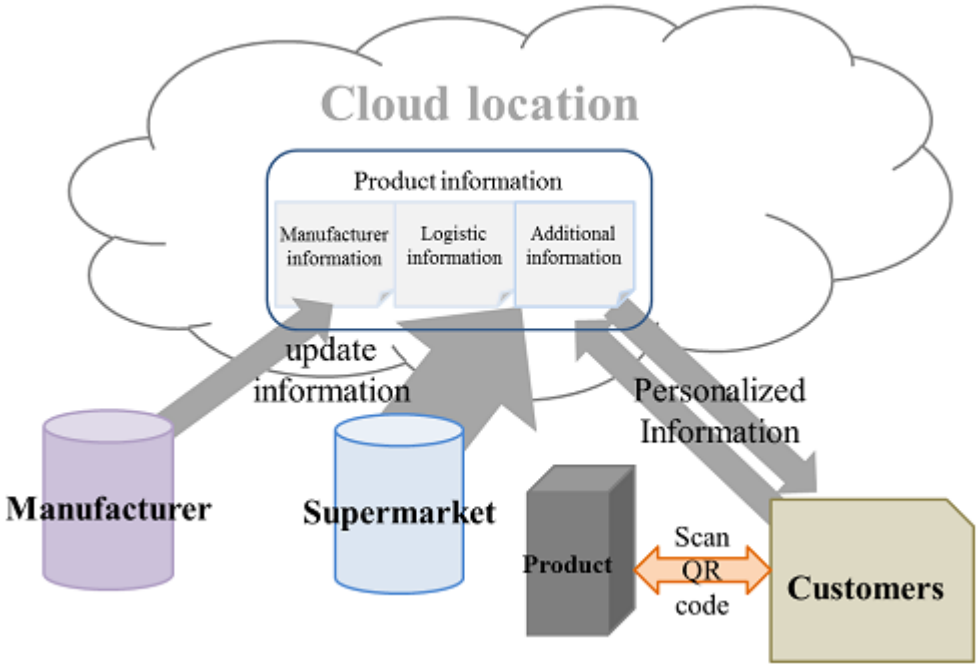

Figure 2: Food awareness concept in pilot developed

The pilot features have been defined and specified by focusing on user needs and ensuring the interoperability of data and knowledge sources across the product supply chain (Fig. 2) .

A key aspect in system design was the definition of a suitable IT infrastructure to ensure easy and secure access, integrity, collection, updates, processing and communication of information to consumers while supporting the Food Awareness concept. In this stage the next guidelines have been defined:

For Supermarkets

1. Setting up an information management infrastructure. This infrastructure must ensure the proper storage and management of heterogeneous information which includes: customer' preferences, profiling features, information updates, notifications, triggered alerts and etcetera. In this process, wireless coverage must be ensured for customers at supermarket premises so that no connectivity issues can affect the shopping process.

2. Communicate with external entities. Another leg of this platform must deal with the communication with external servers that can perform complex tasks. In the solution developed, those external servers take the form of generic enablers that provide the whole system with processing capabilities (logo recognition, identity management, etcetera) that remain isolated from client domain and can be extended to provide more complex calculations and retrieve sharp information based on customer preferences.

For Manufacturers

1. Maintain product information updated Manufacturers can have an accessible interface, via supermarket infrastructure, to maintain and extend information that describes their products.

For customers (Fig. 3)

1. Sign-up to supermarket service The customers should use their smartphone to point the web browser to a particular URL using the supermarket premises (wireless access) and then sign up to create their personalized profiles (set preferences). Alternatively, and for testing purposes, it is considered the option of providing similar services to anonymous users.

1. Scan product codes. This process requires customers to use their smartphone to scan the Quick Response codes or Augmented Reality patterns labeled on the particular product their interested and as a result of this simple gesture, the personalized information can be visualized on screen granulating details based on the preferences they set previously.

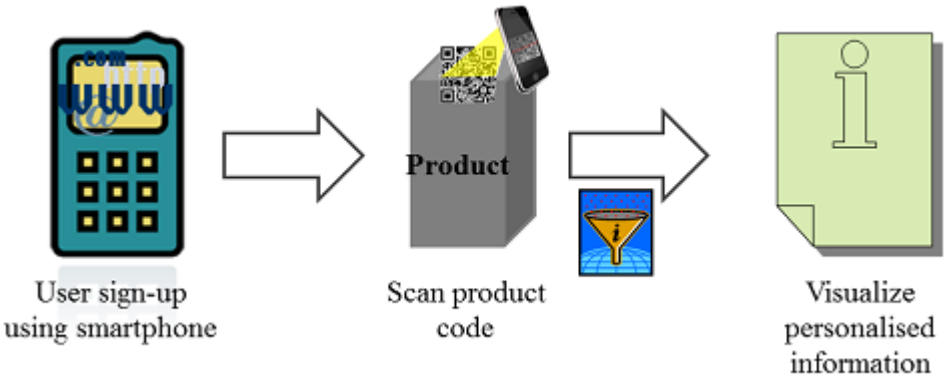

Figure 3: Simple gestures for retrieval of information

Real consumers were selected to both define pilot features and test the pilot itself and assess their satisfaction with the implementation. Feedback from end users (consumers) is a key point to assess viability and compliance with their expectations. For this, several sessions were planned in order to involve consumers in the pilot. The sessions are called workshops with consumers, because of their interactive and open to discussion nature between consumers and retailer.

The objective of those workshops was to involve a panel of 15-20 consumers in all the process of the pilot, its conception, development and evaluation, as to identify their needs and requirements as consumers, then to test and to validate the pilot mock-ups and its final version. The planning of workshops most suitable for our expected objectives resulted as follows:

- Pre-Workshop. Objective: To know the opinion of consumers about the future supermarket and habits of consumption. Participants: A total of 14 people.

- 1st Workshop. Objective: Introduction to the project, analysis of the current situation (myriad of logos, lack of information) and stipulation of which product attributes consumer would like to know and how while shopping. Participants: Panel of consumers of 15 people.

- 2nd Workshop. Objective: Experimentation with the first release of the pilot at supermarket premises to validate the technology and to improve it according to panel of consumers' proposals. Participants: Same panel of consumers of 10 people.

- 3rd Workshop. Objective: Experimentation with the second release of the pilot at supermarket premises to a final validation and to get the feedback of expectative of the panel. Participants: Same panel of consumers.

The results of the workshops helped to ensure the feasibility of an open deployment of the pilot in a real supermarket. The development of all workshops with consumers in a closed environment allowed detecting and improving the pilot in order to make the decision for an open deployment in any supermarket assuring the viability of it.

The workshops have been defined aiming the next objectives:

- Pre-workshop. To know the opinion of consumers about the future supermarket and way of consumption.

- 1st workshop. Introduction to the project, analysis of the current situation (jungle of logos, lack of information) and stipulation of which product attributes consumer would like to know and how while shopping

- 2nd workshop. Experimentation with the first release of the TIC app at supermarket premises to validate the technology and to improve it according to panel of consumers' proposals.

- 3rd workshop. Experimentation with the second release of the TIC app at supermarket premises for a final validation and to get the feedback of expectative of the panel.

The number of workshops has been chosen to match the phases of the pilot development. In this way, a calendar has been developed for setting the dates of each workshop so they could be planed and organised in advance.

As a result of the pre-workshop and first workshop, the attributes that consumers consider as more interesting and are willing to be informed about while shopping are depicted in Fig. 4.

Regarding the ways of getting product information that consumers find more interesting and would like to use while shopping, it points out that consumers want to get the information through a new technology device like a screen, a scanner or a Smartphone. The Smartphone is a mix of screen and scanner.

It has been also identified that there is a lack of information related to products for the costumer in the supermarket environment, and when the information is available it is difficult to understand it. It is notably that not all the currently provided information is useful or interesting for the consumer. Customers disagree with raising the product price or paying any money to gather the tailored information. But in the other hand, they are willing to start using a real market application with the same characteristics that the ones offered by the proofs of concept and are very receptive to use the new technologies while shopping, and they prefer them over the classical supermarket communications, as SMS or old-fashion mailing.

4 Solution Description

In order to implement the pilot with the features and requirements derived from the previous study it became necessary to use all the potential of the expected Future Internet's capabilities [1] to improve

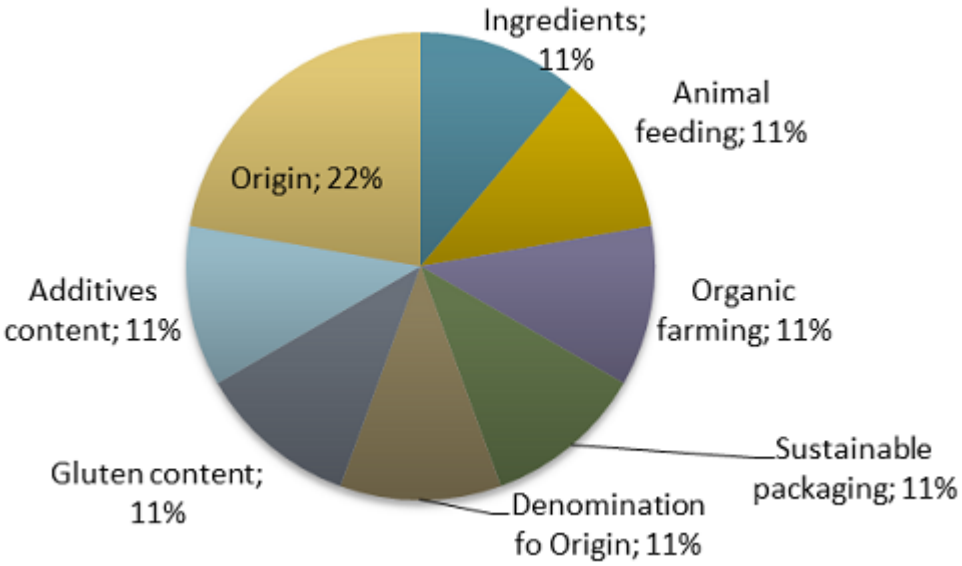

Figure 4: Results on product attributes interest

food awareness among consumers. The Future Internet's capabilities referred above have provided the pilot with scalability, security, performance and data integration by implementing cloud hosting, bridging of IoT enabled interfaces and services and open interfaces to new services.

The pilot targets all the mechanisms (e.g. applications, infrastructure, data and communication models) that enable consumers to request information of a specific product using their Smartphone before/-during and after their shopping process; so they only get the right product attributes of their interest according to their consumer shopping profile. This requires an infrastructure for managing consumer profile data (taking into account security and privacy issues) and for managing product attributes. The pilot is mainly focused on the data management and provision to consumers.

The data provision to the consumer is carried out by two ways:

- Providing tailored product information from selected products that costumers will find in the supermarket.
- Showing hidden information from logos and signs which can be found in some products, usually processed products.

In order to match the consumer's interests, users can create a dynamic consumer profile in order to know what information they are interested in by fulfilling a web form which is later mapped to a JSON document (Fig. 5). The generation of tailored information depends on those profiles so this characteristic allows more accurate information matching in comparison with the generic and fixed information provision of products' labels. Similar process is used to virtualize real world attributes or objects such as: description of products, notifications, etcetera so that can be treated as interacting objects and integrated in the solution.

Having tailored information after a matching process leverages privacy and security issues. As this information is supposed to be managed, in the future, by external entities in the form of Generic Enablers (GE) [7]; consumers, inside the pilot, will be owners of all the tailored data they consume and produce. Consumers can also make use of anonymous profiles in the case they are not interested on permanently sharing their information with the supermarket, the service cloud and GEs behind.

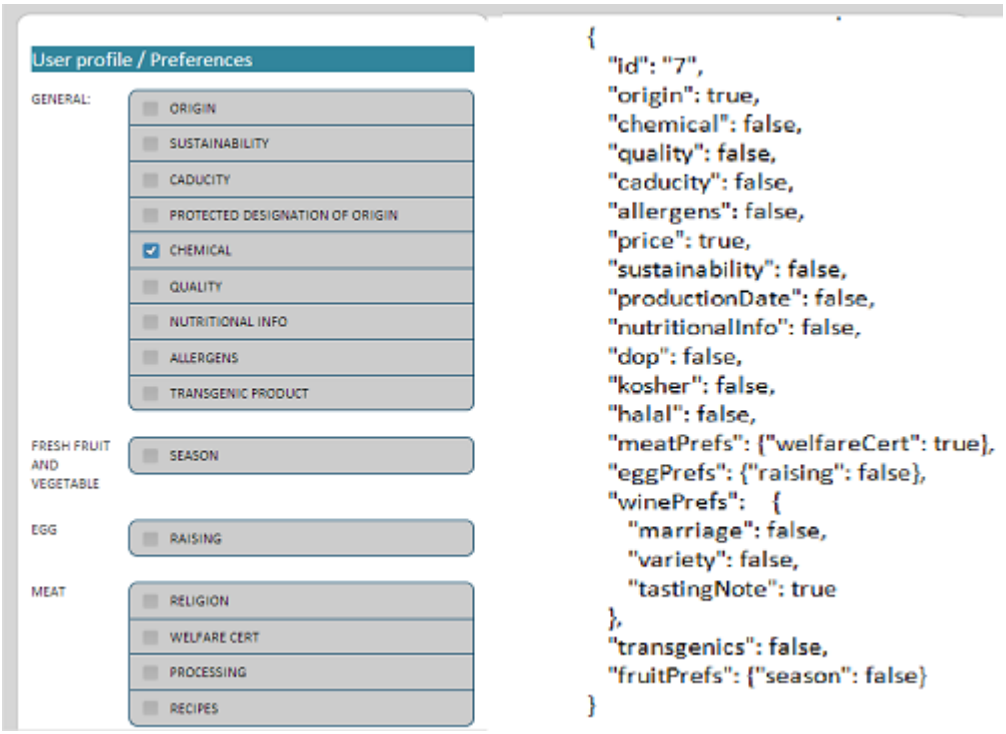

Figure 5: Transforming attributes into interacting objects

There are three main parts in the pilot that are described in this section.

- The client side, which encloses the technological developments that allow consumers getting tailored information from the supermarket infrastructure using a smartphone (user domain).
- The infrastructure side encloses all the developments being executed in the supermarket domain. As the tailored information generation of this side, is not a stand-alone process, the supermarket domain makes use of a set of GEs that provides some functionalities that will be mentioned in next sections.
- The communication approaches implemented to support distinct types of notifications

Clients A standard smartphone with updated software can be used to test the web app pilot. Among standard features to be used are: camera, scanner software and HTML5 enabled web browser. Behind the client side it has been defined a web service based architecture [15], and its corresponding implementation is able to tackle the traditional limitations exposed by typical client approaches where interfaces are tailored to fit specific deployment conditions (varieties of mobile and desktop environments). In this pilot, a web-style client provides service access with a solid and standard-compliant client framework that can be invoked from any user equipment with minimum requirements such as a web browser with HTML5 [4] support.

Since the terminal is the entry point of supermarket's users; the use of HTML5/Javascript based technologies (through web browsers) directly expands the reachability of users. This is because, there are several mobile operating systems, such as: Android, iOS, Blackberry and so on; so tackling the tailoring information process for every existing mobile Operating System (OS) could be a drawback for

the whole process. Focusing on the scanning of Quick Response codes or Agumented Reality patterns simplifies the RFID interaction exposed at [16].

Infrastructure The infrastructure (TIS server) is in charge of linking product related information databases with consumer needs, and gives to them in the easiest way the tailored information requested. A key issue is to develop a subsystem that allows collecting and managing dynamic information and data generated at different points of the supply chain. An additional module has been developed in charge of providing the means for the mobile application to retrieve supermarket privacy policy, which describes what information, does supermarket need from the users of the application and the purpose of usage. As in our case, supermarket only requires the information for a single purpose that is, to provide tailored information, and always wants access to the same information; only one privacy policy was created and exposed via module. This application is called from the GUI to obtain the needed information.

The web services layer is developed through an Enterprise Service Bus (ESB) which exposes Restful web services in order to be invoked by any application. When a request arrives to the ESB, the message work-flow (MF) analyses and determines from source of the URL that invokes this message (Fig. 6). Next, The URL filter determines if that URL is compatible with the existing patterns. Once the URL has passed the filter, it arrives to a router (choice component) that addresses the request to the right service. If there is an error, it is redirected to another message workflow that keeps a log of every request.

Cloud oriented definition of the architecture and use of HTML5 eases the addition of new functionalities.

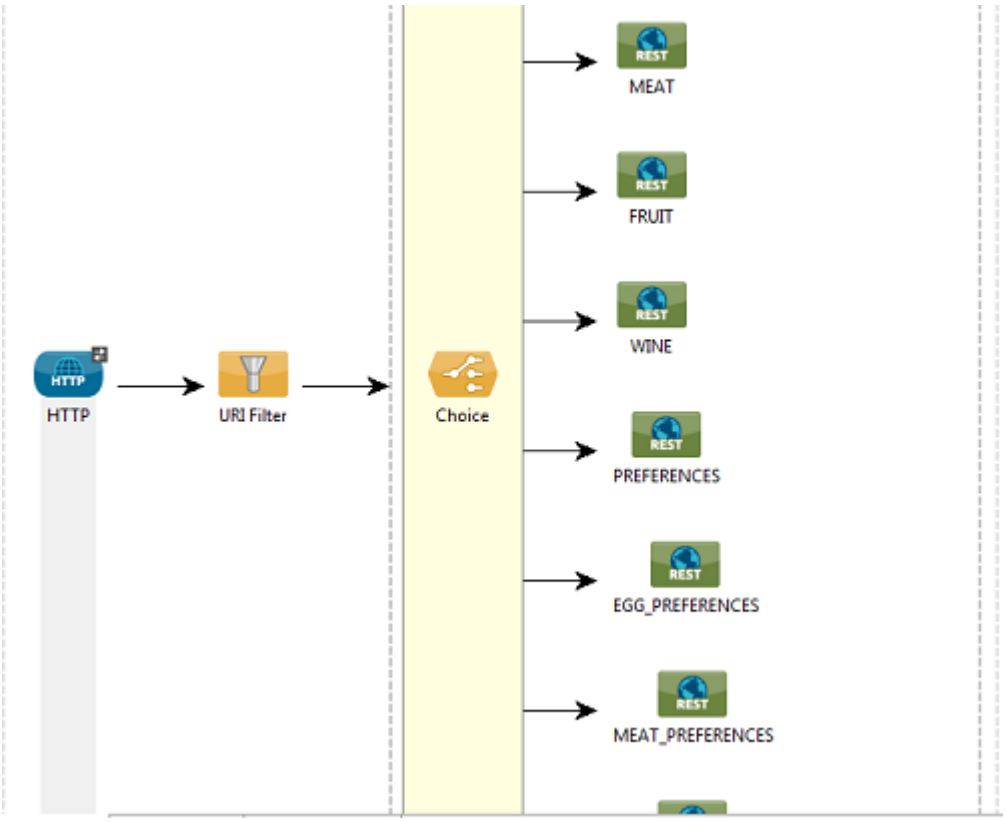

Figure 6: Message workflow in webservices

Notifications Following the pull communication approach, the consumers obtain information from web pilot application once requests automatically trigger an information request to the proper entity (that could also redirect to another application server or process itself the information), and eventually that entity might requests information to the Generic Enablers. In the content adaptation process the TIC application servers should make use of the existing profile information of the user for customizing the content, even if the request has just being issued (Fig. 7).

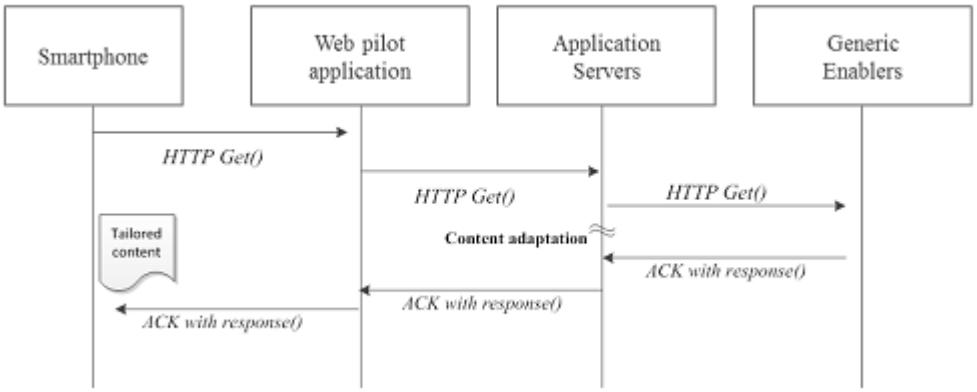

Figure 7: Message exchange

In the scenario of smart notifications, the tailored information is pushed to the consumers' smartphones; so here web pilot accepts event subscriptions from the clients and manage if this subscriptions involves asynchronous events from the application Servers or Generic Enablers systems. Hence, the web pilot not only customizes the information but also correlates the correct events arriving from the proper server (Fig. 8).

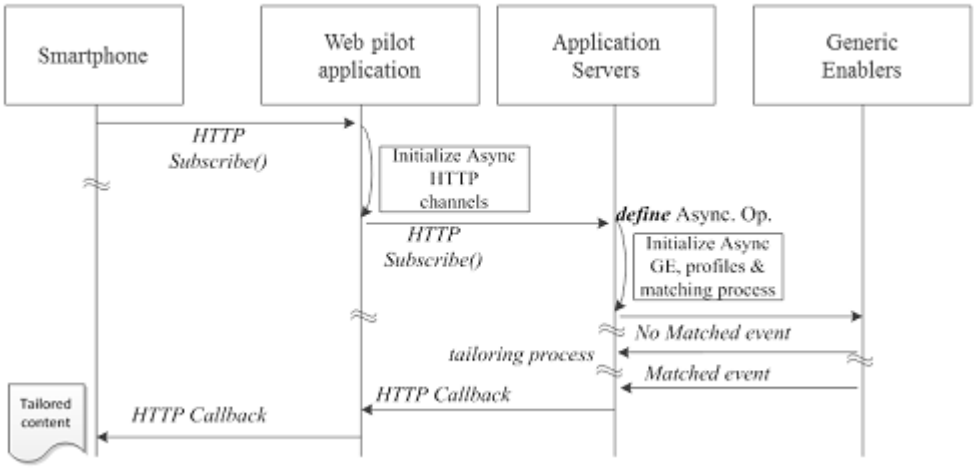

Figure 8: Smart notification scenario

Another important scenario of smart notifications takes place in the post-shopping activities with an alert notification mechanism. A key issue in this regard, was to develop a subsystem that allows collecting and managing dynamic information and data generated at different points of the supply chain to have full transparency data available to the consumer.

In a food alert scenario (contingency notification), a health government organization could detect a problem in a particular delivery of food and trace the supermarkets that sell these products. The supermarket needs to locate the customer which purchased the problematic product and send him/her an alert. As the customer contact information is confidential and restricted to users with Fidelity card we need to change the customer registration business process to ask the customer if they want to be notified when a food alert occurs.

The alert delivery to customers is handled by different media, email, push notifications and also phone calls. In the case of push notifications the specification of the alert delivery is described in the workflow of Fig. 9.

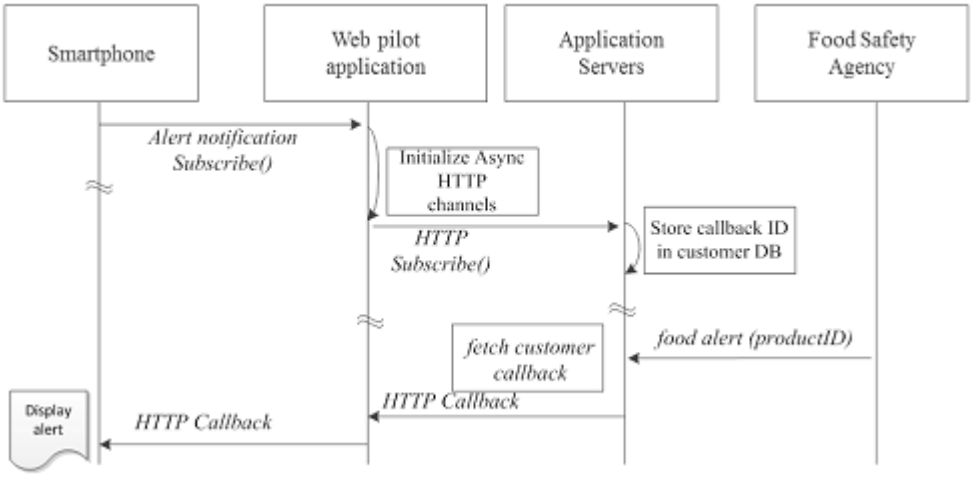

Figure 9: Smart notification in food alert scenario

As can be seen, the customer's mobile device subscribes to the supermarket information system through the Web pilot and this system stores the callback information of the customer in a private database. When the food safety agency notifies the supermarket a food alert, the customer callbacks are fetched and the notification is delivered to their mobile phone.

A list of all features that have been integrated so far in the pilot is summarized below:

- Smart notification system that allows direct messages to particular consumers that fit certain preferences. This feature is mostly useful when information of products is updated, new items arrive to the supermarke, contingencies warnings and etcetera.
- Augmented reality features, by overlapping virtual objects with personalized information.
- Identity Management GCP GE [8]. Identify management controls the way users define policies regarding preferences and privacy.
- IaaS Data Center Resource Management [12]. Provides cloud-based services for deploying applications.
- Tailored information system. The information provider retrieves the information regarding products; so even if the matching occurs outside of the domain of the provider, as an example in the supermarket, this building block can work. As an example of this the front layer of the mobile application is decoupled from the database which stores product data.

- Integration of a logo recognition tool. Logo recognition functionality is provided by a service developed by another partner from Smart Agri-Food project and is focused on identifying logos on products and providing consumers with descriptive information.
- Front-end. Implemented using fully HTML5/Javascript codes which allow users to make use of the application by using the web browser available on their smartphones (no need of additional plug-ins), and define which internal capabilities, such as cameras, will be available through the whole shopping process.
- Integration of fTRACE pilot. The fTRACE pilot [18] is about tracking, tracing and awareness of meat products.

These features together form a M2M communication [2] environment since they integrate devices and heterogonous backend systems into one (Future Supermarket) service platform (Fig. 10). The web pilot has been hosted on a FI-WARE cloud hosting enabler service and its services tested at Bonpreu supermarket facilities located in Barcelona (Spain). Bonpreu is a medium size store composed by a dry products section, a bakery and a big fresh food area with fresh fruit and vegetables, a butcher and fish/seafood services. The main client profile of this shop is middle-aged middle-high class consumers, according to the neighborhood profile.

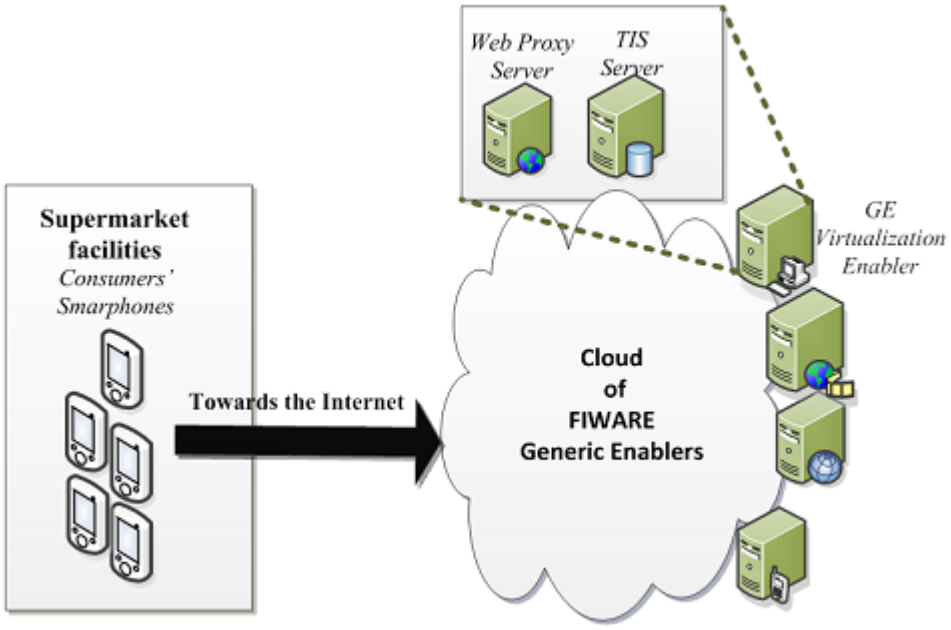

Figure 10: Pilot implementation

The premises include a Consumers' Space which is used for consumer-retailer interaction in order to have feedback from its regular consumers. It has been chosen as the best site for pilot deployment because of the following reasons:

- The medium size of the supermarkets represents the best conditions for a prototype test.
- The location of the supermarket and the Consumers' space is in a young and dynamic neighborhood; and so is the profile of its clients. Young and dynamic consumers are more likely to be used

and interested in new technologies. Therefore, the panel of consumers consisting of clients of the supermarket will be easy to create and be involved in the project.

- The deployment of all equipment needed for TIC pilot can be set up in the Consumers' space, which provides enough room for it.
- The Consumers' space represents a perfect place for developing TIC pilot tests in a closed and controlled environment, using pilot products from the supermarket and totally equipped for the development of the workshops with consumers.

5 Consumer Evaluation

For the 2nd workshop, a variety of products were used for the experimentation, having each product its unique QR code. The process was quite simple: consumers needed to connect to supermarket's Wi-Fi network and to get access to the online app using an URL, select the language, then register to create their own consumer profile by filling in a short questionnaire about their preferences ("I am interested in: food origin, sustainability aspects, chemical content, allergens, animal welfare, etc."), afterwards scanning the QR code to get the product information that fits with their consumer profile and finally the application showed the tailored information of that product.

The 3rd workshop was performed in two parts: (1) presentation of the TIC app (summary of its functionalities), (2) test with the TIC app using the Smartphone of each participant. Instructions on how to proceed with the test were explained. The Web app was valued by the consumers with an average score of 7.2/10.

Starting from 2nd workshop and through 3rd one, consumers were able to test two iterations of the TIC Web app. The first test allowed detecting some problems and improvements that were corrected for the second test. New functionalities were included to be tested in the 3rd workshop. Fig. 11 compares the technical evaluation of the pilot for each functionality and a global evaluation of the web pilot regarding conceptual value for consumers.

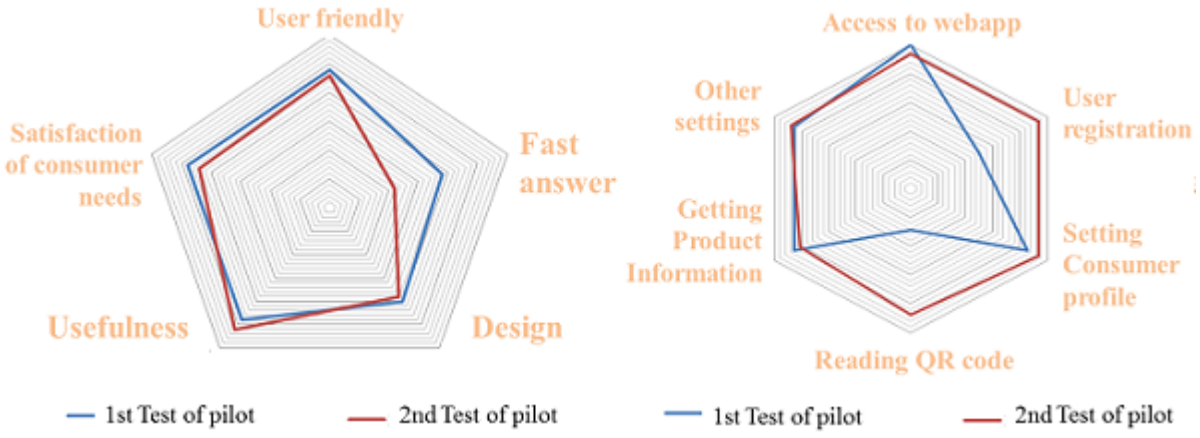

Figure 11: Comparison between 1st and 2nd tests

As a conclusion, we can say that consumers participating in the process for pilot evaluation were very interested and motivated in the web pilot and are willing to use the Web app. Percentage of consumers that would use the web app while shopping grew up from an initial 57 percent after the first test to 70 percent after the second test, showing a substantial increase in appreciation.

With the workshops outputs in mind, a solid architecture has been defined to support the next generic features:

- Accurate, since it retrieves data from reliable sources located at cloud hosting.
- Granulated, since it filters information based on user preferences and profiled with the interaction of Generic Enablers (GE)
- Advanced information, since it has been designed to include new information items and, most importantly, serve as a communication link in order to inform customers in the case of contingencies related to: health, logistics and so on.

6 Conclusion

According to the results of consumer's evaluations of the web pilot developed [10] and the whole development process itself including additions of Augmented Reality and Smart Notification features, we have concluded that the implementation of an information system with support for extended features in a future shopping environment can be radically benefited from state-of-the-art internet-based networks and services such as those provided by the IoT and M2M paradigms. Cloud allocation of servers and use of HTML5 in client side are helpful for the addition of new emerging functionalities. The users (customers) involvement along the development stages helps ensure the successful integration of the expected functionalities and provides with the foundations required in order to continuously satisfy the ever changing needs from customers. Concerning business value, those retailers satisfying customer expectations and needs about food information will have direct economic benefits due to a gain of new customers, loyalty cultivation of the current consumers and a slightly increase of the shopping volume (marginal purchase).

Feedbacks obtained from workshops with consumers have helped us to define new functionalities that shall be tackled in the next phases of the web pilot such as: (i) Improving shopping experience using gesture identification by interacting with devices with multiple sensors that detect gestures; (ii) Extension of shopping trolley and integration with personal devices. An extended shopping trolley with screens or any other human interface can also be integrated with the TIC pilot. In the same way, as the Gesture identification scenario, the trolley can interact with the mobile device for fetching information regarding shopping lists, profiles or preferences; (iii) Prosumerization of supermarket scenarios. The web pilot shall integrate a composition environment which enables service personalization for end-users supporting service publication, search and discovery and updating mechanisms and integration with current supermarket infrastructure (customer identification, accounting, billing, notification processes, etc). This is needed to develop self-contained components to be used in service creation and personalization processes by end-users following the prosumer approach.

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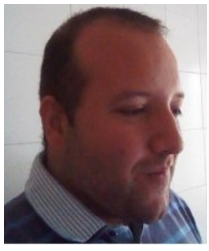

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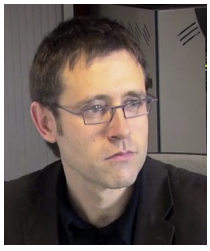

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