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1. Executive summary

This deliverable documents the work done in task T3.2 Food traceability, i.e. the analysis of the business framework and the development a usage scenario and metrics for an ebbits application for enhanced food traceability along the life-cycle of the food; from farm to fork. Chapter 2 is the introduction to deliverable and gives sufficient background for reading the deliverable as well as its purpose and context.

Chapter 3 describes the business ecosystem in food production. The development in the ecosystem from the Second World War is described and how the production has changed to keep up with the growing demand for produce and increasing pressure for sustainable production. Improved traceability could further increase consumer awareness and aid in solving challenges like increase productivity, increase sustainability, optimise consumption habits and optimise distribution so local demands are met.

Traceability is important to make sure that food is of high standard and save for consumption. It has not been possible to implement traceability on individual product level but recent technological advancement has made a widespread unique identification of every product within reach. Ebbits needs to provide a solution to combine *intra-enterprise traceability* and *inter-enterprise traceability*. The drivers and inhibitors for the development of ebbits platform are:

Drivers:	Inhibitors:
• Regulations and legal constraints • The farms economic optimisation • Healthy food • Quality assurance • Eco-sustainability • Predictive models	• Data security and privacy • Internet connectivity • Consistency in infrastructure • Lack of IT utilisation.

Chapter 4 gives political background for the area of food production. Decision makers need to optimise benefits for humans, society and environment while respecting needs of farmers, consumers, protestors, regulators and many other stakeholders. The European Union has had a common agricultural policy (CAP) since 1957. The CAP provides free trade within member states and protects European agriculture with high tariffs on import and subsidises export. The decision makers have since been trying to balance price, production amount, food security and arable land.

Since 1990s food safety has been an increasing concern. There are four important elements in EU's food safety strategy, consumer's right to information, rules on safety, independent scientific advice and control of processes. This spawned a new legislation known as General Food Law that sets the principles applying to food safety. EU introduced in 2006 requirements covering traceability on farm products. This was done to improve food safety and to protect animals from bad treatment.

Chapter 4 introduces standards used for traceability. Pitfalls and trends identified in a report from *Informal Expert Group on Product Traceability* is used as a source. Lessons learned from other traceability projects are also listed

The Electronic Product Code (EPC) is used for tracing products. The EPC code is stored in an RFID tag that scanners in storage houses, trucks and other locations can read wirelessly. The scanners can combine ID information with environmental information like location and temperature and create an event to inform other systems. SAP has a solution, Object Event Repository, which was created to handle this kind of events.

Chapter 6 describes in detail the business environment and lays down the foundation for value modelling in the traceability scenario. The ebbits traceability scenario will demonstrate a sustainable business model with online, ad-hoc access to data. Analysis of stakeholders is presented and value objects are identified and categorized based on where they are created and consumed. These value objects form the information exchange network that is illustrated. In the end the business vocabulary for traceability is updated.

Chapter 7 updates the traceability use case. The traceability will at first be implemented for beef products because it has values suitable for traceability and considerable amount of data is already available. The biggest slaughterhouse in Denmark, Danish Crown, already implements traceability for high end beef and shares information from farmers and from the slaughter process with the consumers on their website. Consumers can there use the ID code that is printed on the packaged meat they bought to get information.

A use case with ebbits is introduced. It is based on a smart phone application that could give consumers access to traceability information inside the store. The information displayed in the app will be extended with more sources compared with the Danish crown case. The app will also provide rating and sharing possibilities to increase the value for the consumer and other stakeholders.

Chapter 8 is about technologies and metrics in the traceability scenario. Agriculture and food processing have increasingly used innovative ICT technologies to optimise and automate processes. This transformation has provided data gathering possibilities that have not been present before and are currently unutilised. EU through EGE promotes innovation in agriculture to ensure food safety, security and competiveness.

2. Introduction

2.1 Business framework

One of the main objectives of the ebbits project is to develop a viable and sustainable business framework for the ebbits platform that align with global economic business conditions in the agriculture domain and, in particular, to develop realistic business models and cases for deploying the ebbits platform in the area of food traceability.

Food traceability, or life-cycle management of food stuff, is intrinsically linked to food safety. Food safety covers the conditions and practices that preserve the quality of food to prevent contamination and food-borne illnesses. It entails protecting the food supply from microbial, chemical and physical hazards or contamination that can occur at all stages of food production and handling: growing, harvesting, processing, transporting, preparing, distributing and storing. Food safety is therefore a heterogeneous and multidisciplinary issue that concerns not only the food products as such but also the production methods.

However, there are more aspects of life-cycle management, which can be supported by the ebbits platform, e.g. environmental impact, such as CO_2 footprint during production and transportation, animal welfare, ecological farming methods, regulatory demands, etc.

In order to fully understand the business potential of the ebbits platform, all of these aspects will need to be taken into account so that the all of the potential business cases using the ebbits platform can be investigated.

In this context, the business framework entails not only the specific business ecosystem that consist of actors and stakeholders involved in the business activities, but also the national and international bodies that impose regulations and requirements on these actors, as well as the technologies and solutions available to stakeholders to either offer and consume values or to monitor and control the flow of values.

2.2 Brief overview of the ebbits platform

The ebbits platform is a cloud based platform that allows the "Internet of People, Things and Services" (IoPTS) to be integrated into existing and new Enterprise systems thus allowing firms and organisations to launch applications that rely on legacy data as well as real-time information from the physical world.

The ebbits platform supports interoperable business applications with context-aware processing of data separated in time and space, information and real-world events (addressing tags, sensors and actuators as services), people and workflows (operator and maintenance crews), optimisation using high-level business rules (energy and cost performance criteria), end-to-end business processes (traceability, lifecycle management), or comprehensive consumer demands (product authentication, trustworthy information, and knowledge sharing).

It will provide semantic resolution to the Internet of Things and hence present a new bridge between backend enterprise applications, people, services and the physical world, using information generated by tags, sensors, and other devices and performing actions on the real world. The platform will be based on a Service-oriented Architecture (SoA), transforming every device into a service. The SoA will allow these services to semantically discover, configure, and communicate with each other.

The ebbits platform will be demonstrated in end-to-end business applications featuring connectivity to and online monitoring of a product during its entire lifecycle, i.e. from the early manufacturing stage to its end-of-life. One of the targets for the demonstrations is online food traceability with enhanced information on foodstuff from farm to fork.

2.3 Purpose, context and scope of this deliverable

The purpose of this deliverable is to document the work in task T3.2 Food traceability, i.e. the analysis of the business framework and the development a usage scenario and metrics for an ebbits IoPTS application for enhanced food traceability along the life-cycle of the food; from farm to fork.

The deliverable will introduce the business framework for service providers who intend to establish the ebbits platform for traceability and thus provide an infrastructure for added value services to all actors in the system.

The deliverable will also provide the first description of the TO-BE usage scenario with traceability and describe the way stakeholders interact using the ebbits platform, and provide samples of the data models that can be used for traceability applications.

In this context, the deliverable updates the processes in *D3.3 Business logic models,* which described the AS-IS model, and illustrates how the processes might look like when the ebbits platform is deployed in the usage scenarios.

Moreover, the deliverables provides the identification of actors and stakeholders and the various value objects provided by the ebbits platform and how these value objects can be offered and demanded by the various stakeholders. This information will be input to the final deliverable *D3.7 Sustainable business models for actors in selected industries, D2.5.2 Prototype application specification 2* and for business rules in WP6.

Chapter 3 of the deliverable details the business ecosystems in food traceability, provides the necessary background information to understand the business drivers and inhibitors in the market. In chapter 4, the ecosystem is completed with an overview of the regulatory demands and constrains that is in place.

Chapter 5 briefly discusses the business strategies and models based on value creation and identify the various stakeholders involved and their potential value objects.

Chapter 6 presents a typical usage scenario for food traceability and chapter 7 discusses the technologies and data models involved in the usage scenarios.

Finally, chapter 8 draws some conclusions from the work presented and lead the way into the future work to be undertaken in task T3.5 Eco-systems and business models, which will develop a viable and sustainable business framework for ebbits based enterprise systems and explore new models of dynamic business value constellations of actors.

3. Business Ecosystems in Food Traceability

The concept of an ecosystem is defined as "an economic community supported by a foundation of interacting organizations and individuals — the organisms of the business world. The economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organisms also include suppliers, lead producers, competitors, and other stakeholders. Over time, they coevolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies. Those companies holding leadership roles may change over time, but the function of ecosystem leader is valued by the community because it enables members to move toward shared visions to align their investments, and to find mutually supportive roles" (Moore, 1996). In this chapter we will look closely at the business ecosystems for food traceability.

3.1 The need for sustainable food production and consumer awareness

International food industry and food supply chains always faced an ever increasing pressure to deliver sufficient, safe, healthy and attractive food in a highly competitive environment. At the European level a turning point for the agriculture sector happened right after the Second World War, as there was a basic need to recover the European capacity to produce food and to increase the food production elsewhere (especially in the United States) for the export to Europe. The goal was, therefore, to supply abundant food at the lowest possible cost to consumers. European farmers accordingly adopted new technologies to enhance production and, at the same time, fiscal policies to externalise the environmental costs of food production were promoted.

At a later stage, steps were taken to optimise the continental production. Farmers moved towards full electrification and mechanisation, wider use of chemicals to control weeds and pests, applications of information and computer sciences to improve management and marketing efficiency, use of knowledge of genetics to select appropriate varieties and modify desired characteristics and, finally, new external devices and sensor systems such as lasers for precise levelling of fields and global positioning system (GPS) technologies with satellite tracking and on-board computer monitoring to assist with more precise application of chemicals.

In the mid-1970s to the late 1980s the growth rate for global demand for agricultural commodities stabilised on an annual grow of 1.5% while from the mid-1990s to the present the market demand increased to 1.9% per year (USDA, Goldman Sachs Commodities Research, 2008). In recent years, although production is an excellent goal, the challenge that lies ahead in the forthcoming period is to make the transition from production agriculture to agricultural sustainability. Moreover, claims made with respect to health effects, sustainability and ethical aspects of the production chain need to be transparent to society.

The rapid growth in world population (13%), overall global income (36%) and meat consumption (beef 14%, pork 11% and chicken 45%) in the last decades are major drivers behind increased demand for raw materials (FAO 2002).

Region	1964–66	1997–99	Projection for 2015
World	2 358	2 803	2 940
Developing countries	2 054	2 681	2 850
Sub-Saharan Africa (excluding South Africa)	2 058	2 195	2 360
Industrialised countries	2 947	3 380	3 440

Table 1: Global and regional per capita food consumption (kcal) (FAO 2002[1])

[1] Published on http://www.who.int/nutrition/topics/3_foodconsumption/en/index8.html

There are essentially four options available to meet this challenge:

1. increase the area cultivated, thus putting further pressure on the remaining land, including marginal ground and forests;
2. increase the productivity of the land currently cultivated, which is a more sustainable option;
3. improve distribution of agricultural products to ensure they are in the right place at the right time;
4. increase the environmental sustainability and optimise the consumption habits.

These challenges can be met by modern ICT technologies, which therefore play a considerable role in sustainable agriculture. The ebbits technologies are aiming at the 4th challenge, i.e. bringing safe and environmentally sustainable food products to the consumers and allowing the consumers to make an informed choice regarding which products to demand.

3.2 Background of food traceability

The concern of the European Union is to make sure that the food we eat is of the same high standard for all its citizens, whether the food is home-grown or comes from another country, inside or outside the EU. Traceability in the food sector is one of the keystones in obtaining this goal, and the rapid technological development in the business has opened a variety of new possibilities for obtaining and exchanging data.

Core to all food traceability systems is the unique identification and registration of all food sites or premises along the supply chain. Locating all premises is the first step to developing a series of management tools and solutions for appropriate use by both industry and government to support informed decision making. Full traceability chain involves in general three elements: premises identification, product identification and movement recording that are consistently linked through trace-back/trace-forward systems developed at each step in the food chain, from production through processing, distribution, retail and to the consumer.

New technologies such as high-frequency RFID tags have made it possible to identify individual animals like slaughter pigs and cattle in the production. This is essential for food traceability, but for the farmer the choice of using RFID tags (e.g. in pig/cattle production) depends on the economic outcome of using this technology. In other words, he expects immediate payback for his investment; otherwise he will not use the technology. The challenge here is that the benefit from using individual identification of animals is the total sum of effects all the way through the production and distribution chain from feed production, through growing the animals on the farm to slaughtering and distributing and finally ending up in the hands of the consumer.

In the distribution environment, identification and tracking has been common in later years. But the tracking is typically based on EPC bar codes that only identify the *type* of product and the supplier. Various endeavours are presently undertaken to enhance standards of identification and tracking in the food distribution sector and the ebbits platform will allow not only product identification but also the very important capturing of on-line data related to the location and the condition of the product at that specific location.

In other words, solving the agricultural traceability challenge will be a combination of developing the proper technologies combined with the proper standards for handling data. Traceability along the food supply chain is basically the combination of two processes: *intra-enterprise traceability* and *inter-enterprise traceability*. If enterprises working in the same sector adopt different ways to describe the input, the production processes, and the output, it will not be possible to communicate information to providers or consumers.

As a product moves through production and processing stages and beyond, its source and movement along the value chain becomes increasingly challenging to pinpoint. Traceability systems that include premises identification, product identification and movement recording are essential tools to underpin the main drivers for traceability:

- Market access: traceability is a necessity in establishing confidence in the security of the food chain;
- Value chain management: knowledge of the precise supply, movement and removal of products over time;
- Product differentiation: traceability systems are integral to verify label claims and in supporting consumer confidence, and critical to obtaining and maintaining market share in both the domestic and international marketplace;
- Emergency management: premises identification and traceability systems can greatly reduce the resultant consequences through rapid and effective identification of locations and problem sources, isolation of affected animals, plants, foods or persons, protection of non-impacted premises, products or persons and reduction or elimination of the hazard.

Consequently, it is necessary to focus on the adoption of common data references at enterprise level (the farm), to describe e.g. crop protection chemicals, implements, interventions, analysis (soil, milk, etc.) in a consistent way. As traceability at intra-enterprise level is becoming established, traceability at inter-enterprise level may be seen as totally linked to logistics that makes it necessary to have a precise identification of all products.

Traceability data generation, exchange and storage have some costs for the involved parties and each player will expect a return on investment, otherwise they will not be motivated to provide the necessary set-up for traceability.

The traceability chain includes a variety of different stakeholders with huge differences in the usage of ICT. Figure 1 illustrates the relations between the different stakeholders based on the flow from farm to fork.

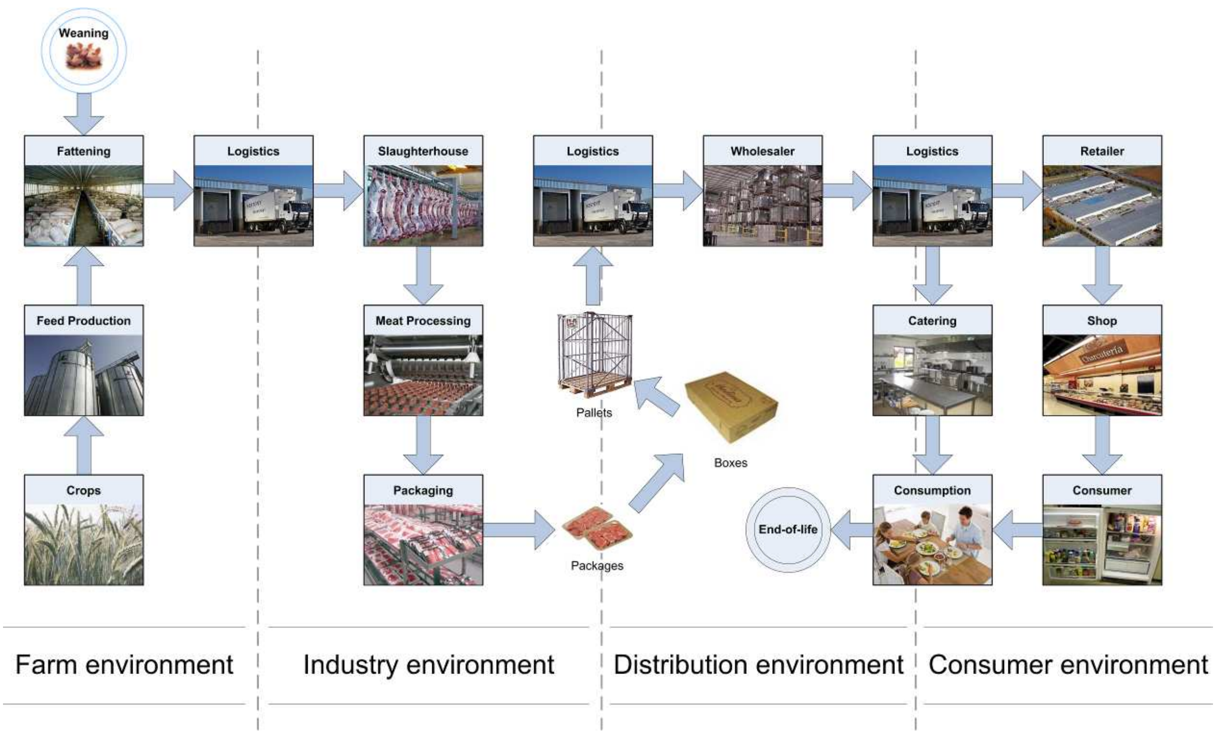

Figure 1: From farm to fork

In chapter 6 some of the main interests for each stakeholder will be described, focusing on the benefits in terms of traceability.

3.3 The importance of local culture and knowledge

It is important to recognise that agriculture is practised at a number of different levels. Industrial agriculture, whether practised in developed or developing countries, cannot be confined to the requirements set out in this opinion, but provides currency and security to countries that can be used for the benefit of the people. It might be necessary to ensure that agriculture addresses the needs of local and/or regional markets first. This consideration makes it clear that development of the agricultural sector calls for an integrative action plan that covers, among other things, local and regional transport systems, health and education infrastructure and systems of accountability of political institutions and companies as much as rules for regional, international and global trade.

The ways in which food is prepared, served and consumed differ from one culture to another. Traditional and local knowledge constitutes an extensive realm of accumulated practical knowledge and knowledge generating capacity that is needed if sustainability and development goals are to be achieved. Many effective innovations are generated locally, based on the knowledge and expertise of indigenous and local communities rather than on formal scientific research.

Traditional farmers, in the European context, embody ways of life beneficial to conservation of biodiversity and to sustainable rural development. Local and traditional knowledge has been successfully built into several areas of agriculture, for example in the domestication of wild trees, in plant breeding and in soil and water management.

3.4 Business drivers and inhibitors

The following important drivers for the development of ebbits platform in agriculture must be considered when developing business models:

- Regulations and legal constraints at the level of EU policy makers, in terms of constitution of the Legal Framework, and at the regional level, in terms of regulatory organizations responsible for control and verification, where changing regulations requires flexible technologies.
- The farms economic optimisation (e.g. animal growth monitoring, monitoring diseases, benefit from benchmark to other farms by getting more information about their production processes).
- Healthy food: food safety, food quality (animals not treated with medicine), traceability as drivers for consumer demand.
- Quality assurance and maintenance (including taste, place of origin certification) as driver for branding efforts from farmers, food processors and retailers.
- Eco-sustainability and environmental aspects (preference for local products, using less water, using less fertilizer, etc.) as driver for consumer demand and process optimisation.
- Predictive models (clustered, targeted groups, social media crawling) for better demand forecasts and branding.

A number of inhibitors still exist in terms of technological or privacy risks also exist and need to be addressed in the business models.

- Data security and privacy shall be regarded as a fundamental requirement, as the information collected and processed in the food production and logistic chain are very sensible.
- Internet connectivity could be an issue in relation to small farms.
- The need to have a consistent and constant access to the farm's infrastructure is a problem for the power consumption in terms of always-on.

4. Policy Framework

4.1 Rights and responsibilities in agriculture

Agricultural ethics is about choices for people engaged in agriculture, either directly as farmers or indirectly as government regulators, extension agents, researchers, industrial workers, lawmakers, technology developers, consumers or protestors. This calls on decision makers and relevant stakeholders to promote and implement responsible use of agriculture, based on respect of a number of (ethically justified) fundamental rights. In this context, decisions on ethically sound design of new technologies in modern agriculture place responsibilities on those called to take them and monitor their implementation.

Of necessity, agriculture is intended for the benefit of human beings, society and, if sustainable, the environment.

These benefits are not necessarily the same, since the benefits to living human beings could, in the short or long term, entail a cost to the environment. Human use of the environment, over the 10 000 years we have been harnessing nature, has been relatively benign. In the last 100 years, however, we have made rapid, and possibly irreversible, changes to the environment, including excessive use of fossil fuels in relation to their replacement, excessive use of water, production of greenhouse gases and a huge increase in the human population. In this context, the concepts of beneficence and non-maleficence acquire a relevance to support the production of safe, healthy and high-quality food in agriculture.

Individual and collective responsibilities for food security and sustainability should not be confused. As far as food security is concerned, responsibility also lies with individuals and their choices in food consumption. For example, following diets rich in meat products and purchasing non-seasonal food certainly have an impact on global warming, food scarcity and erosion of arable land.

Similar considerations apply to management of food waste and global hunger. Consumers' responsibility with regard to food security and the hunger divide is lower than their responsibility for food sustainability, since food security depends mainly on the design of national or supranational agricultural policies and trade rules. Responsibilities also lie with different players involved in the agro-food sector: food producers, food retailers, food distributors and policymakers in the agricultural sector at regional, national or supranational levels (the EU Member States and the EU as a whole).

Food producers have direct responsibilities for food safety and quality (technologies used for production and methods) and food sustainability (methods of production and raw materials imports). Food retailers have direct responsibilities for food security monopolies, food price increases, non-seasonal food, etc.), food safety (food quality and public health) and food sustainability (imports of food, large-scale farm production, etc.).

Food distributors have direct responsibility for sustainability (food miles and methods of transport).

Policymakers have responsibility for implementation of equitable and fair food systems (food security, safety and sustainability) at both national and supranational levels. They also have responsibility for monitoring that all involved in the food production, processing and distribution system act in ways consistent with the abovementioned rights.

4.2 European Union policy framework

4.2.1 The common agricultural policy

The Common Agricultural Policy (CAP) has been a key policy pillar of the European Union since its origins (the initial objectives were set out in Article 33 of the Treaty of Rome). The Common

Agricultural Policy (CAP) is a system of European Union agricultural subsidies and programmes. It represents about half of the EU's budget[2].

The CAP was originally conceived to expand production and provide secure food supplies to Europeans, following the food crisis after the Second World War. The CAP was therefore a key objective of the Treaty of Rome in 1957. The most important step allowed by the CAP in Europe was establishment of free trade in agricultural products between European Member States, in response to the need to allow a controlled market with a system of annual guaranteed prices and a compensation system to maintain fixed prices regardless of market fluctuations.

The CAP also established:

(1) a mechanism of high tariffs to prevent imports of products from non-EU countries at prices cheaper than those agreed in the EU;

(2) subsidies for EU agricultural exports at a reduced price to help them to penetrate non-European markets.

This system, typical of the 1960s and 1970s, led to overproduction of food supplies. In the 1990s it was criticised for lack of food security, for the environmental impact of intensive farming and for its effects on rural employment and global justice. The EU has responded to the price surge on agricultural markets by adjusting market management: intervention stocks have been sold and export subsidies reduced — for example, to zero for dairy products. In addition, the EU Council of Ministers of Agriculture and Fisheries agreed to suspend, for the last year, the obligation for farmers to set aside 10% of their arable land, along with the import duties on cereals. Furthermore, the general move towards more market oriented agriculture, with less market support but also less restrictive supply control mechanisms, is allowing farmers to respond quicker to price signals.

In 2007, the EU adopted specific short-term measures to reduce prices of agricultural products, including increasing the volume of arable land by abolishing mandatory set-aside, increasing milk production quotas for 2008, reducing buffer stocks and export refunds, and suspending import duties on most cereals. On 29 July 2008, the European Commission proposed establishing a special 'facility for rapid response to soaring food prices in developing countries'.

Agriculture is the main provider of food and has a great impact on nutrition and health and on economic growth. There have been many arguments about the distribution of both food and farmland between the rich and poor, in developed and developing countries alike. Most of the world's poor are small tenant farmers.

In order to increase their standard of living, the governments of many developing countries adopted (in the 1970s) policies for 'industrialising' agriculture. The fact that today there are more than 800 million people worldwide whose food supply is uncertain, even though sufficient food is being produced, points to a worrying distribution problem and is a sign of inadequate structures in agriculture and in world trade in agricultural goods. Global food production has apparently more than kept pace with population growth in recent decades and a diminishing proportion of the world's population are undernourished. There is, however, a worrying distribution problem in many countries. As the population has been increasing steadily during the last century in every continent, agriculture has been facing increasing challenges to meet goals such as provision of resources and, most importantly, of food.

As the world population along with its need for food grows, new technologies are necessary for creating and encouraging new methods of agricultural production and trade with a view to developing equitable food distribution capacity and a food-secure world. The current amount of land under cultivation cannot expand much further without detrimental environmental effects. Therefore, food production technology must create methods to improve the productivity of the land currently under cultivation and prevent harvest losses. An integrated scheme for effective use of land is crucial.

[2] http://ec.europa.eu/agriculture/index_en.htm

4.2.2 Food safety regulations

The concern of the European Union is to make sure that the food we eat is of the same high standard for all its citizens, whether the food is home-grown or comes from another country, inside or outside the EU.

EU food policies have undergone a major overhaul in the last couple of years as a response to headline-hitting food safety scares in the 1990s about such things as 'mad cow' disease, dioxin-contaminated feed and adulterated olive oil. The purpose was not just to make sure that EU food safety laws are up to date but also that consumers have as much information as possible about potential risks and what is being done to minimise them. The EU does its utmost, through a comprehensive food safety strategy, to keep risks to a minimum with the help of modern food and hygiene standards drawn up to reflect the most advanced scientific knowledge. Food safety starts on the farm. The rules apply from farm to fork, whether our food is produced in the EU or is imported from elsewhere in the world.

There are four important elements to the EU's food safety strategy:

- recognition of the consumer's right to make choices based on complete information about where food has come from and what it contains;
- rules on the safety of food and animal feed;
- independent and publicly available scientific advice;
- action to enforce the rules and control the processes.

The result was a new piece of umbrella legislation known as the General Food Law (Regulation (EC) 178/2002[3]). This law not only set out the principles applying to food safety. It also introduced the concept of 'traceability'. In other words, food and feed businesses – whether they are producers, processors or importers – must make sure that all foodstuffs, animal feed and feed ingredients can be traced right through the food chain, from farm to fork. Each business must be able to identify its supplier and which businesses it supplied. This is known as the "one-step backward, one-step forward" approach.

4.2.3 Farm to fork traceability

The European Union (from January 1, 2006), the United States, Australia, Japan and other developed countries have over the last few years introduced tough new traceability requirements covering farm products entering their ports. Traceability describes the process of identifying what has happened to a product all along its supply chain, from the producer through the exporter, packager, distributor, retailer, etc., to the consumer.

Such comprehensive information exchange is necessary if traceability is to fulfil its goal of ensuring food safety while letting consumers know precisely what they are eating and assuaging their concerns surrounding such issues as intensive farming techniques, the use of chemical fertilizers and pesticides, and transgenic produce. These strict requirements on tracking farm products can sometimes be quite onerous for farmers. Retailers must increasingly be able to deliver information relating to labour conditions and environmental standards along their supply chains, and the farmers have a choice of doing nothing, and thereby being excluded from markets, or they can attempt to adapt. The web applications, GIS, GPS and RFID technologies are experimenting in developing-world farmers in order to continue to sell their products. With these technologies, control officers, supermarkets and ultimately consumers are now able to track the safety of food products from farm to fork.

It is a further principle underlying EU policy that animals should not be subjected to avoidable pain or suffering. Research shows that farm animals are healthier and produce better food, if they are well treated and able to behave naturally. Physical stress (e.g. from being kept or transported in poor conditions) can adversely affect not only the health of the animal but also the quality of meat.

[3] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:031:0001:0024:EN:PDF

Increasing numbers of European consumers are concerned about the welfare of the animals that provide them with their meat, eggs and dairy products. This is reflected in clear rules on the conditions in which hens, pigs and calves may be reared and in which farm animals can be transported and slaughtered.

4.2.4 Protection of animals kept for farming purposes

In March 1976, the Member States of the council of Europe, considering that it is desirable to adopt common provisions for the protection of animals kept for farming purposes, particularly in modern intensive stock-farming systems, issues a convention to define basic principles should be observed about animal life conditions in a breeding context (No. 87, Council of Europe[4]). In particular these articles define that:

(1) Animals shall be housed and provided with food, water and care in a manner which (having regard to their species and to their degree of development, adaptation and domestication) is appropriate to their physiological and ethological needs in accordance with established experience and scientific knowledge;

(2) The freedom of movement appropriate to an animal, having regard to its species and in accordance with established experience and scientific knowledge, shall not be restricted in such a manner as to cause it unnecessary suffering or injury;

(3) Where an animal is continuously or regularly tethered or confined, it shall be given the space appropriate to its physiological and ethological needs in accordance with established experience and scientific knowledge;

(4) The lighting, temperature, humidity, air circulation, ventilation, and other environmental conditions such as gas concentration or noise intensity in the place in which an animal is housed, shall - having regard to its species and to its degree of development, adaptation and domestication - conform to its physiological and ethological needs in accordance with established experience and scientific knowledge;

(5) No animal shall be provided with food or liquid in a manner, nor shall such food or liquid contain any substance, which may cause unnecessary suffering or injury;

(6) The condition and state of health of animals shall be thoroughly inspected at intervals sufficient to avoid unnecessary suffering and in the case of animals kept in modern intensive stock-farming systems at least once a day;

(7) The technical equipment used in modern intensive stock-farming systems shall be thoroughly inspected at least once a day, and any defect discovered shall be remedied with the least possible delay. When a defect cannot be remedied forthwith, all temporary measures necessary to safeguard the welfare of the animals shall be taken immediately.

4.2.5 Animal transports

On 22 December 2004 the Council of the European Union adopted a Regulation on the protection of animals during transport (Council Regulation (EC) No 1/2005[5]), which helps to safeguard animal welfare by radically improving the enforcement of animal transport rules in the EU.

The Regulation amounts to a radical overhaul of existing EU rules on animal transport and identifies the chain of involvement in animal transport, defining "who is responsible for what" and thus making for more effective enforcement of the new rules. The Regulation has more efficient monitoring tools, such as checks on vehicles via a satellite navigation system as from 2007. It also has much stricter rules for journeys of more than 8 hours, including a substantial upgrading of vehicle standards.

[4] http://ec.europa.eu/world/agreements/prepareCreateTreatiesWorkspace/treatiesGeneralData.do?step=0&redirect=true&treatyId=489

[5] http://europa.eu/legislation_summaries/food_safety/animal_welfare/f83007_en.htm

4.2.6 Food safety and waste

Food safety covers the conditions and practices that preserve the quality of food to prevent contamination and food-borne illnesses. It entails protecting the food supply from microbial, chemical and physical hazards or contamination that can occur at all stages of food production and handling: growing, harvesting, processing, transporting, preparing, distributing and storing. Food safety is therefore a heterogeneous and multidisciplinary issue that concerns not only the food products as such but also the production methods. In this context, considerations relating to agricultural safety (use of chemicals) for the environment, wildlife and farm workers take on key importance.

The major problem for farmers who supply supermarkets is that they cannot raise their prices to pay for the investments needed to meet the quality and safety requirements set by the supermarkets. This appears to be true throughout the world, whether in developed or developing countries. An emerging concern is, therefore, whether the EU CAP should focus on food safety and consumer protection and promote the quality and healthiness of food products. European food safety measures applied to importing countries should be proportionate. The EU, Member States and relevant bodies (European Food Safety Authority-EFSA in particular) are working to enforce the food safety standards and consider it necessary that:

- food safety standards have to be based on scientific data only;
- if food safety standards for food products from arable agriculture differ from international standards, they must be scientifically justified.

Food waste is a major issue in modern times from several points of view. First of all, from an ethical point of view, as better management and distribution of food resources could be beneficial to society's least privileged. Secondly, from an economic point of view, as food waste implies a considerable loss of money. And thirdly, from an environmental perspective, as decomposition of organic material is a major contributor to greenhouse gas (GHG) emissions which cause global warming.

Every process entails a certain margin of error, from production to distribution and consumption. There are several sources of waste all along the process, starting from harvest, where efficiency is never 100% and some of the harvest is lost because it is damaged or not ripe enough. Post-harvest losses then add up to 30% to 70% during storage (where part of the harvest will be lost because of inappropriate storage conditions, e.g. due to mould, rodents, etc.) and during transport from the production, storage or processing site to retail shops, where a certain amount of production is lost because of damage. Eventually food reaches supermarket shelves where, under current marketing practice, a proportion of it is unavoidably thrown away because either it has passed its sell-by date (a problem connected to overstocking of products) or it is overripe or spoiled. Last but not least, at the consumers' end, household food stocks are not optimally managed, resulting in remarkable quantities of food waste (though very difficult to quantify).

Apart from ethical and economic issues, environmental concerns about food waste are attracting increasing attention, as biodegradation of food releases methane, a greenhouse gas (GHG) 20 times more damaging to the environment than carbon dioxide (CO_2) as it adsorbs 23 times as much heat as CO2. Biodegradation in low-oxygen conditions ('anaerobic digestion') produces biogas, a natural gas which is made up of 60% methane and 40% CO_2. If this process takes place in an open landfill, the biogas released makes an extremely negative contribution as a GHG emission, but if it occurs in a controlled manner (such as in a biogas power plant), this form of biogas conversion offers a renewable source of fuel. In this way, organic matter such as food waste could be used to generate energy in an environmentally friendly manner and as an alternative to using fossil fuels for the same purpose.

5. Applications of Traceability

This chapter covers how traceability has been implemented in real businesses and some of the lessons learned. The content is partly based on the work done by *Informal Expert Group on Product Traceability*, which is working under *Directorate General for Health & Consumers* (DG Sanco) who analyses application of EU product traceability legislation by economic operators and how to improve it (Taillard 2011). The report is based on experiences from many traceability projects and introduces the expert knowledge available to avoid the pitfalls in implementing traceability solutions.

5.1 Traceability in practice

5.1.1 Trends in traceability

The ebbits project will implement traceability for food products based on a voluntary exchange of data from producers and processors to the consumer. But as the report (Taillard 2011) describes there are many trends affecting the requirements to a traceability implementation. It identifies the following trends as the most important ones:

- Societal Trends – Increased demand for information and options to share experiences/ knowledge through social media.
- Technology Trends – Many have powerful smart phones with high speed internet access in their pocket that is underutilized.
- Economic Trends – Easier for producers to create brand identity and accessing loyal consumers.
- Environmental Trends – This does also help branding of products for socially responsible companies.
- Political Trends – Increased consumer safety and access to consumers.

All these trends greatly influence traceability, especially in the food industry, as the requirements are high for food safety, socially and environmentally responsible production methods and great pressure on economically efficient procedures.

5.1.2 Traceability pitfalls

Traceability is organising information from a very complex reality. The end-product often contains ingredients from various sources and has been through many production, processing and distribution stages. Figure 2 illustrates the complexity in distribution. Even though a product is sold from manufacturer to retailer, it has often been handled by many actors. In addition food products is often refined and repacked during the steps in the supply chain.

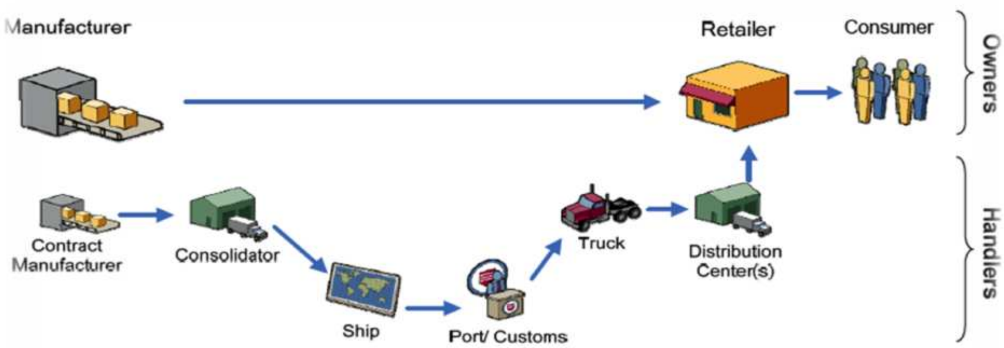

Figure 2: The complex chain of events when distributing products (Taillard 2011).

Because of the complexity there can be many pitfalls on the way to implement traceability. Table 2 shows the most common problems when implementing traceability.

Traceability pitfalls	Consequences
High number of successive operators in the chain (processors, exporters, importers, wholesalers, distributors, …)	Increases the risk to lose track of the product. Increases the security risk where counterfeit's are mixed with genuine products
Mixing products and large size batches in manufacturing	Loss of precision
Manual traceability	Limits in capturing all information, problem of speed to access data and reliability.
Proprietary traceability systems / internal codes for product identification	Loss of traceability when changing of trading partners by changing product identification. No ability for market surveillance and enforcement to rapidly verify product identification (barcode) linkage to branded product.
Counterfeit and fraud	Counterfeited products can carry genuine (duplicated) identification codes. Possibly more at risk where the Brand owner uses non-globally unique and verifiable product identification
Tracing unit	Different stakeholders in the supply chain handle and track different "products" that can be difficult for traceability systems to identify as the same product. Example: Slaughterhouse tracks individual prime cuts while the distributer tracks pallets or packages with many meat cuts.

Table 2: Traceability pitfalls

5.1.3 Existing standards and solutions for food traceability

GS1 is an international not-for-profit association with Member Organisations in over 100 countries. GS1 designs and implements global standards and solutions to improve efficiency and visibility of supply and demand chains globally. GS1 has over 30 years of experience in global standards and is probably best known for standardising barcodes on all retail products used most developed countries.

GS1 has created standards for tracing and Figure 3 illustrates how to identify products based on the traceability needs. From the matrix it is clear that for complete traceability the item needs to be identified with a Serial global trade item number (SGTIN). GS1 controls the SGTIN standard.

Precision of the identification	Shipment	Logistic Units	Trade Item not crossing the point of sale	Trade Item crossing the POS, Consumer unit
Unique (serialized)	Shipment Identification Number (SIN)	SSCC	GTIN + Serial number SGTIN	GTIN + Serial Number SGTIN
Specific (batch)	Not applicable	Not applicable	GTIN + Batch / Lot Number	GTIN + Batch / Lot Number
Generic	Not applicable	Not applicable	GTIN	GTIN

Level in the logistical hierarchy

Figure 3: Traceable item matrix

Many standards for traceability have been developed. Examples are ISO 22005 (ISO 2007), GFSI (GFSI 2005), HACCP (HACCP 2005) and PTI[6]. Figure 4 shows the varius standards created for food traceability. They are arranged based on context. Some standards only indicate what to document and other show how to implement.

Figure 4: Standards in food traceability

5.2 Product identification with Electronic Product Code (EPC)

The EPCIS (Electronic Product Code Information Services) specification describes data types for RFID (Radio Frequency Identification) event data. It also specifies interfaces to collect and query them (Grummt 2009). The Electronic Product Code (EPC) is a unique identifier for physical objects.

[6] http://www.producetraceability.org/

The EPC is stored on a RFID tag. The EPCIS specification has been published in 2007 in version 1.0 as part of the EPCglobal Architecture Framework (see Figure 5) by the EPCglobal industry consortium. One example for EPCIS-conform RFID repository implementation, presented in next section, is the SAP Object Event Repository (OER).

An EPCIS Repository stores event data that has been received from several RFID readers through an EPCIS Capture Interface. This data is provided to applications via an EPCIS Query Interface.

Within the EPCglobal Architecture Framework, several other protocols and data types for the transmission of RFID data have been defined. This comprises the communication between RFID Tag and RFID reader as well as aggregating and filtering event data. EPCglobal Core Services, including Subscriber Authentication and EPCIS Discovery are services that are provided to all EPCglobal Network subscribers. Figure 5 shows the EPCglobal Architecture Framework.

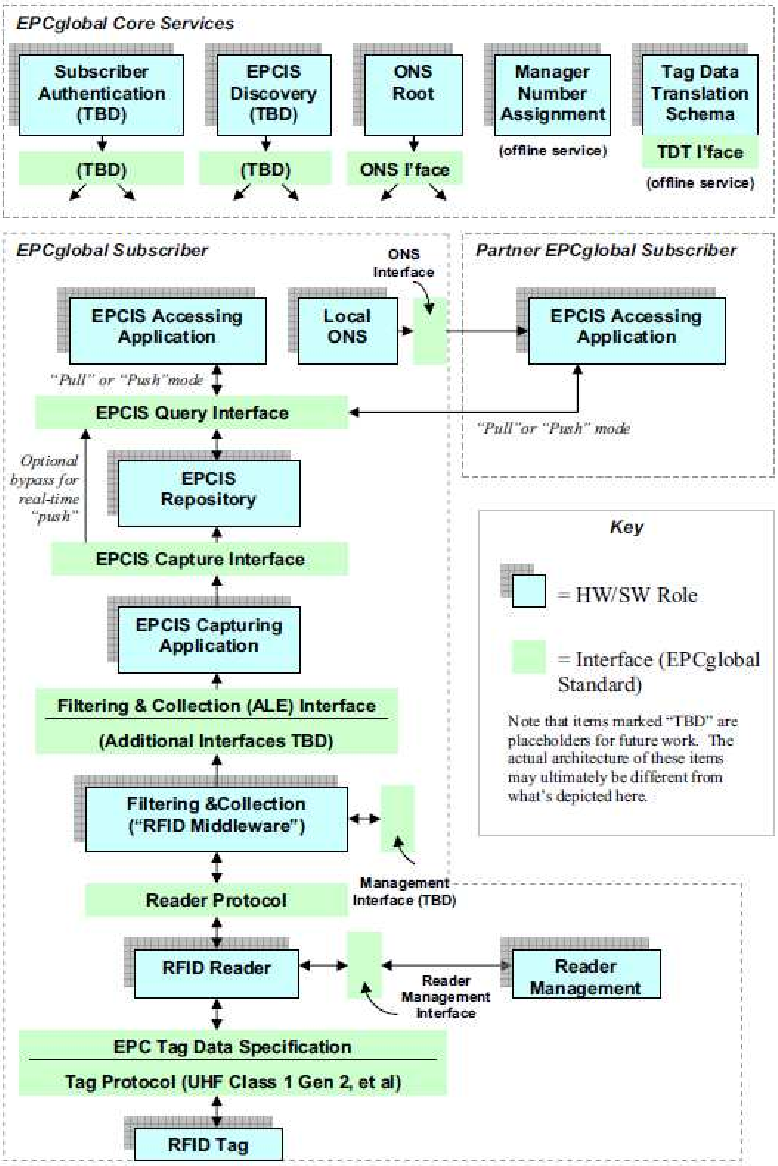

Figure 5: EPCglobal Architecture Framework (Traub et al. 2005)

5.2.1 EPCglobal architecture and relevance to Ebbits

In many ways the EPCglobal architecture resembles the ebbits architecture. Figure 6 illustrates a comparison of the two architectures. It is obvious that the layer functions to some extent reflect each other, which will simplify the integration of EPCglobal into ebbits.

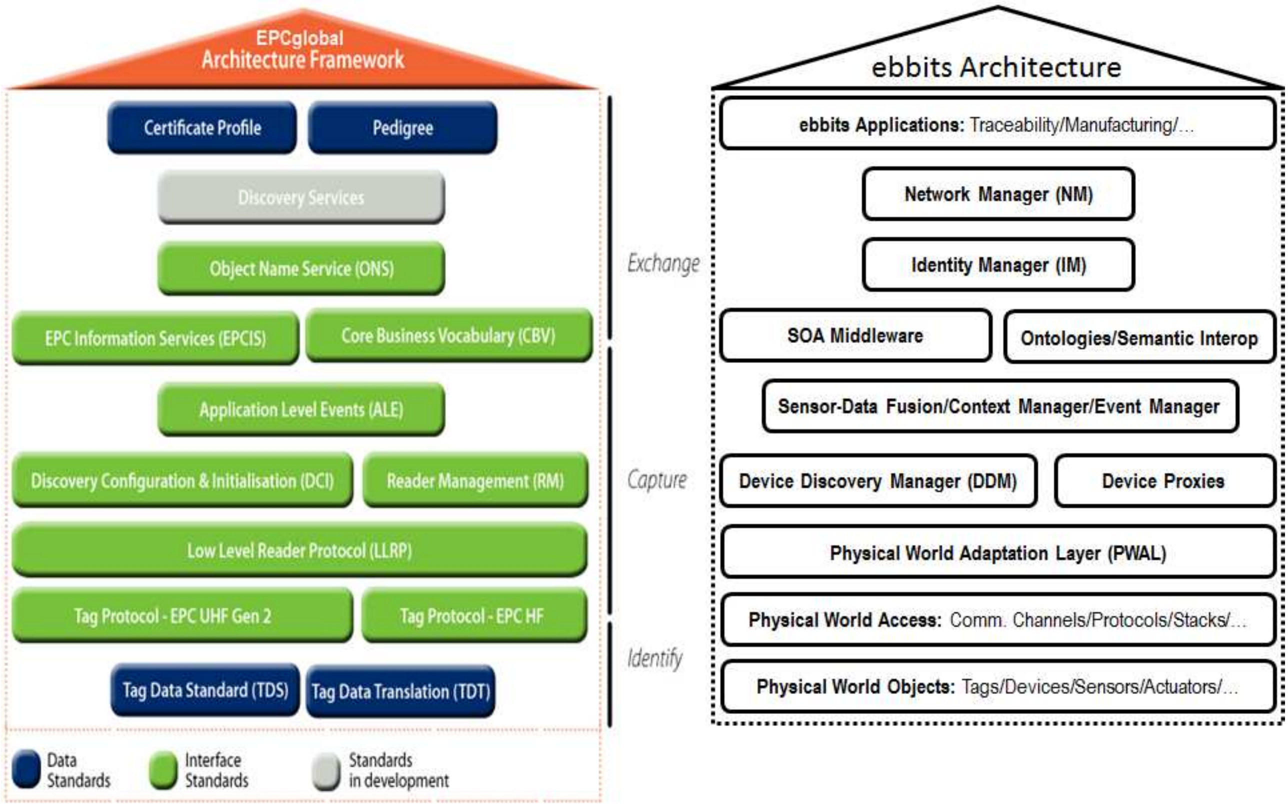

Figure 6: EPCglobal and ebbits architecture comparison

The ebbits architecture closely matches the hierarchical structure of the EPCglobal architecture. At the physical level, the PWAL its access and objects components will support the physical protocols for TDS and TDT in order to access RFID objects. At the device levels, the LinkSmart SOA middleware will handle RFID reader discovery and management as well as the EPC ontologies and vocabularies. At the application exchange level, the ebbits platform will security (certificates) and identity management as well as discovery mechanisms though the Network Manager. This work will be aligned with the development of discovery standards ongoing in the EPC and might lead to valuable input to the standardisation work.

5.2.2 SAP Object Event Repository

SAP Object Event Repository (OER) is an EPCIS conform active repository. It supports tracking the lifecycle of individual identifiable entities. Those entities can be containers, documents, etc. Processing and storing events are the main tasks of the OER. Processing means that new events are generated on the basis of rules. For example, in a cooled supply chain the temperature might rise over a defined threshold. Events can be collected from multiple distributed systems. OER can be used by external systems, including mobile devices, to monitor entities, receive notifications in case of problems, or to analyse the supply chain, e.g. in order to see the flow of products in the supply chain. SAP OER also provides means to adjust the existing (lifecycle-) process. This functionality is shown in Figure 7. Conformity with EPCIS means that:

- events are collected through EPCIS based interfaces, and
- an EPCIS based querying is possible based on a defined query or based on a subscription.

An SAP OER can forward query results from (optionally continuous) queries to external EPCIS systems.

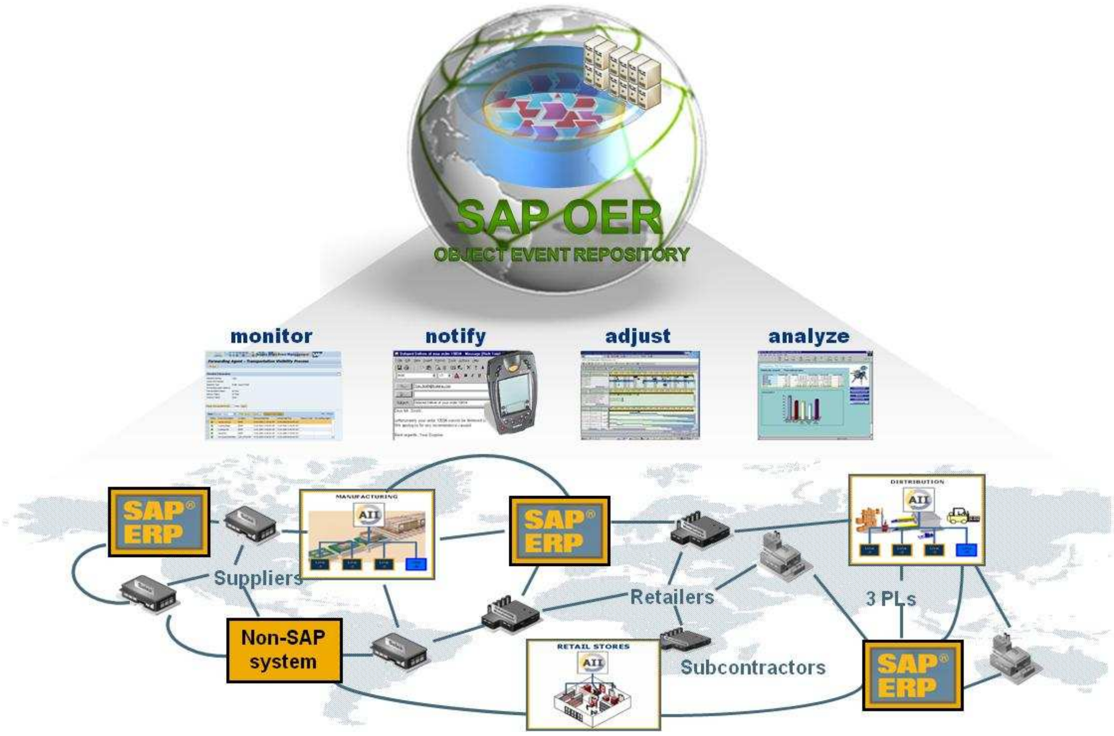

Figure 7: Overview on SAP OER functionality

5.2.3 Examples for EPCIS SAP OER data

To provide some examples for SAP OER data and master data, we selected the following. A master data query could return a vocabulary list containing business locations in different cities, e.g.

```
    <ns3:QueryResults
xmlns:ns2="http://www.unece.org/cefact/namespaces/StandardBusinessDocumentHeader"
xmlns:ns3="urn:epcglobal:epcis-query:xsd:1" xmlns:ns4="urn:epcglobal:epcis:xsd:1"
xmlns:ns5="urn:epcglobal:epcis-masterdata:xsd:1">
      <queryName>SimpleMasterDataQuery</queryName>
      <resultsBody>
        <VocabularyList>
          <Vocabulary type="urn:epcglobal:epcis:vtype:BusinessLocation">
            <VocabularyElementList>
              <VocabularyElement
id="urn:epcglobal:ebbits:loc:4290041.4312345670010.SAP-Stuttgart"/>
              <VocabularyElement
id="urn:epcglobal:ebbits:loc:4290041.4312345670020.SAP-Bremerhaven"/>
              <VocabularyElement
id="urn:epcglobal:ebbits:loc:4290041.4312345670030.SAP-Charleston"/>
[…]
            </VocabularyElementList>
          </Vocabulary>
```

The master data contains also further required vocabulary, such as business steps (packing, transferring, unloading, …) etc. The event data for an event raised when three items have been packed into a container, a so-called aggregation event, could be the following.

```
    <ns3:QueryResults
xmlns:ns2="http://www.unece.org/cefact/namespaces/StandardBusinessDocumentHeader"
xmlns:ns3="urn:epcglobal:epcis-query:xsd:1" xmlns:ns4="urn:epcglobal:epcis:xsd:1"
xmlns:ns5="urn:epcglobal:epcis-masterdata:xsd:1">
      <queryName>SimpleEventQuery</queryName>
      <resultsBody>
        <EventList>
          <AggregationEvent>
            <eventTime>2012-01-18T02:24:51.000+01:00</eventTime>
            <recordTime>2012-01-17T14:12:52.099+01:00</recordTime>
            <eventTimeZoneOffset>+01:00</eventTimeZoneOffset>
            <parentID>urn:epc:id:grai:4290041.00002.357825144158</parentID>
            <childEPCs>
              <epc>urn:epc:id:sgtin:4290041.000001.516811817792</epc>
              <epc>urn:epc:id:sgtin:4290041.000001.215088531791</epc>
              <epc>urn:epc:id:sgtin:4290041.000001.045980017247</epc>
            </childEPCs>
            <action>ADD</action>
            <bizStep>urn:epcglobal:cbv:bizstep:packing</bizStep>
            <readPoint>
              <id>urn:epcglobal:ebbits:loc:4290041.4312345670010.DRE01-PACKING-
AB08</id>
            </readPoint>
            <bizLocation>
              <id>urn:epcglobal:ebbits:loc:4290041.4312345670010.SAP-Dresden</id>
            </bizLocation>
          </AggregationEvent>
[…]
        </EventList>
      </resultsBody>
    </ns3:QueryResults>
```

6. Business Actors and Models

A major challenge in realising the business potential of the ebbits IoPTS is found in the integration of multiple businesses operating in collaborative and ad-hoc environments with dynamic constellations of services and partnerships. In a parallel project task (task T3.5) we will be looking at the relationship between the IoPTS enabled agricultural ecosystem and methodologies for creating value based and process models in order to understand how the business interaction between stakeholders, such as consumers and farmers, consumers and food processors, farmers and slaughterhouses, can be turned into sustainable business cases. In this section we will be looking at the overall framework for sustainable business cases in food traceability.

The goal for the ebbits traceability scenario is to develop and demonstrate sustainable business cases for traceability services in the food production, processing and delivery environment. This will be achieved by extending the current value chain of producers and logistic actors into a value network in which every actor in the network can interact and exchange value objects and where actors can combine their value objects into attractive value packages by forming online and ad-hoc value constellations.

In this environment, an ebbits infrastructure can provide online and offline access to data between the following actors:

- Production data from producers
- Feedback from consumers to producers
- Information sharing between producers

ebbits will also facilitate in aggregating traceability information and processing of all the information gathered.

The stakeholders in the traceability supply chain form a value network where products and information they exchange create value (cf. Figure 1 in section 3.2). To make the exchange of information more effective an ebbits service provider needs to acts as a middle men. The ebbits service provider makes sure the information flows unobstructed between actors and mines valuable information from the data for product/service improvement.

6.1 Business strategies and models

The overall raison d'etre and description of a firm's or organisation way of doing business is described in its business strategy. The business strategy describes the firm's vision, objectives and goals, and the methods and tools it will deploy in order to achieve these goals.

Ideally, the strategy does not describe in detail by which means (products and services) and for whom (customers and target groups) it will achieve its objectives. This information is added at the planning level. A firm separation of strategic and operational goals is the key to successful management of enterprises.

However, the changing business environment and global trends call for regular reality checks and revisions of the strategy. Especially the emerging technological trends in ICT calls for strategy revisions in many product oriented firms. The Hydra project developed a framework for how business models can assist the firm in effective implementation of revised or new strategies with focus on e-Business, by providing a conceptual architecture of the new strategy for subsequent implementation in the firm's business processes (see Figure 8).

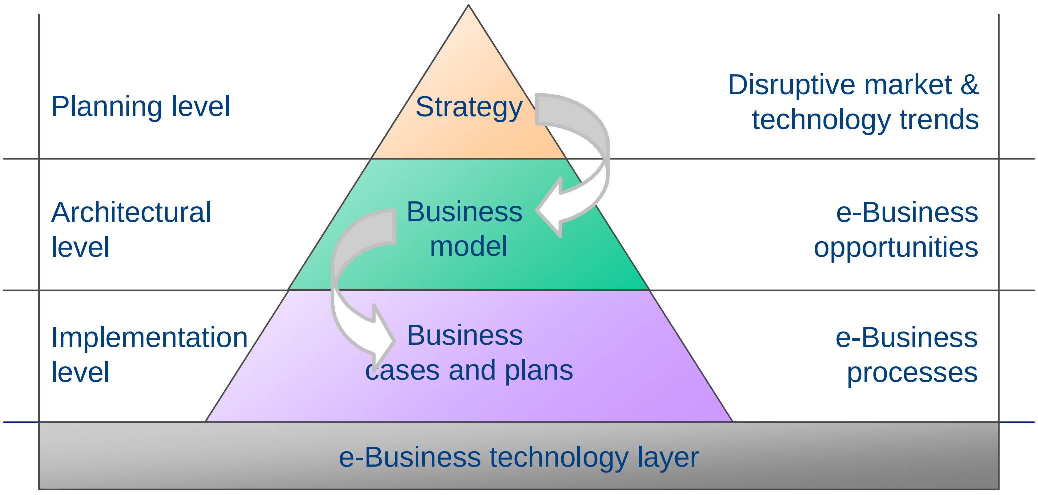

Figure 8: Business model as conceptual architecture (Hydra 2010)

At the strategic planning level, the firm or organisation evaluates overall business opportunities and emerging trends in markets and technologies. With special focus on the emerging trends in disruptive ICT technologies for intercommunication and interoperability, the firm may to wish adjust its strategy accordingly.

Before the strategy can be effectively implemented in the firm's business processes, opportunities and strength needs to be analysed at the architectural level. Value proposition, customer target groups, weaknesses in core elements, such as resources, distribution channels, etc., must be identified and new ways of business interaction must be created and evaluated. This is the role of the business model. The business model allows for visualisation and evaluation of the e-Business opportunity, easy communication among stakeholders and rapid iterations and evaluation of different scenarios. Suitable modelling tools are essential for the successful and effective development of complex business models.

The business model must be instantiated with the most promising combination of value proposition, customer groups, partner networks, etc. into a business cases, whish can be implemented in the business process via a suitable business plan.

The business model can take two very different model approaches: The value model and the process model. ebbits will adopt an ontological perspective on the exploration of innovative service concepts and for quantifying value creation in business modelling (Thestrup 2008) by using a value modelling approach.

As the name indicates, value modelling focuses on value creation; how value is created, by whom and for whom. It is thus foremost a strategic tool with the aim of identifying new business opportunities and how the firm can position itself strategically to derive maximum benefits from new and emerging opportunities which may or may not require substantial redefinition of the enterprise infrastructure.

Our work will therefore focus on analysing the business system and its stakeholders, modelling different potential ecosystems and developing sustainable business cases for important actors. The work will include:

- Identify actors and roles and the value that they create in relation to traceability;
- Develop a suitable framework for business modelling;
- Derive and validate viable business cases for the selected application domains;
- Provide sustainable business models to support deployment of ebbits platforms.

The following section will describe the actors and their roles and identify the various value objects that they can present and demand from the other actors in the value net. This information will be further developed in task T3.5 Eco-systems and business models.

6.2 Actors and roles

6.2.1 The farmer

Producers of high quality beef meat are usually small to mid-size farms. The races used are typically Limousin, Hereford and Angus. A distinctive feature of the meat from these breeds is the marbling and tenderness which brings out flavour when cooked.

The meat quality depends of a variety parameters such as breed, feed and housing conditions for the cattle. With systematic feedback from consumers, the farmer will be able to optimize on production parameters in terms of optimizing the meet quality.

Figure 9: Hereford cattle. A popular breed for beef production

The greatest opportunities, for the farmer, in using ebbits is in getting direct contact with consumer by getting feedback on the products they deliver. They will also have the opportunity to market themselves and create their own brand the consumers will know.

Farmers will need to allow access to a selection of information from their management system, feeding system and other databases they have for their operations. They would probably also have to increase the registration on various information the consumers could be interested in.

The following value objects can be offered by the farmer:

- The animals
- Farm country
- Farm name
- Farmer homepage
- Race (Figure 9)
- Sicknesses and medication
- Time on grass
- Organic
- Picture and map of the farm
- Picture of the animals
- Food given to the animal
- Production forecast
- Age of animals

The following value objects can be demanded by the farmer:

- Rating of product quality from slaughterhouse/distribution/retail
- Meat quality (Fat content and other measures from slaughterhouse)
- Rating from consumers
- Consumer's interest (Number of clicks on the farmer's homepage)
- Forecasts on request for animals
- Recalls of meat

6.2.2 The slaughterhouse

The slaughterhouse is the central actor in the supply chain as they have the contact with the farmer, retail stores and distribution. They usually brand the products and provide marketing materials.

With CEN they have access to even more detailed consumer data which will allow them to price differentiate the animals on more parameters than now which will increase the value of the meat in the long term.

The ebbits infrastructure could help them exchange information with the farmer. Now they farmer informs the slaughterhouse about which animal he needs to send to slaughterhouse and when they have been slaughtered the farmer gets a report on the meat quality. This information exchange could easily be made more effective with ebbits. The ebbits infrastructure could also allow a closer relationship as the slaughterhouse could continuously see what animals are being raised at the farmers and more effectively send requests for animals to come to slaughter when there is low supply for specific types.

Most slaughterhouse need to make significant changes to their processes to enable full traceability. Highly automated slaughterhouses usually could enable traceability but use only batch ID because the return of investment is too long or negative. They do however only look into the added value when meat is recalled and to not consider added value to consumers and other stakeholders.

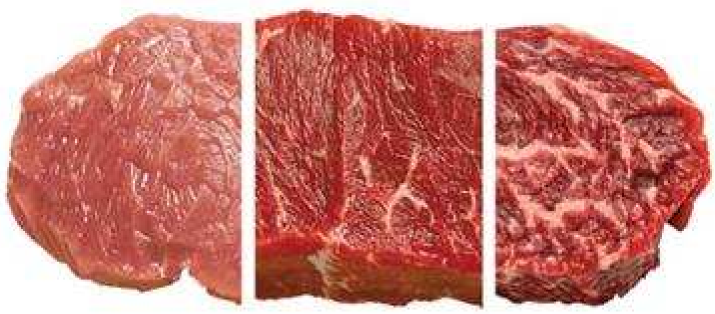

Figure 10: Marbling (amount of intramuscular fat) is an important parameter of beef.

The following value objects can be offered by the slaughterhouse:

- Meat quality (Fat content and other measures from slaughterhouse) (Figure 10)
- The cuttings from the animal (meat)
- Request for animals forecasts
- Slaughtering date
- Aging time

The following value objects can be demanded by the slaughterhouse:

- Rating of product quality from distribution/retail
- Rating from consumers
- Requests/demands on specific cuttings
- Production forecast from farmer
- Forecast on request for products from distributor/retail
- Age on animals
- Recall of meat
- Rating of product quality from retail
- Rating from consumers

6.2.3 The distribution chain

The distribution of food and other retail products is a rather complicated operation. A product is usually handled by many logistics companies and stored in warehouses/warehouse coolers for periods of time. The use of EPC (Electronic Product Code) system is common. EPC allows products to be uniquely identified and most management systems work with EPC identifiers and GLN (Global Location Number) to track packages.

Those companies using EPC standard can easily supply relevant traceability information with little effort.

The following value objects can be offered by the distribution chain:

- Storage information (storage temperature/period)
- Available products on storage
- Products forecast
- Recall of meat

The following value objects can be demanded by the distribution chain:

- Request for new products
- Forecasts on request for products from retail
- Rating of product quality from retail
- Rating from consumers
- Requests/demands on specific cuttings
- Recall of meat

6.2.4 The retailers

The retailers are the stakeholder in contact with the consumer. Retail stores selling high end beef usually have good contact with their customers who require quality at a reasonable price.

Retailers get the possibility to price differentiate the meat based on rating. This will give happier costumers as they know they pay for what they get.

To implement traceability the butcher preparing the meat for the retail store needs redesign the process so that the ID from every prime cut is retained to the consumer packaging. This could mean that ID scanners and label printers need to be used to print the final labelling on the package. They would also need to register all relevant information about the meat to a database which can be accessed by ebbits.

The following value objects can be offered by the retailers:

- Best before date
- Additives
- Recipes (maybe it comes from the service provider)
- Request for new products
- Forecast on request for products
- Rating from consumers
- Requests/demands on specific cuttings
- The different cuttings from the animal (minced meat, sirloin, culottes, etc.)
- Recall of meat

The following value objects can be demanded by the retailers:

- Storage information from distribution(storage temperature/period)
- Available products on storage from distributor
- Request for products from consumer
- Rating of product quality from consumer
- Rating on the retail company from consumers
- Requests/demands on specific cuttings from consumer
- Recall of meat

6.2.5 The ebbits service provider

The ebbits service provider runs the network which binds all other stakeholders together. The service provider will maintain databases with all information about the products and ratings from user. Although producers who provide information to the databases would have access to this information there are others who would be willing to buy this valuable information.

There is also potential for selling advertisements in the application or selling advertisement free version of the application.

The following value objects can be offered by the service provider:

- All the received data + below:
- Homepages of the Farms (perhaps also all the actors: Slaughterhouse/Distributor/Retail/etc.)
- Recipes
- Rating of product quality from other consumer
- Summary of the all the consumers satisfactory with the products
- Rating on the retail company from consumers
- Any earlier rating of the selected meat from the same consumer (if the consumer may have tried the same type of meat before)
- Other retail company where you can by the same meat

The following value objects can be demanded by the retailers:

- Request for new products
- Rating of the meat
- Rating of the retail store
- Recall of meat
- Suggestion of new functionalities to the apps
- Best before date
- Additives
- Recipes (maybe it comes from service provider)
- Request for new products
- Requests/demands on specific cuttings
- Storage information (storage temperature/period)
- Available products on storage
- Meat quality (Fat content and other measures from slaughterhouse)
- Slaughtering date
- Aging time
- Farm country
- Farm name
- Farmer homepage data
- Race
- Sicknesses and medication
- Time on grass
- Organic
- Picture and map of the farm
- Picture of the animal
- Food given to the animal
- Age of animal
- Storage of meat confirmed ok in the complete chain
- Selection of how much information the consumer wants from the apps

6.2.6 The consumers

The consumer gets added value to his purchase by getting history with the product he is buying. This is becoming more valuable as the awareness of the consumers increases; they are getting more interested in locally produced food, that the animals are treated properly by the local farmer and not in some industry production. Consumers also are more comfortable with traceable products as that increases food safety.

From the application they also get history of the products they have bought with their own rating and can also get recommendations based on previous purchases and ratings from others.

The following value objects can be offered by the consumer:

- Request for new products

- Rating of product quality/satisfactory with the product
- Rating of the retail store
- Recall of meat
- Suggestion of new functionalities to the apps
- Selection of how much information the consumer wants from the apps

The following value objects can be demanded by the consumers:

- Best before date
- Additives
- Recipes
- Farm country
- Farm name
- Picture and map of the farm
- Picture of the animal
- Farm properties (any special information of the farm, i.e. Specialities)
- Race of the product
- The different cuttings from the animal (minced meat, sirloin, culottes, etc.)
- Farmers homepage
- Sicknesses and medication
- Time on grass
- Organic
- Food given to the animal
- Age of animals
- Storage confirmed ok
- Rating of product quality/satisfactory with the products from other consumers
- Rating on the retail company from other consumers
- Any earlier rating of the selected meat from the same consumer (if the consumer may have tried the same type of meat before)

6.2.7 Authorities

This set of stakeholder represents various official authorities like government, food safety agencies, producer organizations, health agencies, consumer protection agencies, environmental certification bodies and other. They usually represent and defend interests of a group. They often are an important source if data and could gain from improved traceability and more direct contact with other actors. These organisations often have their access to production data protected by regulations.

The following value objects can be offered by authorities:

- Recall of meat
- Selection of what information is required to be shown to the consumers.
- Request for new products
- Forecast on request for products
- Nutrition information
- Environmental expenses of different products

The following value objects can be demanded by authorities:

- Request for new products
- Rating of the meat
- Rating of the retail store
- Recall of meat
- Suggestion of new functionalities to the apps
- Best before date
- Additives
- Recipes (maybe it comes from service provider)
- Request for new products
- Requests/demands on specific cuttings

- Storage information (storage temperature/period)
- Available products on storage
- Meat quality (Fat content and other measures from slaughterhouse)
- Slaughtering date
- Aging time
- Farm country
- Farm name
- Farmer homepage data
- Race
- Sicknesses and medication
- Time on grass
- Organic
- Picture and map of the farm
- Picture of the animal
- Food given to the animal
- Age of animal
- Storage of meat confirmed ok in the complete chain

6.3 Actor interaction and information exchange diagram

The above descriptions of actors, describes possible value added information exchanges the ebbits system could facilitate. Figure 11 summarises the information flow.

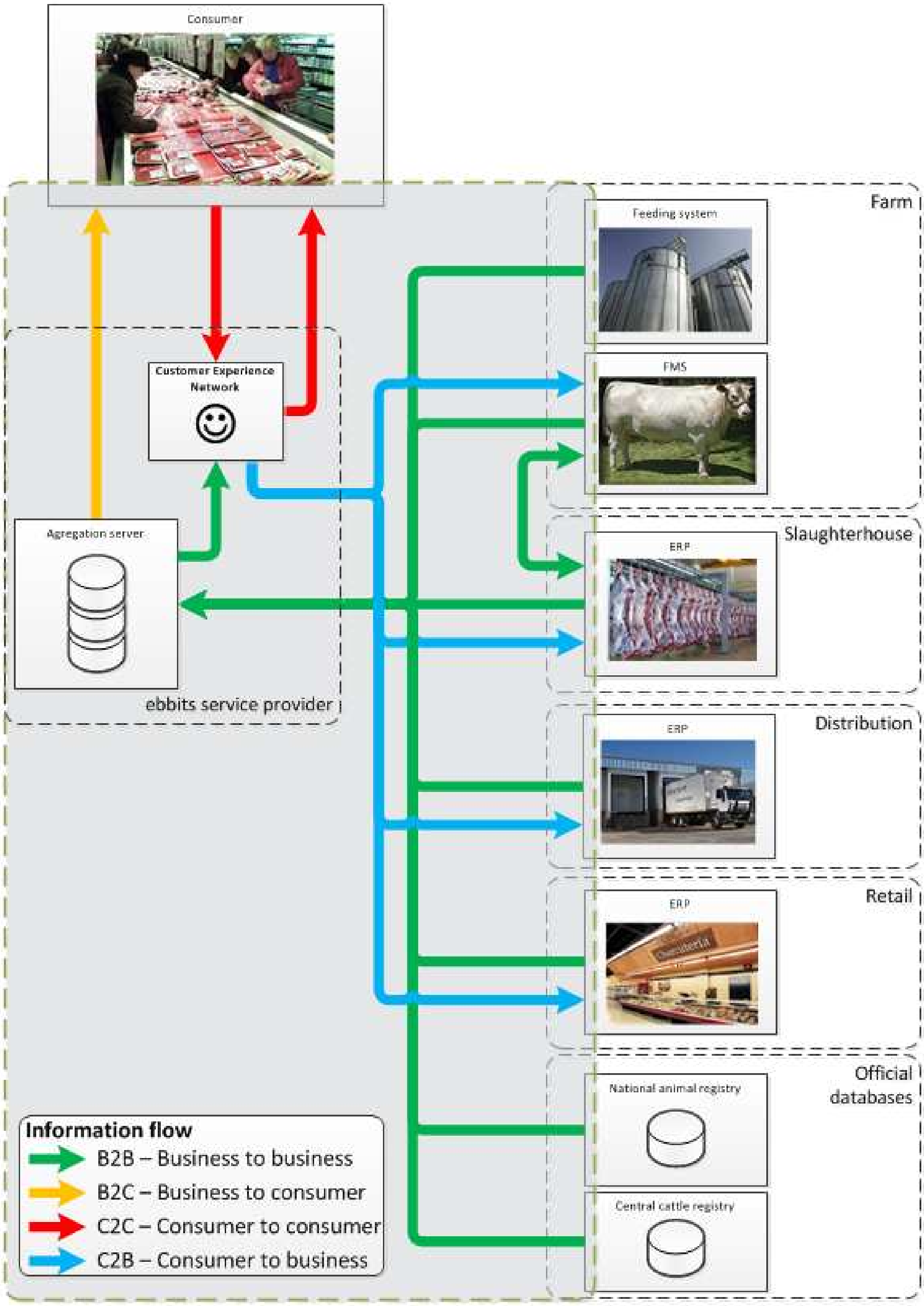

Figure 11: Information exchange diagram for traceability

6.4 Updated business vocabularies

The initial set of horizontal cross-domain vocabulary was examined and presented in the deliverable D3.2. The aim of this section is to update initial vocabulary, according to identification of the terms used in business environment in agricultural domain. At the same time, the relevancy to second, manufacturing, domain was examined and tagged. Identified domain specific and initial business related terms, which describe business framework in agricultural domain, will be extension of the first horizontal vocabulary located on wiki.

Terms	Description and notes	Relevancy to Manufacturing domain
Additives	Substances added in small amounts to something else to improve, strengthen, or otherwise alter it.	
Age of animals	The length of time that animal has existed; duration of life.	
Aging	Growing old of organisms; for products use.	
Angus	Black hornless breed from Scotland.	
Animal	Any living organism characterized by voluntary movement, the possession of cells with no cellulose cell walls and specialized sense organs enabling rapid response to stimuli, and the ingestion of complex organic substances such as plants and other animals	
Beef	A full-grown steer, bull, ox, or cow, especially one intended for use as meat. The flesh of a slaughtered full-grown steer, bull, ox, or cow.	
Carcass	The dead body of an animal, especially one slaughtered for food.	
Consumer	A person that consumes, especially one that acquires goods or services for direct use or ownership rather than for resale or use in production and manufacturing.	X
Cutting	Capable of or designed for incising, shearing, or severing.	
Distributor	A wholesaler or middleman engaged in the distribution of a category of goods, esp. to retailers in a specific area.	X
Farm	A tract of land devoted to the raising and breeding of domestic animals. A tract of land cultivated for the purpose of agricultural production.	
Farmer	A person who operates or manages a farm.	
Food given to animals	Any substance containing nutrients, such as carbohydrates, proteins, and fats that can be ingested by a living organism and metabolized into energy and body tissue.	
Hereford	A hardy breed of beef cattle characterized by a red body, red and white head, and white markings.	
Limousin	Breed of fairly large yellowish-to-reddish-gold beef cattle originally from France.	
Meat	The edible flesh of animals, especially that of mammals as opposed to that of fish or poultry.	
Medication	The act or process of treating with medicine. A	

	medicine; a medicament.	
Order	A commission or instruction to buy, sell, or supply something.	X
Organic	Of, relating to, derived from, or characteristic of living plants and animals. Of, marked by, or involving the use of fertilizers or pesticides that are strictly of animal or vegetable origin	
Packaging	The box or wrapping in which a product is offered for sale.	
Price	The amount as of money or goods, asked for or given in exchange for something else.	
Races	Distinct genetically divergent populations within the same species with relatively small morphological and genetic differences.	
Rating	A classification according to order or grade; ranking.	
Request	To express a desire for; something asked for.	X
Retail	The sale of goods or commodities in small quantities directly to consumers.	
Selling	To exchange or deliver for money or its equivalent.	X
Sickness	The condition of being sick; illness; A disease.	
Slaughterhouse	A place where animals are butchered for food; abattoir.	
Storage information	Information gathered from the storage e.g. temperature, period, etc.	

Table 3: Extended business vocabulary in agricultural domain

Note: This is a living, rolling list, which will be extended to previous (on ebbits wiki page) and continuously updated during the project.

7. Traceability Use Case

In previous deliverables, like *Deliverable 2.1 – Scenarios for usage of the ebbits platform,* the focus has been on pork production as that is the biggest meat producing industry in Denmark. After analysing the state of traceability in Denmark, where the traceability solution will be tested, it is clear that the beef production is much more suitable as a starting place for implementing traceability projects. There are a few reasons for beef being more suitable than pork.

1. Beef varies more in taste, quality and consumer preference.
2. Beef production is not as automated as pork production - it is easier to change processes.
3. High-end beef shares characteristics with wine when it comes to price differentiation, preferences and consumer experience.
4. Traceability has been partially implemented for beef so a considerable amount of data is available and accessible.

This chapter will describe a solution to the traceability scenario with the use of ebbits. The solution is based on a centralized service that aggregates all traceability information from the producers. Traceability information is then available in applications running on consumers' smart phones, smart refrigerators or any other computer device. Initially a solution for smart phones will be created. So the consumer can with the mobile app scan the labeled meat in the retail store.

7.1 Introduction to specific use case

Danish Crown, which is among the largest suppliers of meat in the world, has a division handling high quality meat coming from beef cattle. They have developed processes that keep the animal ID all the way through processing to the consumer package. Every package has a printed label with an ID of the animal the meat originated from, which allows the consumer to look up details on the meat on a webpage the slaughterhouse runs[7].

Friland[8] is a Danish meat producer that focuses on organic and branded meat. They are a part of Danish Crown Group which is Europe's largest slaughtering and processing company and one of three largest exporters of pork.

Since 2007 has Friland worked on improving the traceability of their branded beef products and have a working homepage that consumers can trace the meat they have bought. The information provided is stored in slaughterhouse databases and is mostly static information about the farmer and some of the quality metrics that the slaughterhouse uses to rate their meat.

The traceability is now available for branded beef from beef cattle. The market for gourmet beef was the ideal place for them to start as consumers are willing to pay for extra quality and the market resembles the market for wine where there is a culture for reviews, recommendations and huge price differentiation for brands, years and locations. Gourmet beef is also the only meat product that can support the price for this extra service.

The value of traceability for Friland is in getting the consumer more history with the product he is buying. Providing traceability for them also signals that they are serious and professional producer that cares and has control on their products.

[7] http://www.sporditkod.dk/– example code: 3636400791
[8] http://www.friland.dk/page2273.asp

7.2 Use case 1: Danish Crown / Friland

Data is available from various sources, but in this use case they are mainly created by the farmer who registers their cattle along with feeding and health information in the Danish cattle database (Kvægdatabasen).

Danish Crown then collects livestock data through the Danish cattle database. These data are expanded with Danish Crowns own data, which are created during the processing of the livestock, e.g. muscular structure, fat per cent, meat colour, cut type/ form etc.

The meat is now distributed to retailers who also might process the meat further; and thereby adding additional information to the meat. This information would link a former piece of meat to new cuttings. The retailer labels the meat with Friland's label and is now ready to be scanned/read by a consumer.

The consumer can now walk into a retailer with Friland's products and enter a code from the label into a website or to scan it with a mobile device. Detailed data about the product is shown, the meat can now be rated, which in turn will benefit every stakeholder including the consumer. Recipes will be suggested based on the meat scanned which will provide additional value to the consumer.

The table below illustrates the amount of data available; current (column to the left) and with ebbits (some in the future, some already now).

Metric Name	Available on sporditkod.dk	Available with ebbits
Farm Country	X	x
Farm Name	X	x
Race	X	x
Sicknesses		x
Time On Grass		x
Organic		x
Slaughterhouse Country	X	x
Slaughter date	X	x
Age when slaughtered	X	x
Aging time		x
Recipes		x
Fat contents		x
Additives (*)		x
Cold Chain broken		x
CO_2 footprint		x

Table 4: Comparison on what is available now and what could be available in ebbits.

7.3 Use case 2: Smart phone application

A smart phone application will be implemented. The aim of the application will be to provide consumers with the benefits of product traceability. Details about the producer and the product will be available to the consumer as will secondary data such as recommended usage and recipes. Of equal importance will be the consumers' ability to rate the experience of the product through a rating system.

The purpose of the smart phone application will be dual. Firstly it will bring a case of foodstuff traceability to the consumers. Secondly it will induce feedback back into the delivery chain. The feedback will be provided by the consumers when they rate their experience with the products. This in time will help the stakeholders to optimize their product in various ways.

When a consumer rates a specific product, the information can be leveraged by the stakeholders in the production of that specific product item.

The producer of the original beef cattle livestock will be able to see how well his product was received by the end user. And with enough rating feedback he might also be able to deduce which parameters to adjust to make the best possible product.

Processors will be able to see which product types are well received and in demand and which product types could be on the rise and vice versa. This information could in turn be used in a feedback loop to the producers to ensure that the products are related in the best possible way to consumer demands.

For the consumer there is the obvious benefit of being able to trace your meat and learn a lot more details about it, ensuring that the consumer will be able to make an informed decision about their purchase. But there will also be the added benefit of having access to recipes and the rating of the same type of product from other consumers.

The feedback and benefits are illustrated in Figure 11. The red arrows illustrates the consumer rating the product, which in turn benefits the consumer himself and other consumers who will be able to choose products based on the ratings of other consumers.

The blue arrows indicate how other stakeholders will be able to benefit from the consumer feedback.

8. Technologies and Metrics for the Usage Scenarios

8.1 Information and communication technologies (ICT) in agriculture

In the past 10-15 years, the use of innovative ICT technologies has seen a rapid increase throughout mainstream Europe in almost every area of agricultural production and distribution. In the industry of farm automation extensive consolidation has taken place, resulting in fewer but much larger companies with more powerful R&D departments. This has encouraged a technical evolution towards standard TCP/IP communication on all farm equipment and standardised data definitions, which allow exchange of data between equipment from different vendors (feeding systems, ventilation systems, management systems, etc.). This means that the technological platform in state-of-the-art farm environment is at a level that allows for the necessary data interchange required in a full traceability model upstream and downstream.

ICT is one of the major technologies driving changes in both consumer demand and supply chain organisation. ICT allows the transformation of the food economy from an economy based on the production of physical goods to an economy based on the production and application of knowledge. Value added is created by making smarter use of natural and other resources. This imposes a strong pressure on true innovation in short cycles, which in turn requires a continuous interaction between analytical science (creating new insight), applied research and development (creating new products and processes) and industrial applications.

Information technology plays an important role in increasing transparency, but also in supporting production. New ICT applications are implemented in order to meet changes in consumer demand, sustainability requirements, international competition, logistics and product sourcing.

The ICT support in the domain is two-folded, as it is applicable "within" and "outside" the farm. In the first option the technology is installed or applied into the inner world of the farm or the livestock breeding. It means deploying a technical and organisational infrastructure for the management, control, help and advisory functions and activities throughout the farm business, aiming at information accessibility and elaboration at all places in the organisation through connectivity and interoperability.

After the original product has been realised inside the farm, the technological developments (ICT, processing and transport) make it possible to transform and commercialise it reaching suppliers and customers all over the world. Companies in the food industry are acting more and more on a global scale. This is reflected by company size, increasing cross border flows of livestock and food products, and international cooperation and partnerships. Food supply chain networks develop into open networks sharing information and offering many opportunities for generating added value. Food supply chain networks slowly become a part of the knowledge economy.

The spread of computer technology brought an increased number of agricultural practices that may be remotely controlled and monitored by computer-assisted methods. Although this provides cheap products to consumers, it raises questions regarding the quality, integrity and safety of the food.

The production, processing and distribution of agricultural products and food are generally accepted as routine parts of everyday life, and the (increasing) interest of the agriculture world towards ICT moves step by step. Food and agriculture are means to an end that is not only technical, economic or political in nature but also inherently ethical, namely to feed the world's population while respecting future generations' needs and expectations in terms of food security, safety and sustainability. Moreover there are a few bottlenecks in the knowledge economy:

- new technology is initially used by early adopters, while ease of use is not always the major feature in innovation;
- companies collect many data most of which are not used at all;
- companies are not ready to process all data available.

Managers, employees and the models they work with are not fully prepared for the knowledge economy as yet. ICT and the knowledge economy are about two issues: technologies and people. The most important challenge the food economy faces is getting the people ready for the new era.

8.2 Sustainability of agricultural technologies

The need to maintain productive agriculture worldwide is emphasised by the fact that a large proportion of the world population lacks proper access to food and by the recurrent food crisis in 2007 and early 2008. However, the strong ecological impact of agriculture highlights the need to implement a different model of agriculture in the future: a sustainable and multi-functional agriculture where, apart from securing safe food for everybody, stewardship of the land, preservation of the resource base, the health of farm workers, preservation of the small biota that are rich in biodiversity, the value of rural communities and the value of the agricultural landscape acquire important status.

From an ethical perspective, sustainable agricultural technologies should help to maximise use of natural resources while protecting them from exhaustion and thereby allowing natural regeneration. In order to achieve this:

(1) there is a need to optimise processes involved in primary production, distribution and storage of food;

(2) use of arable land needs to be optimised and methods are needed to turn areas not accessible at present, due to adverse environmental conditions, into arable land;

(3) all other processes involved, 'from farm to fork', need to be optimised and simplified (to reduce harvest losses and waste and, where possible, to implement waste recycling systems).

8.3 Metrics of the usage scenarios

Data Hierarchy

The data hierarchy is flat for the traceability scenario. Most actors gather information in central systems which could be accessed from ebbits. The ownership of the data primarily belongs to the actor who creates the information, although some information can be considered in public domain. Examples of public domain information is Best-before-dates, farm country, slaughterhouse country and other information the producers are required to provide to consumers.

Figure 12 illustrates the sources of traceability information. The hierarchy is flat because the data is accumulated in databases at the producer. The producers perform the linking of information to the animal ID. The animal ID can be used to identify information at all the stakeholders except when the meat is distributed. Packages are identified with EPC identification and the mapping of EPC IDs to animal IDs is created in the slaughterhouse.

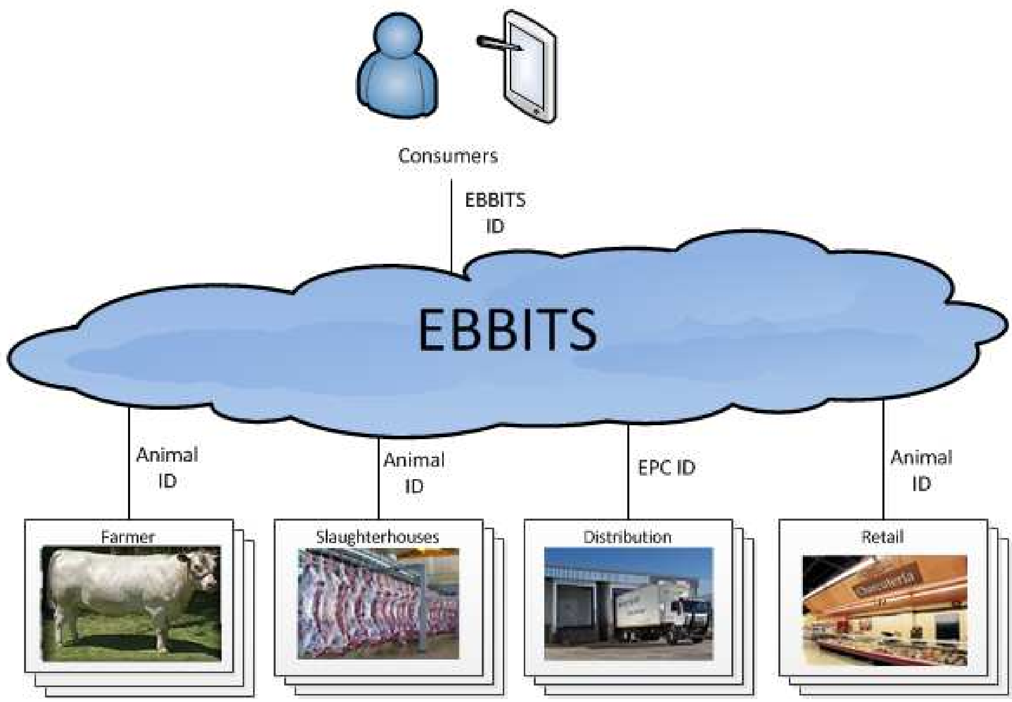

Figure 12: Data Hierarchy for traceability.

Data models (data dictionary)

Traceability information is stored at many stakeholders in the system. Standardised methods for storing this information are required. Table 5 shows units, precision, sources and examples for the traceability information. There is also a column indicating the availability of the data.

Metric Name	Unit	Precision	Source	Example	Availability
Farm Country	String	80 letters	Farm	Denmark	Available
Farm Name	String	80 letters	Farm	Frihedslund	Available
Race	String	80 letters	Farm	Angus	Available
Sicknesses	Count		Farm	Number of medical treatments	Need access to FMS
Time On Grass	%	1%	Farm	55%	Not registered, could be registered in FMS
Organic	BOOL		Farm	True	Available
Slaughterhouse Country	String	80 letters	Slaughterhouse	"Germany"	Available
Slaughter date	Date	Day	Slaughterhouse	30-11-2011	Available
Age when slaughtered	Months	1 Month	Slaughterhouse	22	Available
Aging time	Days	1 Day	Slaughterhouse	16	Not available,
Recipes	Hyperlink	256 letters	Slaughterhouse	https://recipies. slaugherhouse.com /#rec=132452432	Available but needs to be linked with meat.
Fat contents	%	0.1%	Retail	3.4%	
Additives (*)			Retail		
Cold Chain broken	BOOL		ALL	FALSE	Needs RFID chips with temperature sensors
CO2 footprint	Kg of CO2	1 Kg	ALL	3.4	Could possibly be estimated from available information.

Table 5: Metadata for relevant traceability information. (*) Metadata has not been decided.

8.4 Technology impact assessment and the European Group on Ethics (EGE)

In the field of new agricultural technologies, in addition to risk assessment, there is a need for impact assessment at national and European levels. Impact assessments examine the risks and benefits to human health and the environment of using a new technology and those of not using it, including the risks and benefits of retaining current technologies. They take account of the need to ensure sustainability, food and feed security and safety.

Such impact assessments should consider safety (agro-food and environmental) issues and also address the social implications, e.g. how agricultural technologies will affect social, economic and institutional structures, with particular concern for justice (equal access and participation in decision making) and fair distribution of goods. Furthermore, the research should also examine the risk of creating a technological divide which could widen the gap between the developed and developing countries.

The EGE[9] (in science and new technologies) is aware of the great variety in primary production methods for agricultural products of plant origin and of the fact that several regions in the EU still use traditional methods of agricultural production. The group recognises the need to respect the diversity of EU primary production, but is equally aware of the need to make EU primary production of food, feed and fibre of plant origin competitive on the global market and, therefore, of the need for innovation in this sector.

The group supports the current efforts by the EU to promote innovation in agriculture but calls for specific efforts to support mainly technologies that are conducive to food security, safety and sustainability in order to ensure ecologically and socially sound agricultural production (techniques and methods), based on fair treatment both of the environment and of farmers.

The EGE also recognises that agriculture brings both benefits and harm, particularly to the environment, and that all technologies could involve risks with irreversible effects. The group therefore believes that, before a technology is considered for use in agriculture, its effects should be carefully studied and evaluated by means of an impact assessment that takes account of a comparative assessment of the current and new technologies. This assessment should be guided by an integrated approach to agriculture where both environmental and social implications are taken into account.

The group is aware that a number of products currently used in agriculture could pose a risk to human or animal health and to the environment, especially when used in high concentrations. Technologies that reduce the need for dangerous chemicals whilst maintaining yield and quality should be promoted. In particular, protection of human and animal health by lower exposure to chemicals should be encouraged. As mentioned previously, the group urges that an impact assessment should be conducted for all new technologies used in agriculture in the light of the goals of this opinion, giving priority to food security, safety and sustainability.

The group is aware that soil erosion and water pollution are consequences of agriculture and therefore stresses the importance of the non-tillage techniques and improved water management plans developed over the last few decades in order to implement better preservation practices, in keeping with its recommendation on an integrated approach to agriculture. The group encourages use of all technologies and methods to increase soil productivity prevent soil erosion (deterioration of soil quality) and water pollution and promote recycling of waste material (e.g. cellulose biomass for production of ethanol). In this context, the group supports the use of:

(1) proven techniques (such as contour farming and non-tillage techniques), where appropriate for sustainable use of soil;

(2) bioengineering for the sustainability purposes indicated above (e.g. reduction of spray pollution, active ingredients in herbicides and CO2 emissions);

(3) modern genetics, where appropriate and safe in order to improve and select crop varieties appropriate to specific environmental conditions (e.g. in the case of MAS for plant tolerance to high salinity);

(4) ICT tools for optimisation of agricultural plant products (global positioning system and geographical information system or ICT tools to optimise irrigation and monitor physical characteristics of soil, such as topography, salinity, etc.);

(5) all technologies and methods that could be beneficial to better water management and prevention of water pollution. The EU should allocate funding for the implementation of optimal use of water resources.

The group supports precision farming in the EU and developing countries, where its advantages over conventional farming could be greater, and international initiatives such as UNESCO's International Hydrological Programme (IHP) for water research, water resources management, education and capacity-building, which aim to assess the sustainable development of vulnerable water resources and to serve as a platform for increasing awareness of global water issues.

[9] http://ec.europa.eu/bepa/european-group-ethics/index_en.htm

The EGE group encourages the EU to increase the budget for research in agricultural sciences, green biotechnologies and all other sustainability-oriented agriculture research sectors within the seventh EU framework programme for research activities (FP7) in order to achieve the goals supported by the group in this opinion. At the same time, the group believes that Europe should ensure the highest standards of knowledge in these fields (including food safety, food technology, nutrition science, etc.), so that it can monitor introduction of these new products for public consumption. Research in these areas should be encouraged both at European and Member State levels for the benefit of European consumers and farmers.

Modern agricultural research should choose an integrated approach; accordingly, the overall aim of agro system research, including the interaction between different crops and the environment (plant sociology), landscape ecology, etc., should be to achieve an optimum net harvest of solar energy in forms beneficial to mankind and the environment.

9. Conclusion

The purpose of this deliverable was to document the work in task T3.2 Food traceability, i.e. the analysis of the business framework and the development a usage scenario and metrics for an ebbits IoPTS application for enhanced food traceability along the life-cycle of the food.

Standards and experiences from other traceability projects where discussed in chapter 4. Report from *Informal Expert Group on Product Traceability* was the source of lot of quality information. The EPC standard, EPCIS and EPCglobal architecture where also briefly explained. More technical analysis will be performed in the relevant technical work package deliverables

Analysis of the business framework was done in chapter 6 where the actors were defined and their value objects identified. This is the fundament for *D3.7 – Sustainable business models for actors in selected industries*.

Two usage scenarios were presented in chapter 7. The first was an already existing traceability project, implemented in Denmark. The second was a general traceability use case based on smart phones and extends the value network of the actors even further. This use case will ebbits elaborate further and is described in more detail in *D2.5.2 – Prototype Application Specification 2.*

Metadata for the traceability information was defined in chapter 8. This will provide the fundament for processing traceability inside ebbits.

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11. Figures and Tables

11.1 Figures

11.2 Tables