**Executive Summary:**

Transparency in the food sector and especially towards consumers is one of the priority issues on the agenda of consumer policy and consumer representatives. Food scandals and deficiencies in consumer communication have raised consumers' requests for being informed. The requests for improved transparency are also due to increasing interests of consumers and policy in food that is not only safe and of the quality they expect but that matches evolving expectations that food production is based on processes that limit negative impacts on the environment and consider social concerns.

Transparency itself is a fuzzy domain which very much depends on the perception of people, their background, cultural environment, situation, and expectations. One of the challenges in the sector is to reach a level which can be accepted by a majority of stakeholders as sufficient.

The project was aimed at dealing with such issues and to identify research activities and needs for initiatives that could contribute to reaching an understanding on:

a) what could be considered as present or future best practice in transparency and
b) what are knowledge deficiencies that limit developments towards this status and required research to overcome.

Through collaborative efforts by leading experts from 11 Universities and Research Institutes covering a wide range of research disciplines, the project has captured the present state-of-the-art and deficiencies that required research activities in a number of extensive reports. The analysis involved the review of literature, projects, experiences, and communication with stakeholders through surveys and workshops. A specific initiative involved the analysis of best practice examples which demonstrate proven working levels of transparency.

Within the project, an unusual intensive communication between partners but especially the communication with expert colleagues and stakeholders was instrumental for its success. Two major stakeholder meetings with 100+ participants and many more interested in the results demonstrated the interest and provided valuable feedback. The advisory board involved representatives from leading stakeholder groups linked to policy, agriculture, retail, industry, quality systems, and standardization and provided an ongoing stakeholder feedback.

Results of the project were captured in a variety of outlets, including research leaflets, training programs, project reports, web sites and a Strategic Research Agenda aimed at providing guidance in the initiation of new research projects that could support the sector's development towards better transparency. It identifies, in a compressed approach, the state-of-the-art, goals, research challenges and expected deliverables. It is complemented by discussions of research needs in activity domains with relevance for system development and implementation. They deal with issues around consumer communication, the utilization and substantiation of claims, the consideration of data ownership, information markets, the coordination of sector initiatives, and the support in developing sector capabilities.

**Project Context and Objectives:**

It was the general objective of the project TRANSPARENT_FOOD to contribute to the development of transparency in the sector by supporting understanding of its complexities, identifying the present state-of-the-art, learning from experiences, making stakeholders aware, specifying deficiencies and research needs, and formulating a research framework for facilitating future research initiatives.

This general objective was captured in the following four concrete and verifiable project objectives:

1. Identification of the state-of-the art on transparency knowledge and understanding:

This objective was served by a compendium on the state-of-the-art on present knowledge and understanding of transparency needs, transparency solutions, and transparency potentials as derived from research and best practice experiences.

2. Identification of deficiencies in stakeholder transparency and needs for future research initiatives:

This objective was served by a strategic research agenda based on a research framework for the identification of transparency deficiencies, research needs, and research priorities.

3. Providing transparency uptake support:

This objective was served by the specification of a blueprint information backbone scheme (representing an agreement on information exchange between system providers regarding technology and content) that could support the development of a European communication network and facilitate interaction between existing and developing transparency initiatives.

4. Developing transparency awareness:

This objective was served by the establishment of a transparency platform and dedicated dissemination initiatives with stakeholders on a European scale.

**Concept and framework for reaching the objectives**

For its analysis, the project utilized a broad range of approaches, including literature analysis, best practice analysis, chain analysis, work group discussions, expert discussions, surveys, web consultations, and simulation studies to reach results that serve the objectives. The different approaches were linked to a framework which guided the analysis and provided the basis for future transparency research. The framework for analysis built on a layer approach that accounts for the complexity in transparency discussions (see Figure 1 in the attached document with additional information).

The different layers identified different communication needs. One needed to be aware that all layers built on a total chain view reaching from the source of production to the consumer as the final customer. In the organization of transparency schemes, the drivers for the identification of its content were, first, the needs of the ultimate stakeholders (consumers and policy), and secondly, the follow-up needs of enterprises for supporting them in serving markets and dealing with regulatory environments. However, the actual organization of the scheme was being built from the bottom, from raw data to be collected at the source towards the provision of the appropriate signals to stakeholders.

With this view, the framework distinguished the following four information layers:

1. The 1st layer (bottom layer) provided the communication infrastructure and served tracking and tracing needs. This level included the technical, organizational and managerial prerequisites for successful transparency developments, also involving agreements on communication standards and communication units.
2. The 2nd layer served the collection of information about the various project domains (food safety, food quality, chain integrity). This layer represented the classical information collection and communication approach.
3. The 3rd layer involved the transformation of information into signals which served the transparency needs of the various stakeholders (consumers, enterprises, and policy).
4. The 4th layer characterized the transparency needs of consumers, enterprises, and policy and considers differences that were due to, a.o., the different situations they were in, including cultural background, market environment, responsibilities etc.

In the project, the specification of the layers was supported by best practice experiences from various socio-economic, cultural or legal environments and built on a broad stakeholder base partly represented by the National Technology Platforms.

The project built primarily on the establishment of working groups that were linked to the individual framework layers, dealt similarly with the analysis of needs, knowledge, experiences, deficiencies and research challenges in the respective domains and were coordinated and guided by the project partners. The coordination of the working groups and the integration of their results were accomplished through an integration group which built on project partners and complemented by additional members depending on focus.

The working groups were at the core of five work packages (WP) which matched the framework structure. They were linked together through a work package for integration and coordination (WP7) and complemented by work packages on project management (WP 1), and the dissemination of project results as well as the creation of appropriate impacts (WP 8).

The different work packages beyond project management covered the following fields:

**WP2: Feasibility and traceability**

This work package dealt with the basic framework layer Infrastructure and Multi-Dimensional Tracking and Tracing Needs. This work package links up (work group) with the various stakeholders in the provision of baseline system solutions, especially solutions that assure tracking and tracing capability and allow its extension with transparency information. This involved system providers, the providers of technical, organizational and communicational standards (GS1, agroXML etc.), and European projects related to tracking and tracing problems. It identified the potential, pre-conditions, barriers, and agreement requirements for an open European backbone system that distinguishes different levels of development and could provide the basis for a first (lowest level) transparency network on which all further transparency developments could build.

**WP3: Quality and Safety; WP4: Integrity and Sustainability**

These work packages dealt with the information layer and focus, after organization of the work group, on the specification of information and information layers with relevance for food safety and quality or for environmental, ethical or social concerns. They involved literature reviews, the analysis and documentation of monitoring and reporting schemes, and expert consultations on the specification of the information layers in the respective domains (across the various stages of the chain and the various product lines) and on the identification of research needs and priorities.

**WP5: Signals for transparency and trust**

This work package aimed at the analysis and development of appropriate signals and their information base for transparency and trust, considering different product lines and the diversity in expectations and cultural background. It stood out in covering a very broad range of signals and needs involving consumers, industry, and policy and focussing on food quality, food safety and chain integrity. These various aspects have been integrated into one work package because of the very close interrelationships between them. As an example, consumer signals needed to be related to industry signals as industry enterprises have to take market requirements into account in their procurement and production policy but they might also relate to policy interests (as, e.g., the food miles signal with its link to climate policy). The work package built on a work group with two subgroups that focus on consumers and policy needs, respectively. The WP involved literature reviews, the analysis and evaluation of certification and of existing/proposed signalling schemes, and expert consultations on signal needs with corresponding information requirements and on the identification of research needs and priorities.

**WP6: Best practice and performance**

This work package dealt with the identification and analysis of experiences from Best Practice and provided the focus link with professional associations and stakeholder platforms for communication and exchange. It built on a specification of 'best practice' with a view on food safety, quality and chain integrity. It involved literature reviews as well as the analysis, documentation and evaluation of best practice solutions implemented in enterprises with certain quality visibility, implemented in chains (e.g. local quality groups, organic groups etc.), or offered by European system providers (based on a previous comprehensive analysis of the market).

**WP7: Integration and Coordination**

This work package built on a work group involving all partners and work group leaders. It fully relied on the summary expertise of the partner group. It was the crucial integrator for all of the project's results including a comprehensive and integrated documentation of the present situation and knowledge related to transparency and the formulation of a strategic research agenda for the elimination of knowledge barriers. It provided the common approach for analysis and documentation and took responsibility for the integration of work package results (e.g. establishing the linkages between the different layers of the framework and the different stages of the value chain) into the requested comprehensive views. The work package established a common European Transparency Platform that integrated stakeholders, provided networking and provided the basis for the uptake of developments. The work package also coordinated web consultations, one of the crucial elements to reach broad acceptance of results.

**WP8: Exploiting and Dissemination of Results**

This work package built on a work group involving all project partners. It dealt not only with the dissemination of results but provided the focus link with national stakeholder platforms and professional associations. It provided publications for stakeholders (as e.g. transparency development guides, best practice guides), distributed the Strategic Research Agenda, assured the communication of results to stakeholder associations via the European Transparency Platform and through direct approach, and organized in cooperation with partners a number of focused European workshops for stakeholders and associations, system providers, certification and monitoring schemes, research organisations and associations, and for representatives from policy and institutions with transparency links and responsibilities.

**Project Results:**

The main results from the project TRANSPARENT_FOOD followed a layer approach that accounts for the complexity in transparency discussions. This was complemented by presentations based on an integrated view that included best practice experiences from food value chains and some issues of generic nature. In the identification of transparency challenges evolving from a discrepancy between needs, state-of-the-art, and experiences that was presented in the following part and in-depth was discussed in the Strategic Research Agenda, which has utilized a broad range of approaches, including literature analysis, best practice analysis, chain analysis, work group discussions, expert discussions, surveys, web consultations, and simulation studies to reach results that served the objectives.

The Strategic Research Agenda and the main results from the project are still acceptable on the project website http://www.transparentfood.eu/.

Another main result was the establishement of the European Transparency Platform, which is still operational under the following website: http://www.transfood.eu/. Its purpose was to provide a tool for the dialogue with the stakeholders on food transparency. All stakeholders could use it for improving their knowledge and understanding on food transparency systems.

Next, some main findings from the Strategic Research Agenda are pointed out.

Transparency Challenge 1: Transparency for trust in food safety

*Scope and state of the art*

The analysis of the current situation regarding food safety demands (regulations, commercially-applied specifications, consumer perceptions) was the basis for the following analysis and evaluation of hot spots of transparency issues in the food chain. This analysis built on a detailed description of the food chain and a structured description of major transparency issues related to food safety (see Hofstra et al., 2010 (project deliverable 3.1) and Knorr et al., 2011 (project deliverable 3.5)). A number of key thematic areas were identified, namely emerging risks, emerging technologies, food safety governance, and the parallel economy.

Emerging risks: It was well established that intentional and unintentional alterations in practices of primary production such as harvesting, sourcing, preservation, processing, packaging, etc. might have consequences in the production of or the selection for new, unforeseen risks. Likewise new analytical and other scientific capacities could identify, or make more explicit, risks which had previously been unrecognised. It was known that consumers had particularly strong and deeply felt concerns about chemical contamination with delayed pathological effects. Food contact materials were examples of potential sources of exposure to hazards of this type which were, where recognised as representing a risk, highly controlled. Certain packaging systems in which food contact was accentuated were indeed specifically demanded by supermarkets (e.g. individual, blister and vacuum packs for the cold chain, interleaved sliced hams, and cheeses). The consequences of emerging risks in the food chain varied according to the specifics but there were certain scenarios which were similar for any of the sources of such risks.

New technologies: New technologies included, but were not limited to, the physical processing technologies some of which have been developed and extensively studied over the past few years. In some cases, the technology itself was not novel at all but the application presented was (such as the shelf-life extending combinations of microfiltration and pasteurization in milk). Where the application of a novel technology and its communication to the consumer could provide a competitive advantage, its link with food safety issues might lead to considerable transparency challenges. As an option, one might directly mention food safety in communication with consumers, although this was known to be rare at present. It was more common that only some parts of the message might allude to food safety aspects such as the extension of shelf life or the limitation in the use of additives in production. For many novel technologies, elements of potential interest for consumers such as indicators of the impact on food safety of food processing (process parameters) or data capture, were still incompletely defined.

A further issue in this domain pertained to the 'ownership' of the 'brand' of the new technology in generic terms. Where the specific technology in question (e.g. specific antimicrobial edible film) was subject to industrial property protection, the owner of this property was careful to assure that its application did not prejudice the value of the technology. Whilst being obvious, this was a risk which needs to be addressed if new technologies are to be accepted by the consumer.

Food Safety Governance: Since the publication of the White Paper on Food Safety in 2000, all legislation relevant to food safety has been in the form of regulations. This implied the direct incorporation of the EU legislation into the legal systems of the member states. The capacity of individual member stated to implement and apply this legislation varies considerably for a number of reasons. The EC supported comparative implementation through the Food and Veterinary Office (FVO). This approach was highly transparent - with all relevant reports and replies being published in web form. Variations in the application of legislation were thus tending to diminish over time but some were undeniably remain, including those which are embedded in cultural customs.

The widespread application of HACCP principles (as demanded in the EC regulation 852) provided an example of how national bodies (Competent Authorities) were required to 'fill-in' details which the legislation purposefully left out. These differences in specific levels of stringency and detail took on a particular importance when the food in question followed the traditional supply chain and reached the consumer without passing through one of the modern large-scale producer or supermarket brands (see below). In numerical terms, it was possible to determine the relative capacity of any member stated to successfully implement the new (and new style) legislation the numbers of staff at the various levels in the relevant functions were verifiable. Formalized evaluations of the capacity and actual activity of national competent authorities were already carried out by the FVO albeit with a remit to assure harmonization through programmed policing activities. However, detailed knowledge as to the underlying caused of variation and the effects they might have on intra-EU, cross-border trade was still incomplete. Variation in stringency and rigor in the application of legislation led to an environment with a diminished competitiveness, especially for the smaller producers who intended to trade within the EU 27 space.

When food products passed through modern, brand-driven chains the levels of stringency were more harmonized across national borders. This was essentially due to the fact that major

brand holders was stipulated key specifications for food safety, often anticipating or exceeding legally imposed levels of protection according to current scientific knowledge. In addition, the rigor in the application of the controls imposed was also greatly harmonized thus further reducing country-to-country variations (see e.g. http://www.brcglobalstandards.com,http://www.ifs-certification.com). Commercially imposed controls were characteristically non-negotiable in the sense that once applied, either by the brand-holder or the owner of the certification scheme, their compliance was obligatory in order to have access to the chain. Very often the specifications demanded imply extra costs for the suppliers.

Although largely based on risk analysis and on scientific principles, there was no obligation that such approaches were being followed. Customers might formulate food safety demands of whatever kind they want based entirely on their own criteria. Providing that any specification afforded a protection which was at least equivalent to one required by law the adherence to such privately imposed demands was related to extra costs. The lack of transparency in fixing specifications was therefore a cause of tension between suppliers and customers.

Parallel economy: The parallel economy was characterized by distribution activities outside the classical channels as e.g. farmers markets. The inherent variability in the stringency and rigor of implementing food safety legislation due to cultural diversity and economic differences contributed to considerable differences in the way in which the parallel economy operated in the various member states. There might be variations due to differences in opportunities for food sales via the parallel economy both by differences in the ability to providing appropriate agricultural produce as well by differences in the capacity of subsequent stages for serving parallel economy activities.

Furthermore, there were variations in the way the parallel economy was perceived by different groups of consumers. One could expect a spectrum of degrees of acceptance of foods being produced and distributed without passing through the formal economy. This was likely to be influenced, at least in part, by regional and national factors. In rural and rurally-influenced communities, food which was locally produced and perceived as natural or traditional was often perceived of being superior to food purchased in the formal economy. In urbanized areas the existence of an infrastructure of ethnical restaurants and food services building on food prepared according to traditions from all over the world might add to the risks of food safety in parallel economies.

*Goal 1: Addressing transparency issues related to emerging food safety risks*

Emerging food safety risks brought up specific challenges related to transparency. On one hand, it was far from clear, how consumers judged the appearance of new risks or where they saw the responsibility for their emergence. In those cases in which the scientific and technical community knowed of a risk but has not had time to understand, translate and communicate this to stakeholders of the food chain, this could be perceived as a lack of transparency. On the other hand, one needed always to generate new knowledge on the cumulative and long term effects associated with e.g. exposure to chemical hazards including those from food contact materials. Furthermore, the progressive revelation of potential risks via improved

analytical capacity might act as a vector of emergence, requiring a continuing research effort to ensure that the implementation of control measures accompany the risks and not just the technical capacities. The same could be said of the multiple causes of emergence of microbiological safety risks. Better pathogen detection and description should be accompanied by a greater, broad-based perception of the risks they might represent.

*Major research challenges*

Challenge 1: To understand the perception of consumers of messages they received concerning the appearance of new risks related to food and to understand how and to what degree consumers could accept new risks without losing confidence in the chain.

Challenge 2: To assure that emerging risks were both technically and scientifically identified as early as possible and that all relevant information was communicated to stakeholders in ways which were appropriate to them.

*Goal 2: To ensure that transparency issues did not impede emerging technologies from achieving their potential*

This goal was mostly centred on those technologies which were claimed to represent some contribution to food safety, by partially, or totally, substituting existing technologies whilst adding value through cost, efficacy or quality benefits. Technologies might even represent an entirely new opportunity of reducing risk which creates a new range of possibilities. The long history of successes and failures in the introduction of new technologies illustrated that there were intrinsic and extrinsic factors which influenced whether these were accepted or not. This area has received considerable attention in literature. However it was important to know the effects of introducing new technologies on the overall confidence in the food chain. It was a pre-condition for the successful introduction of new technologies with inherent merits to know how they contributed to food safety in the chain in which they might be integrated. This knowledge was required not only for the stage at which they might be applied, but in the context of a full chain risk assessment. Such science-based performance objectives were key instruments in transparency.

*Major research challenges*

Challenge 1: To more fully understand how consumers perceived the use of new technologies in the food chain and how their perception affected their trust in food safety.

Challenge 2: An expanded and improved definition of the safety contribution of new technologies. This should not be limited to the stage of the food chain in which the technology intervenes, but also to potential impacts on food safety of the food chain as a whole.

*Goal 3: Providing a fair and functional governance of food safety*

The responsibility for the governance of food safety was, in reality, shared between official bodies and the enterprise actors in the chain. Safety-driven, brand protection specifications driven by large supermarket chains (e.g. BRC, IFS) were very stringent. Safety demands were often in excess of what is legislated and were always non-negotiable. This stringency was passed back down the production and supply chain. Also brand-holding producers often practiced their own, non-negotiable schemes with suppliers and co-packers. Differences in the criteria applied by commercial operators (and between different operators) and official agencies (and amongst official agencies across the EU space), was a cause of tension. Measures needed to be taken to ensure that criteria were applied in a transparent manner and knowledge had to generated on how to ensure that such measures were being successfully applied.

*Major research challenges*

Challenge 1: To understand in detail the differences in the way governance practices were employed by the official agencies responsible for food safety in the EU member states and their component regional structures. These practices needed to be compared and contrasted with governance practices employed by modern retailers, branded wholesalers, brand holders who emploied contract manufacture, and by modern large scale restaurant chains.

Challenge 2: To understand the differences in the stringency of the criteria applied in the application of food safety legislation across the EU. In this case it was not the practices and capacities themselves which were of interest but rather the actual realizations of process and product specifications which were deemed to be acceptable or not-acceptable.

*Goal 4: Understanding the effects of the parallel economy on food safety*

The existence of uncontrolled and unregulated activities in the food chain was a concern for those responsible for food safety assurance. By avoiding official recognition, chain actors could simply ignore many of the demands that ensured that food was consistently delivered in safe conditions to consumers. This applied to all parts of the chain reaching from primary production to food services and involving activities such as packaging, manufacturing, laboratory and consultancy services. Thus the parallel economy could impact negatively on food safety in a number of ways.

*Major research challenges*

Challenge 1: To understand the role of cultural and regional diversity in the development of the parallel economy in the EU. It was known that different cultures view the parallel economy in different ways. While some were relatively permissive others do strongly reject it.

Challenge 2: To understand the impact of unregulated labour on food safety. Many hygiene-sensitive jobs, particularly but not exclusively, in retail and food service, were unskilled and poorly paid.

Transparency Challenge 2: Transparency for trust in food quality

*Scope and state of the art*

Food quality was a crucial success factor in order to maintain high standard products. An appropriate transparency was a key success factor for the ability of the food chain actors to guarantee a maximum level of food quality. This was due to the complexity of the food chain which might consist of multiple single stages from the production of raw material by agriculture up to the final distribution by retailers. In addition to the many stages, the food sector was characterized by a great variety of food products and processes as well as by numerous regulations regarding food quality. Furthermore, as food production was not dominated by a few global corporations but builds on a multitude of SMEs, its complexity involved organizational particularities including cultural diversity.

Food quality was a key factor for consumers in their buying decisions. In food, the assurance of certain quality requirements for raw materials and semi-finished goods was the prerequisite for achieving maximum end-product qualities within a multi-step production process. The reliability of food quality controls depended partly on time consuming and cost intensive methods and procedures which affected their application and use. Hence, recent emphasis was placed on the development of rapid, cost effective and preferably non-destructive techniques that found increased application in the food sector. Furthermore, although a variety of analytical means was available for the measurement of quality attributes, their correlation to consumer perception remains a challenging task.

The availability and transfer of quality related information within the food chain was directly linked to transparency issues. However, up till now, the transfer of information related to food quality along and within the chain, and the appropriate coordination of this transfer, was still limited. Apart from such deficiencies, the generation and transfer of information related to food quality in industry might result in a number of signals which integrate available information and provide a certain message to recipients. The major food quality related information could be summarized in some categories such as chemical and nutritional product composition, sensorial and physiological characteristics, characteristics of the production process, the status of raw materials, contaminants, microbiological quality and food packaging. However, new complex product formulations were on the market and require the adaptation of characteristics attributed to the aforementioned categories as well as the modification of the available analytical methods for their control.

A number of research needs derived from the aforementioned aspects in order to overcome the currently existing limitations. Priority was given to five aspects discussed in the following section including food chain communication and integration, re-evaluation of traditional technologies, development of a synchronized assessment for emerging food processing technologies, improvement of suitable analytical methods, and development of concepts for the update of quality standards and legal provisions.

*Goal 1: Food chain - Better integration from farm to fork*

For many consumers, production processes of food might seem to lack transparency. Information concerning product streams (e.g. origin of raw materials, transport routes), quality characteristics or the kind of processing used were difficult to access in most cases. On the other hand, transparency and the availability of this information could be a prerequisite for gaining trust in the food chain.

*Major research challenges*

Challenge 1: Managing the higher degree of complexity for multi ingredient products was a challenge that involves the traceability of complex product streams that might extend over the whole globe as well as the monitoring of quality parameters. New technologies needed to be developed that allow an automated, cross-stage and gap-less monitoring as well as an easy transmission of relevant data.

Challenge 2: Optimising the interaction between all members of the chain and selecting the data needed to create or maintain trust and transparency. Market and consumer research programs were of crucial relevance in this context and for evaluating the relevance of information to be communicated.

Challenge 3: Consideration of post-shopping consumer behaviour for maintaining quality as a basis for transparency on food quality and quality development. Food handling at the point of sale and at the point of use by consumers had a major impact on product quality.

Challenge 4: Realising interdisciplinary co-operation between the different stakeholders, organisations and research institutes dealing with transparency in food quality.

*Goal 2: Traditional and emerging technologies: A synchronized assessment*

Traditional food processing and traditional food processes have been widely used in Europe in the past and still included local particularities. However, in order to respond to the consumer demand for more natural, healthier and sustainable food products and processes, emerging technologies have been initiated. Reservations regarding food processing technologies needed to be overcome by providing information on process performance, risks, and benefit that might support consumer acceptance and trust.

*Major research challenges*

Challenge 1: Re-evaluation of traditional food processing. Re-inventing these processes required the understanding of the traditional process mechanisms and subsequently their transfer and upgrading to modern industrial processes. A re-evaluation of existing technologies from a food quality pointed of view seems essential. Novel processes had to undergo an intensive evaluation regarding toxicological risks etc. There was no systematic approach for the existing traditional foods and certain critical points e.g. the formation of acrylamide were only revealed accidently.

Challenge 2: Integrative food process optimization. An effective integrated modeling of food chains and enterprise units was required for generating and validating information regarding changes in food quality during food production, storage, retailing, and point-of-use. Issues such as packaging technology played a crucial role for quality changes in logistic, for freshness and for food safety.

Challenge 3: The establishment of a synchronized process assessment scheme including the development of criteria for the analysis and evaluation of process performance of emerging technologies. The lack of information on inactivation kinetics and reaction mechanisms of nutrients, toxins, allergens, microbes and viruses, shelf-life studies, epidemiological studies, effects on digestibility, on allergens, phytochemicals and melanoidins clearly indicated further research needs regarding emerging food processing technologies but also regarding traditional food processing.

Challenge 4: The development of manageable industrial scale technologies for translating consumer perceptions into innovative products was a key step for the further successful development and integration of emerging technologies.

*Goal 3: Analytical methods: Improving speed, detection limits and process adaptation*

The improvement of analytical methods contributed to an improved availability of information and might increase the level of transparency. Fast and non-destructive methods for quality analysis needed to be further developed as a basis for immediate quality control and management.

*Major research challenges*

Challenge 1: With regard to emerging technologies, a re-evaluation of current analytical means were necessary in order to prove their suitability to characterize relevant process-product interactions.

Challenge 2: Fast and non-destructive methods with appropriate detection limits. Speed enhancements in terms of sample throughput and analytical time requirements were necessary in order to increase the total amount of samples tested and to improve the response time.

*Goal 4: Improving food quality standards and making provisions more stringent*

In times of globalisation and international product streams, long transport distances and a complex traceability problem contrasted with increased consumer need for high level of quality, safety and transparency. Improvements in quality standards and legal provisions were necessary for increasing and strengthening consumers' trust.

*Major research challenges*

Challenge 1: Advances in scientific knowledge and the development of new analytical methods were the basis for improvements in food quality and safety and should be implemented into the requirements of quality and safety standards without delay in order to guarantee optimal food quality at any time.

Challenge 2: Clear, unambiguous provisions in labelling. Surveillance reports showed that major deficiencies regarding requirements and consumer complaints were related to labelling. Although, a step in the right direction was made by adopting the new European food information regulation, much more stringent legal provisions were needed for preventing loopholes and for improving the reliability of food labelling. The transformation of available product and process related quality information into signals related to consumer information needs remained a core task.

Transparency Challenge 3: Transparency for trust in food chain integrity

*Scope and state of the art*

Ethical, social and environmental impacts were important for building trust in the food chain, yet they could not be measured on the food product as such. Thus the integrity of the food chain relating to these aspects had to build on transparency.

The minimisation of negative impacts and the enhancing of positive impacts of social, ethical and environmental aspects of food chains were increasingly becoming important values around which food choices were made. Communication of these values relied to a great extent on processes of transparency. These processes were varied but could rely on tracking and tracing in combination with the use of clear, simple and up to date information communicated in an effective way. The following built on an analysis of the state-of-the-art on information use in food chains with relevance for environmental concerns (Oestergren et al., 2010; project report D4.1) as well as for ethical and social concerns (Barling et al., 2010; project report D4.2), and on an analysis, evaluation and documentation of selected 'best practice' monitoring and reporting schemes (Östergren et al., 2011; project report D4.3).

On a company basis the transparency of environmental, ethical social aspects was addressed in two ways. First, by business to consumer communication by labelling food that was supposed to have certain integrity characteristics, like carbon footprint or fair trade. Second, by business to business information that ensures that certain standards have been used in producing the goods used in the further processing. One example was GlobalG.A.P. that ensures that food was produced on the farm by using state-of-art Good Agricultural Practices aiming at reducing detrimental environmental impacts of farming operations, reducing the use of chemical inputs and ensuring a responsible approach to worker health and safety as well as animal welfare.

At the policy scale EU had implemented the integrated product policy (IPP) which sought to minimise environmental impact from products by looking at all phases of a life-cycle and taking action where it was most effective. To achieve this objective, the EU IPP was contributing to addressing the environmental challenges identified in both the Sustainable Development Strategy and the Sixth Environment Action Programme. The IPP principles had been taken up and carried over by the Sustainable Consumption and Production and

Sustainable Industrial Policy (SCP/SIP) Action Plan which in turns constituted a major input to the ten-year framework of the UN/UNEP programmes on sustainable production and consumption. It was a key assumption of the IPP that the environmental performance of a product or a service could be a factor giving companies or their products a competitive edge, and thus it was a separate aim of the IPP to create the right framework for market conditions that favour environmental improvements in the product chain. An increased transparency in the food chain was crucial to reach this goal.

Another important policy initiative was the Life Cycle Initiative which was launched by UNEP and SETAC .This international life cycle partnership has identified the need for guidelines for social life cycle assessment of products to complement environmental life cycle assessment and life cycle costing, and by doing so contributing to the full assessment of goods and services within the context of sustainable development. December 2010 the European Council invited the Commission to develop a common methodology on the quantitative assessment of environmental impacts of products, throughout their life-cycle, in order to support the assessment and labelling of products. A communication on this methodology should be adopted in 2012, as part of the revision of the SCP/SIP Action Plan.

Furthermore, the Commission was currently undertaking a study to explore the feasibility of establishing reliable EU Ecolabel criteria for food and feed products. In parallel, the European food supply chain had gathered around the European Food Sustainable Consumption and Production Round Table (RT), an initiative with the objective to establish the food chain as a major contributor towards sustainable consumption and production in Europe by developing a harmonized framework methodology for the voluntary environmental assessment and communication of environmental information along the food chain, including to consumers. The RT had just recently (August 2011) carried out a scientific workshop, hosted by the EU Joint Research Centre, to discuss methodological issues and recommendations. In their draft conclusions, the RT called for targeted research efforts to better understand consumer perception, understanding and action on environmental product information, and for the development of specific guidance on communicating the environmental performance of products.

*Goal 1: Valid indicators for estimating the integrity performance within an operational and sound traceability reference unit*

Assessment of the performance of environmental ethical and social dimension such as e.g. environmental impact or animal welfare was often performed on a farm over a long time interval. In a transparency perspective this might not in itself be interesting, since a consumer or a company bought one piece or a smaller quantity of goods. Thus, information regarding the integrity performance had to follow the relevant quantity, which again had to be traceable along the chain, carrying information from the farm to processing to retail. A traceability reference unit was the quantity of product for which a specific integrity performance assessment or claim was valid being either in the form of a specific assessment (e.g. a carbon footprint calculation) or a label based on management practices (e.g. animal welfare or organic).

The traceability reference unit thus refered to what level of aggregation was relevant; was it one single pig, all pigs from one batch or a regional average pig during one year? Moreover, whatever the choice made, data were connected to different batches of products, but batches might be amalgamated later in the process. For example, environmental impact data were often calculated over a year on a farm and were presented as an average, from a number of farms or a country or region and sometimes also as an average of several years. This aggregated information could rarely be used to distinguish between similar products and therefore did not allow for a benchmarking process, which would help in using the best performing cases as models for others. Finally, the different integrity dimensions required a certain scale in time and space in order to make meaningful assessments.

*Major research challenges*

Challenge 1: Establishment of a sound, manageable and robust framework that pointed out the relevant aspects to take into account when choosing the traceability reference unit in different types of food chains and covering different integrity dimensions in order to harmonize indicator calculations.

Challenge 2: Methodology to describe different integrity dimensions with appropriate indicators needed to be developed. The fact that different dimensions of integrity did not have the same relevance for all food products needs to be taken into account (e.g. animal welfare).

*Goal 2: Cost effective systems for data collection and sharing that take advantage of existing data collected through a food chain*

In performance based schemes, like the carbon footprint, the information related to a product basically needed to be present at each point of the supply chain in order to accomplish a final assessment of the product presented to the consumer. In principle the information (values and principles for calculation) could be stored and made available to all within the chain and outside the chain. However, some parameters might contain protected knowledge, which the company might not want to share, and some data might have little interest to end users.

Environmental impact data sets were generally aggregated from a very large number of data points supported with a limited number of background data. For transparency a reported value, associated with a product, needed to be supported by a large amount of data and meta-data according to existing standards for LCA (methodology) and e.g. EcoSpold (data format) etc. Further on, aggregation of information and data might be necessary in order to communicate information to consumers and non-expert stakeholders in an understandable way.

For rule based systems other types of data and information were generated e.g. through an inspection process. For this type of non- quantitative information no appropriate system seemed to be developed that effectively could be used to communicate such information.

To promote the development of information exchange, open access data bases needed to be established and maintained in order to fulfil the needs for open, robust and reliable data/information.

*Major research challenges*

Challenge 1: Establishment of a framework for cost effective systems for data sharing that allowed connection to a relevant traceability reference unit and allowed a timely and transparent update of process information and a reasonable degree of open access for all interested parties.

Challenge 2: Identification of barriers and opportunities for making inspection results from rule based systems publicly available in a meaningful way.

*Goal 3: Robust concepts for guaranteeing the integrity performance of different food chains*

The coherence between what stakeholders perceived as covered by a claim and how the food chain actually impacts on the integrity dimension in question had to be assured.

Most integrity dimensions were in reality seeking to address more long term and societal concerns and were less linked or allocated to the very specific batch of a product which was more important when considering for example food safety. A number of integrity aspects might not be important to link to a specific small quantity of product from a consumer perspective, but could be assured on a more general level (e.g. animal welfare on a system level) which presently was the case for a number of labelling schemes.

Furthermore, from a consumer perspective, transparency was about creating trust (and the task of the monitoring system was to make sure that this trust was justified). Thus, fully open systems might not be needed. 'Transparency on demand' might be a solution where information was retrieved from a third party (e.g. a database containing confidential company specific data) and processed on demand to a format being acceptable and understandable for the customer without revealing sensitive business information.

A valuable way to create transparency, as an alternative to a routinely quantification of often relative narrow indicators to estimate the integrity impacts might be an independent assessments of the performance of farms, processors and other actors in a food chain vis-à-vis the promises of the label scheme.

*Major research challenges*

Challenge 1: In depth understanding on how existing schemes and their rules and practices translated into true impacts that could be communicated to the consumer and to provide feedback to the owners of the schemes.

Challenge 2: Establishment of criteria to be used in guidelines for external reviews and assessment of schemes in order to facilitate comparability between schemes and over time.

Challenge 3: To develop a framework for information management along the food chain for increased integrity, trust and business opportunities.

Transparency Challenge 4: Signaling information to build confidence and trust in the food chain

*Scope and state of the art*

The objective was to identify information that related to environmental, ethical, and social impacts of actions and processes in the food chain, and so to determine the potential, the deficiencies, and the research needs. This allowed the food chain to transmit information related to such impacts towards consumers and policy.

Greater and more appropriate forms of transparency in food chains were a potential facilitator for innovation and change to more sustainable food chains and a more sustainable food system. That was a food system that was more sustainable environmentally, socially and ethically, and, ultimately, economically. Information in food chains and the transmission of that information in ways that were effective through being informative and understandable to the recipients could result in public policy desired behaviour change by the food chain and by consumers. Measurable improvements in sustainability impacts were facilitated by improved and suitable transparency.

Food chains needed to move towards transparency that promoted the disclosure of relevant and usable information from food chains to the wider public. Such transparency provided more symmetry in information flows and allowed the sustainability metrics and methods employed to improve over time as the information becomes more relevant to better environmental and social outcomes. That was, the information signaled resulted in greater public understanding of the sustainability attributes of food products and so facilitate informed choice by consumers of more sustainable food in their purchasing. The signals deployed to consumers were largely in the forms of on product labels and logos (such as based on certification schemes) as well as in store information and information campaigns, and business advice called lines for customers.

The signaling of such relevant information to the public and consumers involved a complex set of processes of transmission. Our understanding needs to go beyond the simple and predominant business-to-business (B2B) and business to consumer (B2C) models. Equally important were the transmissions of information from business to business and then on to the consumer (B2B2C). Also, rapidly emerging was the importance of social networks in relying consumer-to-consumer information and opinion (C2C). Hence a more realistic transmission sequence of information that was recurring, and that transparency has to enlighten, was the B2B2C & C2C transmission of information. Furthermore, there were other social and professional intermediaries who interacted with the public and impact upon the information flow to consumers. Civil Society Organizations, such as NGOs, sought to influence consumers' knowledge and decisions through information campaigns, usually from a particular value perspective (e.g. animal welfare). Professional groups might offer information such as veterinarians and animal welfare, or nutritionists and dieticians, either as independent professional bodies and networks, but usually not from within the food chain unless as employees of the food industry.

*Goal 1: A more sustainable food chain that utilised transparency in signaling its sustainability criteria from business to business and on to the consumer*

Key actors in food chains managed and edited the information about food products offered for sale to consumers. Within contemporary food chains, not least in Europe, retailers and foods service companies were key gatekeepers between the consumer and the rest of the food chain. Retailers and some manufacturers had responded to societal and market demands for food integrity around a range of environmental, social and ethical criteria. In part, the response had been a selective uptake of independent or third party certification schemes that signal the integrity of the food through logos. These schemes offered retailers and manufacturers a means to construct a narrative of their business profile and brand while conferring third party validation in the logo based signals sent to consumers.

In order to achieve goals around sustainability, some market innovators (retailers and manufacturers) were seeking to develop their own product supply chains that embed sustainability criteria. Such efforts might be signaled to consumers directly via food products but were communicated also through non-label provisions of information, such as annual corporate responsibility and sustainability reports. These 'first mover' retailers (notably through the large growth of own label manufactured foods and fresh produce sold) and 'first mover' manufacturers were seeking primarily to strengthen their business model to make it more sustainable and resilient; particularly in terms of both their natural resource impact and the resilience of the supply chain sourcing of food commodities and produce.

A secondary benefit was to create or reinforce a brand identity around sustainability issues, sometimes in a selective manner. For public policy, the corporate innovators who were providing a more sustainable food supply were leading the policy and governance response. The interaction of public authorities at national and EU levels with the industry on sustainable food was a important dynamic as was the role of public authorities in framing and co-opting the actions of the industry to realise publically desirable goals. One way in which public authorities were seeking to engender greater sustainability was through the use of market based information for consumers in the form of labels on food, where the authorities were monitoring the initiatives of private sector certification and labeling.

*Major research challenges*

Challenge 1: To adopt efficient methods of communicating sustainable food choices from the food chain to the consuming public through the effective promotion of appropriate information transmission and signals from the food chain.

*Goal 2: Providing signals around the environmental, social and ethical aspects of food that were understood by consumers and respond to their needs*

This goal covered a wide range of issues that were centered on: 'signals' and target areas for information disclosure, content of information disclosure and process as well as associated barriers. Widespread efforts to establish signals and generally increased disclosure for greater perceived transparency might not necessarily led eventually to equally evident results across

all contexts. Fostering targeted transparency might be: an equally more effective course of social and business actions, proved sustainable business-wise, foster accountability but also positive public deliberations. Target areas might attract increased attention and become hotly debated, likely grounds for uneven media attention, and grounds for political confrontation, thus they were pivotal for ensuring perceptions of greater transparency. Lack of performance (and subsequently, lack of public policy performance) in these areas might be perceived to exist when the nature, speed and detail of information currently communicated through current adopted information disclosure practices were not actually, consumer-useful. Pertinent information/signals (label/non-label) might be incomplete perceived as filtered/distorted, non-updated, non-timely, non-accessible, discriminatory, proprietary and thus motivated, at inadequate level of (dis)aggregation, non-comparable, or confusing/inconsistent/non-standardized.

The information/signal gap might not be easily bridgeable. The problem might not lend itself to measurement and there was lack of consensus on measurement, so that performance might be feasibly improved. Communication might be impractical being too multifaceted and complex. Consumers might not have the will, capacity and cognitive tools to handle complex information given the problem. Variability and uncertainty might not be easily acceptable.

*Major research challenges*

Challenge 1: To identify effective ways of making food chains transparent to the growing demands for information disclosure.

*Goal 3: Establishing consumer trust (the role of the media) and managing the transition to greater transparency*

Perceived trust was fundamental and it formed the basis for greater or lesser needs for information disclosure. Yet, its complex nature and interrelated interfaces had undermined the full understanding of its functioning for social engineering issues. 'Trust' interrelated aspects were linked to several aspects. Trust might be determined or influenced by multiple and interwoven individual and socio-cultural characteristics of those who exhibit trust or lack thereof. Trust was determined or influenced by the (perceived) characteristics of the content and amount of information received. Public trust in institutions functions differently according to how a particular risk was managed or communicated; sometimes, the perception of risk appears to be a component of trust, other times referred to as a consequence rather than a determinant of trust, in the sense that, if people trusted an institution to manage a specific risk, they perceived the communicated risks as smaller or the benefits as larger.

Trust increasing or destroying features attributable to an institution and those responsible for risk assessment, management and/or communication, benefit(s) perceptions of innovations and actions as well as issues of credibility and motives was also relevant. Perceived industry motives were important here and regulators' vulnerability compared to third party /independent actors. Moreover, consumer questioning on motives might not limit itself to food supply chains' motives alone. Individual citizens and consumers might distrust the motivations of regulatory institutions under conditions where they perceive regulatory

activities to be promoting the interests of specific parties rather than public welfare. The role of media and handling or transmission of pertinent information as well as the process of doing so as well as the involvement of perceived as independent parties was fundamental here. Furthermore, the issue of unveiling through the media illegal trade (either linking to the parallel economy) or fraudulent actions needed to be examined further.

*Major research challenges*

Challenge 1: How to establish and manage consumer trust, taking into account the role of the media in this process and how managing the transition to greater transparency.

*Goal 4: The development and utilization of technologies to facilitate the flows of information and transmission of signals thus enabling better transparency*

Information and Communication Technology (ICT) played an important role in data and information generation and gathering, storage, access and transmission along food supply chains. Increasingly, signals relied on technology at the points of purchase and post-purchase. This included the use of hand held devices and greater use of RFID technology or other technologies in the future. In addition, advances in Symantic Web technology allowed for much more sophisticated information to be collated, disseminated and delivered to mobile devices at point of purchase (in store or when ordering via the web), and post purchase in response to specific questions about products being or having been purchased. The growth of 'infosumerism" meant interested and attentive publics demanding more information and transparency about their product purchasing.

Technology had the potential to facilitate participatory forms of transparency and disclosure in which actors along the supply chain could make specific information requests, or, in the case of producers, could allow for greater elaboration on the information currently shared. Thus, for example, origin as a signal had the potential to go beyond a reference to a national location or address of manufacture but could also be a point upon which information about producers and their localities were shared. Consumer engagement on the application and use of these technologies, including their accessibility, was integral to their enhancing the greater uptake of more sustainable food.

*Major Research Challenge*

Challenge 1: To adapt and promote the application of new ICTs that enabled and facilitated the potential purchase of sustainable food by the public.

Challenge 2: To unlock hidden information for utilization by consumers. Products were increasingly linked to labels or certificates of any kind (e.g. eco labels, quality labels). Labels were usually representatives of clusters of information regarding controls, process organizations, product compositions, origins, etc. Intelligent IT devices in consumers' hands such as smartphones might link up with the respective label owners through e.g. the internet cloud for unlocking the hidden information.

Transparency Challenge 5: Technological baseline infrastructure for tracking and tracing

*Scope and state of the art*

To facilitate management of production chains, information technology supported tracking and tracing and quality assurance systems had been developed and applied also in the food sector. Existing solutions currently in most cases focused on a certain production chain or a part of a chain. This had led to a number of information exchange islands with barriers and media breaks between systems. In reality, changes in supply chain configurations and interconnections between chains led to the transformation of the linear structure into a highly dynamic food sector network. Interoperation of different tracking and tracing systems was thus a prerequisite for appropriate food sector transparency. There was currently no solution available that was suited to all stakeholders within the food sector and that satisfied the requirement of being able to track and trace according to different scopes of a chain.

Within the food sector, a broad diversity of enterprise size distribution characteristics across countries and across different stages of the food chain could be found. While the larger enterprises commonly were small in numbers but contributed a relatively large part to the economic outcome and to the percentage of bound labour force, small enterprises still played a major role in various stages of the food sector, especially in primary production and specialized retail stores. With this regard, the sector differed from other industries like e. g. the electronics sector, where there were almost no small enterprises present in the supply chain or the automotive sector, where there were lots of medium sized enterprises in the pre-production parts deliverer stage of the chain and a small number of very large corporate enterprises doing final assembly. An important challenge in drafting a backbone solution specification worked thus out how the scalability requirements resulting from the sector structure could be achieved. Methods and technologies used had to accommodate on the one hand large amounts of smaller data packages and on the other hand a large number of small stakeholders.

Concerning technical implementation of tracking and tracing systems, web technologies had found their way into systems, but methods used differ. Nevertheless, there were a number of commonalities among systems and generally applicable methods. The central database paradigm was still widespread in comparison to a distributed storage approach. Mapping existing systems' data content into a distributed, networked infrastructure resulted in research challenges formulated in Goal 1. It was a crucial factor for success to find a set of standards and methods that were up to the task but at the same time simple, clear and generic enough to be accepted by everybody. Four aspects had been identified that had to be considered on the technical level in building a backbone infrastructure: identification of items, protocols used in communication, syntax and semantics of data exchanged. For each, several technologies existed to provide the necessary functionality.

Complex messaging protocols based on SOAP could be used in well-defined, controlled environments but were probably too difficult to implement on a larger scale. RESTful web services had been proven to be better suited to networks with large numbers of small, anonymous stakeholders and a lack of control. On the syntax level, XML was already widely used in the food and agricultural sector. It was thus well understood and could easily be

implemented by most stakeholders. The disadvantage of XML was its inefficiency during data transfer on-the-wire due to its verbosity. This might result in problems on large scale tracking and tracing. There were however replacements for XML that were easy to handle and could be converted without much effort like e. g. JSON, so that syntax issues were not a limiting factor in implementing the backbone. Data items in the basic tracking and tracing data set were semantically well defined. Giving additional data for enhanced transparency with regard to other aspects however required a flexible and extensible container that called for concise formalized and machine readable semantics of its content.

*Goal 1: Making different subdomain level data encodings interoperate*

A crucial part in communication across a network was a common understanding of the meaning of data items allowing for correct interpretation within information technology systems. In simple networks, this problem could be tackled by bilateral agreements. For larger-scale communication purposes, data dictionaries and vocabularies were defined, that could be shared among the respective stakeholders. Within a basic tracking and tracing data set this was of importance, especially for encoding product names and categories. Naming and encoding of further attributes was relevant as soon as additional information on origin or processing parameters was demanded.

A number of data dictionaries, thesauri, ontologies and encoding systems existed in the food and agricultural sector that focused each on certain subdomains. For the description of food, the multilingual thesaurus LanguaL existed. It offered a framework using facetted classification. Each food was described by a set of controlled terms. The classification could thus be used to derive food's nutritional characteristics. In the agricultural area, the thesaurus Agrovoc, managed by the FAO, was a hierarchical scheme of terms being suited to describe agricultural resources. There were a number of additional, implicit vocabularies available like the one laid down for process steps in the GS/1 EPCIS standards. Most of them couldnot interoperate with other vocabularies at the moment, i. e. there were no automatic linking mechanisms in place. Relationship definitions between concepts and terms were often missing or too flat to be useful for flexible and dynamic information exchange using e .g reasoning mechanisms to derive new information and generate signals.

Thus increasing the usefulness of a European backbone solution by offering more than just simple tracking and tracing reached its limits quickly if this problem was not tackled. The Food and Agricultural Organization of the United Nations (FAO) currently provided the KOS registry for collecting and referencing different knowledge organization and sharing systems in the agricultural and food sector thus providing a basis from which further harmonization and interconnection work could start.

*Major research challenges*

Challenge 1: Creating universal food sector domain ontology by networking subdomain models implicitly given in existing standards, vocabularies and coding systems. Finding technical methods to automatically map content of information and data packages to alternative representations, data formats and information models by using this domain model.

*Goal 2: Feasible identification of holdings, production sites and units and sound definition of traceability reference units in primary production*

Identification mechanisms were a prerequisite for tracking and tracing. This applied to both the objects being tracked and traced as well as to the intermediate steps and locations encountered along the chain. Concerning the moving objects in a tracking and tracing system, the Traceability Reference Unit (TRU) was a common concept describing a collection containing several product units with identical properties. In general, TRU status was assigned to uniquely labelled - and therefore identified - fixed size containers. In an IT supported system the TRU was also the smallest possible information unit in that way, that properties and the possibility to track and trace apply to the whole unit. Therefore the larger the TRU, the less precise tracking and tracing will be.

On the farm level, unique identification was in place but it serves several purposes, e.g. registration of establishments rearing laying hens, or the registration of farm animals for veterinary purposes. Therefore, a single farm or another food production unit might obtain multiple registration numbers. The format of numbers differed depending on the country. Identification standards common for supply chain management in industry were not used much in agriculture. It was therefore necessary to overcome barriers with regard to interoperability of different identification systems and simplify usage for SMEs.

*Major research challenges*

Challenge 1: Developing good practices for handling traceability reference units that had a change history with regard to properties that might influence the product carried within/upon. Creating an identification scheme based upon a reference information model of change history and proposing an appropriate distribution of responsibility for holding and storing information on TRU properties.

*Goal 3: Supporting balancing of demands for confidentiality versus demands of open information*

Tracking and tracing of food products required the storage and retrieval of a substantial amount of data. There was a demand for open information by the customer. On the other hand, companies had an interest in protecting intellectual property like recipes and values of production process control variables. Nevertheless, information like that might be required by other stakeholders or in certain cases like e. g. by relevant governmental authorities in cases of toxic contaminations. To establish a food transparency system, it had to be clarified how much and which data could be made accessible to the different user groups without violating the confidentiality needs of the producers while still ensuring adequate and timely information of others. With an increasing number of stakeholders having individual transparency and confidentiality requirements on a tracking and tracing system, an accompanying access and authorization system’s complexity was increasing in a disproportionate manner. It was therefore required to sketch roles, access rights and data

flows in respective request-response cycles and to provide generic mechanisms that could be applied on a large scale.

*Major research challenges*

Challenge 1: Establishing a food sector stakeholder role system, that supported network participants' individual information and confidentiality requirements but on the other hand was feasible to be implemented in an economic manner. Providing a distributed infrastructure to support that role system within a tracking and tracing backbone.

*Goal 4: Sector wide economic and technical feasibility of a baseline information infrastructure*

Food products generally had a relatively low monetary value per unit and the profit margins were small. Therefore, the economic effort which could be put into an individual product item was limited. A crucial factor for success of an information infrastructure for transparency was thus low implementation cost for production chain stakeholders. While in large enterprises, necessary IT infrastructures existed that could be used to handle provision of tracking and tracing information to other stakeholders, small and in part also medium sized enterprises face difficulties.

On the level of networking, they commonly could only rely on temporary or unreliable internet connections. Although broadband internet connectivity was becoming more and more common in every country in the EU, the percentage of reliable internet connections was constantly decreasing. This came from the fact that on the one hand more connectivity options today relied on wireless technology (UMTS, satellite modems etc.) - especially in rural areas - and on the other hand there was an increasing number of connections without having throughput and availability guaranteed by either technical measures or appropriate service level agreements (cf. DSL lines with variable bit rates vs. various incarnations of ISDN multiplexed lines like E1-E5 with guaranteed bit rates). It was therefore required to provide an operational model for service provision with simple mechanisms to synchronize local (unreliably available) and remoted (reliably available) data pools.

*Major research challenges*

Challenge 1: Developing low-cost, commodity hardware technology based solutions to support SMEs in tracking and tracing. Identifying a suitable business model for service provision within such an environment.

Transparency Challenge 6: Integration

*Scope and state of the art*

Transparency was one of the most complex and fuzzy issues the food sector was facing. It was widely acknowledged that an appropriate transparency was of crucial importance and a critical success factor for 1) sustainable development 2) guaranteeing food safety and quality 3) providing consumers with information to support their buying behaviour and 4) identifying a suitable regulatory environment.

Consequently, transparency was one of the most popular concepts within chain management in general and within food chain management in particular. However, researchers as well as practitioners often raised the question of whether the more transparency the better. To answer this question, one needed to analyze good practice experiences regarding food chain transparency.

Given the economic (e.g. employment, added value), ecological (e.g. food miles) and ethical (e.g. animal welfare, fair trade) importance of the agri-food business, one of the objectives of the Transparent Food project was to compile a good practice inventory regarding food chain transparency and to analyze selected good practices in-depth to (1) help making the concept of transparency more understandable, (2) provide useful examples from different transparency domains (e.g. food safety, food sustainability etc.), (3) illustrate the difficulties of transparency, (4) provide good practice experiences that have proven themselves over time to reach transparency in the food chain, (5) provide good practice experiences where the optimal level of transparency could be delivered more effectively with fewer problems and unforeseen complications, (6) provide useful examples to improve the average performance of existing transparency systems, and (7) provide useful examples for all stakeholders within the food chain to develop new transparency systems. Hereby, we focused on transparency needs of consumers, industry and policy towards food safety, food quality, food origin and food sustainability (environmental, social and economic issues).

Results from the good practice inventory (Gellynck et al., 2011; project deliverable D6.2) indicated that a number of experiences existed which were effective in addressing transparency issues.

*Goal 1: Developing optimal transparency systems*

The European food system was active as well on domestic markets as on international markets. In this food system, innovation was taking a leading role as precursor of competiveness, growth, welfare and well-being. Researchers as well as practitioners modelled the above relationship under perfect competition, whereas perfect information was one of the assumptions of perfect competition. However, within real-life contexts - especially when competition was optimized under (information) constraint - it was more realistic to consider optimal competition rather than perfect competition. Similarly, it was more realistic to consider optimal transparency systems, whereas the stakeholders had the information that they needed to make decision, however full transparency was not achieved. Since transparency systems incorporated multiple stakeholders, an optimal transparency system should consider different interests (e.g. market versus public authorities) regarding transparency.

*Major research challenges*

Challenge 1: To understand the problem the transparency system tries to address and to identify the goals of the transparency systems: For whom did we want to create value? There was no agreement on how to measure the performance of transparency systems, or how to develop an optimal transparency system. Still, performance could generally be defined as the extent to which goals were achieved. Consequently, evaluation of performance of transparency systems (development of optimal transparency systems) remained incomplete or impossible if the achievement of goals was not taken into account.

Challenge 2: To understand the differences in stakeholders' interest regarding transparency. In addition to commonly shared interests, conflicting interests of stakeholders might also coexist in transparency systems. The interests of stakeholders were said to be conflicting if they could hinder the achievement of other stakeholders' interest. As such, in order to develop an optimal transparency system, the common and conflicting interests of stakeholders should be evaluated, because optimal transparency systems should build on the common interests of stakeholders, while addressed the conflicting interests in the same time.

Challenge 3: To identify the optimal level of information to obtain optimal transparency instead of complete transparency (superfluous information).

Challenge 4: To identify how the optimal level of information could be realized. Firstly, one needed to determine the required governance structures that encourage reaching optimal transparency that effectively and consistently evaluated transparency performance and provided sufficient support and direction through implementation. Secondly, the responsibilities of the different stakeholders needed to be defined. Thirdly, the determination of the return on investment of realizing optimal transparency. Fourthly, after identifying the optimal level of transparency, it was important to have a look at not only information quantity but also information quality (reliability, accessibility etc.).

*Goal 2: Understanding cost and benefits of transparency systems*

Stakeholders agreed that effective chain management and competitiveness required among others a good transparency system. Although, ensuring transparency throughout the food chain could also present challenges and according costs: the cost of providing information (recording, communication etc.), the cost of selecting and interpreting relevant information. These costs, of building a transparency system, had often been cited as a cause of objection.

*Major research challenges*

Challenge 1: To identify the costs and benefits for the different transparency domains (e.g. food safety, food sustainability etc.): How were the costs and benefits distributed in the chain? Was there a balanced distribution?

Challenge 2: To identify local, national, international (EU) and global cost and benefits of transparency systems to determine the value of transparency systems and to analyze possible valorization on third markets (e.g. North America, Asia).

Challenge 3: To identify the determinants of limited transparency (e.g. trust, power, dependency etc.) and its effect on costs and benefits. For example, lack of communication skills (e.g. not communicating typical failures, weaknesses, and recommended behavior in crisis situations) could result in limited transparency systems.

Challenge 4: To determine how to create a balanced distribution of costs and benefits: What governance structures were required, with public and market responsibilities? Who should lead/be the initiator?

Challenge 5: To compare internationally (within EU) transparency systems, and to identify the effect of different control systems and different (non) coercive systems on the competitive position.

*Goal 3: Creating multi-target transparency systems*

Transparency systems could focus on one target (e.g. economic target by price transparency, ecological target by carbon footprint transparency) or more targets (e.g. sustainability: environmental, economic, social concerns). Addressing more than one target did not result automatically in more transparency. On the contrary, multi-target transparency systems could be confusing during communication and difficult to evaluate. Moreover, these transparency systems were often lacking a clear focus.

*Major research challenges*

Challenge 1: To determine how the different targets could be bundled into one denominator. Transparency systems that focused on one only target, for example carbon footprint (ecological transparency), could be easily evaluated. Multi-target transparency systems, on the contrary, target different aspects which made it difficult to evaluate the performance. Therefore, it was important to define a denominator which included the different aspects of the multi-target transparency system. Moreover, it was important to investigate management tools for the different stakeholders and how to deal with conflicting targets.

Challenge 2: To determine how one needed to communicate with different stakeholders (from farm to fork) when dealing with multi-target transparency systems. When more than one aspect was targeted in a transparency system, a clear communication process was essential to prevent confusing messages.

Challenge 3: To extend food safety towards other management practices: Quality signs for transparency. The objective would be to extend food safety, which focused up till now mostly on labeling and accreditation, towards management practices which included risk and productivity/operations management. Hereby, the question was how this could be realized in the food sector, and more specifically how this could be realized by SMEs.

*Goal 4: Identifying best practice transparency systems as reference systems for future scenarios*

Future transparency systems had to deal with future expectations and the opportunities provided by technology in data collection, communication, and use as well as by data base services that could complement individual data management in collection but also in communication within the chain and with consumers.

Data base services could provide data bases where data of general validity had been collected in advance as a basic input for meeting transparency needs of users. While such data bases might refer to data relevant for any stage of the chain including consumers, they would not have to be communicated throughout the chain but were available wherever needed. Information technology might especially provide support in communication, in dealing with situations where information collection takes place at enterprises within the chain after the product had left the enterprise premises, a situation typical for laboratory testing, on a product's path through the value chain (monitoring) and in communication with consumers where technologies of the Future Internet might provide new opportunities.

*Major research challenges*

Challenge 1: Provided chain information reference processes that constituted future best practice cases for transparency in various scenarios. Based on present best practice such reference processes provided enterprises and policy with a guideline on where to move. This could facilitate communication between chain members and the enterprise investment decisions towards the future.

Challenge 2: Provided a roadmap towards future reference processes. Developments in transparency were a dynamic process where investments support a stepwise improvement. This required the identification of suitable development stages that balance transparency priorities with investment opportunities for various types of chains considering reach (local, global) and major product alternatives.

Transparency Challenge 7: Communication with stakeholders and media

*Scope and state of the art*

For serving the transparency needs of consumers related to the sometimes complex characteristics of food products and food processes, value focused, simple, clear and easy to understand messages were necessary. An information overload caused by too many details communicated to consumers who were usually not food experts might result in confusion, involve the risk that key messages were being overlooked, and might endanger their perception of being properly informed. As a consequence, information for consumers had to be aggregated (in whatever form) and transformed into a simplified message. However, the message had to be linked with background information that included the details the message built on and that might be requested by consumers. This was a well-established approach in literature where it was being referred to as 'drill-down' capability.

The other stakeholders of the food chain such as retailers, industry, service operators or policy might want to build their decisions on signals that communicate much more detail than communicated in consumer messages.

There was a need for a systematic identification of the content, the level of detail and the format of signals and messages that met the expectations of the different stakeholders. Furthermore, there was a need for the development of effective communication strategies, which covered the exchange of transparency information between the different stakeholders, the transformation into signals and messages, and the provision of backup information for serving specific requests. In the development of strategies, the utilization of newly emerging information technologies characterized by functionalities of the Future Internet might provide new opportunities in developing appropriate communication schemes.

*Goal 1: Improving the access of stakeholders to transparency information*

Different stakeholders had different preferences for communication tools for collecting and communicating transparency information. Communication channels were means to ensure that the required information was available for the target audience in the right time, in the right place and at an affordable price. Communication tools were needed that allow meeting the different needs to ensure appropriate perception and absorption by the target audience. Furthermore, the selection of communication channels and tools had to consider the effects on the recipients' trust in the verity of messages and supporting signals.

The provision of transparency information might build on label based and non-label based solutions. Non-label based solutions included Web-based applications that allowed utilizing different communication dimensions such as audio and visual communication opportunities. Such opportunities were especially of interest in communication with consumers who needed to pick up information 'on the fly' and, if possible, filtered and focused according to their personal preferences.

*Major research challenges*

Challenge 1: To understand the preferences of different stakeholder groups for different communication channels, communication tools and communication formats such as languages and audio-visual opportunities considering present and emerging technologies incl. those of the Future Internet. Analysing the effects of alternatives on perception and trust.

*Goal 2: Organizational specification of efficient and balanced transparency systems with fitting levels of detail*

Organizational specification involved specification of the levels of detail and the consideration of a fair balance of interest between the providers and users of transparency. Consumers and policy makers needed less details of transparency information than retailers and food industry. Consumers' and policy's needs for details were not a constant, but might change with the development of knowledge, with changes in public interest in specific claims, and in crisis situations. The higher interest of business users in information details might conflict with the business interest of information providers. There was a need for methods to evaluate how a fair balance could be achieved. Furthermore there was a limited knowledge

available on measuring the impact of different transparency communication methods on efficiency.

*Major research challenges*

Challenge 1: To understand the motivators of different consumer groups for requesting transparency information and to develop methods for determination of the optimal level of details of transparency information to consumers, policy makers, and media.

Challenge 2: To understand which factors influenced the fair balance between transparency needs of the recipients and the needs of the information providers.

Challenge 3: To evaluate the impact of the efficiency of transparency communication.

*Goal 3: Improving the exchange of transparency information between consumers and SMEs*

Consumer requests for transparency information were permanently increasing. Enterprises and especially SMEs might have difficulties in meeting the transparency requests provided by retailers and the society because of lack of knowledge, lack of resources and lack of facilities.

*Major research challenges*

Challenge 1: To improve the capabilities and facilities of SMEs for communication of transparency information.

Challenge 2: To improve consumers' understanding of the concept and use of transparency.

*Goal 4: Establishing open innovation exchange between consumers and members of the chain at various stages of the chain*

Open innovation in the food sector described a concept that built on direct communication between members of the chain and consumers as the chain's final customers. This direct communication might support enterprises in the identification of strategic innovations and, in turn, in strategic innovation regarding transparency.

*Major research challenges*

Challenge 1: Analysing and evaluating open innovation concepts for suitability regarding innovations in transparency in different scenarios. Identification and experimental evaluation of most suitable concepts for utilization in industry.

Transparency Challenge 8: Dealing with claims and data ownership

*Scope and state of the art*

Data and claims had in common that they were based on ownership. The use of data as well as the use of claims was subject to approval by owners. Furthermore, if used by actors in the chain, the utilization required some understanding of their reliability.

Product characteristics that couldnot be measured at the final product were principally provided as 'claims'. The reliability of claims was of critical relevance for the evaluation of a product's characteristics and for consumers' trust in the claims. Its specification and control was especially complex in issues that were difficult to measure and quantify. Of specific importance were claims that incorporate clusters of information such as certificates. In transparency developments, the availability and use of claims was of high relevance. They usually provide clusters of information that could be picked up from the claim wherever needed and without a need to communicate the individual information items across the chain. Furthermore, the ownership of claims put responsibility for substantiation on ownership relieving chain actors from the burden of providing information guarantees.

Data ownership (see also Schiefer, 2010; project report D7.2) was a critical issue in the food sector. As the distribution of data ownership did usually not match the power balance in chains, it was a source of tension and debate. Data could be owned by individual enterprises, by groups of enterprises, or by the public. Presently, transparency interests had a major view on data potentially available from agriculture. This included prominent subject areas as carbon emissions, animal welfare, use of pesticides, etc. The collection of data was connected with costs, their use with benefits. Furthermore, data provided by actors in the chain could be used by other members of the chain against their interest. This was part of the debate on the provision and use of data between agriculture, industry and retail.

*Goal 1: Substantiation of claims*

A claim was in itself just a statement that might refer to any of the aspects of relevance for the provision of transparency. For its utilization by any actor in the chain and especially in communication with consumers it needed substantiation that supported its reliability and, in turn, trust in the statement’s content. Especially claims based on major certification schemes such as GlobalG.A.P dealing with agriculture, IFS dealing with suppliers of retail, and others build on sophisticated controls to provide the requested guarantees. However, even in certification schemes, controls vary between schemes, countries, and certification bodies which were a challenge for using claims in the provision of transparency one could trust in.

*Major research challenges*

Challenge 1: Development of a concept on the specification of the reliability of claims. Using claims from whatever sources in the development of transparency systems required a unified evaluation approach of the control and guarantee system behind the claims. Such an approach was a pre-requisite for motivating enterprises and consumers to accept claims as part of a trusted transparency system.

Challenge 2: Substantiation of the reliability of commonly used claims in the food sector and the analysis of costs and reliability benefits of different control and guarantee systems behind the claims.

*Goal 2: Protecting and considering data ownership*

Protection of data ownership was a core requirement of any communication systems. This was more complex as it might sound. It involved issues of costs and benefits, the protection against misuse of data (e.g. use for purposes not agreed upon in provision agreements), the protection against distribution by recipients to third parties not agreed upon or the protection against access to data not authorized by owners. It was apparent from this list that the protection of data ownership and its consideration in transparency systems requires different disciplines to cooperate.

*Major research challenges*

Challenge 1: With increasing interest in transparency, the provision of data became an important issue in competitiveness. It was necessary to understand the added value of data and to relate them to the costs of collection, transformation and communication. This could open the way for the development of information markets where the provision of data was evaluated (and priced) in accordance with costs.

Challenge 2: The power balance in chains was a source of distrust which could be overcome by contract schemes and organizational developments especially linked to agriculture. Similar challenges were being faced by other SMEs in the chain. However, it was especially relevant for agriculture as one of the major provider of information with relevance for transparency. It was envisaged that model arrangements developed for this stage in the chain could be transferred to other groups as well.

*Goal 3: Designing markets for information and claims*

With increasing relevance of transparency information and transparency claims for competitiveness of enterprises and chains, they had to be viewed as products in their own right and with own market relevance. They might be part of a product's value but might also become issues of independent marketing activities. This asks for the development of appropriate market environments and market rules adapted to different scenarios. Early examples were represented by initiatives like 'book and claim' where claims were completely separated from the products they initially were linked to.

*Major research challenges*

Challenge 1: Understanding different options for the organization of information markets that fitted the specific needs of SMEs in trading of information for use in transparency systems. Analysed, simulated and evaluated newly emerging options that utilized state-of-the-art

information technology and might serve customers in the chain as well as data base service providers that might offer data of more generic nature to third parties outside the customer range of the data provider.

Challenge 2: Understanding different options for the organization of markets of claims that were based on initiatives by major providers of claims such as providers of certificates dealing with quality, environmental, social or ethical issues. Analysed, simulated and evaluated newly emerging options that utilized state-of-the-art information technology and provided transparency all along the chain and also towards consumers. This incorporated explicitly market opportunities with consumers that might e.g. subscribed to receiving transparency on the reliability and background of claims.

Transparency Challenge 9: Coordination and cooperation initiatives

*Scope and state of the art*

A prerequisite for making transparency work was the assurance that all enterprises along the chain adhere to the requirements of a suitable chain information process and were able to link up with their suppliers and customers for appropriate information exchange. Even if information processes had been clearly defined, enterprises still needed to be coordinated in their efforts and to have the technological, organizational, and intellectual capability as well as the legal and contractual right to collect, process, provide, and communicate the requested information.

The coordination need was a critical issue in a sector dominated by independent SMEs in agriculture and food industry while to a large extent being connected to multi-national enterprises in agricultural inputs and retail. Furthermore, coordination was a pre-requisite for any sensible chain transparency initiative as chain transparency couldnot be assured by any individual enterprise along the chain. Retail couldnot deliver without farms, agriculture couldnot deliver without industry and retail. This was a situation where groups have called for policy action to break a possible deadlock.

Coordination needed to assure that the technological, organizational, and intellectual capabilities of enterprwases engaged in a chain transparency system do fit efficiently together. As an example, if an enterprise communicated necessary information in paper format while the recipient expects information in digital form the system organization of the partners did not fit and the transparency system involved a communication barrier that needed to be eliminated. This capability might be referred to as an enterprwase's 'T-readiness' (Schiefer, 2010; project deliverable D7.2). It was a concept derived from the concept of 'E-readiness' where the focus was primarily on technology. 'T-readiness' integrates 'E-readiness' and information content. Serving transparency needs of stakeholders towards the end of the food value chain including consumers requires a level of chain or network development where trading partners operated on a similar level of 'T-readiness'.

*Goal 1: Identifying suitable organizational infrastructures for coordination support towards increasing transparency in the sector*

For reaching transparency, there was a need for organizational support. Agreements on the utilization of standards for data exchange, the utilization of technology, the organization and management of interface platforms (data backbones), the evaluation of claims and other wassues required coordination in a sector with a diversity in stakeholders, a high percentage of SMEs, and no natural focus point that could assure (from the viewpoint of all stakeholders involved) cooperation and fair coordination initiatives.

*Major research challenges*

Challenge 1: Identification of major barriers towards increased in transparency and identification of potential blueprints for possible organizational infrastructures in support of transparency. This might involve new privat or public institutional initiatives or organizational developments within the sector.

*Goal 2: Reaching a sector status in information availability and information handling that fits transparency needs and efficiency requirements*

Any coordination initiatives in the sector had to build on enterprises ability to receive, collect, use, and communicate information that fits the transparency needs of the chain as well as the technological, organizational and intellectual requirements of the chain transparency system (T-readiness). The organization of an appropriate level of ‘T-readiness’ within the sector was beyond the decision competence of individual enterpriseses and requires a chain or sector view.

*Major research challenges*

Challenge 1: Determining the indicators for a suitable analyswas of 'T-readiness'. Analyzing and mapping the actual level of 'E-readiness' and 'T-readiness' at enterprise and sector level in the sector. Identification of possible layers of feasible enterprise networks with fitting T-readiness.

Challenge 2: Analysing needs for investments and initiatives on enterprise and sector level for moving upwards in layers, e.g. moving from a lower to a higher level of T-readiness. Analysing costs and benefits of selected (content specific) transparency systems of different layers and specification of the benefit-cost ratio of moving from lower to higher levels of T-readiness on enterprise and sector level.

**Potential Impact:**

The ultimate goal of the project was to contributing to the long-term sustainability and competitiveness of the food sector in serving consumers with food that meets their expectations now and in the future within the dynamically changing environmental, social and ethical framework set by society.

The project's immediate contribution to this goal was on supporting the elimination of sector deficiencies in providing transparency to consumers, policy and enterprises along the chain which would enable 'informed decisions' and an 'informed appreciation' of the sector's efforts towards sustainability at all levels. Deficiencies in transparency are considered one of the crucial barriers in sector developments towards sustainability which are not just of relevance for food but with the crucial relevance of food production for the society, of broad societal implications not just in Europe but on a global scale.

The lack of a European approach has been limiting the development of systems that could support transparency on a broad scale, e.g. involving the many small and medium sized enterprises active in the sector. There have been many past efforts to provide solutions for the 'transparency problem'. None of them proved to be successful beyond the immediate project environment, primarily due to remaining deficiencies in the system approach required for solving the transparency problem in the dynamically changing network situation of the food sector with its many SMEs.

The project aimed at providing transparency in deficiencies that required attention for making a sector wide transparency solution feasible. A small illustration of one of the domains under consideration should clarify the situation. There have been a number of projects dealing with the establishment of tracking and tracing systems in food. However, there is not yet any agreed communication standard that allows exchange of data between agriculture, industry and retail, a base requirement for any communication system. Similar deficiencies are in communication with consumers, in concepts for dealing with data ownership etc. etc.

The project's has provided the basis for a major impact on the development towards comprehensive and feasible transparency systems. This major impact will be reached if the needs for research and initiatives identified in the project will be picked up by research organizations and their funding agencies. To this end the project identifies its immediate impact through making policy, research and stakeholders aware of the transparency in deficiencies provided by the project.

The project has reached its awareness goal in making stakeholders of various kind aware of the analysis. Workshops, stakeholder meetings, training programs, utilization of a stakeholder database of about 3000 users, presentations at major stakeholder meetings of FoodDrinkEurope, involvement of the National Technology Platforms of the ETP 'Food for Life', web presentations, dissemination by the European Retail Academy, and a distribution of a professional 'Strategic Research Agenda' throughout Europe have contributed to a broad based awareness within Europe.

It is beyond the capability of the project to identify all the activities that might be initiated by the project results. However, some follow-up activities including the support for a web based ‘European Transparency Platform’ are documented.

The project created a European work group of system providers of all sizes that were contributing their competence in technology and user transparency platforms to the project. This working group is managed by a project partner, continues to operate, and has been carried over to other European project activities. Furthermore, the project provided the base for a comprehensive European PPP program (FI-PPP) which builds on a sequence of project activities and has as one of its goal the 'large scale implementation' of 'Awareness' throughout Europe. If successful, this program could provide a major breakthrough being fully aware of the deficiencies identified in this project.

While of major interest, the PPP program is not the end of interest. Ongoing initiatives towards future project proposals are actively integrating results from the project Transparent_Food. It is also contributing to various Strategic Research Agendas presently under development in various food domains as e.g. in Food Safety within the project FoodSEG. This second level dissemination activities multiply the awareness effect of the project and will reach more into the future than the project itself could reach.

**Main dissemination activities and exploitation of results**

For optimal dissemination and exploitation of the project's results to the stakeholders in the European food sector, the project organized a broad initiative for improvements in transparency, which has been reached through a broad awareness on opportunities, needs and the value of transparency for the sustainable development of the sector. The following initiatives have been created:

*1. BEST PRACTICE INVENTORY ON FOOD TRANSPARENCY*

The inventory contains descriptions of successful cases of food transparency systems. These cases can be used by the food businesses as a source of practical information to build up and improve their transparency systems. The inventory is freely available.

Impact: improving supply of information to consumers and customers to enable their informed decisions.

*2. BEST PRACTICE GUIDE ON FOOD TRANSPARENCY*

The objective of the guide is to provide practical advice to food businesses to build up and improve their transparency systems and to policy makers in designing policy measures to improve transparency for consumers. All potential users can have a free access to the guide. The owners can use it for contract work for food businesses and in other research projects. CCH and UBO use already this knowledge in the SmartAgriFood FP7 project.

Potential impact includes enabling consumers for better informed decisions and development of better policy measures.

*3. TRAINING PACKAGE ON FOOD TRANSPARENCY*

The objective of the training package is to provide the basis for systematic knowledge transfer on food transparency. The owner will provide training on fee paying basis. The project partners can have a free access right from the owner to deliver the course. Other interested organisations can have an access right to deliver the course by individual agreements. Expected impact includes improved knowledge on transparency practices and better legislation leading to better information of consumers enabling their informed decisions.

*4. STRATEGIC RESEARCH AGENDA ON FOOD TRANSPARENCY*

The purpose of the exploitable foreground is identifying the directions and topics of future research and to provide input for the EU and national research programmes.

Potential impact: focused research on key challenges related to food transparency.

*5. EUROPEAN TRANSPARENCY PLATFORM*

The purpose of the European Transparency Platform is to provide a tool for the dialogue with the stakeholders on food transparency. All stakeholders can use it for improving their knowledge and understanding on food transparency systems.

Impact: improved knowledge on food transparency leading to better information of consumers enabling their informed decisions and leading to better policy measures.

*6. BLUEPRINT PROPOSAL FOR EUROPEAN BACKBONE SOLUTION*

The purpose of the foreground is to provide a knowledge base for standardisation of the ICT infrastructure for food transparency systems. KTBL and UBO can use it for contract work and further research including the SmartAgriFood project.

Impact: improved compatibility of transparency systems making possible better communication of systems of different companies.

**List of Websites:**

In general the project website has been designed yet at the beginning of the project to offer a platform for communicating to the public and to industry operators the results and achievements of the project. The website was continuously updated and informed about the state and results from the project. This website was located at a domain specifically registered for the project:

http://www.transparentfood.eu.

Prof. Dr. Gerhard Schiefer
University of Bonn
Department of Food and Resource Economics
Chair for Business Management, Organization and Information Management

Meckenheimer Allee 174
D-53115 Bonn
Germany
E-mail: schiefer@uni-bonn.de
Phone: +49-228733500
Fax: +49-228733431