European Technology Platform
Food for Life

European Technology Platform "Food for Life"

Strategic Research and Innovation Agenda
(2013-2020 and Beyond)

Table of Contents

Strategic Reseach and Innovation Agenda (2013-2020 and Beyond)

European Technology Platforms are industry-led, public/private partnerships encouraged by the European Commission to drive innovation and unite stakeholder communities in reaching strategic research objectives of key European industry sectors. The main goals of the ETPs are to strengthen the European innovation process, improve knowledge transfer and stimulate European competitiveness across the food chain.

In 2005, a European Technology Platform (ETP), Food for Life was established under the management of the Confederation of Food and Drink Industries of the European Union (CIAA), which has since been renamed FoodDrinkEurope in June 2011. FoodDrinkEurope is the trade body representing the interests of food and drink manufacturers at the EU level.

Since its establishment, the ETP has brought together the main European stakeholders of the food sector; consumers and society, food and related industries, academia and research community with the aim of working together to define the European research priorities in the food chain.

The ETP's first Strategic Research Agenda (SRA) was published in July 2007. The newly revised Strategic Research and Innovation Agenda (SRIA), "2013-2020 and Beyond" now focuses specifically on innovation.

Going forward, this publication will be available online at www.fooddrinkeurope.eu and will be updated on a regular basis.

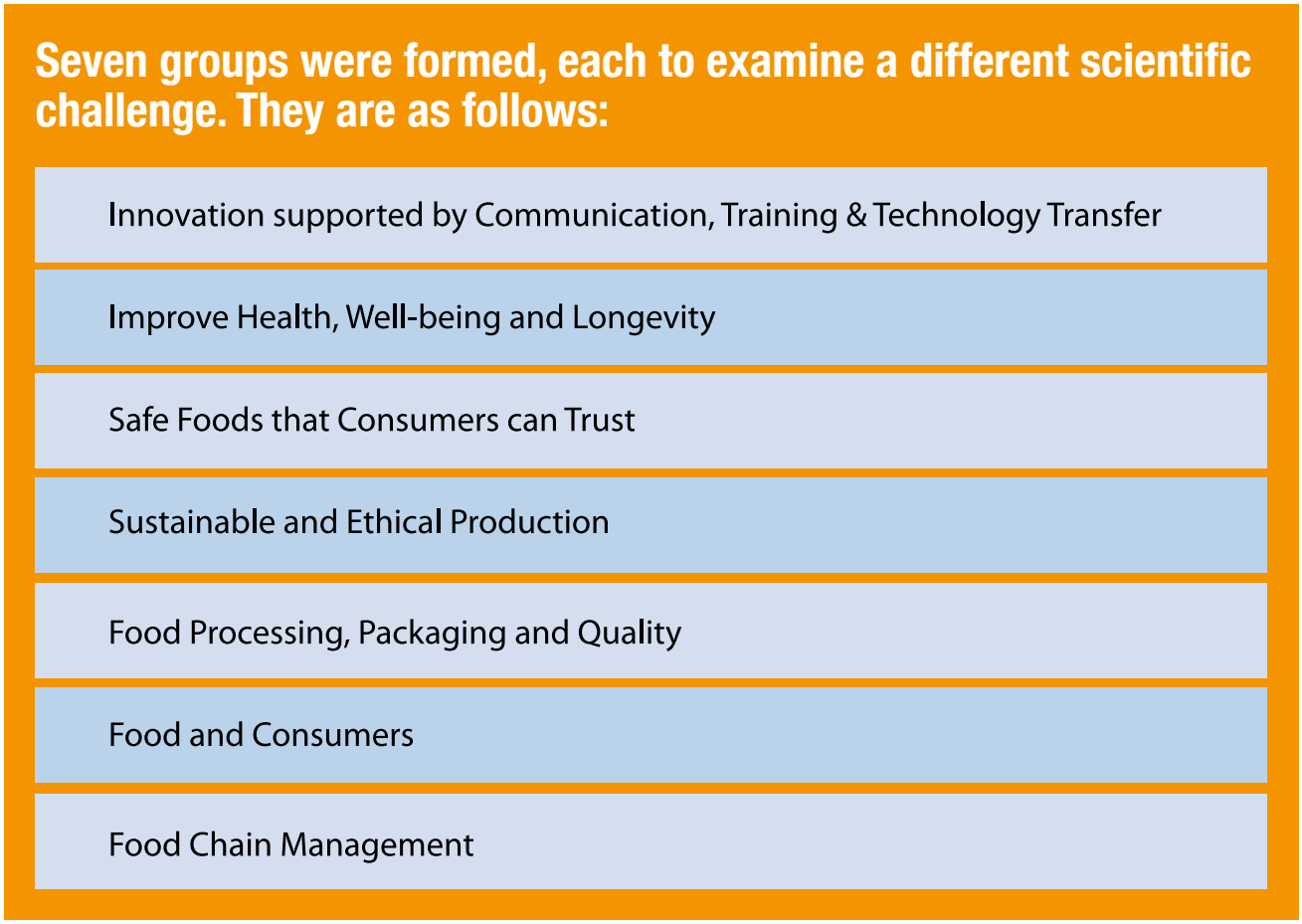


Figure 1. Challenges addressed by this Strategic Research and Innovation Agenda

An extensive network of national and international working groups was established as part of the drafting process.

Particular care was taken to ensure that both the structure and objectives of Horizon 2020 were taken into account in the development of each of the challenges listed above

A series of scientific goals or sub-themes and a list of priority research topics were developed for each scientific challenge. The goals of these sub-themes are as follows:

Innovation supported by Communication, Training & Technology Transfer

- Innovation Awareness – Communication
- Innovation Uptake – Training
- Innovation Processes - TechnologTransfer
- Transdisciplinary Collaboration

Improve Health, Well-being and Longevity

- Understanding human metabolic energy efficiency including human gut microbiota
- Catering for the nutritional and sensory needs of an ageing population
- Plant protein sources for use in high quality food
- Early biomarkers to detect deviation from the norm
- *In vitro* models for *in vivo* nutritional predictions
- The use of stable isotopes in food and nutrition research
- The role of the diet in:
  - pregnancy and on the outcome of the offspring
  - preventing cognitive decline
  - treatment of low grade inflammation
  - drug delivery
  - delivery of health promoting ingredients
- A reduction in 'anti-nutritive' components in food such as:
  - allergens
  - the gluten challenge

Safe Foods that Consumers can Trust

- Microbiological hazards and challenges
- Chemical hazards including toxins of biological origin
- Robust and cost-effective risk analysis (RA) concepts based on sound, cutting-edge scientific understanding
- Real-time & rapid detection tools to ensure safety and security in the food chain, including food defence

Sustainable and Ethical Production

- Sustainable production
- Sustainable consumption
- Tools and methods

Food Processing, Packaging and Quality

- To generate information leading to a European food indus try that has:
  - optimum sustainability
  - optimum efficiency (on economic, technological and ecological)
  - extended delivery of food products with new properties and functionality aimed at fulfilling preference, acceptance and needs of consumers (by reverse engineering approach)
- To have greater integration in research between processing, food quality and safety, nutrition/health and sustainability
- To update training of food science/engineering students, in order to avoid exclusive specialization, and enable the initiation of research across the borders of scientific discipline
- To strengthen an SME innovation platform

Food and Consumers

- Societal challenges:
  - food safety and security
  - health
  - sustainability
- Behavioural changes:
  - consumer decision making; out-of-home
  - consumption, etc.
- New developments:
  - consumer engagement
  - price (uncertainty) as a determinant of
  - food choice
- Methodological innovations:
  - networking European Food Consumer
  - Science Capability
  - longitudinal analysis in consumer science research
- Dissemination for SME applications

Food Chain Management

- Reduction of waste (dealing with diminishing natural resources
- Assuring trust within the chain to better serve society and consumers
- Supporting the present and future food chain scene
- Supporting newly emerging chains (analysis and optimisation)
- Coping with changes in demographics
- Dealing with structural change
- Improving governance and innovation
- Developing metrics for social responsibility to enhance fundamental/applied research and SME-led innovation

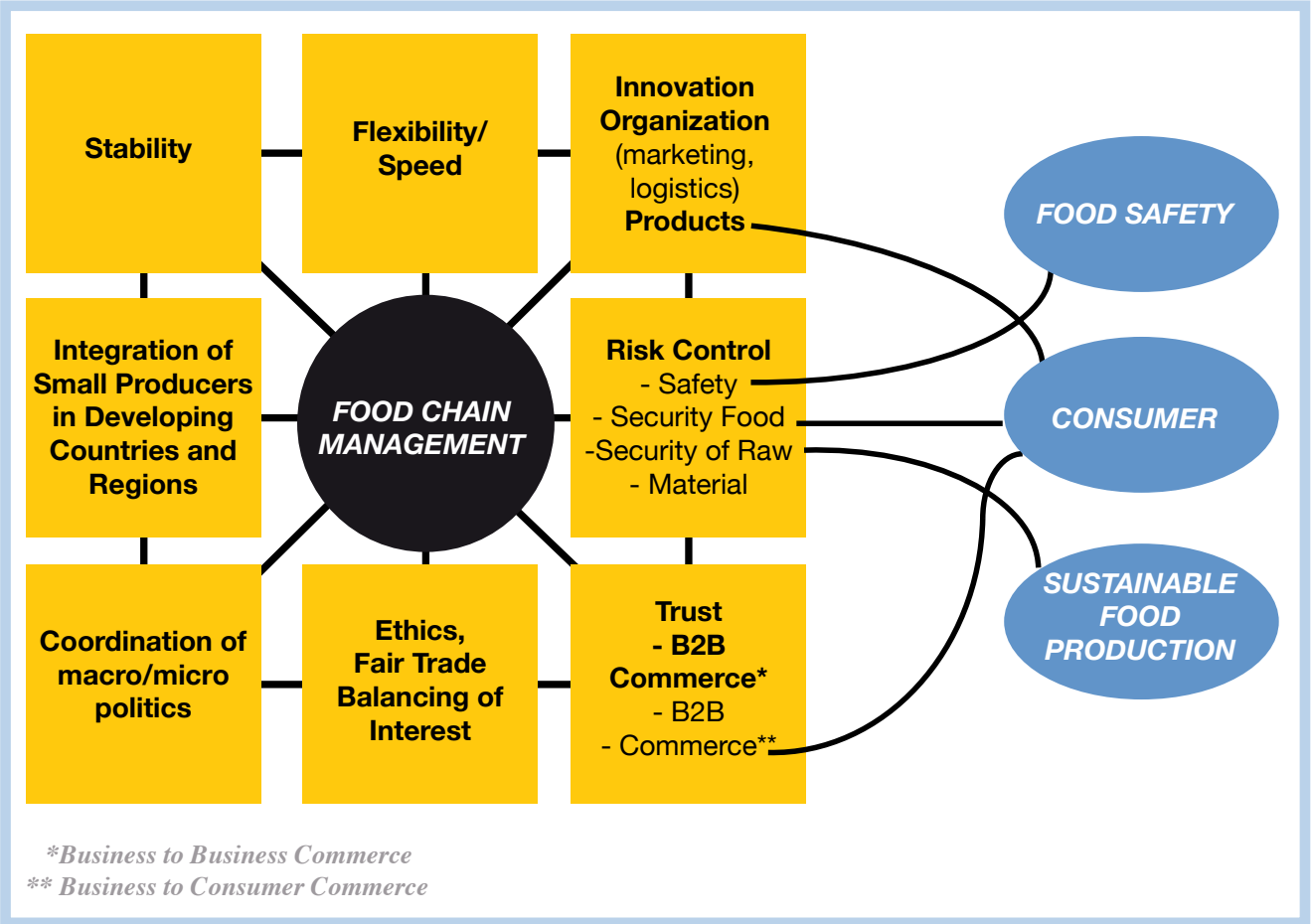


Figure 1: Key success factors in food markets and challenges for food chain management with interfaces to other principle themes of the ETP Food for Life

A separate chapter was developed on the operating modalities recommended for Horizon 2020. This chapter makes recommendations on operations, SME involvement, Joint Programming Initiatives (JPI) and Knowledge & Innovation Communities (KIC) as applied to the food industry.

Chapter 01 Introduction

The European Technology Platform Food for Life (ETP) was set up in October 2004 under the auspices of the European food industry and aimed to support a successful and competitive pan-European agro- food industry having global leadership securely based on economic growth, technology transfer, and sustainable food production and consumer confidence. Three key thrust were identified that lead to products, processes and services that:

- improve health, wellbeing and longevity
- build consumer trust in the food chain, and
- support sustainable and ethical production

- To attain this goal a strategy was developed to:
  - identify and prioritise the research needs of the European food industry
  - coordinate food research in Europe and avoid duplication
  - promote SMEs participation, specific programmes and networks
  - focus, align and collaborate transnationally between stakeholders
  - increase multidisciplinary / cross-sector education and researchers carriers
  - increase multidisciplinary / cross-sector education and researchers carriers
  - optimise knowledge capture and transfer know ledge between Member States and towards SME's
  - increase R&D strategy and funding

Using a series of scientific working groups drawn from industry, academia and research institutions, the ETP developed a Strategic Research Agenda (SRA) that was published in September 2007 after extensive national, regional and web-based consultations. This was followed in October 2008 by an Implementation Action Plan.

One area in which its effectiveness has been easy to quantify is its use in research calls under the food-related areas of the Knowledge-based Bioeconomy section of the 7th Framework Programme of the European Union. Of course, food research is clearly embedded into the Bioeconomy challenge. Food production is at the core of biological production and less negotiable than other products from biological systems. A detailed examination shows that more than 90% of topics in these calls directly correspond with topics suggested in the 2007 Strategic Research Agenda. Less easily quantified is the success rate in influencing calls under various national funded research calls. However, there is significant evidence that suggests that in all countries, both in those with and without formalised national research agendas, the suggestions of the SRA were of significant influence.

An important result of the ETP Food for Life was also the setting up of a Joint Programming Initiative "A Healthy Diet for a Healthy Life" where coordination and alignment of national programmes will take place.

With the 8th Framework Programme (now called Horizon 2020) being developed, it was agreed by the ETP Board that an updating of the SRA was timely. Not only was the document now almost 4 years old, but national and EU research agendas had evolved to include innovation as a more prominent core principle than hitherto. Consequently, a full updating was commenced in October 2010 and has resulted in this document.

In addition to the use of working groups developing the research needed to meet the grand challenges of the European food industry (as had been used for the 2007 document), a very large consultation structure had been developed by the ETP in the intervening years.

The challenges used in the development of this document are identified in Fig 1 below. Scientific working groups were set up in each of these areas with representatives drawn from industry, academia and research institutions. Their role was to identify the research needs of the European food industry between 2012 and 2020. Their findings were then refined by a wide consultation process using a network as shown in Fig 2 below.

Scientific challenges of the ETP Food for Life
1. Improve Health, Well-being and Longevity
2. Safe Foods that Consumers Can Trust
3. Sustainable & Ethical Production
4. Food Processing, Packing & Quality
5. Food & Consumers
6. Food Chain Management
7. Communication, Training & Technology Transfer

Figure 2: Challenges addressed by this Strategic Research and Innovation Agenda

National Technology Platforms

36 National Technology Platforms were set up in 35 countries (Albania, Austria, Belgium Flanders, Belgium Waloon, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lebanon, Lithuania, Montenegro, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Netherlands, Turkey, Ukraine, United Kingdom). Representatives of these platforms meet twice a year and provide input into the development of this Strategic Research and Innovation Agenda. More than 6000 individual companies, industry associations, universities, research institutes and individual scientists are represented in this network. This network is still expanding.

Mirror Group of national funding agencies

The Mirror Group consists of representatives of the funding agencies for food research in every European country. This group meets twice a year, often jointly with the National Technology Platforms, and provides input into the implementation of the Strategic Research and Innovation Agenda.

Through the input of these two groups it is possible that relevant themes and topics from national agendas may be incorporated into the overall European agenda of the ETP.

Science and Research Groups of FoodDrinkEurope

FoodDrinkEurope (formerly CIAA – Confederation of the food and drink Industry of the EU) represents the European food and drink industry, the largest manufacturing sector in the EU in terms of turnover and employment. It aims to promote the industry's interests to European and international institutions, contributing to a framework addressing, inter alia, food safety and science, nutrition and health, environmental sustainability and competitiveness.

FoodDrinkEurope's mission is to facilitate the development of an environment in which all European food and drink companies, whatever their size, can meet the needs of consumers and society, while competing effectively for sustainable growth.

FoodDrinkEurope's contribution is based on working within the regulatory framework to ensure that all food and drink issues are dealt with in a holistic manner. The organisation promotes its members' interests in areas such as food safety and science, nutrition and health, consumer trust and choice, competitiveness, and environmental sustainability.

In addition to providing the Secretariat for the ETP, its Science Group and its Research & Development Group provide an input to the research agenda of the ETP.

SME taskforce

Since the majority of the close to 400,000 companies which make up the European food industry are Small to Medium sized Enterprises (SMEs), it is important that the views of SMEs be incorporated into any research agenda. This is especially true when considering the modalities of operating of any research programme and the barriers that may exist to successful innovation from research outputs

Consequently, an SME taskforce was set up by the ETP and it is represented on the ETP Board and its Coordination Committee.

The ETP Board

The Board of the ETP is industry based with representatives from the major food companies, the larger food associations, the SMEs and a small number of scientists. The chairs of each ETP committee are also members of the board. It meets three times per year to ratify the outputs of the various ETP committees.

Coordination Committee

The Coordination Committee is the management group of the ETP. It meets at approximately six week intervals or as required and makes interim decisions on the working of the ETP.

All stakeholders in the European food industry

While the ETP has approximately 6,000 companies/organisations/individuals within its structure, this is only a very small percentage of the 4.2 million employed in the European Food Industry. Consequently, it is the policy of the ETP Food for Life to have an open consultation process during the development of its strategic documents. This was done before final publication of the 2007 document. For the current document, an open web consultation was held during September and October 2011 and was followed by an open stakeholder day on 22 November 2011. Suggestions received during these processes are incorporated into this document.

1.1 The structure of the Strategic Research and Innovation Agenda

This Strategic Research and Innovation Agenda is an update of the 2007 Strategic Research Agenda and its 2008 Implementation Action Plan. While the underlying societal challenges remain relatively unchanged, their emphasis has varied somewhat and, of course, many new scientific questions (see Chapter 10) have come to the fore. While a basic scientific structure underlying the topics of the challenges outlined in section 1.1 seemed appropriate and practical for the internal work of the ETP, it is also useful to consider how the food sector can contribute to the objectives and challenges of Horizon 2020 using the structure currently proposed by the EU Commission for the whole of the Horizon 2020 programme. This is shown below in Figure 3.

STRUCTURE OF HORIZON 2020
(EU Commission, Nov 2011)

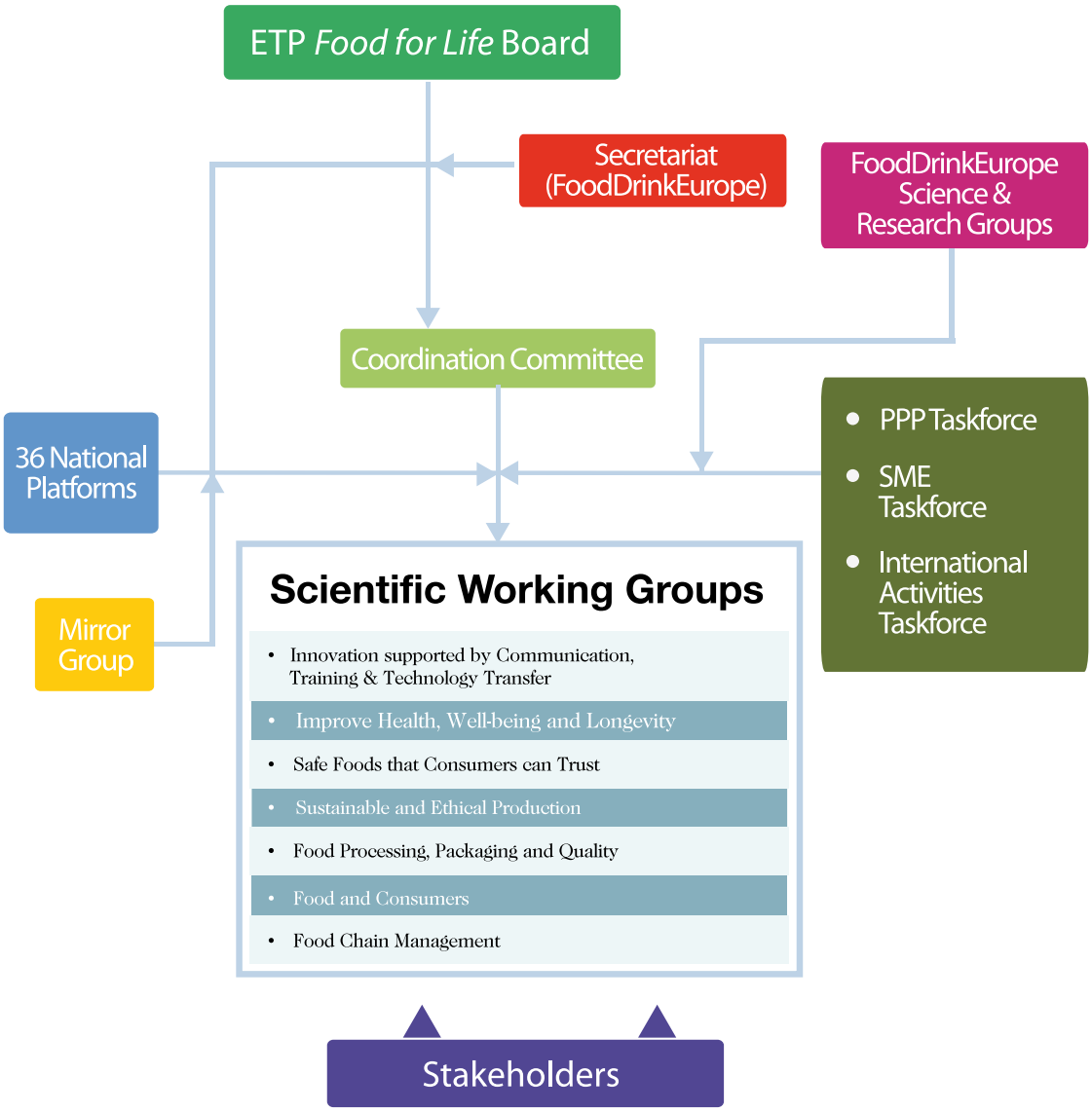
Excellent Science	Industrial Leadership	Social Challenges
OBJETIVES: 1. The European Research Council 2. Future and emerging technologies 3. Marie Curie actions 4. Research infrastructures	OBJETIVES: 1. Leadership in enabling and industrial thecnologies: -Information and Comunication Technologies - Nanotechnology - Advanced materials - Advanced manufacturing and processing - Space 2. Access to risk finance 3. Innovation in SMEs	CHALLENGES: 1. Health, demographic changes and wellbeing 2. Food security, s ustainable agriculture and the bioeconomy 3. Secure, clean and efficient energy 4. Smart, green and integrated transport 5. Climate acttion and resource efficiency including raw materials 5. Inclusive, innovative and secure societies

Figure 3: Structure proposed for Horizon 2020

While there are sections of the above structure that provide a good fit with the challenges of the ETP (e.g. Challenge 1 of the societal challenges fits well with the Health well-being and longevity theme of the ETP), the fit for other areas is not quite as clear. Consequently, the scientific structure of the ETP will be retained for this document but each chapter will commence with a brief outline on how the subject area fits into the Horizon 2020 structure.

1.2 Chapter structure of the Strategic Research and Innovation Agenda

Following from the foregoing argument, the structure of the remaining chapters will be as in Figure 1. However, innovation, which will incorporate communication, training and technology transfer, will be dealt with in chapter 2 since innovation must be incorporated into every aspect of research over the coming years. This will be followed by six chapters outlining the scientific themes or challenges while some suggested ways of overcoming barriers to innovation will be considered in Chapter 9 on the modalities of operation suggested for Horizon 2020. Finally, detailed research topics will be outlined in Chapter 10.



Chapter 02 Innovation supported by communication, training & technology transfer

Innovation is at the core of Horizon 2020 and also of this Strategic Research and Innovation Agenda. The three main elements of innovation awareness, innovation uptake and the innovation process are considered in some detail in this chapter. In chapter 10 some operational issues will also be addressed to enhance this subject.
Quite apart from being the central core value within Horizon 2020, the challenge of innovation fits well with many of the elements of the three pillar structure of Horizon 2020. This is shown in Figure 2.1 below.

Innovation supported by communication, training & technology transfer

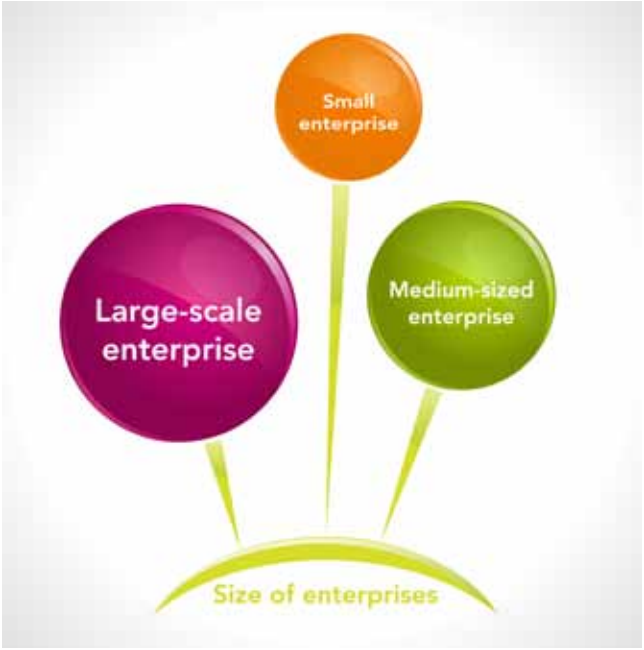
Excellent Science	Industrial Leadership	Societal Challenges
OBJECTIVES 1.- The European Research Council 2.- Future and emerging technologies 3.- Marie Curie actions 4.- Research infraestructure	OBJECTIVES 1.- Leadership in enabling & industrial technologies - Information & Communication Technologies - Nanotechnology - Advanced materials - Advanced manufacturing & processing - Space 2.- Access to risk finance 3.- Innovation in SMEs	CHALLENGES 1.- Health, demographic changes and wellbeing 2.- Food security, sustainable agriculture and bioeconomy 3.- Secure, clean and efficient energy 4.- smart, green and integrated transport 5.- Climate action and resource efficiency including raw materials 6.- Inclusive, innovative and secure societies

Figure 2.1: Innovation Supported by Communication,Training and Technology Transfer

With such a large percentage of its enterprises being SMEs, the European food industry demands innovation within its SMEs if food research over the next decade is to be successful. Equally important will be the communication tools addressed at the industry and the consumers if new food products, processes and technologies are to be accepted. Indeed, one could also argue that this challenge also fits into the Inclusive, innovative and secure societies theme of pillar 3.
It can also be argued that different approaches must be adopted for different sectors of the food industry and for different categories of SMEs. Indeed, all SME's need training on the techniques of managing innovation and commercialization of R&D outputs. It is also important that equal emphasis be given to the dissemination and use of existing knowledge from R&D as well as the generation of new knowledge. It has been suggested that the existing National Food Technology Platforms could be used to improve access to SMEs and build on the good linkages already established between SMEs, national food federations and research associations. Indeed, there may even be a case for establishing national food industry technology transfer centres in association with the NTPs.

Public funding will be required to support the absorption capacity of SMEs for innovation and to support the better transfer and diffusion of knowledge from R&D. This may require changes in the evaluation of schemes targeted at enhancing innovation activities with innovation aspects being given prominence rather than research aspects. Taxation incentives may also be useful in encouraging SMEs to undertake the risk of innovation.

Stimulating societal awareness on science and technology should focus on all stakeholders with a direct or indirect agenda on food issues and be directed also at the public at large. Sound information about the food sector and its products will contribute to a more positive attitude in society and, as a result, lead to sustained support for science and innovation. In order to most effectively exploit the potential for innovation in the food sector, a coherent communication strategy has to be developed, which embraces all stakeholders. This strategy has to recognise that the nature and aims of communication with these stakeholder groups will differ and that a single communication channel will be ineffective.



2.1 Innovation Awareness - Communication

There is no single communication system that can achieve this goal. Effective communication across Europe and across stakeholder communities can only be assured through a number of complementary and integrated activities, covering Europe-wide, regional and national events. Best practice from one country or region should only be extended after demonstration of its effectiveness and/or adaptation for broader use. Subsidiarity considerations demand that the majority of initiatives be implemented and funded at national level and be harmonised with, and integrated into, the specific actions of the national food platforms which will ensure that exchanges of experiences and best practices are effectively achieved.

The main messages from individual governments and policy-makers must emphasise the importance and opportunities of the food and drink sector across Europe, because of its:

- generation of sustainable economic growth through innovation
- creation of employment, both full- and part-time
- contribution to improving the quality of life, thereby delivering health benefits to society
- reduction in spiralling welfare and social costs associated with foodborne illnesses
- ensuring food security and availability at affordable cost

By achieving these objectives, it should simultaneously improve competitiveness for both the European and Global food industries.

To respond to these opportunities, the ETP Food for Life communication strategy will be implemented at three levels:

European wide initiatives, which are general in character and address food-related issues and innovation within the context of the global economy and the positive effects of individual foods and the overall diet on quality of life and public health. Such initiatives would be targeted at high-level representative bodies, such as the European Parliament, individual Directorates of the European Commission, the European Food Safety Authority, regional associations for businesses and entrepreneurs, food trade unions, consumers' associations, etc. Effective communication would also be established with European associations of professionals active in the sector, including scientists and technologists. The key aim would be to communicate and explain the European dimension of the ETP Food for Life.

National communication initiatives, which will be identified and managed within the framework of the national food platforms since these are better suited to the needs and expectations of companies and consumer bodies. Measures will be implemented to ensure that the core content of the SRIA is most responsive to the community of food businesses and that their ongoing needs are addressed. National bodies representing science and technology at national level would be engaged via their involvement in national food platforms.

Subsidiary communication actions, which relate to specific issues (nutritional content of given foodstuffs, malnutrition, decreasing sugar and salt content, GMOs, differences in food safety approaches related to different types of products) and requiring a rapid response. Such communication will need to be prepared and disseminated on a case-by-case basis.

These initiatives will only be successful, if for each stakeholder group the core actions for spreading information are identified. Above this, each stakeholder group will have to be targeted with different communication channels. These communication requirements for the different target group are outlined in Table 2.1 overleaf.

TARGET GROUP	CORE ACTIONS	COMMUNICATIONS CHANNELS
Governments and policymakers	Enabling of strategies for future research and innovation policies that foster applied research and innovation uptake and raise awareness about the innovation opportunities and the importance of the food and drink sector across Europe	European and National Federations and Associations, ETP, National Food Technology Platforms, etc. International Events, Newsletters, etc.
General Public	Securing a steady and continuous relationship with consumers via the 'umbrella role' of the consumer associations. Also assuring an important societal dialogue with governmental and non-governmental bodies with a direct or indirect agenda on food issues.	European and national Federation and Associations, ETP, Consumer organisations, etc.
Companies, Focus SMEs	Exchanging reliable information and using appropriate communication technologies including direct contact on a national level to companies and associations. Enabling the National Food Technology Platforms NFTPs as 'partners of trust' and giving motivation to the companies for the application of innovation processes and applied research.	European and National Federations and Associations, ETP, National Food Technology Platforms, etc. International Events, Newsletters, etc.
Researchers	Establishing measures to motivate food researchers to see their work in a larger societal context, and where their success ultimately will be determined by their ability to understand and support the interests of companies and consumers.	Scientific magazines, brokerage events, National Food Technology Platforms, TDUs on national level.
Other members of the chain food	Explore collaboration opportunities with other stakeholders along the food chain.	European and National Federations and Technology Platforms of the other stakeholder disciplines of the agri-food chain.
Other disciplines providing solutions for the food sector	Identify the areas for interdisciplinary collaboration with the ICT, manufacturing, energy, water, nanotechnology, transport sectors to adapt already existing solutions developed for other users and to develop new solutions to enhance innovation in the food sector	ETP National technology platforms, ETP EPoSS, ETP Nessi, ETP Manufuture, PPP Future Internet, EUREKA, ITEA2, EUREKA EURIPIDES, EUREKA EUROGIA, EUREKA E!Surf, EUREKA ACQUEA, EUREKA EUROAGRIFOODCHAIN, etc

Table 2.1. Communication requierements of different target groups

2.2 Innovation Uptake - Training

Training is one of the main tools for transfer of knowledge and the acceptance and application of innovation. It is a key component in increasing competitiveness. At a time of rapid advances in technology and changing consumer demands, lifelong learning will increasingly be needed throughout the whole professional career pathway.

Although training is perceived by all actors in the food sector as crucial to maintaining the competitiveness of companies, and such activities are organized and promoted by the trade associations and academia, the investment of the food industry in training for its workforce is lower than is necessary and this deficiency is even more apparent within SMEs. The proportion of companies employing internal or external training as a key component of a clear innovation strategy is particularly low.

To increase the capacity for innovation development of food SMEs, their staff has to be trained and assisted in innovation management, skills to convert outputs of commercially viable R&D projects to new products, processes, services and business skills, including information, knowledge and resource management.

Evidence indicates that the majority of SMEs prefer to learn from each other and from practical examples, which suggests that the use of collective research activities that offer the opportunity of learning through exchange of views with other industry personnel and with scientists should be promoted.

One encouraging solution is the use of "Training and Dissemination Units" (TDU) of Food and Drink Federations equipped with a number of "Techno-Science Mediators" (TSMs). TDUs are specified units aimed at the fostering of communication and increasing innovation awareness within companies. TSMs are specifically-trained mediators, skilled in technology audit and communication and are a very effective instrument to stimulate innovation with SMEs. It is more than education; in contrast it is the real technology transfer applied to the SMEs desires. They are working in order to fulfil the TDU strategy at national level. This model is a well-established "new frontier" in the link between the demand from the companies, new efficient training formats and innovation transfer programmes.

To secure a future to this triangle (company needs, training initiatives capable of serving the companies, efficient and pervasive innovation transfer), some meta-initiatives can be useful. This objective can be achieved by networking the best available practices in Europe with the help of a new virtual organisation implemented in the form of a European Academy for open Innovation. It will be a resource of skills and advice for the European system of food research and implementation communities, which mixes company employees, scientists and engineers.

It will function as a Think Tank, combining the European Union's best competencies and the main task would be to exercise a coordinating and stimulating role on training and technology transfer practices in Europe. The Academy would secure a two-way dialogue with existing experience and resources in diverse parts of Europe.

The network of national trainers coordinated via the Academy, will be responsible for the training of internationally accredited Techno-Science Mediators who at the national level will represent the link and dialogue between the needs of food companies and the deliverables from the research community.

2.3 Innovation Processes-Technology Transfer

Technology transfer at its simplest is the conversion of existing knowledge into an appropriate format so that it can be used by the industry to develop new products, processes and services. Because the European food and drink industry has a clear need and high potential for innovation, a credible partner supporting innovation and delivering its associated solutions should be the driver for its future success.

The introduction of efficient and successful innovation processes is a very holistic exercise; interaction and collaboration with new programmes and tools, which will be implemented in the future European Innovation area, is also necessary.

Innovation in the food and drink industry can be significantly increased by the creation of more partnerships with innovative institutes of research, education and small and large innovative companies. Therefore, a Food KIC (essentially a public private partnership from the three sides of the knowledge triangle - research, higher education, and innovation-entrepreneurship-business, addressing a long-term horizon of 7-15 years while also meeting certain short and mid-term objectives such as the essential commitment of increasing R&D investment by 2020) is fully supported by "Food for Life".

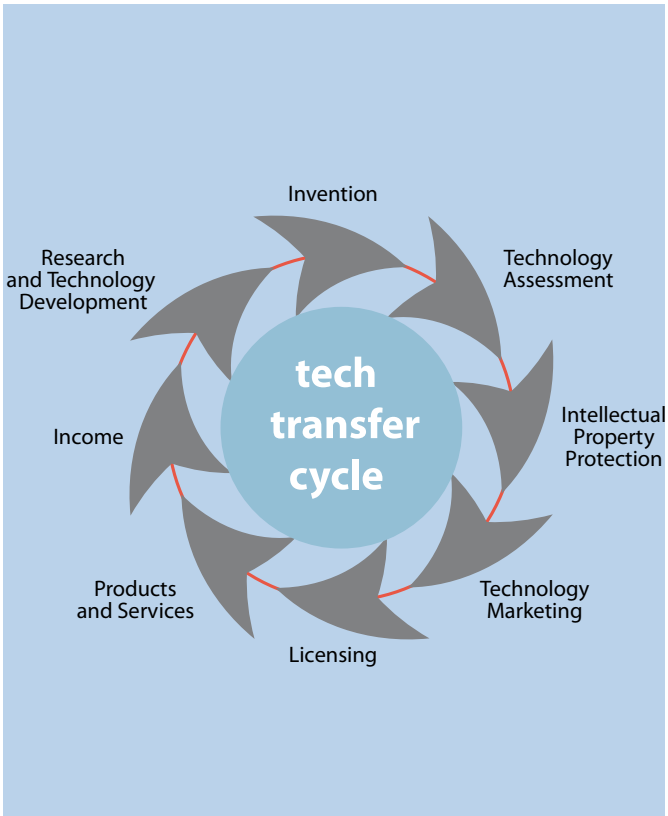
The ETP "Food for Life" is also very interested in the implementation of the Horizon 2020 Framework and will interact with the framework in the priorities:

- excellent science
- industrial leadership
- societal challenges

Yet the reality is that the appropriateness of innovation available from the research community to industrial application is far from optimal and a substantial variation can be observed between different countries, regions and (receiving) companies. Large companies usually have specialised staff to manage this activity, but SMEs need external help. To deal with this situation it will be of crucial importance to explore the effectiveness of existing models of technology transfer and potentials for improvements. Within Europe, such models are available in many European countries and initiatives for the improvement of innovation transfer have to be launched. The use of the Techno-Science Mediators will ensure successful innovation transfer to support company-oriented innovation and the link to research.

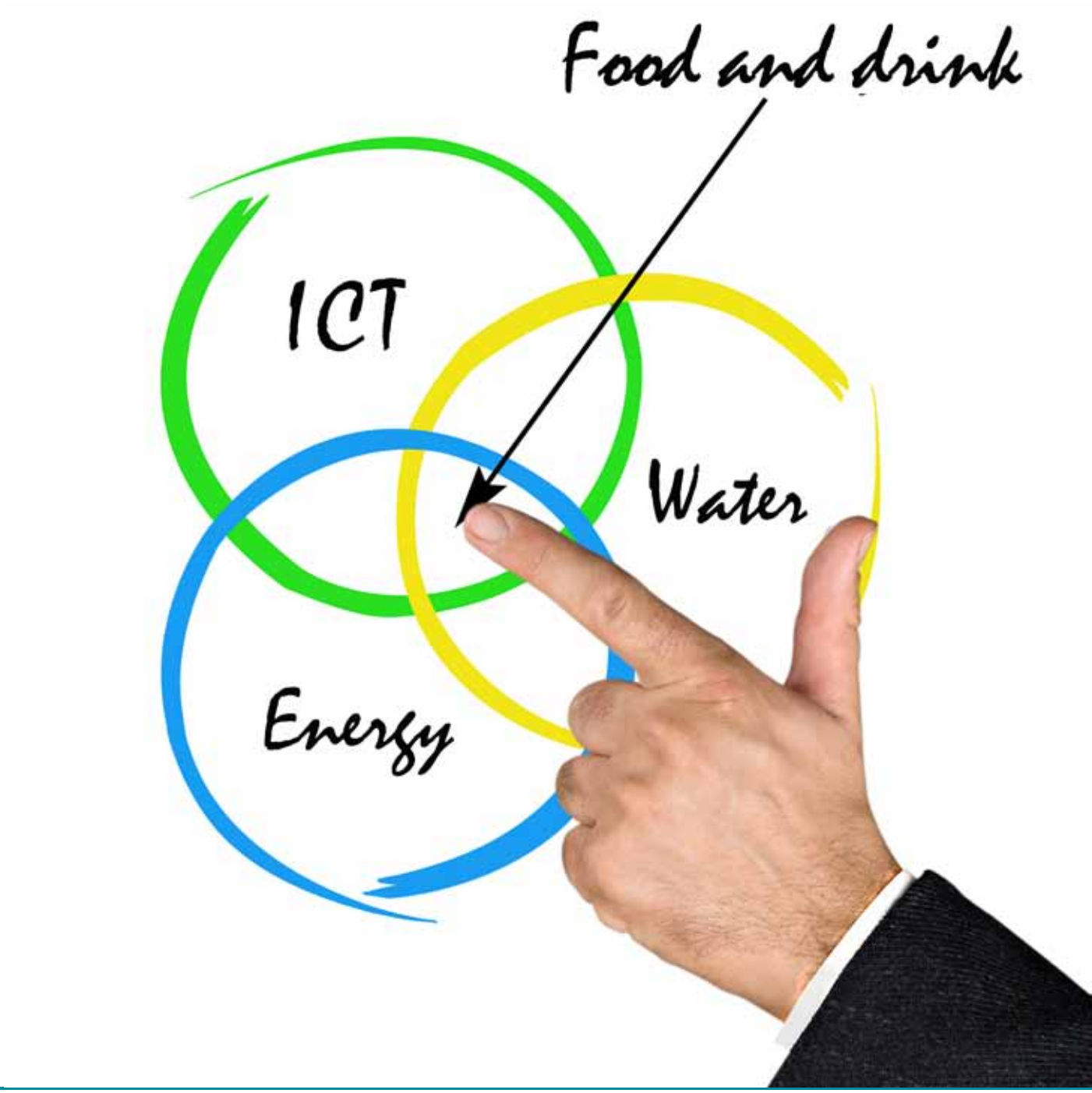
Adapted to country specific needs, the highly effective network of National Food Technology Platforms (NTPs) has the important role to act as a network of national innovation transfer centres, being the partner of trust for the food industry on site. In addition, these centres will close the triangle between consumers, research and innovation providers and companies. As part of this strategy, the National Technology Platforms have already defined some priority actions that should be incorporated into Horizon 2020. These include:

- undertaking national surveys on changing R&D needs of the food industry with specific focus to SMEs
- developing methods for the best use of collective research, marketing and supply chain resource management activities in order to enhance innovation at food SMEs
- undertaking a concept design study for an educational approach to meet industry needs more effectively and for better co-ordination of existing training capacity

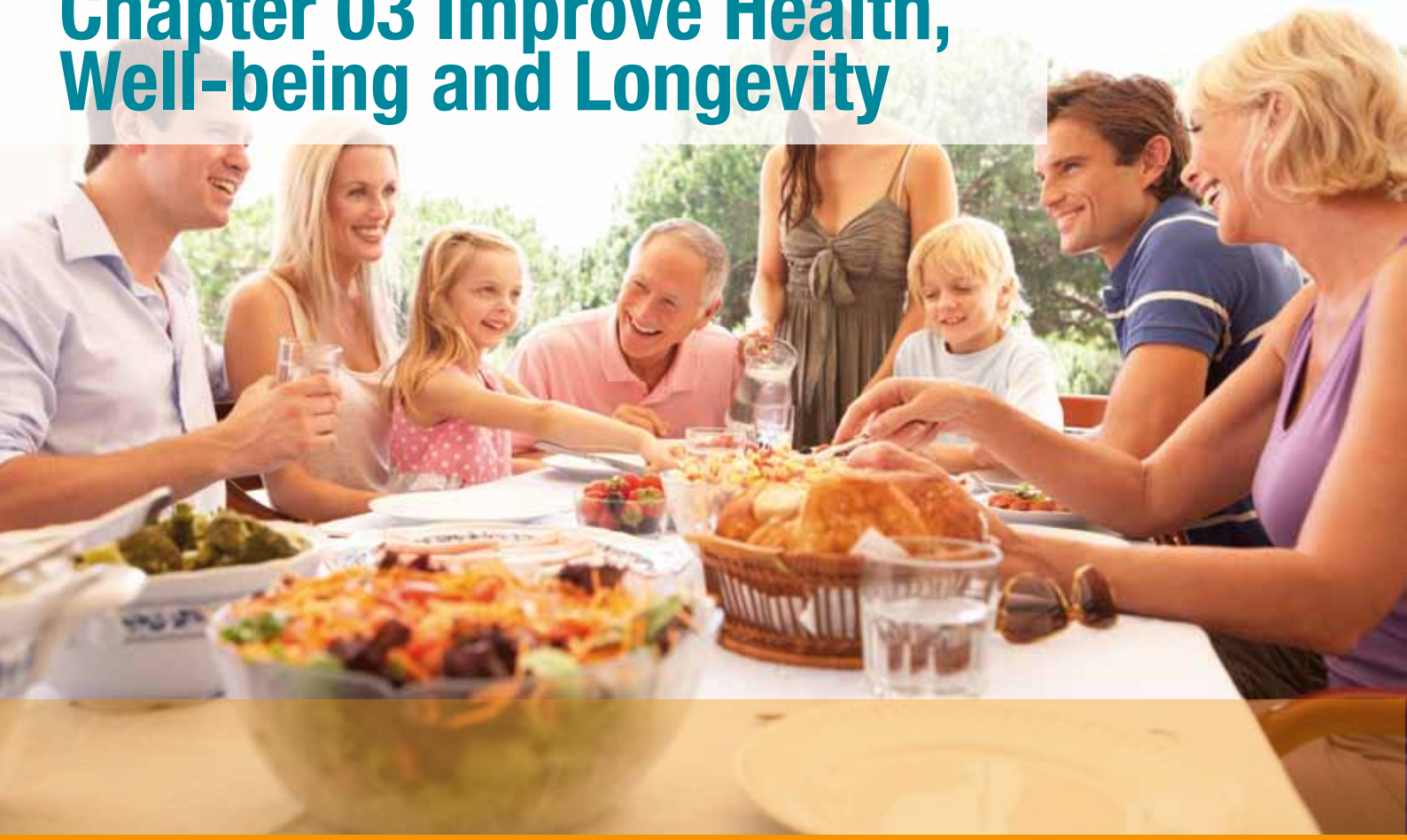


2.4 Transdisciplinary Collaboration

ETP Food for Life seeks collaboration with other sectors such as ICT, manufacturing, energy, transport, nanotechnology, water, agriculture, etc. to identify joint innovation opportunities. The collaboration with these solution providing sectors provides excellent opportunities for using the knowledge, the enabling technologies and the solutions, which have been developed for other sectors to generate innovation ideas to solve the problems in the food sector and to provide joint solutions to meet the needs and expectations of the European society and economy. This activity can be implemented through a systematic collaboration with the relevant ETPs of the other sectors.



Chapter 03 Improve Health, Well-being and Longevity



This challenge fits the Horizon 2020 structure better than any of the other challenges of the ETP Food for Life. As can be seen from Figure 3.1, there is a near perfect fit with the first challenge of pillar three.

Improve Health, Well-being and Longevity

Excellent Science	Industrial Leadership	Societal Challenges
OBJECTIVES 1.- The European Research Council 2.- Future and emerging technologies 3.- Marie Curie actions 4.- Research infraestructure	OBJECTIVES 1.- Leadership in enabling & industrial technologies - Information & Communication Technologies - Nanotechnology - Advanced materials - Advanced manufacturing & processing - Space 2.- Access to risk finance 3.- Innovation in SMEs	CHALLENGES 1.- Health, demographic changes and wellbeing 2.- Food security, sustainable agriculture and bioeconomy 3.- Secure, clean and efficient energy 4.- smart, green and integrated transport 5.- Climate action and resource efficiency including raw materials 6.- Inclusive, innovative and secure societies

Table 3.1: Health, Weel-being and Longetivity within Horizon 2020

This challenge is also one that is being considered elsewhere within the European research structure, namely, the Joint Programming Initiative (JPI) on A Healthy Diet for a Healthy Life. The ETP Food for Life adopted its theme Health, Well-being and Longevity (with a sub-theme Adding life to years) in 2009 and was anxious to ensure that both it and the JPI were promoting similar activities. Consequently, close working relationships were instituted between the two organisations and the link was affirmed by the ETP ensuring that its scientific working group for this challenge was a subset of the corresponding group within the JPI, thereby ensuring a good match between the two scientific agendas.

In developing a scientific programme for this challenge, the ETP working group concentrated on developing a detailed set of research proposals that could be used directly in future calls.

This list was further augmented by the consultation process that took place during the latter part of 2011.

It is, however, possible to group these research proposals into several subthemes:

• understanding of the human metabolic energy efficiency in cluding the human gut micro biota
• nutritional, sensory and textural needs of the elderly
• plant protein sources for the use in high quality food
early biomarkers for deviation from the norm
• *in vitro* models for *in vivo* nutritional predictions
• use of stable isotopes in food and nutrition research
    - to develop techniques for food labelling
    - to determine the metabolic fade of nutrient's
• role of diet in
    - pregnancy on the outcome of offspring
    - preventing cognitive decline
    - treatment of low grade inflammation
    - drug delivery
    - delivery of health promoting ingredients
• reduction of "anti-nutritive" components in food
    - allergens
    - the gluten challenge

Details proposals in these subthemes are noted in Chapter 10.

Chapter 04 Safe Foods the Consumer can Trust

Food safety has been a priority of the European food industry for several decades now. This has been reflected in the emphasis placed on it in both the 2007 Strategic Research Agenda of the ETP and in successive Framework Programmes of the EU. Horizon 2020 continues this emphasis although it has become a little less clear when looking at the Horizon 2020 structures.

Figure 4.1 shows that this challenge fits into two of the topics of pillar 3 of Horizon 2020, namely, those dealing with health and well-being and that of food security. Of course, it could be argued that it should also be included within the secure society's element of challenge 6. Nevertheless, the food industry is confident that its continuing emphasis on food safety will be adequately considered within Horizon 2020.

Safe Food that Consumers can Trust

Excellent Science	Industrial Leadership	Societal Challenges
OBJECTIVES 1.- The European Research Council 2.- Future and emerging technologies 3.- Marie Curie actions 4.- Research infraestructure	OBJECTIVES 1.- Leadership in enabling & industrial technologies - Information & Communication Technologies - Nanotechnology - Advanced materials - Advanced manufacturing & processing - Space 2.- Access to risk finance 3.- Innovation in SMEs	CHALLENGES 1.- Health, demographic changes and wellbeing 2.- Food security, sustainable agriculture and bioeconomy 3.- Secure, clean and efficient energy 4.- smart, green and integrated transport 5.- Climate action and resource efficiency including raw materials 6.- Inclusive, innovative and secure societies

Table 4.1: Safe food that consumers can trust within the Horizon 2020 structure

4.1 The Food Safety Challenge

One of the non-negotiable for Europe is the necessity for a safe food supply; it is an imperative for health, social, and economic reasons. While the food produced and consumed in Europe is now considered safer than ever, there are still several critical gaps in our knowledge of food safety and contaminants that limit our ability to prevent, predict and respond to food safety incidents.

Public food safety crises create a high degree of concern among consumers, and cause huge economic losses. A case in point is the 2011 European outbreak of a new variant of pathogenic E. coli that claimed thousands of cases of disease and several lives in Germany and in other countries. Another recent example concerns the melamine contamination of milk and powdered infant formula from China that impacted on infant health and worldwide food chains. Both incidents have seriously undermined confidence in the food industry. In addition to this there are other, more emotionally or politically influenced issues such as GMOs, hormones and some additives that influenced consumer confidence in a negative way. Consumer perception has evolved to a high level of awareness and a much reduced certainty, a combination which has led to this generalised lack of confidence. Indeed, this increasing concern about "chemicals in food" has led to what is now described as "chemophobia" in the public psyche. Coupled with a misunderstanding of "hazard" and "risk" there is clear evidence of the public's "risk of risk perception" leading to rejection of perfectly safe foods and hence inhibiting innovation.

Food safety is a major public health and economic issue for Europe both for foods consumed within the EU and those that are exported. The total costs attributable to failures in food safety are huge but notoriously difficult to estimate since they include costs associated with the consequence of the diseases themselves as well as losses of product (such as recalls, production stops, trouble shooting, brand value) and consumer confidence. For instance, the annual costs of Salmonella outbreaks alone have been estimated to be around $2 billion for the USA alone. This gives some idea of the economic losses for a single pathogen. Added to these costs are the considerable costs of measures set in place to control this pathogen in the food chain, including analyses, specific management and hygiene measures, research and surveillance.

It has been claimed that the majority of reported food borne cases are caused by food prepared in the home, with a high variation between countries. Food producers or retailers are often pointed out as responsible in food associated outbreaks, despite the fact that proper handling by the consumer would in many cases eliminate the risk. Therefore, knowledge about consumer behaviour is important for the company risk analysis for existing products. Also, knowledge about consumer handling would enable production of safer products through optimization of the products, packaging or labelling.

While food safety is far more in the public eye, spoilage of foods is as serious and economically impactful - if not more. As much as 40-50% of foods (raw materials to finished products) can be wasted because of spoilage issues. This causes an extensive environmental burden, and novel solutions to reduce this effect are central. Consumers become more demanding in terms of food quality in a broad sense, sometimes with conflicting demands and expectations. This includes minimal processing, longer shelf life, lower salt, fat and sugar contents, environmental aspects, use of preservatives, methods of pre packing and distribution logistics etc. Therefore industry and regulators have to ensure that safety and stability of foods are not compromised. In the rest of this document, when a reference is made to "food safety", it should be understood to include "food stability" (i.e., freedom from spoilage) also.

The control measures required by regulators, distributors and retailers are not necessarily always adequate for the protection of health and the economy. Such a situation represents a cost burden, supported by producers and consumers, which does not necessarily contribute greatly to a reduction in morbidity. To adequately protect the health of the consumer and, at the same time, ensure competitiveness of the food industry it is essential to have effective and targeted control measures. It should also be taken into account that the measures needed may differ considerable as a function of the size of the actors involved, e.g. multinationals, mid-size companies and SMEs.

The above are just a few of the many reasons that make food safety an essential element of a competitive strategy for the European industry. The capacity of EU Member States to contribute to the maintenance of a safe food supply in an increasingly science and technology-driven society is intrinsically linked to its scientific resources in areas relevant to food safety. The desired model of a united, but diverse, continent requires that food traditions be both preserved and modernised. Competitiveness is essential within all parts of the EU food industry and at all levels; therefore, the science applied to support it must respond to the needs of the sector as a whole.

4.2 New Tools and Possibilities

Science is progressing at a very rapid rate - especially in the areas of human, microbial and plant biology. The advances in "omics" technologies and Systems Biology tools allow scientists unprecedented access to correlating genomics to functional metabolomics to physiology and ecology. These powerful tools have the potential to transform our ability to predict the appearance of newer, more severe pathogenic species of microorganisms. Microbial activities may be deciphered for specific microorganisms at a molecular level leading to a novel and improved predictability of production of toxins, virulence factors, and spoilage capacity. At a second level it will be possible to understand and predict interactions within ecosystem (foods, human hosts and the environment). It will continue to provide real-time, rapid and reliable methods for detection and monitoring of contaminants in relation to foods (e.g., using DNA-based detection methods).

Likewise, numerous applications of omics-approaches and other novel technologies such as developments in identification and validation of biomarkers of biological effect and exposure, probabilistic modelling of intakes and understanding toxicological thresholds continue to help refine and improve the risk analysis process.

Taken together, recent scientific advances allow us to make a potential step change in our ability to conduct accurate risk assessments that can be used by both government and industry to set the appropriate, robust and consistent standards that enhance safety and foster innovative food product design.

4.3 Ensuring Food Safety

The European food and drink industry's response must be to develop an integrated and holistic approach to food safety & stability. Safety is not guaranteed only by "'safe" product manufacture; the total chain has to be taken into account. Designing safety into foods requires the integration of know-how and interventions along the "research to market" continuum. Research, which addresses the European food industry's needs over the coming years in relation to food safety, will be applied through this integrated, holistic approach. At the same time, there should be a focus on those aspects of understanding, development, application/implementation that will exert the biggest impacts on alleviation of food-borne safety issues. Such well-focussed research will provide a framework for rapid incorporation into practice in a manner which will bring maximum impact. Any such research endeavour should feel it absolutely necessary to use cutting-edge scientific tools and knowledge wherever these can be found and applied.

Current reality also thrusts the responsibility on the industry to ensure that food production processes conform to challenging sustainability goals that are being proposed worldwide.

Any Strategic Research Agenda that the European industry sets up must, therefore, ensure that sustainability is a critical enabler for success. This provides an additional challenge to the food industry.

4.4 Important Research Areas

The research areas we propose broadly fall into the following 4 Goals outlined below. Two main categories are included; microbiological contaminants and chemical contaminants. Research is important for the gathering of intelligence, assessing the risks and assuring safety along the food chain.

4.4.1 Microbiological hazards and challenges

Over the years, food microbiology research has uncovered a lot of knowledge on the behaviour of pathogens and spoilage organisms, which has led to the development of the current standards and regulations worldwide. However, microorganisms are moving targets. New variants emerge from mutation and adaptation, and long-forgotten microorganisms re-emerge. The interaction in ecosystems is complex. A number of knowledge gaps should be given attention within the next decade:

- improvement of our knowledge on the persistence of microorganisms (pathogens or spoilers) in food matrices and food processing environments is fundamental for improved microbial control. Better understanding of cold-tolerance, salt-tolerance and survival of food-borne pathogens in the food chain is needed

- the behaviour of microbes that cause spoilage needs specific attention for improved understanding of the evolution of destructive strains. The relationship between spoilage microorganisms and pathogens also needs to be understood in an ecological context

- understanding the impact of antibiotic resistance and other biocide resistances and control of organisms if they enter the food chain. This includes the recycling of antibiotic resistant microorganisms through the food production chain e.g. though the use of surface waters and manure. The intended use of microbiological biocides such as phage or protective cultures exerting a controlling effect on pathogenic microorganisms has great potential to control harmful microorganisms. In depth understanding is needed to fully understand and explore this potential

- although changes in agricultural practices remain the main drivers for the emergence of zoonotic pathogens, the possible consequences of global warming should be taken into account, e.g. the appearance of emerging and re-emerging pathogens due to climate changes

- the risks associated with food-borne viruses should be studied. Very little knowledge is available, and in most cases, risk assessment is based on “surrogate” bacterial and virus species

- predict and monitor the behaviour of relevant known and emerging technologies and challenges, e.g. synthetic biology an nanotechnology

4.4.2 Chemical hazards including toxins of biological origin

Chemical hazards include plant protection products, veterinary pharmaceuticals, persistent organic pollutants (POPs), packaging residues, process products such as heat-generated toxicants, heavy metals, biological toxins and numerous natural constituents of our food; they represent known and potential health hazards to humans, most commonly by long-term exposure, through the consumption of foods in which they are present.

The manner in which these hazards are currently controlled is sub-optimal for two main reasons: firstly, there is a large knowledge gap as to the identity, dietary exposure and, hence, risk of many chemicals at the quantities at which they occur in foods and are actually consumed, and secondly, detection and monitoring are often complex and expensive.

The risk assessment and risk management of chemicals need to be evaluated by considering the entire food chain, giving a particular attention to the conditions of agricultural practice, which is a main source for contamination of foodstuffs with biological and chemical hazards. There is a need to develop knowledge on the occurrence of chemical agents as well as their complex interactions in various foods, and to develop an innovative and holistic approach to chemical food safety.

Foods should be treated as complex chemical mixtures when addressing the generation of chemical toxins in situ or as introduced externally. Thus, tools to carry out safety assessment of such complex mixtures need to be developed. This also includes the assessment of novel food materials such as those developed through nanotechnology applications, whether in foods, sensors or packaging.

While allergens are very high in priority, we believe that efforts to reduce levels of allergens would not be successful. Better information for the consumers is the way to follow. Quantitative Risk Assessment of allergens needs fine tuning (see also next paragraphs on RA).

Inherent toxins, e.g., plant toxins - like alkaloids - in crops and weeds are a growing problem and should be assessed as a high priority as should evaluation of the endocrine interference of some plant natural compounds (e.g. genistein, daidzein), either in etiopathogenesis, or in the chemotherapy of human diseases.

A research priority should be the finding of novel biomarkers of exposure and susceptibility to key hazards, with some regard to critical effects (including endocrine, immune and neurological effects) for vulnerable population groups, such as people affected by chronic disorders, or pregnant women, children, and the elderly.

A number of issues should be given special attention within the next years:

· understand the generation of cooking or heat-induced contaminants such as advanced glycation end products or AGEs.
· accumulating evidence supports the pathogenic role of food derived AGEs in human health
· alternatives for animal based food protein production are needed for a sustainable innovative food production. Novel proteins may, however, potentially pose high allergenicity risks. Methods to assess and predict their allergenicity are needed
· possible consequences of global warming should be taken into account, e.g. the appearance of new mycotoxins or their Northward shift
· migration of per- and poly-fluorinated compounds (PFCs) from food packaging and food contact material into food commodities need attention. Analytical methods to estimate this transport rate and quantity should be developed
· increase knowledge regarding toxicological effect of arsenic species and investigate whether storage and processing of food result in increased concentrations of arsenic species of human health concern

4.4.3 Robust and cost-effective Risk Analysis (RA) concepts based on sound, cutting-edge scientific understanding

Quantitative risk assessment is the knowledge base for building a food safety strategy. The tools being developed within this area (including predictive modelling) are important competitive instruments that underpin innovation in the development of novel products. Research in this area will be important both to further develop the science and to make these tools more widely available within the food industry. The approach will need to address the increasing complexity of food products and it is certain that the trend will be towards risk-benefit assessment. As an aspect of benefit, economical aspects need to be considered.

Applying risk-benefit analysis in a holistic way is the means to evaluating the real impact of the total of a food (or dietary pattern) to human health and well-being in its many forms. This approach should be prioritised as the main avenue for evaluating the real impact of the complete food or of a diet pattern on human wellness, as an alternative to applying a “brute force” approach by singling out the toxicology of each molecule and the virulence of each pathogen.

In addition, further development of applications of the Threshold of Toxicological Concern (TTC) concept to chemically complex and undefined mixtures is needed for a cost-effective risk analysis of complex food products processes and novel foods. A tiered approach including analytical screening steps based on thresholds and margins of exposure for distinct toxicological endpoints and targeted bioassays would enable such application of the TTC concept.

The background scientific knowledge necessary to carry out reliable, robust and rapid risk-benefit analyses is essentially generated as results of the microbiological and chemical research described in the paragraphs above. The holistic concepts elucidated in these paragraphs should seamlessly feed into appropriate Risk-Benefit Assessments.

A number of issues should be given special attention within the next years:

- develop a Quantitative Decision Tree for Allergen Assessment and Management
- further develop translational research using biomarkers. Biomarker identification and validation for actual health effects is needed
- renew focus and on and develop tools for Risk-benefit assessment of Genetically Modified Organisms (GMOs) and their perception by consumers. This is especially true in the face of food shortages in the future
- unification, revising or standardisation the methodology of food safety issues in order to simplify the certification procedure. This would benefit both "well-known" traditional (historically proven foods and drinks) and innovative food products and make the process more understandable to the customers
- develop decision support tools for the industry based on predictive microbiological models and models on occurrence, development, migration of chemical contaminants
- extend the scope / applications and validation of the threshold of toxicological concern (TTC) and Margins of Exposure (MoE) approaches to support food safety assessments
- develop further investigations and applications of the key event dose-related framework to a range of chemicals in food to improve risk assessment
- develop improved methods for risk communication of chemicals in food
- consumers understanding of food, safety and risks needs to be improved, to avoid and reduce chemophobia

4.4.4 Real-time & rapid detection tools to ensure safety and security of the food chain, including food defence

The aim of this research is to further improve the safety of competitive foods in the market place by developing and making available tools for prevention and control of specific hazards, traceability, authenticity and food defence (adulteration and bioterrorism) at appropriate points in operational food chains. These should preferably be in- or at-line. This will provide the technologies on which harmonised, focussed and cost-efficient management activities and safety policies can be implemented. The understanding and knowledge generated from the research needs identified the above three paragraphs will be employed in the development of technologies.

New techniques for detection of hazards or their controlling parameters are constantly being sought to improve food safety assurance. Successful new approaches frequently represent new opportunities for surveillance, tracing of sources of hazards and many other areas of research, which have a direct impact on food safety at a societal level. Research on new or improved measurement of hazards will have a multiplier effect and these lines of study should always be advanced wherever they show genuine promise. Advanced technologies for safety interventions throughout the food chain will provide new options for control over the safety of raw materials, processes and finished products.

Their development, validation and implementation must cover all aspects of food production:

- there is the need for harmonised policies and methods to be prepared for problems related to bioterrorism
- explore the opportunities in the use of the modern information and communication technologies to provide real-time, rapid food safety information to the industry to support informed food-safety decisions and for on-line process control for hygiene

Chapter 05 Sustainable and Ethical Production

The area "Sustainable and Ethical Food Production" is extremely broad and covers a multitude of different disciplines; hence the research needs are also distributed broadly.
This is reflected in the structures of Horizon 2020 where it can be seen that the theme of sustainability is included under several topics (see Figure 5.1 below).

While this topic finds an obvious home within the food security, sustainable agriculture and the bio economy challenge, aspects of it could fall within several other challenges such as, resource efficiency including raw materials and secure clean and efficient energy. Food distribution is also a candidate for inclusion within the smart green and integrated transport challenge.

In order to help the communication a structure based on what we want to achieve rather than traditional science areas is used. Many research areas will require a multi-disciplinary approach which complicates the matter even more. In Figure 5.2 the structure is depicted.

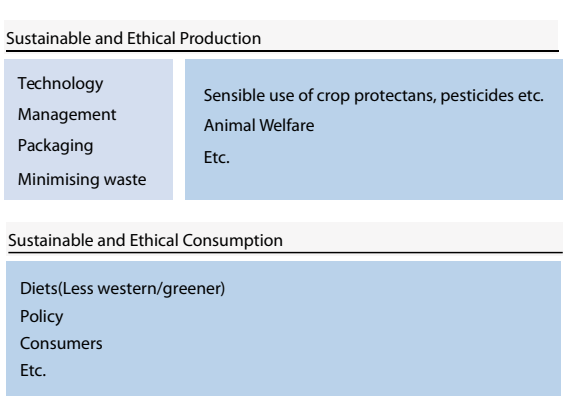


Figure 5.2: Structure of how the research areas are organised

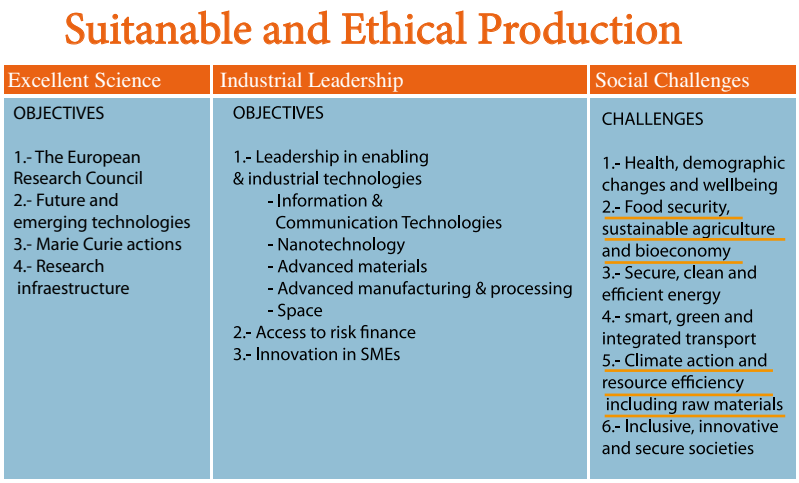


Figure 5.1: Suitanable and Ethical Production within the Horizon 2020 structure

5.1 Sustainable and Ethical Production

Food production is at the core of the bio economy and also affects all three pillars of sustainability (environmental, economic and social) in both positive and negative ways. Hence food innovation (products, processes, systems, social innovation) that enhance productivity/efficiency are required to make the entire bio economy viable, by freeing resources (land etc.) for other uses that in turn can contribute to energy production and products from biological sources.

5.1.1 Material efficiency from farm to fork – reduced waste and increased utilization of by-products

As has been shown by many studies, a large share of food produced globally is lost; approximately 1/3 of food leaving the field is never consumed. Increasing the raw material efficiency in all steps of the chain and improving food chain management could be a significant contribution to reduced environmental impact, increased global food security and higher value creation in food chains. There are a number of difficulties however, connected to technological, managerial, economic and behavioural aspects that need to be addressed and these are outlined in Chapter 10.

5.1.2 Production systems for alternative protein sources

Protein supply is nutritionally crucial and environmentally even more so, linking climate change and biodiversity loss through nitrogen fertilizer production and degradation (ammonia emissions), respectively. Livestock products have disproportionate impacts on depletion of natural resources and constitute ideal targets for replacement by inherently less resource intensive products from plants or invertebrates. However, there are a number of behavioural, economic and technological issues that need to be addressed, cross-linking this area with sustainable consumption. Similar concerns have been expressed in relation to alternative sources of fats and oils.

5.1.3 Sustainable water consumption

Globally, water scarcity is a critical issue, even though the regional variations are large. Moreover, in a future facing climate changes, it is clearly predicted that water availability will be even more limited, especially in already water stressed areas. This will be a challenge for global food production, and hence also European.

5.1.4 Sustainable primary food production

All food industry is dependent on reliable and efficient production of raw materials, and sustainability of food supply systems needs to include also primary production as agriculture, aquaculture and fisheries. The more detailed parts, such as agronomic research in this research area, should preferably be coordinated with food research. Of course, primary production of the ingredients for the European food industry is not only based in Europe but is a worldwide issue e.g. >30% of global oil & fats are palm oil based, which can only be grown in the tropics) while vegetable protein and animal feed, so essential for the European dairy/meat industry, relies heavily on South American soya. Consequently, non-European partners will be essential in future sustainability research.

5.1.5 Developing sustainable processing, preservation, packaging and logistic systems

A core aspect of the challenge to improve the sustainability performance of food systems is energy-, water- and resource efficient technology and logistics. There is a long history of developing such systems. But since a lot of that development have been focused on unit processes and not production systems new research with a sustainability focus including a systems perspective (looking at processes, packaging and logistics as a whole) is needed.

5.1.6 Sustainability of nano-packaging of foods

Nano science and technology allows coating and modifying food packages, improving resistance, reducing permeability and extending shelf-life. Research should focus on how to enhance their sustainability (e.g., waste management, environmental impact, cost, biodegradability).

5.1.7 European food production and supply chain

Besides technological measures to improve sustainability in food chains there is large scope for improvements in how entire food chains or networks are managed. There are probably large gains in making food chains as a whole work more integrated and efficient, reducing wastage, energy use and improve competitiveness. This is however an area that previously has been more or less neglected; hence there is a great need for food chain focused research.

5.1.8 Developing scenarios of future European food production and supply chain

A major issue in recent and future food markets and supply chains is the rapidity and unpredictability of changes in prices, development paths and technologies. This will be even more so in the future. In such a context, strategic decisions by the EU will become more and more critical, but, at the same time, more difficult to be taken. Research is needed in devising potential scenarios and connecting them to decision support tools suitable to support EU and local level decision making. Advances are sought in both methods and understanding of costs and benefits in alternative technologies.

5.2 Sustainable and Ethical Consumption

5.2.1 Understanding consumers and their behaviour regarding sustainable food consumption (Sustainable European Consumption)

It is very likely that an efficient way of increasing the environmental sustainability in European food systems is changing consumption patterns, away from resource demanding products towards less demanding. This will also have large long term implications for global food security and hence to global equity and social stability. Diet changes will however have repercussions on social and economic aspects in the food sector, both within the EU and globally. Diet changes are extremely difficult to implement, for a number of reasons, and research is needed to understand the processes behind such changes. Another important research area in this field is how to quantify the impacts of large scale diet shifts, since such shifts will inevitably have large impacts on how food chains are built up and managed. There is a need for social and natural sciences as well as economics to answer these pressing questions.

5.2.2 Diet change in Europe

A trend all over in the world, we observe, is, that consumers shift to a "Western" diet relying more heavily on meat consumption when the income increases. The adoption of such "Western diet" and sedentary lifestyle is impacting negatively on the planet as well as the human health. Obesity among the health problem is becoming endemic in a number of European countries, and changing diet to a healthier one and lifestyle to an active one is essential. Understanding the consumer behaviour is key to finding a strategy.

5.3 Tools and Methods

5.3.1 Development of new tools and methods for assessing and analysing sustainable food systems

In 1987 the report of the UN World Commission on Environment and Development (or Brundtland Commission) indicated that sustainable development "meets the needs of the present without compromising the ability of future generations to meet their own needs". The chapter dedicated to food issues focused on the necessity to sustain the great agricultural potential achieved with the Green Revolution, and to attain a better distribution of food production. After 25 years, the number of undernourished people has not been reduced and the potential of the world food production has become much more uncertain. The constraints of energy, land and water resources have found only partial solutions. Moreover, the food industry is confronted with new challenges imposed by increasing urbanization of world population and changing lifestyles: the capacities of producing, processing, and delivering food should be enhanced without compromising safety and quality of supplies, and the promotion of sound dietary habits has to be supported.

The basic notion of sustainability is universally accepted and does not need to be redefined. Nonetheless, these concepts should be reinterpreted in the perspective of tackling both the old unsolved and the new emerging food issues. This will be the starting point for improving the capacity of stakeholders to understand and assess the wide and multi-faceted implications (environmental, social, and economic) of sustainability in the food systems.

Chapter 06 Food Processing, Packaging and Quality

This challenge is also one that can be included under several topics within the structure of Horizon 2020. This can be seen in Figure 6.1 below.

Food Processing, Packaging and Quality

Excellent Science	Industrial Leadership	Societal Challenges
OBJECTIVES 1.- The European Research Council 2.- Future and emerging technologies 3.- Marie Curie actions 4.- Research infraestructure	OBJECTIVES 1.- Leadership in enabling & industrial technologies - Information & Communication Technologies - Nanotechnology - Advanced materials - Advanced manufacturing & processing - Space 2.- Access to risk finance 3.- Innovation in SMEs	CHALLENGES 1.- Health, demographic changes and wellbeing 2.- Food security, sustainable agriculture and bioeconomy 3.- Secure, clean and efficient energy 4.- smart, green and integrated transport 5.- Climate action and resource efficiency including raw materials 6.- Inclusive, innovative and secure societies

Figure 6.1: The location of Food processing, packaging and quality within Horizon 2020

There are two obvious areas of fit within the first two pillars of Horizon 2020. Under Scientific excellence, the objective of Future and emerging technologies immediately suggests itself, while that of Advanced manufacturing and processing under Industrial Leadership is also obvious. However, Nanotechnology, Advanced materials and Innovation in SMEs can play a role in the development of this challenge.

The area of food, quality and manufacturing was seen as playing a central role in the new structure of the ETP. For a more effective fit, the title of the Working Group was modified from that used in the first SRA, i.e. "Food Quality and Manufacturing (FQM)" to "Food Processing, Packaging and Quality (FPPQ".

While the old title contained the term "manufacturing", this was considered too narrow to define the field, as this implies that processes of change in the food product stop when the food product is made, but that is not the case. Indeed, in terms of the food product, we need to look beyond the current structure of the food once manufactured and thus, the term processing was considered more appropriate in the title of the Working Group. Processing in general refers to the process of changing a food structure to obtain new desired properties and qualities or to prevent undesired changes in quality, and furthermore, to include the term packaging, because in addition to being an integral part of processing, it plays a crucial role in communication, logistic, freshness and safety monitoring. This approach encompasses the whole life-cycle of processed foods.

6.1 Definition: Food Processing and Packaging

This is based on recognition of the contribution of food structure and function, arising from food processing and packaging, to nutrient bioavailability and impact on host physiology, thus appreciating that food processing does not stop when the food is manufactured, or indeed when it is placed in the mouth, given the role of food structure and functionality to the performance of the food in the gut. Changes in food structure, texture, composition and quality continue in the food product following manufacture, during storage, meal preparation, following consumption as well as during digestion (gastrointestinal processing), and furthermore, are impacted on and monitored by the types of food packaging technologies used. The concept of farm to fork is too limited, and needs to be expanded to that of from farm through digestion.

6.2 Aim

The aims of the working group developing this challenge were firstly to define processes and packaging for management of the food structure life cycle to obtain high quality products with new and improved properties (aimed at PAN-achieving preference, acceptance and fulfilling needs) related functionality, aimed at aspects of three other challenges, namely

- improved Health, Well Being and Longevity ("Life to years")
- consumer Trust in the Food Chain, and
- sustainability

A second aim was to describe what the physiological impact of changes in food structure is, in the context of the process-structure-functional property relationships in order to prevent deleterious changes, which negatively affect product quality, nutrient bioavailability and functionality.

6.3 Objectives of the Research

To generate information leading to an EU Food Industry capable of achieving

- optimum sustainability
- optimum efficiency

(on economic, technological and ecological levels)

- extended delivery of food products with new properties and functionality aimed at fulfilling preference, acceptance and needs of consumers (by reverse engineering approach)

To have greater integration in research between processing, food quality and safety, nutrition/health and sustainability. This could be achieved by making it mandatory for research programmes to foster collaboration between disciplines, particularly in large research programs like Marie Cure schemes, therefore bringing together scientists such as nutritionists, clinicians, environmental and/or consumer specialists with technologists and process engineers. The topics should be integrative for a trans-disciplinary approach, not the sum-total of interests of the participating disciplines. The logic should follow processing creating/transforming structure and structure determining properties to be specifically categorized within nutritional/health supporting and environmental food standards. Such pioneering work should finally also support standardization by the WHO/FAO - Codex Alimentarius.

To update training of food science/-engineering students, in order to avoid exclusive specialization, and enable the initiation of research across the borders of scientific disciplines. This should in particular involve the integration of knowledge from disciplines, such as nutrition, medicine and physiology, pharmaceutical and cosmetics technology as well as material science, health science and resource economics.

To strengthen an SME innovation platform. - Innovation is not just about new ideas, but how to use and combine process and material aspects in new ways. Innovation efficiency by SMEs can be improved based on infrastructural improvements reducing "time to market". Often there is a gap between researchers developing new technologies and SMEs that must be more efficiently bridged. In some cases, innovation by SMEs is low and infrastructural improvements are necessary, as SMEs do not have the capacity to take up new technologies from the research. In other cases, the situation is exactly the opposite, and an example of this is the very successful model in Switzerland, referred to as the "CTI projects". These are open for SMEs, universities and start-ups where the government pays the half and the participating large companies the other half. The IP is for the small company which should be strengthened. The win-win for the larger ones is that certain processes, methods and new science & technology, which will not find in-house investment and support, can be developed by universities and SMEs which will bring the results to market. It builds on the creative strengths of SMEs and universities in quite a practical sense.

Chapter 07 Food and Consumers

The challenge of better understanding the consumer and ensuring that new food related developments as part of balanced diets and active lifestyles are accepted by the consumer is a daunting one but one which must be tackled if the European food industry is not to lose its innovation initiatives to other regions of the world. There is plenty of scope for this within Horizon 2020 as can be seen from Figure 7.1 below.

Food and Consumers

Excellent Science	Industrial Leadership	Societal Challenges
OBJECTIVES 1.- The European Research Council 2.- Future and emerging technologies 3.- Marie Curie actions 4.- Research infraestructure	OBJECTIVES 1.- Leadership in enabling & industrial technologies - Information & Communication Technologies - Nanotechnology - Advanced materials - Advanced manufacturing & processing - Space 2.- Access to risk finance 3.- Innovation in SMEs	CHALLENGES 1.- Health, demographic changes and wellbeing 2.- Food security, sustainable agriculture and bioeconomy 3.- Secure, clean and efficient energy 4.- smart, green and integrated transport 5.- Climate action and resource efficiency including raw materials 6.- Inclusive, innovative and secure societies

Table 7.1: Food and Consumers within Horizon 2020

The role of communication and information technology is critical to this challenge. However, the creation of inclusive, innovative and secure societies also plays a part in the success of the challenge.

The Food and Consumer Group of the European Food Technology Working Group, has identified a number of key research topics that would require further research attention at the European level. Given the broadened focus on Strategic Research and Innovation, the research agenda encompasses research needs which link thorough and theoretically grounded understanding of consumer behaviours related to food choice with concrete and actionable policy relevant to product development (for example, integrating consumer preferences into the design of novel foods, balanced diets and active lifestyles), chain innovation (improving the sustainability of food production systems in line with consumer preferences) and policy innovation (developing interventions designed to improve consumer health and quality of life). In other words, the "innovation trajectory" associated with novel foods development needs to integrate technological possibilities with consumer and policy priorities if societal and market acceptance of novel products is to occur.

7.1 Structure

The research priorities are organized around five key areas with multiple themes within them leading to the research priorities detailed below:

A. Societal challenges, including food safety and security, health and sustainability

B. Behavioural changes, related to consumer decisionmaking (including out-of-home eating and the consumer groups to be addressed)

C. New Developments, relating to consumer engagement and price (sensitivity)

D. Methodological innovations, relating to disciplinary, relating to disciplinary integration, longitudinal approaches and EU wide standard and tools

E. Dissemination, for SME applications

Detailed research proposal based on the above subthemes are detailed in Chapter 10.

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Chapter 08 Food Chain Management

This chapter on food chain management will, of necessity, overlap slightly with the chapters on sustainability, food processing, packaging and quality and, to a lesser extent, on that of food and consumers. Any integrated area will probably find its sub-themes and sub-challenges somewhat spread over the various themes in an overall research structure. With food chain management and the structure of Horizon 2020, this is very evident from Figure 8.1 below.

Food Chain Management

Excellent Science	Industrial Leadership	Societal Challenges
OBJECTIVES 1.- The European Research Council 2.- Future and emerging technologies 3.- Marie Curie actions 4.- Research infraestructure	OBJECTIVES 1.- Leadership in enabling & industrial technologies - Information & Communication Technologies - Nanotechnology - Advanced materials - Advanced manufacturing & processing - Space 2.- Access to risk finance 3.- Innovation in SMEs	CHALLENGES 1.- Health, demographic changes and wellbeing 2.- Food security, sustainable agriculture and bioeconomy 3.- Secure, clean and efficient energy 4.- smart, green and integrated transport 5.- Climate action and resource efficiency including raw materials 6.- Inclusive, innovative and secure societies

Table 8.1: Where Food Chain Management fits within the Horizon 2020 challenges

Of course, this ETP challenge fits with the technology based challenges of Horizon 2020. However, food distribution, an integral part of the whole food chain, fits very comfortably into the smart, green and integrated transport theme. Resource efficiency including raw materials cannot be ignored when one considers goal 1 (below) of this challenge. Sustainability, energy efficiency, innovation and innovative societies could also have been highlighted in the above figure. Again, this multiplicity of points of fit between the two is not surprising given that we are dealing with the entire chain.

8.1 Challenges in Food Chain Management

The food sector as a whole is faced with major challenges that arise from changes in the sector's economic and non economic environments, from changes in lifestyles, from global increases in food consumption, and from a diminishing production base due to, e.g., the loss of arable land or its divergence for non food production alternatives. The challenges cannot be met by any individual enterprise but require concerted actions and coordination of initiatives. Food Chain Management (FCM) provides support for the identification and realization of "best" concepts for such actions and coordination needs. This support, in turn, provides enterprises with the means for improving their own and the sector's competitiveness, sustainability and responsibility towards the expectations of its customers and the society.

In meeting its challenges the **sector needs to innovate in organizational relationships** that reach beyond innovations in process improvement by building on the innovation potential inherent in enterprise networks and their flexibility in responding to customers' and consumers' demands. There is an urgent need to adjust the trend towards increased process integration along the value chain to the organization of a flexible and responsive network approach by utilizing the potential of technological change, of information and communication systems, and of institutional change.

Food Chain **Management support is towards the actors** that represent the food value chain, suppliers, primary producers, processors, manufactures, and retailers which have consumers as the final customers. Its support can focus on operational improvements or on strategic development perspectives (Strategic Food Chain Management) that involve major investments and long term commitments. A specific strategic development perspective concerns the investment in sector wide infrastructures such as electronic networks for food safety assurance, quality assurance and transparency in business communication as well as towards consumers.

Such infrastructures could serve and benefit the sector as a whole but are beyond the investment capability of any single group, especially if their benefit depends on participation of a majority of enterprises, including SMEs which might take time to materialize. For the infrastructures to become feasible and to deliver the envisaged benefits not just for enterprises and the industry but for society as a whole the investment in conceptual design, organizational agreements, and financial responsibilities require complementary engagement of groups from outside the value chain including research and policy, i.e. a Food Chain Management view that **integrates policy and management initiatives alike.**

Specific issues the food sector and its individual actors need to deal with for timely and appropriate response to the sector's challenges.

• to adapt rapidly (through changes in resource use, products, processes, services, and governance structures) to changing scenarios (markets, policy, resource availability etc.) and their requirements within a sector organization that is difficult to coordinate as its enterprises are rarely confined to well structured chain relationships with established communication and coordination mechanisms but are usually part of an open enterprise network where enterprises may change their suppliers and customers at will

• to overcome the sector's structural problem with its large number of SMEs. Their ability to innovate and interact successfully with the large and multinational enterprises, especially in agricultural supply industry and retail, depends on cooperation initiatives and the provision of external coordination support

• to focus on changing consumer needs. These depend on a continuous adaptation of new developments in technology, production, management, communication, organisation or cooperation and on the establishment of trust between all stakeholders along the food value chain including the consumer

The **challenge for Food Chain Management** is to integrate and balance the interests of all stakeholders, including enterprises, consumers, and society as a whole considering of all of the relevant factors for successful integration e.g. economic efficiency, environmental control, process organization, food safety, marketing or transaction rules, etc.

Four interrelated strategic **research domains** have been identified as decisive for the sector's ability to meet its future challenges and to overcome its inherent development problems. They focus on serving:

• **consumers** through the provision of quality and diversity in food they can afford and trust
• **food chains** through better transparency for advancements in governance, trust, efficiency, and innovation dynamics
• **SMEs** through better integration into the global and regional value chains, and
• the **sector** through better understanding of the dynamics in those critical success factors that will improve competitive perf ormance and sustainability in times of globalisation and change

.

These research domains constitute the challenge for Food Chain Management research which:

• is building on system analysis and optimization
• is focusing on e.g. business relationships between actors, on partnership formation and networking organization, on cost-benefit and risk management, and on organization
• is dealing with e.g. present and future food chain scenarios, with reduction of waste in resources, products, packaging, and time, with trust throughout the food chain, with emerging chains, with structural change, with demographics, and with governance
• having an impact on e.g. competition in the "new world scenario", employment (new and better jobs), SMEs (generation changes, gender development, survival, R&D), sustainability (reduction of resources: water, waste and packaging), climate change (reduction of energy, CO2, etc.), and structural dynamics

Actual priorities for Food Chain Management research can be captured in 8 major goals and a number of objectives related to them

8.2 Reduction of Waste (dealing with diminishing resources)

Reduction of waste is, in times of diminishing resources a very first step in dealing with emerging scarcities. Waste is a broad concept which covers in principle all resources used during the production and distribution of food as well as food itself.

The priority research areas are considered to be the reduction of waste through the utilization of waste from products and packaging through recycling and the reduction in resource use and especially in the use of energy and water.

8.3 Assuring Trust within the Chain for Better Serving Society and Consumers

Trust is a critical success factor within the chain but also between the chain and consumers. Distrust and the loss of trust are disrupting markets and are as such major challenges for the sector. It is a problem especially in commodity markets (or markets where product ingredients build on commodity products) were branding is of limited protection. Research in Food Chain Management would focus on trust generating and trust preserving activities and focus on the four principle objectives detailed in Chapter 10. Trust is a critical success factor within the chain but also between the chain and consumers. Distrust and the loss of trust are disrupting markets and are as such major challenges for the sector.

It is a problem especially in commodity markets (or markets where product ingredients build on commodity products) were branding is of limited protection. Research in Food Chain Management would focus on trust generating and trust preserving activities and focus on the four principle objectives detailed in Chapter 10.

8.4 Supporting Present and Future Food Chain Scenarios

The volatility of markets, the challenges posed by increasing production needs within limited resource availability, the globalization of markets with increasing competition, and the challenges posed by society's request on lowering negative impacts on environmental (e.g. climate change) and social concerns pose new challenges to food chain actors that require responses not yet dealt with in research.

8.5 Supporting Newly Emerging Chains (analysis and optimization)

The classical view on food chains leading to the common food products is changing. Diversifications in the needs of customers and society regarding products or services, changes in demographics, increases in cultural diversity etc. have a profound effect on the organization and operation of chains. Food Chain Management Research needs to analyse such emerging chains and provide a base for sustainable development.

8.6 Coping with Demographics

Changes in demographics in most of Europe and beyond will have a decisive effect on the needs for services and products which in turn will affect the organization of food networks. These developments are aggravated through the urbanization of societies.

8.7 Dealing with Structural Change

The sector is challenged with a broad range of structural changes that involve consumption, lifestyles, regional development, employment scenarios, urbanization, or international competition. For Food Chain Management the challenge is to identify opportunities and potentials for the sector and especially SMEs to integrate into developments but also to find appropriate policy and management initiatives that not only assure its future competitiveness but to allow early consideration for innovation advantage.

8.8 Improving on Governance and Innovation

In dealing with the challenges ahead, the sector does not only need to respond but to actively move forward through changes in governance and innovation that could change the situation. Food Chain Management research would need to especially provide supporting management schemes that fit the needs of SMEs through networking and cooperation, as well as through suitable systems for information, risk and knowledge management.

8.9 Developing Metrics for Social Responsibility to Enhance Fundamental/Applied Research and SMEs Innovation

Social responsibility calls for the development of metrics to assess and promote fundamental/applied research excellence while simultaneously facilitating and enhancing technology and knowledge transfer to drive implementation and innovation and outcome at SMEs.

Chapter 09 Operational modalities

Operational requirements for food research under Horizon 2020

9.1 Simplification of Application Process

The ETP Food for Life would like to see a number of operational changes instituted under Horizon 2020. The first of these is simplicity of application. At present, the application process is viewed by the food industry as being too complex and bureaucratic. This deters many companies, especially SMEs, from participating. While it is recognised that legal requirements of the contract process may be difficult to simplify, there is no need for complication at the application and assessment stage. However, the scientific rigour of the assessment must be maintained. A two-stage process of a short, simple outline application with shortlisting to a few consortia, followed by a full application from the short-listed candidates is preferred.

9.2 Flexibility within the Calls for Proposals

While the current practice of stating the funding available for each topic should be maintained, there should be flexibility in the number, type and size of projects that will be funded within that total. Currently, every application will be for the full amount published whereas the funding of a range of projects of differing format and size might be preferable.

9.3 Administration

Over the course of recent Framework programmes, the EU Commission has clearly stated that it wishes to reduce its involvement in the detailed administration of projects and calls. The ETP Food for Life has no objection to such a reduction, although it does imply that the EU Commission will eventually move to some form of sub-contracting of such administration. The only view we would take on this is that any sub-contractor must be administratively competent, have access to sufficient scientific expertise to operate the process, have a high reputation and be able to demonstrate sufficient impartiality. Many organisations and consortia, including this ETP, would see itself competing for such sub-contracts.

9.4 Greater involvement of SMEs

Few would argue that the involvement of SMEs from the food industry in EU funded research has been satisfactory. There are many reasons for this, not least of which is the high degree of fragmentation of the European food industry with close to 400,000 companies, primarily SMEs, in the sector. The nature of food SMEs, with either none or only small numbers of scientists employed in each makes it difficult to attract suitable SME partners. This difficulty is compounded by the universal definition of SME adopted across all sectors of each Framework programme. For example, a food SME of with 200 employees will consist largely of unskilled workers with a handful of scientists involved in quality/safety management. Contrast this with a similar sized SME in the IT sector where the majority of the 200 will be scientifically skilled, yet both are classified equally as SMEs. The ETP suggests that the EU Commission institute a review of its SME definition and either make it sector specific or alternatively include some metric on scientific skill available.

In addition, it could be more attractive for SMEs to be involved in research projects only after tangible research results have been obtained, this usually occurring 12-24 months after the beginning of the project.

9.5 Innovation

It is considered that the innovation arising from publically funded food research in Europe, either national or EU led, is less developed that is desirable. There are many reasons for this and one can list regulatory impediments (often safety driven rather than innovation driven) and the lack of scientific skills within many SMEs as contributory factors. Elsewhere in this document there are suggestions on how innovation can be fostered. However, the ETP would recommend the establishment of a short-term innovation forum to examine the problem and suggest solutions. The ETP would be happy to contribute to such an exercise.

9.6 Joint Programming Initiatives (JPI)

The ETP welcomes the establishment of JPIs, in particular the JPI A healthy diet for a healthy life which overlaps with one of our challenges (Health, well-being and longevity). We fully support this initiative and would welcome other JPIs in the food area over the coming years.

9.7 Knowledge and Innovation Communities (KICs) of the European Institute of Innovation and Technology (EIT)

The ETP Food for Life welcomes the decision to create a food-based KIC in the second phase of KIC creation in 2014 and fully supports the initiative. The food sector is the largest industrial sector in Europe (12.9% of all turnover; turnover €954 billion; 4.2million employees) and the creation of a KIC will be the stimulus needed to raise its research investment from its current low percentage of turnover. This, in turn, will drive its innovation, increase its exports outside of Europe and increase its percentage of the world food market. While the private funding for a KIC might, at first glance, appear difficult to find, it is such a very small percentage of turnover of the industry that, with sufficient focus in forming a KIC consortium, it should be possible to find.

Chapter10. Detailed Research Areas

Section A

Innovation supported by Communication, Training & Technology Transfer

Project 1: To establish an effective dialogue with consumers, food businesses, researchers and other stakeholders; to create a better awareness of the importance of innovation in the food industry for improved public health, enhanced quality of life, competitiveness, business success, and for gaining back its reputation; to improve the innovation culture in the research community and to improve mutual understanding, trust and respect between researchers and industry, and to establish new, efficient methods for structuring of existing fragmented information to SMEs and make it available in an easily-understandable format including existing tools as well as modern technologies of communications.

Scope:

- promoting channels of communication and discussion among stakeholders in the whole food chain (through seminars/workshops, technology days, workgroups for technology evaluations, technology assessment, etc.)
- encouraging effective national links between policy makers, scientists, technologists and food and drink companies
- demonstrating the importance of R&D activities, technology transfer initiatives and increased training for the sector's workforce to reduce the vulnerability to competition of the European food sector, especially SMEs
- elaborating improved training methods based on best practices as documented from the companies' feedback and achievements

- elaborating improved training methods based on best practices as documented from the companies' feedback and achievements
- stimulating and exploiting new methods and formats for the effective diffusion of awareness for consumers and the food producers
- optimising trust and confidence between all stakeholders
- development of standardised guidelines for the communication of research results using synergies developed by existing tools and project

communication and Integration of knowledge arising from complementary disciplines (e.g. medical, cosmetic, IT, manufacturing, energy, water, surface technology)

- developing and updating best practice guides for the food industry

Section A

Project 2: To stimulate the development of effective training programmes to establish and maintain the skills base for high quality and innovative food production.

Scope:

• building up a virtual organisation for creating and diffusing new, quality-assured formats for effective training linked to the innovation processes; this is the core task in the System of the European Academy for open innovation

• training of new scientists in the skills of Techno-Science Mediators, to promote new training techniques closely associated with national programmes of technology transfer

• elaborating improved training methods based on best practices as documented from the companies' feedback and achievements

• ensuring that the training and technology transfer programmes for industry and researchers are regularly updated and systematically extended with new research results

• stimulating and guiding national training initiatives

Project 3: To significantly enhance the innovation culture of the food and drink sector in Europe by identifying weaknesses, proposing solutions based on sound experience, and benchmarking results.

Scope:

• developing and promoting appropriate measures and mechanisms for technology transfer and training, including on-the-job options, based on benchmarking

• developing R&D and industrial partnerships for training and technology transfer, addressing both low and high tech food SMEs

• encouraging personnel transfer and exchange at all levels of the food chain

• providing training and dissemination services to stakeholders in the agro-food sector

• developing SMEs innovation platforms acting at national level and featured by the NTPs for efficient interdisciplinary share of knowledge

• fostering of interdisciplinary collaborative research in the food chain

Section B

Health, Well-being & Longevity

Projects suggested by the ETP Working Group on Food, health, well-being and longevity

Project 1: Effects of diet/dietary constituents in delaying/preventing the decline of cognitive functions in the aging human brain

Scope:

To prevent age associated decline of cognitive functions is of high societal relevance and will provide a substantial quality of life gain in seniors/geriatric patients to remain participative and independent as long as possible. The current knowledge base on the effects of diet and their individual constituents for maintaining brain functions in the elderly is insufficient for any concise dietary recommendations, for food product development or other public health measures.

Expected impact:

By combining longitudinal epidemiological studies with experimental studies (intervention studies) using tools of cognition science, basic knowledge should be gained that provides the basis for food product developments and dietary recommendations. A special emphasis may be given to lipids, other lipophilic food ingredients and/or antioxidants.

Project 2: Understanding the variation in human metabolic energy efficiency - including the contribution of the gut microbiota to energy homeostasis

Scope:

There is growing evidence from animal as well as human studies that the microbiota contributes substantially not only to immune functions but also to energy homeostasis of the host. In addition, a considerable variability in basal metabolic rate in humans is determining the response to a caloric load and affects long-term weight management. Most interestingly, these differences can yet not be explained neither by body composition analysis not by genetics or variables such as fidgeting. For a better understanding of those processes in human energy balance, new approaches are needed and call for a revival of human studies that target energy efficiency and energy balance.

Expected impact:

Human obesity and associated diseases are key drivers for health care costs in the EU and affect quality of life and well-being and calls for better assessment tools that help to understand human variance in body weight responses to caloric intake and energy expenditure including consolidated knowledge on the role of the gut microflora. Delivered research should be targeted to improved methods to assess set-points in energy homeostasis, easy assessment methods and experimental methods proofing the role of the microbiota.

Section B

Project 3: Better understanding of the effect of diet in pregnant women for the development of the offspring in view of obesity and diabetes predisposition and for optimising fetal and early postnatal development.

Scope:

There is no doubt that intrauterine conditions and the nutritional environment (nutrition of mothers and placental functions for nutrient supply) are controlling growth and development of the fetus and similarly postnatal early nutrition is of critical importance for long-term health perspectives. Our knowledge base for the effects of quality of fetal and postnatal nutrition (with a special emphasis on lipids and other lipophilic compounds) are insufficient for health outcome predictions and the basic processes underlying the preconditioning of health outcomes via epigenetics and imprinting are far from understood. This could also be applied also for allergy and/or gluten intolerance/Celiac Disease:

• Impact of maternal diet (including allergens) on the sensitization of infants

• Impact of weaning (type of foods – including allergens-, timing and order of new foods introduction) on sensitization, allergy and gluten intolerance/CD manifestations in infants

It can be also applied to susceptibility to infections, neurodevelopment (gut and brain), infant behaviour (sleep quality, crying time, hyperactivity...) and functional gastrointestinal disorders. It could include lactating period.

Expected impact:

A better understanding on how the nutritional environment affects health outcomes in later life, both on the mechanistic levels as well as via epidemiological tools to improve mothers and infant nutrition and health.

Project 4: Stable isotope labelling of food products for use in food sciences and human nutrition research

Scope:

Advances in analytical techniques such as NMR and mass spectrometry allow isotopologue profiling on large scale. When stable isotopes are incorporated (random and full labelling) into food raw materials (different plant foods), the isotopes provide a wide range of applications in all areas of food and nutrition sciences. This includes food processing technologies, food chemistry issues and use in human studies to trace the ingredients and metabolites produced. It is a project that should bring together experts across disciplines (from plant sciences, food sciences and human nutrition with an emphasis on metabolomics approaches).

Stably labelled milk proteins: Currently Prof Y Broirie (INRA) and Prof Luc van Loon (Maastricht) have small scale production of labelled cow's milk protein allowing studies on whole body and muscle protein synthesis in response to whey/casein in different amounts, timing etc. etc. An available, larger scale production of such stably labelled milk proteins would be of great advantage for such studies Stably labelled 41-Ca subjects for Ca absorption/resorption studies. (Currently Prof R Hurrell, Zurich and Prof Connie Weaver, Purdue Uni are the only ones in the world with 41-Ca for such studies. As this is an expensive but effective technique that many partners (DSM, TNO etc.) are interested in, a common effort to make this available would be of great interest. Include in this concerted effort labelling of probiotics to trace metabolites and their fate.

Expected impact:

Concerted effort for large scale production of stable isotope labelled food (standardised raw materials and products) for future food processing and human nutrition research. Development of new algorithms for isotopologue tracing and metabolic modelling. Setting up of a repository for isotope labelled food reference compounds.

Section B

Project 5: Treatment of low grade inflammation by diet / dietary constituents in view of its central role in the pathogenesis of a variety of diet-dependent or affected diseases such as type 2 diabetes and other chronic diseases.

Scope:

Low grade but chronic inflammation is a unifying process underlying most of the chronic diseases whether diet-dependent or not, including cancer. Low grade inflammation, most likely resulting from increased intestinal permeability, is a newly identified mechanism underlying gut dysfunction. However, organ-specificity in disease initiation and progression in the context of low grade inflammation is not well understood and biomarker research has not yet provided proper surrogates that can be applied in real life conditions. To which extent diets/ dietary components that can prevent or at least dampen inflammatory processes and thereby affect disease development has to be explored and new concepts that go beyond for example antioxidant actions are needed. Dietary components and probiotics are suggested to improve barrier function and may therefore represent a new and interesting approach to treat disorders such as functional dyspepsia and irritable bowel syndrome

Expected impact:

Better understanding of the individual's susceptibility to chronic inflammation in the context of nutrition and life style, a better understanding of the organ specificity of low grade inflammation and most importantly robust biomarkers and new concepts by which dietary means inflammatory processes can be reduced.

Project 6: Defining the nutritional and sensory and food texture needs and development of strategies for an adequate nutrition in the elderly and geriatric patients

Scope:

In advanced age, sensory and textural quality of food, nutrient density and bioavailability become most critical for an adequate nutrition of the elderly (at home or hospitalized). There is insufficient knowledge on the nutritional status of the advanced age groups in view of energy supply and needs for nutrient intake (vitamins, essential amino acids, fatty acids. minerals, trace elements). Moreover, new concepts for providing appropriate savoury foods with proper textures, high nutritional quality and easy to handle (including packaging) are needed.

Expected impact:

Knowledge base on nutritional status and needs of the elderly (70 or 80 plus) across the European population. Approaches to improve foods in view of the impairments in sensory perception in the elderly, their needs regarding texture and a high level of convenience with proper nutrient supply. Improved (cheap and easy) methods for assessing nutritional status in the target groups are also needed.

Section B

Project 7: Improvement of plant based protein sources for high-quality food production (including animal-based products) for a more sustainable food chain

Scope:

Emerging problems in food security within a growing world population, the impact of global food production on climate change and the needs of more sustainable food production systems in general will in particular address the quantity of animal products consumed by European consumers. Development of new plant derived products that can replace parts of the animal products in the diet with lower dependence on feed imports and more sustainable high quality food supply systems.

Expected impact:

Crops grown in Europe that may not be used on large scale for food purposes (because of tradition or containing anti-nutritive components but providing high quality proteins and lipids) may be explored as food products (or by providing ingredients) that can replace parts of dietary fat and animal protein in high quality (sensory, dietary and environmentally friendly) food production systems of the future.

Project 8: Defining the "etches" of human metabolic/homeostatic control in response to food intake with standardized challenge tests for obtaining (early) markers for deviation from normal with predictive quality for health maintenance

Scope:

Biomarker approaches to assess human health status in context of food, diet and life style have not yet revealed the expected outcomes. It is an intrinsic problem to define human health, to measure it and it is even more difficult to show that healthy humans more healthy. This is actually also an intrinsic problem underlying "EU health claim regulations". The identification, validation and acceptance by EFSA of biomarkers reflecting a physiologically relevant response to bioactive nutrients is key to the design and success of our clinical trials. In the domain of bone health we have already submitted our arguments for the recognition of bone biomarkers in relation to physiologically relevant outcomes (fracture risk) . Furthermore, in the current EFSA pre-opinions there is a section on collagen turnover and that would be relevant to bone, joint and skin health if accepted as a biomarker as such. Conceptually, human metabolic plasticity can overcome disturbances in the biological systems preventing biomarkers to be derived (so can experimental animals for example certain knock-out mice without any obvious phenotype). However, when the biological system is forced to its capacity borders for compensation, reliable changes can be observed. For human studies a highly defined and standardized challenge scenario should be developed and tested to derive biomarkers under capacity limits that better help to define health and that may be predictive.

Expected impact:

Collaborative efforts of academia and industry should define and validate such studies for the sake of defining "normality" in responses to food intake challenges and for deriving novel biomarkers. This can conceptually be validated also with putative health-promoting ingredients and should encompass measures that employ all available life science technologies.

Section B

Project 9: Validation of in vitro models for the in vivo prediction of the behaviour of food ingredients in digestion, absorption, distribution, function and elimination

Scope:

The limits (capacity, money, regulations) in assessing the fate of food ingredients with respect to human metabolism and health are overcome by a more wider use of in vitro models simulating the human metabolism and response (i.e. artificial intestine) including in silica models. Although such models may be valuable, only very limited (if at all) validation has been carried out. As advantages these in vitro models may be, as limited they are. A concerted effort of academia and industry should validate some of the models, define their most useful applications and define the limits. This is of equal importance for academic researchers as well as R&D experts in industry.

Expected impact:

Collaborative efforts of academia and industry should define and validate such studies for the sake of defining "normality" in responses to food intake challenges and for deriving novel biomarkers. This can conceptually be validated also with putative health-promoting ingredients and should encompass measures that employ all available life science technologies.

Project 10: Defining and cataloguing the fate of plant secondary components as health-promoting ingredients in mammalian metabolism by assessing the role of CYP (Cytochrome P450 family) enzymes in ingredient handling, by applying stable isotopes for metabolic conversion analysis within the host and its microbiome and with improved (parallel) methods for detection and quantification of metabolites.

Scope:

Effects of plant secondary components (phenolic acids, flavonoids, isothiocyanates, glucosinolates, phytosterols and others) are used in hundreds of studies (from cell culture to human interventions) with the goal to demonstrate health benefits. Yet, numerous studies demonstrate huge differences in bioavailability (even depending on microbiota) and substantial metabolisms in phase I, phase II pathways in intestine, liver and other tissues with minor amounts of the parent compound found at target sites. Enzymes (mainly CYP´s) and transporters in drug research are well characterised and each new compound has to undergo rigorous testing for handling by these proteins. It needs a similar effort for food constituents and in particular for the plant compounds which are xenobiotics for the human system. Similarly, understanding heterogeneity in individuals (host and microbiome) in handling of these compounds is important as are new parallel methods for detection, identification and quantification needed including stable isotope labelled standards.

Expected impact:

Better understanding of the fate of plant derived compounds in human metabolism, understanding heterogeneity, understanding parameters that determine bioavailability and cataloguing xenobiotic enzyme reactions for secondary plant components in the human system. Development of improved analysis tools and data bases that provide the knowledge on metabolic conversions for representative structures from different subclasses of ingredients is expected. This calls for a concerted effort of industrial R&D with academic partners.

Section B

Project 11: Assessment of food-drug interactions for risk-benefit-analysis in use of bioactives in food and on the role of foods in drug delivery and metabolism.

Scope:

Bioactives in foods may use the same pathways in xenobiotic metabolism as drugs and this means that food ingredients can alter drug bioavailability and drug efficacy. The most impressive examples are the ingredients in grapefruit (1 glass of grapefruit juice) which were shown to alter drastically the plasma concentrations and functions of numerous drugs (some 30 different drugs) and these possible side effects are labelled in drug use leaflets (package insert). In an aging population with use of a large variety of drugs on a regular basis (because of multiple morbidities) food-drug interactions are a growing problem and this in particular with bioactive food ingredients. But also other food ingredients (fat, protein etc.) can alter drug availability, action and elimination. It is a necessity also for food industry to address this issue (liability) and create awareness. A research effort that addresses in proof of concept studies food-drug interactions with partnerships along pharma and food (R&D and academia) is needed to provide a knowledge base and create awareness for this growing problem.

Expected impact:

This project is of high societal importance and crosses borders between pharma and food for the safety of the European consumers. Comorbidities are treated with a variety of drugs and in aging societies this issue addresses not only drug-drug interactions but also drug-food interactions. Impressive examples with normal food constituents and normal serving sizes affecting a multitude of different drugs in their efficacy are available but are largely neglected by the food industry. It can be foreseen that this issue will obtain more public attention and may become important also from a liability perspective.

Project 12: Comparing the influence on human health of four categories of food/drinks: (1) traditional food products vs. (2) organic vs. conventional (3) "healthy – biological active compounds, plant ingredients, etc. and (4) innovative (functional) foods/drinks

This project can be aimed to provide the clear scientific and practical evidence to clarify the health influence of all analysed type of the foods via summarising experience, analysing the data are known – recently obtained, correction of definition, investigations (comparable test-study) and conclusions.

Additional topics suggested in the consultation process:-

Section B

Project 13: Role of the Gastrointestinal Barrier for the Development of Obesity and Metabolic Diseases

Obesity and metabolic diseases are a major burden for public health, individual quality of life, and medical care systems. There is increasing evidence that the gastrointestinal barrier is an important site influencing the pathogenesis of obesity and metabolic diseases, e.g. by diet-dependent hormone release or bacterial translocation. The possible impact of such findings for understanding the mechanisms of such diseases, for the identification of new biomarkers and individuals at risk, and also for new treatment strategies needs to be further explored at a basic science and clinical level.

Project 14: Food, health, well-being and longevity

Developing the scientific knowledge for modifying agricultural crops (using both molecular biology and traditional methods) to provide specific nutrients targeting the unique health, well-being and special needs of the growing elderly population.

Project 15: Identification of specific health component (bioactives) in European food products and optimising the process and storage condition

- identification of specific health components in European food products and raw materials
- optimizing food processing technology that improve the preservation and improve the bioavailability of the health components
- what is optimal meal composition to increase the availability of the health components?

Project 16: The relationship between social representations of health and aging and the adoption of a healthy diet

Protective health behaviours are influenced by common social beliefs. The study is aimed to evaluate the role of social representations of health and aging on the adoption and maintenance of a healthy diet. We hypothesize that a complex and integrated representation of health and old age (as a phase of life not only characterized by losses, but also by gains and personal growth) is positively correlated with the adoption of a healthy diet and lifestyle in order to reach, or maintain an overall well-being. The results could be an important knowledge for prevention programs and for communication with old people by practitioners and others health professionals.

Project 17: Use of effective food-based strategies to prevent vitamin D deficiency in European populations and promote health and investigation of new biological functions of vitamin D

Vitamin D deficiency is a public health issue which affects all ages and crosses gender, economic, educational and ethnic groups, with huge potential human and economic cost implications for European societies. New data around potentially important roles for vitamin D in non-skeletal as well as skeletal health outcomes has facilitated some authorities to undertake the process of re-evaluating dietary recommendations for vitamin D. Recently published US recommendations have highlighted a substantial gap between the newly established RDAs and typical vitamin D intakes. New data suggest that the amount of sunshine exposure needed to prevent vitamin D deficiency may be higher than previously believed, prohibiting its use as a deficiency prevention strategy due to risk for skin damage and cancer. Supplementation as a public health policy to correct widespread nutritional deficiency has been previously ineffective due to relatively low compliance. Therefore, appropriate food-based strategies are required for prevention of vitamin D deficiency across all sectors of the population. To date, no strategic initiatives have been undertaken by any major global funding agency to enable immediate implementation of nutrition policy and to inform policy evaluation to provide the greatest returns for population health across Europe, including addressing the technological issues underpinning appropriate and sustainable food-based strategies to prevent vitamin D deficiency and improve health and quality of life in all citizens. Strategic investment will provide the evidence for development of food-based strategies to address endemic, preventable vitamin D deficiency in European populations. This will reduce chronic skeletal and possibly non-skeletal disease burden and will increase competitiveness of the European food industry through the development of new food products. It will place the ERA in a position of global leadership in vitamin D research. It aligns very closely to the major objectives of the ETP Food for Life. It will contribute to the activities of EFSA and other policy organisations and support European public health policy.

Section B

Project 18: Update of regional Food Composition Tables

Advances in the development of Food Composition Databases in Europe (e.g. the EuroFIR project) have established standards for the identification and description of foods, identified new analytical methods for each nutrient and planned Standard Operating Procedures to achieve harmonised compilation process across Europe. Food Composition Databases need to be updated within the proposed quality framework.

Project 19: Development of National Nutrition Survey

There is an unequivocal need to develop and/or establish national nutrition surveys across Europe in order to closely observe dietary habits and the nutritional status of European citizens. Studies designed to assess the health and nutritional status of adults and children combining interviews and physical examinations are necessary.

Project 20: Elucidation of the functionality of non-cow milk

Traditionally, goat and sheep milk products have been a fundamental part of the diet in most Mediterranean countries. These types of milk as well as their products are rich in a large variety of essential nutrients, such as minerals, vitamins, proteins, carbohydrates and lipids, which at the same time significantly differentiate goat and sheep milk from cow milk. They also present very peculiar sensorial characteristics, while their consumption has been associated with beneficial health effects. However, a coordinated approach for the holistic elucidation of their functionality is still missing.

Project 21: Alert and advise consumers on diet through advanced IT measures

Intelligent system to alert and advice consumers on the right dietary approach, based on personal way of life. Ubiquitous information and advice through multiple IT platforms (web, tablet, phone, TV, Digital Radio, ...)

Project 22: The gluten challenge: a public health issue of growing significance

A. Reduction of (celiac) toxicity in regular wheat- and gluten-containing foods.

This will benefit the general population including the non- and wrong-diagnosed groups and possibly also the non-CD-related gluten-sensitive group. Starting point is the assumption that every reduction in the consumption of harmful (CD-toxic) gluten will contribute to general reduction of the prevalence of the disease(s) and of symptom severity in the population

B. Production of guaranteed safe foods particularly for individuals that are already diagnosed with CD and GS and have to follow a life-long gluten-free diet.

Strategy A can be performed in two ways: a). general reduction of gluten in food products, comparable to current salt, fat and carbohydrate reduction, which also might include the development of technologically more efficient but less toxic gluten; b). switch to the application in food of well-characterized low-toxic wheat varieties, which are currently under development and which might/should become a global wheat breeders' aim (using currently developed immunological and molecular [e.g. 454-sequencing] tools for quantification of toxicity and for molecular marker-assisted breeding) with concomitant development of separate wheat production lines. Strategy B can be directed on: a). wheat and its gluten with focus on the (recombinant or by processing) production of safe gluten proteins based on currently gained knowledge on the elimination of the toxic fragments and (sourdough) fermentation techniques; and b). alternative cereals, among which oats appears more and more to be a good replacement for wheat, rye and barley by serving as an important supplement to the patient's daily diet. By EC Regulation 41/2009, oat products containing less than 20 ppm gluten are now allowed to be sold as gluten-free.

Section C

Safe Foods that Consumers Can Trust

Project 1: Understanding bacterial colonization of food: control of contamination on fresh unprocessed foods

Fresh unprocessed foods including meat, dairy, fish and vegetables produce (e.g. salads, fruit) may be contaminated with a wide range of pathogenic bacteria as they progress along the food chain from "farm to fork" posing a risk to consumer health as recently demonstrated with the German crisis. Despite this, there remains a very poor understanding of the frequency and nature of bacterial pathogen association to these foods and the mechanisms of interaction at cellular and molecular levels remain unknown. It is a prerequisite that to allow development of rational, innovative and efficient strategies to control contamination requires a better understanding of these bacterial attachment / colonisation mechanisms. In development of new approaches to prevent / limit bacterial associations with food consideration must also be given to the environmental impact of such treatments.

This topic aims at providing enhanced understanding about the interaction of key food-borne pathogens (namely EHEC, Salmonella spp., Staphylococcus aureus, Listeria monocytogenes) at cellular and molecular levels with fresh unprocessed foods Besides molecular analysis and functional genetics, the heart of the project will be based on integrated biology approaches (combining genomics, transcriptomics and proteomics as well as state-of-the-art microscopic technics). Alternative and innovative strategies for controlling food contamination will be further evaluated. The environmental impact of these treatments needs to be fully considered in a context of sustainable development.

Expected impact:

- improved bacteriological safety of fresh, unprocessed foods
- assurance of safety by food-producing company protecting them from the economic fallout from food contamination events
- control of the environmental impact of decontamination treatments
- contribution to EU microbial food safety policy, prevention of food contamination crises

Section C

Project 2: Elimination of Enterohaemoragic E.coli (EHEC) from the fresh produce production chain

During the last two decades, fresh produce has become increasingly popular among European consumers. This growing market is facing constant challenges to ensure that these foods are safe for human consumption. Fruits and vegetables are unique foods in that they are often consumed raw or with minimal preparation. Thus, microbial intervention strategies previously developed for other foods are inadequate at providing the appropriate measures to eliminate the microbial food safety hazards associated with consumption of fresh produce. The occurrence of repeated European outbreaks of EHEC associated with consumption of fresh produce is of particular concern. To develop an effective strategy to prevent contamination of fresh fruits and vegetables with this pathogen, one must obtain detailed knowledge on the sources of contamination and entry points of the pathogen in the production line, as well as increased knowledge on the factors that allow bacteria to survive on the surface of fresh produce. New knowledge in this area is essential to decrease the occurrence of future outbreaks associated with fresh produce and sustain consumer reliance and to develop new systems (safe, no-toxic, active and natural packaging, entrapment of biomolecules or useful microorganisms) capable to prevent or limit microbial contamination, and concurrently to improve the shelf life of fresh and highly perishable foods.

Expected impact:

Decreased incidence of EHEC outbreaks and protection of consumer safety and public health. Increase product safety leading to increased producer competiveness as compared to non EU producers. Consumer health benefits by sustained consumer consumption of healthy food.

Project 3: Microbial Persistence (Biofilms in the food chain: bacterial interactions and novel preventive actions)

Biofilms are communities of microorganisms attached to a surface. In most real-life situations, microorganisms are present in multispecies consortia on surfaces. Biofilms in the food chain are considered to be a major source for bacterial recontamination thus providing challenges for food safety, quality and spoilage; the formation of biofilm can also mean the potential pathogenicity of bacteria (Quorum sensing activity). The physiology of surface associated microorganisms differs from their planktonic counterparts, as surface adhered bacteria are more resistant to environmental stress including disinfectants.

Due to the significance of bacterial biofilms, identification of the microbiota of biofilms in various food production chains should be addressed. Their role for surface adherence and biofilm formation of potential pathogens/spoilage bacteria including bacterial interactions, mechanisms and metabolites responsible for biofilm development, physiology and properties should be identified. Quantification of planktonic and attached cells in biofilms as well as of other forms for bacterial growth and survival (i.e., constrained, immobilised cells) should be investigated with a combination of conventional microbiological methodologies and complementing state-of-the-art technologies including (i) molecular genetics (ii) analytical chemistry, (iii) systems biology, (iv) "-omics" e.g. genomics (proteomics, transcriptomics) and metabolomics, (v) bioinformatics, (vi) image analysis. Knowledge on sources and contamination routes of the biofilm associated bacteria are important for being able to provide targeted actions towards biofilms. Increased knowledge on biofilm formation mechanisms could provide effective strategies for the prevention of biofilm formation and/or removal or inactivation of biofilms in the food chain, also through use of biomolecules or beneficial bacteria, or through the development of functional and safe packaging materials with antimicrobial and antiquorum sensing activity.

Expected impact:

- reduced contamination with bacteria during food processing
- novel solutions to prevent/remove biofilms
- reduced spoilage and thus reduced food waste

Section C

Project 4: Reduce the food waste in the value chain

In the last few years there has been an increasing focus on waste generation in food value chains nationally and internationally, especially related to reduce starvation in developing countries and greenhouse gas emissions from agriculture and food production and distribution in the developed countries.

Food waste, mainly vegetables and fruit, can constitute the basis for the recovery of an extraordinary amount of functional biomolecules with high added value that could be used into the development and formulation of new functional foods and as natural preservatives in food processing and manufacturing, as substitutes of chemicals. Research focused on new product formulation technologies from food waste regulated by the European Community (2008-98 EC) will be encouraged. Systematic risk analysis should be performed identifying hazards, response of hazards and management of hazards.

Expected impact:

Safe recovery of vegetable food waste for food and pharmaceutical purposes.

Project 5: Realistic microbial shelf life determination in real time

Defining and understanding of the correct shelf life for products and the risks related to managing product quality in relation to shelf life seems to be a key issue with regard to food loss in the logistic chain, in retail shops and by consumers. Neither consumers nor food chain stake holders completely understand the difference between the two different shelf life labelling "best before" and "use before". Furthermore, today's labelling is static, and do not respond to actual temperature condition which have a dramatic effect on real shelf life. Present use and understanding of shelf life predictions and labelling contribute to big amounts of waste from the households and retail sector.

It is essential to get an improved understanding on the spoilage microbiota in terms of identity and activity. Novel approaches for experimental designs of challenge testing are necessary for an improved and realistic estimation of microbial response of specific spoilage bacteria alone and in combinations during laboratory conditions. Moreover, new knowledge about the lag phase of spoilage bacteria will be fundamental for an improved understanding of how it may be controlled, and possibly be extended. From this knowledge good predictive models of spoilage may be constructed and used for in real time monitoring of shelf life.

Expected impact:

Novel approach for accurate and realistic determination of product shelf life in real time

Section C

Project 6: Management of microbial contamination

In the assessment of food spoilage and safety of food products, information about growth, survival and inactivation is collected along the production chain. This provides information about changes in bacterial number as affected by processing, storage, packaging conditions etc. Contamination frequently occurs during processing, by direct contact with contaminated or surfaces, water or hands, or indirectly via air. The extent of contamination has an important impact on safety and spoilage, but is not sufficiently understood. New knowledge is needed on routes and sources of contamination. In this context the role of biofilms should be studied, and also the role of airborne microorganisms in droplets. Furthermore, the mechanisms of bacterial attachment, detachment and persistence on surface (including food) should be elucidated. How is the microorganisms affected during transitions from surface, air to food and how is the growth ability on the food affected? Models of contamination should be developed with significant factors identified to calculate the probability of food contamination along processing. Significant factors could be temperature, humidity, cleaning routines, air flow etc. Biofilm detachment needs to be understood and introduced in model for different types of food and food contact surfaces. Using HACCP principles critical sources and routes, specific control points will be identified.

Expected impact:

Novel approach for accurate and realistic determination of product shelf life in real time

Project 7: Suitability of certain bacteriocinogenic strains of lactic acid bacteria as starter cultures for fermented foods with improved preservation potential

Production of bacteriocins in situ; Microbial antagonism and development of microenvironment that excludes pathogens; Starter functionality and quality aspects

Project 8: Use of chitosan to extend the shelf life of chicken carcases and sliced meat products

- use of chitosan in the refrigeration water of chicken carcases (tanks or spraying) and in slice device of the machines, during slicing of the meat products
- formation of a chitosan thin layer on the external surface of the products
- study of the antibacterial and antioxidative effects of chitosan. Extension of the shelf life of the products

Project 9: Factors affecting the safety of beef steaks produced with transglutaminase

- beef-steaks produced from bovine meat cuts, which are attached with transglutaminase, have serious safety risks, especially if they are not properly cooked
- study of the survival of pathogens in the core of these products
- use of natural antimicrobial substances during the production of these products

Project 10: Implementation and validation of natural antimicrobials in foods.

Although many natural antimicrobials have been described in recent years (e.g. antimicrobial peptides, known as bacteriocins, produced by lactic acid bacteria), the food applications are scarce, mainly due to technological limitations, which vary depending on the food type. There is a need for improving and / or developing food processing technologies for the better and efficient implementation of natural antimicrobials in foods.

Section C

Project 11: Strategies to minimise pathogenic bacteria in fresh produce.

There is a need from the EU fresh produce industry to reduce or circumvent the use of chlorine, while at the same time minimising water use and waste water. The proposed strategy will respond to a requirement identified by the industry to coordinate and reinforce European research in sustainable cleaning and disinfection technologies (innovative) of fresh produce.

Project 12: Minimizing risk in Ready to eat products

The aim of the proposed idea is to go beyond the current scientific state-of-the-art in predictive microbiology in order to provide the European food industry with new probabilistic predictive models and decision-making tools that can be easily applied to quantify and manage microbial spoilage and safety risks in food so as to produce safe products while remaining globally competitive.

Project 13: Novel non-destructive tools and methodologies for evaluation of food

The current practice to meet the legislation demands relies heavily on regulatory inspection and sampling regimes. It is, therefore, crucial to develop valid methods to monitor freshness and safety to ensure quality, irrespective of perspective (i.e., that of the consumer, the industry, the inspection authority, or the scientist). The goal of this suggestion is to develop an innovative toolbox (ANN, network science) of novel methodologies (e.g. FTIR, Raman) for the reliable and inexpensive evaluation of foods including freshness, spoilage and safety.

Project 14: Identification of genotypes/varieties of wheat with high and low acrylamide-producing potential for food manufacturing processes

Acrylamide production during food processing has become a major difficulty for the European food industry. This project will identify the wheat genotypes most likely to mitigate the problem.

Project 15: Development of cost-effective safety assessment strategies for chemically complex food matrices

To ensure future sufficient food supply, new sustainable sources, new raw materials, new production systems and techniques, re-use of waist, and new product concepts are required. Such innovations however develop slowly, while once developed, it takes a long period before these really can be applied in food production. This is illustrated by the very limited number of novel foods that have been introduced on the European market since the EU Novel Food regulations came into force. One of the major hurdles in food innovation is the safety assessment. Generally, food is to be considered as chemically complex matrices. Current safety assessment methodologies are not optimally attuned to assessing such complex matrices and the safety assessment often remains non-conclusive while consuming great amounts of time, resources and animal experiments. This is mainly due to the fact that such complex matrices generally are composed of hundreds or thousands of different chemical constituents, most of which are unidentified and have unknown toxicological properties.

But also existing food still poses risks associated with its complex composition and effects of processing and preparation. Our daily food is composed of hundreds of thousands of chemicals, most of which with unknown identity and unknown toxicological properties. Acrylamide discovered several years ago is an example. Our poor knowledge of the hazards of chemical constituents of our food is due to the fact that health effects of chemicals often develop at long term exposure and sometimes even become manifest in next generations. As a consequence, risks of chemicals are often difficult to be related to diseases. Therefore, it is important to improve our knowledge and methodologies for the safety assessment of unknown constituents in food.

Objectives:

Develop cost-effective (in terms of time, costs and use of animal) safety assessment approaches for chemically complex food matrices.
Innovative character and solution to problems: Interdisciplinary between analytical, toxicological and epidemiological approach, improvement of analytical characterisation, optimal use of new toxicological concepts, and replacement of animal experiments.

Expected impact:

Improvement of safety of existing food and higher speed of innovation to develop safe novel food.

Section C

Project 16: Development of methods for assessing the risk of allergenicity of (novel) food proteins

To ensure sufficient sustainable food supply in future, introduction of alternative protein sources for food production are essential. A major health hazard of proteins is the ability of causing allergic sensitisation. Food allergy is a major public health problem affecting between 2 to 6% of the European population. Besides resulting in morbidity and mortality, food allergy causes a strong impairment of the quality of life, not only for those suffering of food allergies, but also for their environment. In the development of sustainable food on the basis of new or modified proteins, it therefore is important to ensure that new or increasingly introduced proteins possess low allergenic potential. However, methods for (semi) quantitative allergenicity assessment are lacking.

Objectives:

Develop methods for (semi) quantitative allergenicity assessment of food proteins.

Innovative character and solution to problems:

Identify and develop hazard parameters and develop already proposed qualitative allergenicity assessment flow chards into (semi) quantitative allergenicity assessment approach.

Expected impact:

Safe introduction of sustainable protein sources for food production.

Project 17: Development of methodologies for early identification of (re)emerging risks

Despite enormous efforts, industry, authorities and society still are frequently confronted with food incidents and crises. These are a major cause of societal stress, health loss and economical damage. The increased globalisation and intensification of our food production and supply chains and economical pressure even increase the risk of development of incidents and rapid spread of worldwide crises. In many cases of incidents and crises, information was previously available on the basis of which risk managers might have been able to early identify the hazard and proactively manage the risk. However, the relevant information often appears not to be in the possession of the risk manager or is not picked up or identified to be relevant by the risk manager. This of course is in major part due to the enormous amount of information that is available or needs to be managed. Technology is needed to better retrieve information that is relevant for identifying (re)emerging risks.

Objectives:

Develop technology to better retrieve information that is relevant for identifying (re)emerging risks.

Innovative character and solution to problems:

Interdisciplinary between food safety experts, toxicologists, microbiologists, epidemiologists, risk assessors, risk managers, linguistic experts, text mining experts, ICT experts, etc.

Expected impact:

Reduced numbers and impact of food incidents and crises.

Section C

Project 18: Development of methodologies for early detection and identification of chemical and microbiological hazards

Despite enormous efforts, industry, authorities and society still are frequently confronted with food incidents and crises. These are a major cause of societal stress, health loss and economical damage. The increased globalisation and intensification of our food production and supply chain and economical pressure even increase the risk of development of incidents and rapid spread of worldwide crises. To reduce the occurrence of incidents and crises and to minimise their impact, early detection and identification of chemical and microbiological hazards is needed.

Objectives:

Develop technology for early detection and identification of chemical and microbiological hazards.

Innovative character and solution to problems:

In and at line detection and identification using sensors and microbial genomics.

Expected impact:

Reduced numbers and impact of food incidents and crises.

Project 19: Human exposure to PFCs through food consumption and their migration from food packaging and food contact material into food.

The aim of the proposed idea is to increase knowledge regarding exposure to per- and polyfluorinated compounds (PFCs) through food consumption. To achieve this inter-disciplinary research is required and various analytical challenges have to be overcome to assess the migration of PFCs from packaging and food contact material into food commodities, e.g. estimate transport rate and quantity.

Project 20: Increase the knowledge regarding toxicological effect of arsenic species on humans.

The aim of this proposed idea is to further investigate toxicology, toxicokinetics and biotransformation of arsenic species in humans. Further, to investigate whether storage and processing of food result in increased concentrations of arsenic species of human health concern.

Other project ideas, in brief:

• new and emerging issues need to be identified, addressed and appropriate RA tools developed. Examples include new proteins, new and emerging pathogens, new food structures and matrices, etc. More realistic RA models are needed for complex food matrices

• risk-Benefit evaluation of functional foods as it relates to consumer use/misuse (over and under-consumption) should be addressed, reinforcing both in vitro and in vivo studies under standardised conditions

• identification of trends of growing importance and development/application of tools to carry out Risk-Benefit Assessments. Examples include climate change, water shortage, changing trends in consumer preferences, rural, traditional, organic and ethnic foods

• explore advanced multi-hurdle concepts, modelling and combining different types of hurdles (e.g. preservatives, advanced preservation techniques, active packaging, etc.), including those technologies enhancing the activity of natural antimicrobials

• develop harmonised chemical and biological analytical methods and sensors, including on-line control, proteomics and genomics technologies and nano-technologies along with new developments in information and communication technologies

• investigate the development and application of the Threshold of Toxicological Concern (TTC) , Margins of Exposure (MOE) and key-event dose-related framework (KEDRF) concepts in the risk analysis process

• improvements in all stages of risk assessment – hazard identification; hazard characterization; exposure estimation; risk characterization – e.g. using biomarkers, omics technologies, probabilistic modelling (for exposure), population sub-group differences and similarities, alternatives to animal testing and validation of in vitro models

• investigate improved risk benefit contributions to risk analysis and better methods of risk reduction

• investigate risk communication methods to enable consumers to understand “risk” v. “hazard” and allay their concerns over chemicals – chemophobia – and safety of emerging and new technologies

Section D

Sustainable and Ethical Production

Project area 1: Avoid / reduce food losses and waste

• optimisation and reduction of food waste in a food chain perspective (the food technology aspects are covered under the heading "Developing sustainable processing, preservation, packaging and logistic systems" below)

• biodegradable packaging materials made of food waste or other raw materials that does not compete with food production, e.g. by use of by-products and waste

• management instruments to ensure sustainable food losses and waste in chains, e.g. provisions in contracts, cross compliance policies, etc.

• biorefinery concept: Device and models of a biorefinery concept to obtain 100% valorisation of agricultural raw materials, for high value added food and non-food production

Section D

Project area 2:

Alternative protein sources in the food diet

Protein sources:

- novel plant proteins from crops such as soy and lupine
- insects such as locusts and mealworms
- marine sources such as algae and seaweed
- blue biotechnology

Consumer acceptance and use of alternative protein sources:

- replacing animal protein with plant protein, including hybrids
- economic instruments such as subsidies and taxes
- health aspects
- international cooperation, technology transfer to developing countries

Project area 3:

Sustainable water consumption

• prediction of water use and possible mitigation options for food chains/products
• tools & Method: Global water management through food chain signals (water footprints, virtual water etc.)
• how will the "water debate" influence the future of sustainability of food production? What innovation can it lead to

Project area 4:

Sustainable primary food production in Europe

• reduction of environmental impact of animal biomass production. New ways of more sustainable, less resource demanding methods

• how are the multiple land use requirements for the bioeconomy (e.g. biochemicals, biofuel) influencing the sustainability of food production?

• research and creation of database on quality of agricultural products as a way to better value the initial sustainability of ingredients. Quality – energy, protein and nutrient

• localisation of activities: Determinants and evolution of production/processing/ retailing localisation regarding the issue of large cities feeding and land use. Questions on food miles, urban agriculture, resilience

• tools and Methods:

- methods for land use issues in sustainability assessments (e.g. Bioenergy vs. Food)

- research on finding good measurement of an integrated indicator for "quality value of the initial agricultural ingredients"

- development of tools for assessing the sustainability of specific sectors (e.g. dairy, meat, vegetable oils)

Section D

Project area 5:

Developing sustainable processing, preservation, packaging and logistic systems

• food processing technologies that improve food chain sustainability:
- non-thermal processes (use micro/macro nutrients, bioactive compounds etc.)
- small scale processing with high performance
- energy- and water efficient processes
- waste minimisation, "management of clean flow" (avoid mixing and contamination of side streams)
• packaging design to improve sustainability; easy to empty, environmentally friendly materials, design for recycling, design to increase efficiency in logistics/storage etc. Packaging design must be addressed towards packaging simplification and must consider the evaluation of the corresponding shelf-life
• biodegradable packaging materials made of food waste or other raw materials that does not compete with food production
• development of a public database: Implement a public database of environmental impacts of processed foods

Project area 6:

European food production and supply chain

• production management in a chain perspective (production, storage, distribution, cooking etc.) to facilitate sustainability improvements (Management, technology)
• pathways to develop resilience and flexibility in food production
- to understand the motivation of SMEs to implement measures and systems to increase sustainability
• education and training programmes to increase entrepreneurship of food, food professionals, including researchers
• to develop practical guidelines for the SMEs on implementation of the state of the art knowledge to assess environmental impact and to reduce it
• exploring opportunities in collaboration with the ICT and Manufacturing sectors to reduce waste and environmental impact to optimise the use of available resources – Food Factory of the Future

Project area 7:

Developing scenarios of future European food production and supply chain

• devising food scenarios for Europe in different time frames: context, supply, demand, technologies, trade flows, policies
• understanding, using scenario methodologies, the influence of BRIC on: food demand and prices; food security; environmental issues; health (global and EU)
• identifying key technology areas for decision support, e.g. waste to biomass fractionation for green chemicals and fuels
• providing a very broad and holistic assessment of sustainability issues attached to GM food, including both negative and positive consequences
• exploring different approaches concerning urban – rural interaction in the field of wastes (e.g. recycling of urban waste in agriculture), considering a broad spectrum of issues such as food quality and safety, energy balance, economic sustainability, and citizens' and farmers' attitudes

Section D

Project area 8:

Sustainability and the consumer

• how will future challenges of feeding the population ensuring health, impact the sustainability challenges of production? This area covers increased productivity, food secure products and more balanced diets. Here scenario studies are an efficient tool
• can "Less is more" be used as a concept of sustainable development in the food sector? How to implement such a radical shift and what measures are needed?
• research on synergies and conflicts between changed consumption patterns, including environmental, social and economic aspects
• research on trends on social innovation connected to shorter circuit from farm to consumers, as regional foods. This includes all three pillars of sustainability
• tools & methods: development of useful indicators for "Sustainable nutrition", e.g. environmental impact, related to different diets effects on humans ad for sustainable sensory profiling
• how to involve consumer society and other stakeholders in research and innovation on reducing household food waste and researching the concept "Sustainability intelligent" (knowledgeable) consumers and stakeholders

Project area 9:

Diet change

• how to speed up the diet change, through actions of individual actors as well as their concerted actions
• potential learning from consumer behaviour change in other sectors that could be transferred for diet change (e.g. health programme, marketing new product, etc.)
• acceptance and use of alternative protein sources, e.g. animal vs. plant protein
• innovation in institutions and policy (new future instruments)
• role of human behaviour; wants vs. needs, societal norms and values
• developing the concept "Sustainable Nutrition", i.e. products that are promoting health, are demanded by consumers and produced in sustainable production systems from fork to farm

Project area 10:

Tools and methods for sustainability

• reinterpret the sustainability concepts to indicate solutions for the current and emerging food issues. It is a dynamic matter, which is evolving and is context and time dependent. This needs to be understood in order to make sustainability an operational concept
• find out new useable tools for measuring sustainability (taking into account the four pillars approach, where sustainable development is based on economic development, social development, environmental protection and cultural diversity). New measuring tools should be: a) Simple/cheap, b) Acceptable, c) Trustable and d) Enforceable
• develop specific instruments for the sustainability assessment of new technologies
• social and environmental impacts of globalization and deregulation of food trade
• develop methods for food scenarios (Local, Regional, Global and combinations thereof)
• develop methodology and processes to perform multi-disciplinary research projects ranging from nano- to global scale

Section E

Food Processing, Packaging and Quality

Project area 1: Food structure and the PAN concept (Preference, Acceptance, Needs of consumers)

- food processing aimed to manage the food structure lifecycle to obtain foods with PAN-adjusted properties (i.e. modelling process and products onto sensory insight of the consumer)
- design of new properties of foods, based on processing, aligned to consumer-relevant PAN profiles
- quantitative understanding of food structure – functionality relationships, enabling to tailor functional properties
- structural life cycle engineering of food (build it up/break it down): From structure synthesis in-factory to structure disintegration in the GI-tract
- achieving the PAN goals with ingredients and processes as "natural" as possible. "Natural" is a basic assumption by the consumer when he/she speaks about nutritious food
- a property-targeted full chain approach: Exploitation of food raw materials by process-based enhancement of specific functional characteristics
- improved understanding of structure-life history
- overcoming process related hurdles for novel foods
- design and formulation engineering in food
  - exploitation of the functional properties of ingredients
  - step by step design and built up of a specific food from its components
  - formulation and process interactions in the final product

Section E

Project area 2:

Processing for functionality and nutrient security

• nutrient Security. Nutrient security is of paramount importance. It is a framework rather than a technology or approach. New research shows that normal diets (represented in public databases) exhibit nutrient security when all food items are regularly use (5000 years of food production development has nicely compensated for uneven distribution of essential nutrients). This is also the "common consumer" view. "Eat balanced and you eat healthily". However, processed foods do not always comply with a nutrient secure usage (i.e. essential nutrients are lost or only kept under the price of increased health sensitive nutrients, like fats, salts, sugars, etc.). The research should provide lead-edge knowledge, i.e. kinetics of degradation & stability, novel preservation technologies through active packaging, robust and minimal processing optimized through precision processing and modelling, biotechnological replacements of outdated chemical-engineered approach, etc.

• integration in research between processing, food quality and safety and nutrition/health.

• Processing technology developments to "preserve" the highest amount of essential nutrients by simultaneously achieving food safety

• engineering food structures with physiological beneficial impact, via gastro intestinal modelling approaches for digestion and metabolism-relevant processing (including probiotics, prebiotics, aspects and gut microbiota characteristics). Gut models of digestion and gut function include batch and continuous fermentations, seeded with human microbiota or candidate probiotics, into which micro and macro nutrients can be introduced and their metabolic fate followed. Animal models would provide more complex physiological responses giving immune and metabolic (metabolomics) readouts

• engineering approaches on tailor-made products for gut microbiota (e.g. effect of the food matrix structure on the functionality of foods modulating the gut microbiota. (Using direct microbiota population shifts and transcriptional and metabolic micobiota responses to specific nutrients including commercial ingredients and micro and macronutrient groups. Such studies will also look at metagenome and metatranscriptome in individuals fed specific diets. Such studies are particularly relevant at the extremes of life i.e. in infant and elderly)

• development and use of high throughput methodologies for evaluating the health-related and sensory performance of processed food systems

• bioactive ingredients incorporation in new structures
  - Interrelations between bioactive ingredients, functionality and structure

• robust technologies for flexible use in raw material processing (e.g. with altered composition and functionality (arising from new agricultural techniques) and exploitation of indigenous methods and tools, e.g. solid state fermentation
• redefining traditional processes with respect to optimizing local traditional foods in order to improve their specific functionality. This requires understanding of the traditional processing mechanisms and subsequent transfer into appropriate modern industrial processes

• technologies towards extending the funnel of raw materials (e.g. insects-unleashing the availability of new raw materials)

• re-evaluation of existing technologies with respect to recent insight into process-structure-property relationships and adaptation of respectively optimized new technologies

• rethinking ways of processing for functionality retention

• investigations to replace extraction with enrichment technologies. Complex food matrices are in many cases ideal carriers of valuable components, albeit the concentration of such components is too low to fulfil specific requirements (e.g. antioxidant activities, antimicrobial activities, bioactivity etc.). To date, these components are therefore extracted (thereby destroying the carrier matrix) and re-added to food products. A much more intelligent processing would be to develop technologies to enrich the specific components in the food without destroying the carrier matrix

• food grade nano-formulations for effective nutrient delivery. To respond to the challenge of nutrient bioaccessibility and bioavailability Nano-formulations could be developed and used as food ingredients. They should be biocompatible, easily obtained, stable and acceptable by the consumers

Section E

Project area 3:

Modelling and ICT for improved processing and quality

• next generation modelling, taking into account the whole chain in multiphasic properties of food components

• multi-scale modelling for improved understanding of characteristic length- and time scale interactions in food systems in order to support decision-making for food process and product optimization

• multiscale modelling of food process-structure-property relationships
- for hypothesis testing
- for engineering/reverse engineering approaches (e.g. starting from targeted nutrient bioavailability or sensorial property perception and ending up with structure engineering of complex foods materials in industrial manufacture or in food formulation engineering)
- effective food process optimisation by integrated modelling of food chain related unit operations, based on kinetic data and related models describing structure and quality changes during food production and storage
- integrated processing and modelling approaches, taking complexity of the food structure and related functionality into account
- modelling the whole food chain, to integrate/collect the concepts of quality and safety.
- handling of databases including data mining and pattern recognition
- modelling to understand the relationships between structure and sensory attributes like sweet/salty
- developing knowledge representation and decision-making tool based on stakeholders PAN (not only consumers) of the whole processing chain and on the development of knowledge reasoning models and tools that will go until the resolution of conflicts (interface with ITC)
• intelligent process management for retention of health relevant compounds and their bio-accessibility in end products
- process control by off-line/in-line analytical tools and process sensors in the context of life history structure-life-cycle, that follow the food material testing for damage of the product (post-harvest optimised design) applicable for equipment in thermal and non-thermal processing
- exploring the opportunities of the Future Internet in process control, foreign body control, virtual design, etc.

- optimization of processes not simply for safety but to create or maintain specific structures. In this context, input of mechanical energy leads in many cases to a structure "destruction" process that results in a loss of biological and technological functionalities in foods. Thus new equipment and processes for less invasive processing, which maintains structures or transforms structures with minimal loss of functionality are needed. This approach may simultaneously save energy

- development of inline measurement techniques to ensure a constant composition and quality during continuous processing and to address the issue of dosing minor components, as well as maintenance of integrity of sensitive compounds (e.g. bioactives). The aim is to achieve a paradigm change from an end of pipe quality control with a reworking off materials towards a continuous quality optimization via a knowledge based process control

- investigations to improve the applicability of robotic manipulation of unpackaged food. Robotic systems that are currently commercially available are not designed to be integrated into food process operations. Their main use is currently in automotive production systems and there, hygienic, speed and handling/gripping requirements are vastly different. As such, new design concepts need to be developed to introduce this promising technology into the food manufacturing sector. This must be accompanied with specialized sensors and image analytical tools adapted specifically to the handling of food matrices

- use of rapid techniques to monitor and control the quality and safety of foods during production. The simultaneous production of food products and the monitoring and control of safety and quality indices is of high significance for food industries. The development of rapid techniques for quality and safety control and the validation of their results will offer a lot in food production

- use of approaches from the science of complexity, taking into account adaptiveness and dynamic self-organisation within and between the systems under consideration

- current integrations of different application areas are hampered by a lack of being able to deal with different functions in different contexts, for which a common language does not exist. This poses mathematical challenges, suitable to be addressed within this area of modelling

Section E

Project area 4:

Packaging innovation

• exploiting the wide field of packaging's innovation potential by combining rational environmental and health concerns with advanced technologies:

- holistic approach to develop sustainable food packaging solutions by integrating the whole food chain processing, while anticipating safety issues (sensitivity balance)
- reducing cold / frozen chain use (energy consumption and carbon emission) for fresh (low processed) foods by developing novel modified atmosphere technologies and smart intelligent /communicative packaging solutions (to reduce energy consumption, preservatives intake and food wastes)
- in-package food processing: (re) inventing food processing technologies based on using packaging e.g. as simplifying factor (for reducing physical-chemical stabilization treatments)

• exploiting the wide field of packaging's innovation potential by combining rational environmental and health concerns with advanced technologies: It is necessary to adopt a holistic approach to develop sustainable food packaging solution by integrating the whole food chain processing, while anticipating safety issues (sensitivity balance). Another important area of development is the reduction of cold chain use (energy consumption and carbon emission) for fresh (low processed) foods by developing novel modified atmosphere technologies and smart intelligent/communicative packaging solutions to reduce energy consumption, preservatives intake and food wastes. In-package food processing opens new research area by (re) inventing food processing technologies based on using packaging for example as simplifying factor (for reducing physical-chemical stabilization treatments)

• effects of dynamic conditions of packaging on product characteristics. Modelling the effect of dynamic environmental conditions on the quality, safety and life span of packaged food products based on real case studies

Section E

Project area 5:

Sustainable processing

(Note: This processing related area could fit equally well with the sustainability areas of Section D above)

• broaden the raw material base and increase biodiversity in order to derive plant based-new technologies which may allow for the exploitation of raw materials not currently used

• sustainable exploitation of the endogenous potential of new plant-based raw materials via related exploitation of existing and new methodologies

• increase efficiency in production of plant-based proteins

• interdisciplinary research on water (environmental aspects of water use in food processing, water processing/cleaning and management)

- water use ((de-) salination, in-food processing water)
- waste water and recycling
- minimising water use (e.g. in blanching, separation processes by new membrane technologies, dry-cleaning of lines as alternative to using water)
- water as a vehicle for transportation

• re-evaluation of existing processes in terms of sustainability
- to save energy in processing (e.g. by reduction of process temperature, use of membranes, etc.)
- alternative drying to avoid phase transition processes, e.g. osmotic drying to remove water and avoid phase transition

• investigation into the design of liquid precursor systems, their energy efficient conversion to dry powders and associated equipment design and their subsequent –re-dispersion. The goal of such a complete "use-chain" consideration is to minimize energy needs and maximize quality of the later reconstituted products, again under the considerations of the specificity of the involved food matrices

• investigation to generally improve energy and mass flows in industrial food process operations. To date, most investigations focus on energy savings within a specific unit operation rather than the entire process. Instead, a holistic analysis of steam, electricity, water, raw material, product and by-product flows is needed. Such a comprehensive approach regarding energy consumption will enable also an optimization of process – product quality relationships

• transformation of waste into products for a different sector. This research focuses on the concept of waste minimization; In particular it explores the transformation of food losses and waste into products of a different sector (aesthetic and herbal products, active principles, supplements, inert remains for biomasses)

• environmental impact and energy optimization of the use of novel non-thermal technologies for production of safe products of superior quality. The aim is to produce safe food products of superior quality using novel non-thermal technologies optimizing the energy consumption and the environmental impact. The production of health promoting foods and food ingredients maintaining their (health promoting) activity after processing should be the focus of the research

• use of technical enzymes as gentle but efficient processing aids. Enzymes efficiently and selectively catalyse the chemical modification of a food constituent under mild conditions, i.e. in energy saving and environmentally friendly processes. Consumers widely appreciate the "natural", biotechnological/bioeconomic way to replace food additives and to process food raw material using the tools of nature

• traditional foods as a tool for functional foods production: The market share of traditional fermented foods in Europe (20% of Europe's food business with an annual turnover of 800 billion €) is growing, as consumers have an increasing awareness for artisan handling, gastronomic quality, and healthy food status. The existence of many SMEs, typical producers of those foods, is threatened because of loss of traditional know-how and severe market pressure deriving from increasing industrial globalisation of multinational food companies. Thus, it is expected that at least 30% of the traditional fermented food heritage will disappear. This will result in a loss of microorganisms with potential innovative technological and health-promoting aspects. Efforts are needed to obtain a better and more complete insight in European traditional fermented food products, so that new microbial strains with a considerable genetic, metabolic and technological potential could be selected and used to control traditional fermentation processes and to formulate functional starter cultures. These starter cultures can then be applied in the production of innovative foods, which enables SMEs to respect the appropriate and severe regulations.

Section E

Project area 6:

Small scale processing

• re-engineering by rescaling of existing processes (e.g. use of multiple small-scale units in series, instead of large units)

• post-shopping technology and food preparation at-home approaches

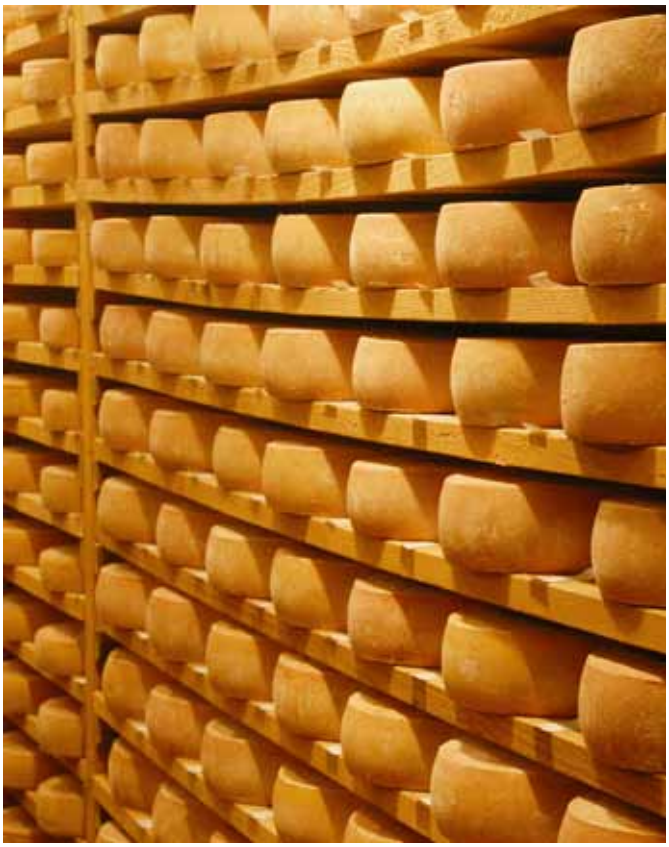
• point-of-sale retailing and processing (including distribution)

• point-of-use processing (PAN Concept - based)

• search for traditional small-scale food processing techniques (both EU and outside of EU)

• downscaling of industrial production techniques to SMEs and households

• upscaling of pilot plants and scale up to continuous processes of traditional batch processes for artisanal products (e.g. cheeses, breads, sausages) while maintaining their characteristics. Investigations must address the issue of process dimensions, residence time distributions, and equipment needs. All developments must take into account the specificity of the food matrix under investigation



Project area 6:

Processing for SMEs and use of technologies from other sectors

• decision supporting tools for SMEs on food processing issues
• post-shopping technology and food preparation at-home approaches
• decision supporting tool for SMEs on food packaging
• exploiting the available technical solutions from the manufacturing and ICT sectors for the food Factory of the Future
• exploring the collaboration in education and training for SMEs with existing European networks

Section F

Food and Consumers

Area 1: Societal challenges

Theme 1.1 Food safety and security

Project 1:

Food sovereignty, local production and social impact

Food sovereignty, the assurance that European member states can produce adequate food to ensure availability in the face of global crises, or in the context of climate changes, is an important element of improved food security. It also raises important consumer issues. Food sovereignty may entail costs, or food chain innovations, to "localize" the food supply. Technological innovation may also be required in developing new foods which are amenable to local production, as an alternative to reducing the range of available consumer products, overall and seasonally. Research is needed to understand consumer preferences for the implementation of European food sovereignty, (for example, in terms of product range and product choice) as well as communication policy (for example, tracing and labelling locally produced products). Information about local and European-wide social impacts (for example, relevant to local and national employment, or the economic and logistic structure of the food chain) is also required as part of the research conducted. The research will establish the relationships and parameters that are keys to coherent European food security and sovereignty policy.

Expected impact:

A theoretically based understanding of the advantages and disadvantages food production will be used to underpin policies facilitating food sustainability and food security through increasing localization of production. Socio-economic impact as well as consumer issues associated with food availability and technological innovation in production systems will be assessed.

Section E

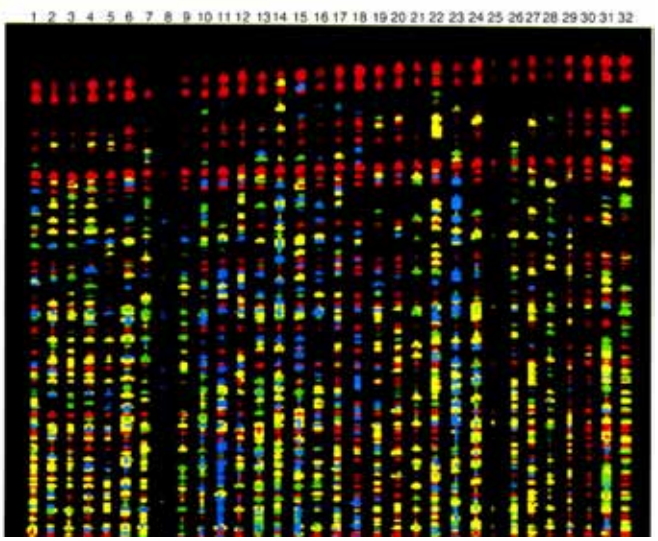
Project 2:

Trust, confidence and governance

Different governance frameworks are applied to different food production approaches within Europe. The regulatory framework applied to many traditional food production technologies is simple than that applied to some areas of technological innovation (for example, genetic modification of plants and animals). At the same time, some technological innovations (for example, genomic mapping of food species) requires little additional input in terms of regulation. An important issue relates to understanding the extent to which applying different regulatory approaches to innovation in the food chain enhances consumer trust and confidence in food security. A second issue is focused on the extent to which benefit, as well as risk, can be incorporated into governance frameworks,(for example in relation to risk assessment, management and communication), across a range of food production technologies, whilst simultaneously developing and maintaining consumer confidence in regulatory practices. Research is needed to map and compare the impact of different regulatory practices on consumer confidence in food chain innovation, and to predict the potential effects of risk-benefit analysis on consumer trust and confidence. The research should also address approaches to metricise social and economic assessment in addition to health and environment.

Expected impact:

The results will allow optimal governance to be developed in the agri-food sector, through the development of policy frameworks which have demonstrated to maximize consumer confidence in the food chain innovation, whilst simultaneously addressing both benefits and risks associated with agri-food innovation.



Project 3:

Trust, authenticity and naturalness

European consumers trust natural and authentic products more than they trust products that they perceive as highly processed, as employing advanced technology, as modified or altered. This preference for the natural and the authentic has given room for niche production in the range of local and traditional foods, but at the same time creates problems for consumer acceptance of other food products that are safe, healthy and nutritious, but that consumers reject because of a lack of perceived naturalness and authenticity. This project will investigate how consumers develop trust based on the perception of naturalness and authenticity, and how consumers form perceptions of naturalness and authenticity. Based on these insights, this project will identify key elements of food production processes that support notions of authenticity and trust, and that can increase consumer trust in the food production process. This project will work with a variety of food products, both traditional and novel, combining expertise in food processing technology with expertise in the analysis of consumer impression formation.

Expected impact:

Better ability of food producers to design production processes that will be perceived as congruent with demands for naturalness and authenticity; Insights into which factors, both in production process design and in communicating about it, will be perceived as indicating naturalness and authenticity; More consumer trust in the food chain.

Section F

Theme 1.2. Health

Project 4:

Social impact of food-related diseases and the mitigation potential of functional foods

Health is strongly influenced by food consumption. This suggests that a clear understanding of the balance between economic costs and health benefits for foods, new food technologies and diets is needed to allow policy makers and producers to make the best choices for supporting health. An important question then relates to assessing the economic impacts of diet and dietary choices, in terms of the functioning of individuals, households, health care systems and society in general. In the pharmaceutical situation the focus is on disease as identified by medical science. The foods situation differs from this in a number of ways. For foods both disease reduction and positive health benefits are relevant. Furthermore, for foods a broad set of benefits including physiological benefits but also psychological benefits related to health and well-being are relevant. Another challenge is the generalizability of clinical trials to real-life consumer situations. Thus, the development of a food-appropriate health economics approach is called for. Such an approach could be extended by combining it with the assessment of the social impact of food-based health interventions.

This proposal then suggests that the health economics approach should be developed to be applicable to food. The new approach should allow for multiple types of benefits to be included. In particular Quality of life and other consumer-relevant health benefits such as, for example, quality of sleep should be included.

Expected impact:

The development of a health economics approach for foods will allow policy makers and producers to optimize the health impact which foods can have for the European population.

Project 5:

Consumer acceptance of reformulated foods

For a large number of European consumers diet is unbalanced with an excess consumption of fat, salt and low-size sugars. One way to solve this problem is to reduce the content of these potentially negative ingredients in foods where they are particularly abundant and frequently eaten. This could be done by a simple reduction of these ingredients or by compensating these ingredients by other ingredients. Both types of reformulations still concern a limited number of food products. Moreover, even when this is possible from a technological point of view, simple reductions are rarely used by manufacturers who are worried about its negative impact on consumers' acceptance. Compensation strategies are not necessarily well perceived by consumers and maintain the preference for the taste of these negative ingredients. However, the optimal levels of these ingredients could be overestimated due to the methodology used to test reformulated products (comparison with the original products, short-term tests on small quantities). Thus, there is a need to develop more ecological approaches to test reformulated products. There is also a need to compare different approaches for introducing these reformulated products on the market: one is to reduce significantly the content of these negative ingredients and labelling these new products, the other one is to reduce progressively without specific communication on such reductions. There is a need to compare the long-term efficiency on these two approaches on different profiles of consumers and in particular on the most vulnerable population, i.e. those who are high consumers of the products with high contents of these ingredients and are not necessarily the most health-oriented population. Socio-economic parameters (prices, market segments) must also be taken into account for analysing the success of reformulated products. Collaborations must be established with projects aiming at monitoring the current supply of packaged foods and the market structure for each product family.

Expected impact:

To encourage the various players in the food industry (manufacturers but also retailers) to adopt strategies aiming to improve the nutritional quality of the food supply. To develop a platform for exchanging data

Section F

Project 6:

Consumer acceptance of reformulated foods

Elderly malnutrition appears today and will be for the next years as a real public health stake. Malnutrition is more frequent for elderly who are partly or totally dependent concerning food purchase, food choice and food preparation. Physiological factors among which the decrease in sensory abilities (in particular in taste and olfactory perception), psychological factors (in particular depression), and socio-economic factors (in particular loneliness, mobility, income) can contribute to reduce food intake and decrease diet variety. There is not only a need for specific products from a nutritional point of view but also a need to find solutions to avoid loss of appetite or reinstate appetite, desire to eat and pleasure in eating. Today there are few specific or adapted foods for the elderly people and they are not developed taking into account the likes or desires of this population. These products for elderly are rarely tested on the undernourished elderly target, and specific methodologies to test them are to be developed. Besides optimizing product palatability, there is also a need to identify solutions for increasing intake. New and more ecological approaches are needed to analyse diminishing flavour perception, changing sensory specific satiety and satiety signals and their impact on intake. The different factors influencing reduced intake and consequently malnutrition should be representative of those currently pertaining at European level, with a view to contributing to better strategy in public health. The research will aim at augmenting scientific understanding in the determinants of malnutrition and will aim at providing innovations in terms of products and recommendations. This will be achieved thanks to a combination of different approaches and a multidisciplinary collaboration of researchers in nutrition, sensory, anthropology as well as with food producing enterprises.

Expected impact:

This research will help to increase understanding of the importance of different factors to overcome malnutrition for elderly with different levels and different types of sensory, physical and cognitive impairments. The results would support development of food products specifically designed for the very old malnourished European population. This research would also provide ways to prevent malnutrition. This research will help to support recommendations for service providers in charge of elderly care at home or in nursing homes.

Theme 1.3. Sustainability
(Note: This consumer related area could fit equally well with the sustainability areas of Section D above)

Project 7:

Sustainability communication

Much of the sustainability value of food products remain essentially hidden to the consumer unless communicated to them through information on the food packaging and/or at the point of purchase. Transparency is crucial when the purpose is to enhance the informed sustainable choice on the part of the consumer, and on-pack information is an important way to achieve this. As sustainability is a multidimensional concept, including issues related to environmental (e.g. sourcing, processing, manufacturing, and logistics), social (e.g. fair trade), and animal welfare considerations, effective communication that promotes consumer understanding, is a complex process. Across Europe a variety of sustainability-related food labelling schemes are available, sometimes induced by national governments, individual food companies or retailers, and/or industry wide initiatives, often in close collaboration with certification bodies (e.g. Fair Trade). However, the effectiveness of these labelling schemes in moving food consumer behaviour into a more sustainable direction overall is still unknown. Also, more research is needed into the cross-cultural dimensions of sustainability labelling schemes, to ensure that for the individual consumer transparency does not stop at the country border. This project will provide fundamental insight into the effectiveness of alternative sustainability labelling schemes in enhancing informed sustainable food choices. It should take a European perspective, including an inventory of existing (inter-)national labelling schemes and their underlying rationale and evidence. If should define and empirically illustrate the underlying consumer decision making processes that enhance and/ or hinder the effective communication, and should include European-level segmentation to identify the most appropriate sustainability labelling scheme for different (vulnerable) segments within the European population.

Expected impact:

Baseline knowledge on the effectiveness of alternative sustainability labelling schemes and their impact on sustainable food choice, Europe-wide. New insights into possibilities for the science-based design of a European standard(s) in sustainability communication.

Section F

Project 8:

Trade-offs between sustainability and other consumer benefits

Sustainable food production may be defined to include the maintenance of a supply of safe and secure foods, as well as those which deliver nutritional, environmental, and ethical benefits. Thus consumers may need to make decisions about properties of foods simultaneously. As part of this, they may need to also consider broader societal issues associated with innovations in food technologies targeting improved consumer or environmental health. Important research questions relate to understanding how different attitudinal and perceptual determinants influence sustainable and healthy food choices, and how these vary across different demographic groups within the population. In particular, simultaneous consideration of the risks and benefits (to health, the environment, socio-economic factors, and ethical concerns) of food consumption may be representative of how people operationalize consumption decisions. The lack of validated theoretical predictive models of consumer food-related behaviour, which consider decision-making in the context of both sustainability and environment, is an area which requires further development, as well as policy translation into actionable recommendations relevant to both industry and government.
This proposal then suggests that the health economics approach should be developed to be applicable to food. The new approach should allow for multiple types of benefits to be included. In particular Quality of life and other consumer-relevant health benefits such as, for example, quality of sleep should be included.

Expected impact:

Information will be delivered, relevant to policy development, addressing co-development of both healthier and more sustainable food choices across European consumers. In addition, information will be provided to industry to enable the design of healthier, more sustainable food production systems and products.

Project 9:

Animal welfare

European citizens and consumers are increasingly sensitive to animal welfare as a process and product characteristic of food and derived products from animal origin. Previous projects have developed methods and tools to assess animal welfare in livestock production, e.g. Welfare Quality. Animal welfare concerns extend beyond the traditional terrestrial livestock species, such as pigs, poultry and cattle, to aquatic species including wild and farmed fish. The implementation of the newly developed tools raises questions concerning farm level profitability, stakeholder and supply chain members' interests and consumers' willingness-to-pay. A first important research question is whether it is economically feasible to implement the latest tools to monitor and assess animal welfare standards while maintaining European livestock industry competitiveness. A second research question is whether and to what extent European consumers are willing to pay for extra guarantees related to animal welfare, relative to other process-related attributes. Third, the most effective and efficient means of communicating about animal welfare (e.g. through product labelling or quality marks) need to be addressed. The study will aim to address the feasibility of policy decisions related to animal welfare from the perspective of food producers, food chain members, food consumers and European citizens.

Expected impact:

Information will be delivered to assist policy decision-making with respect to the implementation of animal welfare standards in livestock production, while maintaining industry competitiveness, meeting European citizen concerns regarding this issue, and satisfying European consumers' demand for animal welfare-related information and product characteristics.

Section F

Project 10:

Protein supply

Animal protein consumption is well-established in most European consumers' diets, despite being often criticized for its negative impact on human health (e.g. World Cancer Research Fund reports), animal welfare and environmental sustainability (e.g. externalities and carbon footprint from livestock production). An increasing number of European consumers are interested to lower their meat consumption frequency and amount, but their intention may not be realised owing to several real and/or perceived burdens. Besides mapping European consumer interest in lowering meat consumption and related motives and expectations, this topic also addresses the real and/or perceived burdens for doing so. These may relate for example to the availability of alternatives for animal protein consumption (e.g. meat replacers), personal attitudes and perceptions vis-à-vis available alternative protein sources (e.g. insect protein), lack of information and knowledge, as well as socio-demographic, economic, cultural and anthropological factors that shape current and future protein consumption in Europe. Experiences from other cultures beyond Europe with different protein consumption habits should be integrated in this project.

Expected impact:

Insight will be delivered in European consumer interest for lowering meat consumption and perceived barriers for adopting meat replacers. The research will help to understand related motives and barriers, as well as information needs as perceived by European food consumers. The research will provide recommendations for both European meat industries in terms of possible adaptations, and European food supply chains and industries dealing with meat replacers and alternative protein sources.

Area 2: Behaviour change

Theme 1.1 Food safety and security

Project 11:

Nudging: affecting consumer decision at the point of purchase

Much of consumer decision making at the point of purchase and point of consumption is based in habitual and routinized processes, often associated with a limited degree of information processing and deliberation (i.e. "low involvement"). For consumers with a higher level of involvement on societal impact of their food choice decisions, information transparency and public communication campaigns may be appropriate. However, such information may go largely unnoticed by the low involvement food consumer, thereby reducing the effectiveness of informational approaches. Recent developments in academic and policy circles are beginning to focus on relatively small changes in the so-called "choice architecture" that can stimulate healthy and responsible choices among consumers, without restricting their freedom of choice. These so-called "nudging" approaches build on implementing implicit social norms and /or selectively changing just the accessibility (rather than availability) of healthy and responsible options within the choice context. The project should provide an inventory of the potential of nudging approaches to enhance the healthy and responsible food choices among consumers and empirically identify the underlying consumer behaviour processes and mechanisms, and come up with policy advice to how selective nudging approaches can be implemented at the European level. The project should actively involve the retail and catering sector as well as food manufacturing industry to map out the multi-stakeholder potential of this approach. There should be due attention to the ethical aspects of nudging. In addition, the opportunities provided by the current and future internet to improve consumer awareness should be exploited.

Expected impact:

Basic knowledge on the potential of nudging approaches in effectively stimulating consumers' healthy and responsible food choice and consumption. A policy document outlining the key managerial, policy and ethical issues among the various stakeholders (catering sector, governments, retail, food manufacturing companies, consumer organisations) involved in a joint approach at the European level to move nudging forward.

Section F

Project 12:

Out-of-home consumption

Out of home consumption is increasing. This increase is driven by changing demographics, changing work patterns, and changing meal patterns. Out of home consumption covers eating in canteens and institutional cafeterias, at fast food restaurants, at gourmet restaurants, and on the go. It covers a wide variety of forms of food intake, and a wide variety of products with vastly differing degrees of healthiness and quality. Nevertheless, most efforts to encourage consumers to eat in ways that are compatible with desires for good health and quality of life have been aimed at food choice in the retail domain and in-home meal preparation. This project will provide basic knowledge on drivers of out of home consumption, different types of consumption, and the motives and decision-processes that will lead consumers to choose particular forms of out-of-home consumption. It will also analyse the effect of out of home consumption on nutrition and health, and characterize different forms of out of home consumption in terms of their nutritional impact. On this basis, and in cooperation with actors in the catering sector, it will provide guidelines for new forms of healthy out of home eating that will find consumer acceptance.

Expected impact:

Baseline knowledge on determinants of out of home food consumption choices and their impact on health and well-being. New insights into possibilities of improving public health by new out of home eating concepts. Science-based innovation in the catering sector and in the development of simple, environmental friendly, single-serving packaging for out-of-home consumption.

Project 13:

Meal patterns and eating habits

Identifying the determinants of meal patterns, that is, when, what and how much is eaten, in the context of abundant food supply, is fundamental to understanding and influencing healthy and unhealthy dietary behaviour. Despite the enormous range of foods and food products available and the many potential eating opportunities open to consumers on a daily basis, individuals tend show a relatively restricted and repetitive pattern of choice and intake. Nonetheless, changes in meal patterns (and fatness) occur with major changes in life circumstances (e.g., leaving home for college, change of job and migration). Investigation of determinants of meal patterns will involve longitudinal, cross-sectional and experimental studies to analyse the roles of characteristics of the food (composition, portion size, etc.), the environment (home, canteen, restaurant, watching TV, etc.) and the person (age, BMI, genetics, physical activity level, stress, self-control, weight concern, etc.). Such studies would be expected to reveal how cognitive, learned and physiological controls interact to influence hunger and satiety, food and portion size choice decisions and the timing of eating episodes, and in turn contribute to knowledge guiding interventions for achieving successful dietary change, healthy weight control, and product innovation and development.

Expected impact:

Generation of evidence on major influences on daily food and portion size choices and food intake. Generation of a knowledge base for product innovation and for development of strategies for achieving healthy dietary choices and healthy weight.

Section F

Area 3: New developments

Theme 3.1 Consumer engagement

Project 14:

The role and value of social media and social networking to encourage and support longer term behavioural change in respect of healthy life styles.

Is it possible to change nutrition, health and lifestyle behaviours with social media? What type of cross-functional effort that includes off-line and in-person interactions might be needed for true change? On the other hand, many of the external conditions and individual behaviours that are the root for health and disease are learned or shared from our closest contacts. So what is the role of social media and on-line networks in magnifying or inhibiting social and behavioural determinants of health?

The aim of this project is to valuate current uses of social media in public health that can be tied to measureable and effective outcomes and impact on behavioural change – what has been shown to work, and what has not worked.

Expected impact:

A better understanding of the role of social media and social networks in public health campaigns, interventions and policies, and examples of best practice.

Project 15:

Engaging consumers with (innovative) consumer research approaches

What is the most effective way to engage and communicate with consumers on new food-based technologies? Various methods have been proposed to involve consumers in the development of new food technologies and associated products, ranging from a range of methods focused on consumer and citizen engagement (such as citizens juries or consensus conferences) through to exploitation of new social media. An important research question relates to the extent to which the application of such approaches has an impact on agri-food policy on one hand and consumer behaviour on the other. Research is therefore needed to develop assessment methodologies relevant to measuring the impact of such interventions on policy development associated with the introduction of novel food technologies, as well as consumer behaviours related to innovative new food products developed using them.

Expected impact:

The potential impact of novel engagement and communication approaches will be understood, and can be used to successfully engage the public in general, and specific consumer segments in particular, in the food innovation process associated with novel technologies, thereby increasing the potential success of commercialisation strategies.

Section F

Theme 3.2. Price (uncertainty) as a determinant of food choice

Project 16:

Consumer response to food price instability

Over recent years, food commodity prices have been subject to major oscillations, mainly due to weather patterns, fluctuations in energy prices and rising demand from emerging economies. Although commodity price volatility is generally mitigated by price transmission mechanisms along the food chain, its combination with the overall economic instability can generate relevant adjustments in consumer choice and diet quality, especially for vulnerable groups, although little evidence exists. This project will provide quantitative evidence on the extent of these impacts in terms of food purchases and overall dietary quality. The quantification of consumer response should be addressed at a sufficient level of disaggregation across food products, considering the overall diet outcome, accounting for differences across European regions and making use of official secondary data-set and commercial retail-level data, if necessary. Quantification of consumer response should be based on appropriate economic models, but also addressing the influential role of psychological variables related to perceptions, attitudes and information processing, as well as lifestyles. The results are relevant to policy-making and to marketing strategies in the food sector.

Expected impact:

Generation of quantitative evidence on the impact of price fluctuations on dietary and health outcomes. Contribution to policy initiatives related to supporting vulnerable groups towards a healthier diet. Generation of knowledge for pricing and marketing strategies along the food chain.

Area 4: Methodological innovation

Theme 4.1 Networking the Food Consumer Science Capability across Europe

Project 17:

Integrating scientific disciplines and databases

Increased differentiation of (European) populations on socio-economic grounds may increase vulnerabilities in some target populations, and this might be exacerbated by genetic differences across populations. For example, some sections of the population are more vulnerable to diet related diseases through the course of the entire lifetime (for example, population groups with a lower socio-economic status, socially excluded groups, some immigrant communities and ethnic minorities) and differentially vulnerable during critical periods throughout life, such as pregnancy, lactation, infancy, childhood and older age. More effective collaboration between the natural and social sciences is required, as many of the issues and emerging problems may be caused by biological and socio-economic factors. Models which systematically integrate determinants of appetite (including over- and under-eating), hedonic responses to foods and food choice originating in the natural and social sciences are urgently needed if effective policy is to be developed regarding optimisation of consumer health. Understanding the determinants of healthy food choice would be a long term goal of research in this area. Although there has been extensive research in different disciplinary areas focusing on this topic, integration is poor and resulting policy fragmented. An initial integrating activity would involve developing a network of excellence which will enable researchers from different disciplines to collaborate and set up joint data bases for further analysis. Additional activities might include developing standardised approaches to assessing the impact of chronic diet-related diseases on Quality of Life, Economic Functioning of individuals and households, Health Service Impact, and Perceived Individual wellbeing, harmonizing methods to assess key psychological determinants of health, risk-benefit perceptions associated with specific food choices, and standardized behavioural indicators regarding what food choices are being made. Biological and psychological determinants of appetite and food choice can be studied using a variety of methods, including genetic analysis, behavioural ecological modelling, neuro-imaging (e.g., FMRI) and experimental studies (e.g., measurement of eye-movements to study attention). A key challenge is to bridge the gaps between the relevant research disciplines to enable dialogue and collaboration in the study of decision making in relation to dietary behaviour.

Section F

Expected impact:

An important outcome will be to design the infrastructure for long term prospective studies which can track change and the impact of policy interventions in European populations in the future. A set of standardized methodological approaches in both the natural and social sciences can be developed, which will facilitate long term collaboration between biological and social sciences relevant to understanding European food choices.

Project 18:

Defining EU-wide standards and tools in Food Consumer Science

There are a large number of psychological variables relevant to the study of food choice by consumers and to the impact of those choices on health. At the present time, no validated and standardized measures are available to facilitate integration of findings across different studies and secondary analysis of pooled data. As a consequence, research into the determinants and health consequences of food choice is limited. Lack of standardized research tools also limits co-operation between research groups, and the creation of joint data-sets etc., as data cannot be easily compared. Thus, a structured approach aimed at improving the availability of validated measures in key areas is needed.

The variety of possible measures is large. This suggests that in the first place existing measures should be collected, evaluated and made available through a generally accessible database. This can be followed by strategic analysis to identify key variables for which additional measures are needed. Key areas might include evaluation of quality of life and consumer understanding of. A rigorously tested and robust set of assessment measures can be made available to researchers within the European research area.

Expected impact:

The identification, development and dissemination of measures for key variables will enable effective research. As the results are based on standard measures they will provide more effective input for policy.

Section F

Theme 4.2. Price (uncertainty) as a determinant of food choice

Project 19:

Dietary change and obesity determinants: evidence from longitudinal analyses

The time dimension of the factors driving dietary quality and obesity rates in Europe has been overlooked in research, mainly because of the paucity of adequate longitudinal data. However, evidence from other countries and especially the US suggests that few factors have shown relevant changes over the last two decades, mainly technical progress, income distributions and relative prices, while the time variations of psychological and social factors has received little attention. Furthermore, longitudinal analysis and the application of the appropriate econometric techniques will shed light on the role played by habit formation and time discounting in determining unhealthy behaviours, as well as the potential feedback effect of health status. The objective of this project is to explore the time patterns of food choice and its drivers and outcomes, in order to capture the key determinants and enable evidence-based policymaking in the medium and long term, including the evaluation of policy measures adopted in recent years. To this purpose, the project will combine, match and merge existing secondary longitudinal and repeated cross-sectional data-sets in different domains into a comprehensive pseudo-panel data-set, considering all European regions and different population segments, including available information on time patterns in the economic, lifestyle, social and psychological determinants, as well as the relevant health indicators. The project shall develop and apply appropriate dynamic models to capture the aforementioned longitudinal effects.

Expected impact:

Generation of an extensive evidence basis for medium and long-term policies to improve diets and health. Generation of knowledge on the interaction of economic, lifestyle and psychological factors in determining dietary and health outcomes.

Area 5:Dissemination

Theme 5.1.Dissemination to European SME's

Project 20:

Making food consumer science actionable for SMEs

Food consumer behaviour related research-based knowledge has substantially been developed over the last few years. Its exact nature and extent can be adequately captured by a review of published outcomes, and peer reviewed publications still been considered as a primary vehicle for dissemination of such knowledge. Nonetheless, it is still questionable whether European SMEs (either market research firms or food industry) have fully adopted and exploited the innovative outcomes and/or the method advances that have been produced and been published in academic outlets. Possible reasons for delays in their adoption may relate to their characteristics as the outcomes or methods may have been seen as not offering a relative advantage, not been compatible, or being complex to current practices and knowledge; difficult to experiment, even on a trial basis; not been sufficiently visible; or probably involving risk and adverse experiences for any potential adopters.

The objective of this project will be to develop a "metrics" instrument that will be used to assess the innovativeness characteristics of the food consumer behaviour related research-based generated knowledge (either funded by EU funds or not but published in peer reviewed academic outlets) as perceived by potential adopters, either in the market research or food industry sectors. Related to this objective, another aspect will be to investigate what are any other barriers, internal or external to SMEs that delay adoption of such knowledge and what vehicles can be used to overcome any barriers or/and accelerate adoption. Second, to investigate the time-duration related aspects of the diffusion adoption (by the SMEs) curve(s) that published knowledge follows and the dynamics of such adoption curve(s). Third, to assign an economic value to what such knowledge and methods have generated through their adoption by European SMEs. Pan-European coverage is necessary. SME knowledge-transfer capacity on sensory qualities towards consumers will be considered and assessed and available knowledge based on the results of publicly funded research projects (mainly FP6 and FP7 and others) structured and collected to produce practical guidance for SMEs.

Expected impact:

Generation of an extensive evidence basis for the innovativeness characteristics of the outcomes and methods food-consumer behaviour related research as these are perceived by European SMEs; a plan for action to diminish the impact of barriers and accelerate the impact of facilitating factors; identification of the economic value produced by European SMEs that relates to published research-based outcomes and methods.

Section F

Other

Project 21:

Sensory perception of health and wellness foods: Consumers' willingness to change approach to food choice

People appear to have homogeneous conceptions of healthy eating, which are generally in line with the dietary guidelines. However, despite their knowledge about healthy eating, many people have difficulties in making healthy food choices. Understanding the underlying reasons of such difficulties requires insight in the processes that play a role in food choice. Food choice is a complex human behaviour, which is affected by many intrinsic as well as extrinsic elements. The project has to be aimed at understanding consumer sensory perception of new foods and creating an approach to design of products for health and wellbeing nutrition which provides sensory pleasure and high acceptance of new foods by the consumer.

Project 22:

Coping strategies and healthy diet in old age

The objective of the study is the evaluation of the relationships between three coping strategies (proactive, preventive, reflective) and the adoption of a healthy diet. The ability to hypothesize future negative health outcomes and to coordinate actions actively in order to prevent them could be relevant for the adoption and maintenance of a healthy diet. The proactive coping strategies could be improved through specific training predisposed towards health outcomes and should confirm a significant relationship with a healthy diet.

Project 23:

Organizational structure

Study on how different organizational structures of the food chain (short chain / long, or not localized food chain, chain of local products) and the flow of information of the risks and benefits influence the perception and trust of consumer.

Project 24:

Construction of a consumer friendly food-database in the internet

This database could contain suggestions about safe handling of foods, kitchen hygiene, placing foods etc. It could also contain information about microbial pathogens, food crisis events, nutritional information, etc. The most important issue is that all the information must be delivered in a simple and understandable, for the average person, in non-scientific language and an easily accessible form, resulting in well informed consumers and reduced food related hazards.

Project 25:

Exploiting the opportunities provided by the current and Future Internet to improve (Smart) consumer awareness

Collecting and structuring available knowledge based on the results of publicly funded research projects (mainly FP6 and FP7 and others) into guidelines providing practical guidance to SMEs. This may include all areas of consumer research on food.

Section G

Reduction of waste

(Note: This food chain management related area could fit equally well with the sustainability areas of Section D above)

Project 1:

Utilization of waste from food products (innovation in logistics)

Waste can become a resource for energy creation. Food chains generate large amount of waste and therefore, new and innovative approaches are required to consider maximizing energy creation. The opportunities for this energy creation can be identified by "mapping" the areas of the food chain where waste is generated at large and by illustrating which products can generate energy under a more efficient and environmental friendly manner.

Project 2:

Reduction of Waste from Packaging (innovation in distribution)

Packaging generates vast amounts of waste especially consumer packaging (dealing with the final product, e.g. bottles, cans). The concept of "reverse logistics" is relevant here as it aims to maximize the reuse and recovery of the final products whilst food waste recovery can support the further optimum use of products in different ways. Utilization of simple, environmental friendly, biodegradable, reusable packaging will be encouraged. Existing technologies (e.g. fermentation) or newly developed technologies can be applied to transform food processing waste in new, novel, and packaging materials. Dealing with consumers will be a key aspect of this topic as they will need to be incentivized / convinced / motivated / considered for any approaches followed.

Section G

Project 3:

Reduction of Waste in Energy (processes, logistics/distribution)

Considering the vast amounts of energy required in the food chain and the current scarcity of resources, further work in reduction of energy waste is required. A "total chain" approach is needed where chain members will be identified responsible for both large energy consumption but for large energy waste too. The reasons for that waste will be identified including the energy "bottlenecks" or "hot spots" where efficiencies can be achieved. It will be useful to examine possible collaboration models between these chain members at either horizontal, vertical, dyadic or network level too.

Project 4:

Reduction of Waste in Energy (processes, trade in virtual water)

Water is becoming a scare commodity and contemporary food chains should be water conscious aiming to minimize its usage and maximize its alternative use too. The key chain members responsible for the larger amounts of water waste should be examined. A slightly different but fully integrated methodological thinking may be required as various chain members will have different types, purposes and priorities of water usage (water usage by farmers versus manufacturers versus retailers).

Assuring trust within the chain for better serving society and consumers

Project 5:

Building trust through transparency and awareness

Transparency throughout the chain and awareness of consumers is a core requirement for improvements in chain sustainability, for efficiency in logistics and for the preservation of trust with consumers. It depends on knowledge about what constitutes transparency but also on knowledge on the organization of communication schemes and institutional environments that could make it work.

Project 6:

Assuring support of claims (organization of information and communication systems)

Claims on the safety, quality or sustainability of products or processes refer to issues that are not easily verifiable by customers or consumers. Trust in the claims is a pre-condition for their effective used. The objective does focus on the identification and evaluation of organizational alternatives of claim support incl. certification schism, information systems of various kind etc.

Project 7:

Dealing with communication schemes that integrate consumers all along the chain

Communication with consumers for better meeting market requests, for better reacting to emerging needs and for improving competitiveness is of relevance for enterprises all along the chain. Furthermore, it is a core concept in support of open innovation. Newly emerging network capabilities including social networks open new opportunities that need to be identified, analysed, and integrated with food chain needs.

Project 8:

Assuring and communication of tracking and tracing ability within networks

This project deals with an on-going challenge. The establishment of tracking and tracing ability requires an integrated view where organizational issues, issues of technologies, institutional set-ups, standardizations, and the political and legal environment need to fit together to make it work. The objective is to provide a system view that reaches beyond the traditional focused type of analysis. Of specific concern is the complementation of the classical backward look with a forward look that supports enterprises in making informed decisions and the evaluation of risks on their distribution activity.

Section G

Supporting present and future food chain scenarios

Project 9:

Dealing with the volatility of markets

Food Chain Management is faced with increasing volatility of markets due to resource competition and changes in the geography of demand and supply of food. Volatility involves risks. Food Chain Management Research deals with the development of risk strategies of various kinds (sourcing, organization, etc.) and the provision of decision models that could support management in dealing with the risk.

Project 10:

Dealing with emerging environmental and social concerns

Climate change and other environmental issues of major concern require the engagement of all stages of the food value chain in reducing its impact through emissions of e.g. CO2 and equivalents. Hot spot analysis and life cycle analysis provide the base for action, optimization of improvement strategies by Food Chain Management Research delivers decision support. Social concerns might ask for upper or lower limits regarding specific concerns (e.g. wages) but are subject to optimization in a multi-criteria decision situation where social concerns are embedded in issues of regionalization, development etc.

Project 11:

Integrating scientific disciplines and databases

Increased interest in regionalization, in the preservation of identities, and in the identification with food products and their origin is supporting demand for traditional food and food of certain origin. This contradicts traditional developments towards unified food products that could be efficiently produced and marketed on large scale. As the production of traditional food and of food of certain origin is limited in volume it is very much a domain of SMEs. The support of SMEs in the integration of production and distribution networks that could compete in the market is a core challenge for EU policy and a focus activity of Food Chain Management Research. One of the challenges in this research is the organization of networks that are efficient and sustainable and of information loops that support trust and provide guarantee on origin.

Project 12:

Dealing with limitations in the availability of affordable food

Limitations in the availability of affordable food require the development and operation of ad-hoc chain organizations that deal with the situation and reduce the short and long term effects of deficiencies in food availability. Efficient action models and reference systems with global reach are required that provide support in case of needs.

Project 13:

Dealing with emerging types of competition

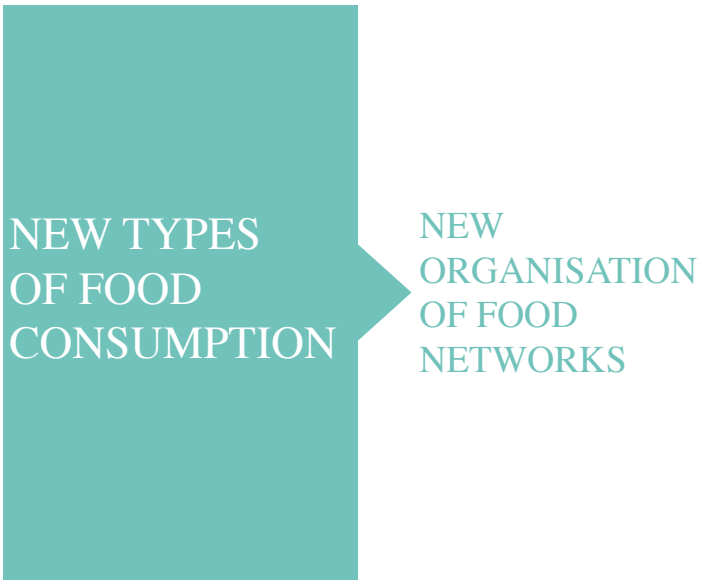
With global markets developing, new competition from emerging markets is entering the European Union challenging the established food chain networks. Food Chain Management Research will identify and analyse developments and their impact on the European food system.

Section G

Project 14:

Dealing with new types of competition

New types of food consumption including a tendency towards convenience products and an increase in out of home consumption (catering activities) have an effect on the organization of food networks. New logistics and information systems are emerging that require support to assuring efficiency in resource use and limitations in environmental impacts from the very beginning. Food Chain Management Research could identify, analyse, evaluate and optimize opportunities for providing development support.



Supporting Newly Emerging Chains (analysis and optimization)

Project 15:

Dealing with New Information Markets

The increasing relevance of information drives developments towards information markets. The provision of information that support claims on the safety and quality of products might differ between products and "owners" of information might require reimbursement for their collection and monitoring activities. Furthermore, information might be detached from products as in the "book and claim" development resulting in markets independent of the product market. Food Chain Management Research will need to identify, analyse and evaluate alternatives and provide support in linking them to various scenarios.

Project 16:

Dealing with distribution systems for personalized products

The responsiveness to changes in markets and market needs and the ability to serve the increased diversity in needs (due to demographics, cultural diversity, dietary needs for specific population groups, etc.) becomes a major concern in the food industry's competitiveness and has been brought forward as a critical challenge since some time. Food Chain Management Research will take up the challenge and identify, analyse, and evaluate new types of efficient and responsive coordinated production and distribution systems incl. production and distribution "on demand" as well as developments towards the provision of "tailor made goods". These research initiatives need to integrate developments in organization and technology.

Section G

Project 17:

Dealing with flexible and market driven chains: production based on the combination of functional food components according to needs

This project is a focused one linked to Project 16. Its focus is on chains where products based on functional food ingredients are being provided on an individualized basis according to needs. This leads to different types of chains that build on functional food ingredients and a production activity at chain's end. Food Chain Management Research will identify, analyse, and evaluate the newly emerging types of chain relationships.

Project 18:

Dealing with chains focusing on Ethnic Products

Food chains focusing on ethnic products have not yet been dealt with in a sufficient way. Food Chain Management Research will identify, analyse, and evaluate such chains. Furthermore, it will provide support in their integration into the classical European food chain environment, by suggesting in-use technological alternatives to the process used for their production.

Coping with demographics

Project 19:

Dealing with increasing urbanization: urban chains

Increasing urbanization combined with changes in demographics constitute new challenges. Older population and the expected increase in disabled people in urban concentrations requires new distribution concepts and formats that focus on serving lower mobility people. The integration of e.g. e-commerce, social (technology) networks, institutional arrangements, and adapted food chain organizations might allow new opportunities for support. Food Chain Management Research could identify, analyse, evaluate and optimize opportunities and provide development support.

Project 20:

Better serving urban concentrations while protecting the environment

Urban concentrations ask for innovations in logistics and packaging that might differ from traditional production and distribution activities. Developments in other sectors might provide references on which to build. Food Chain Management Research could identify, analyse, evaluate and optimize opportunities and provide development support.

Project 21:

Urban food systems involving agriculture and food production

Project 21 reaches beyond the tasks in project 20 and asks for a complete rethinking of food production and distribution. Vertical agriculture and roof agriculture are some of the brainstorming initiatives that need to be dealt with in further analysis. Short chains and the linkage of chain activities with social networks are discussed for food production and distribution. Food Chain Management Research could identify, analyse, evaluate and optimize opportunities and provide development support.

Section G

Coping with structural change

Project 22:

Integrating the food system with life styles, regional identification, regional development perspectives, and occupation policies

This project touches a broad range of issues. Food Chain Management Research could provide a broad mapping of opportunities and potential impacts in support of policy initiatives.

Project 23:

Integrating the food system with life styles, regional identification, regional development perspectives, and occupation policies

Food chains and especially the early production and the later distribution stages are always linked to regional activities. Movements towards further regionalization increase chains' identification with and their impact on regional developments. This supports the integration of SMEs, the creation of job opportunities, and the contribution to the development of regions. Food Chain Management Research may identify, analyse, evaluate, and optimize suitable regional chains and evaluate their impact on regional development depending on the development status and the economic scenario of regions.

Project 24:

Internationalization of food enterprises

With the internationalization of enterprises, new challenges arise especially for SMEs or SME groups. The identification of needs supports the necessary re-structuring of enterprises. Food Chain Management Research will identify organizational and managerial needs and analyse opportunities. It will specify reference models that provide a basis for organizational and managerial activities for a better global integration.

Section G

Improving on Governance and Innovation

Project 25:

Management needs from a perspective of SMEs (incl. management rules fitting for SMEs and GMP management needs)

Most management support concepts and tools are linked to the needs of large enterprises or multinationals with strategy divisions and a clear identification and separation of leadership groups. There is a lack in transformation concepts that make these concepts and tools suitable for use by SMEs and their management practices, including those linked to GMP (good management practice). Food Chain Management Research will design and test appropriate concepts and tools which allowed SMEs to link up with other SMEs and large scale enterprises.

Project 26:

Promoting knowledge networks for innovation support

It is of clear evidence that, in principle, network organizations support the identification and realization of innovations. Knowledge networks are supported by on-going technological developments which facilitates networking. Food Chain Management Research will identify, analyse and evaluate various network concepts and provide information on suitable organizational developments.

Project 27:

Dealing with management information systems for better operation, control and risk management in enterprises, chains, networks, and sectors

Dealing with the organization of information networks the objective identifies needs, opportunities and institutional requirements.

Project 28:

Dealing with lean management concepts through improved knowledge and information exchange

Improvements in knowledge and information exchange support the ability of management in performing its tasks. Best practice case study analysis may provide references on opportunities and improvement potential.

Project 29:

Institutional infrastructures for SME management support

The design of organizational infrastructures does build on the identification, analysis, and evaluation of best practice experiences.

Project 30:

Flexibility for optimal response to emerging risks

This project focuses on the design and evaluation of flexible organizations, infrastructures and management models that support swiftly adaptation to changes in sourcing, in lifestyles, needs, risks or societal requirements.

This document was developed by individual ETP Working Groups following consultations with stakeholders and it was subjected to an extensive national-, regional and web consultation process.

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European Technology Platform
Food for Life

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