EUROPEAN TECHNOLOGY PLATFORM
"FOOD FOR LIFE"

IMPLEMENTATION PLAN

WORKING DOCUMENT

September 2007

Foreword

This draft Implementation Plan (IP) explains how the research priorities that were identified in the Strategic Research Agenda (SRA) can be implemented. For each research theme it describes the issues that need to be addressed to realise its respective potential. It also illustrates activities required by the ETP “Food for Life” and its stakeholders to facilitate this process. While the SRA focused on topics and themes, the **IP focuses on activities and actions**.

This document is a **WORKING DOCUMENT** produced by the workings groups of the ETP “Food for Life”. The objective of the stakeholder meeting that will be held on 13 September 2007 is to discuss and improve this draft. The evolution of the IP is very much up to its stakeholders. So please get involved and help to shape the future of the food research and innovation in Europe!

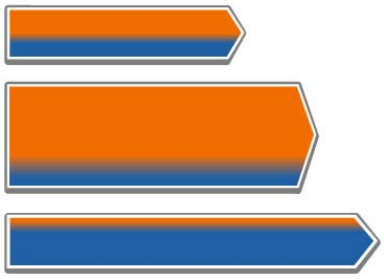
Jan Maat
Chairman of the ETP “Food for Life” Operational Committee

Contents

Introduction to the Action Plan

The Action Plan defines priority research areas for several themes that are of major importance for the food industry. Priorities are already defined in the “Food for Life” Strategic Research Agenda. However, the IAP focuses on those which require the most immediate steps to be taken. For each priority, a set of activities is proposed that need to be followed to enable the goals set forth in the Vision and Strategic Research Agenda to be achieved

The requirements and the time frame for each activity are also presented in graphical form in order to allow easy visualisation. Beyond the graphical summary of activities, the subsequent chapters will also provide reasons for choosing an activity, expected outcomes, the contribution to gap closure and other valuable information. For the diagrams, the following symbol keys are used:

Icon	Description
Participants / contribution 	The arrows describe start and duration of the project as well as the contributions needed from academia and industry. Orange stands for academia, blue for industry. The ratio of this contribution is depicted by the area ratio within the arrow.
Project Type 	Different types of projects might be needed depending on the envisaged activity: • ***Research projects:*** Projects ranging from frontier/basic research to applied, pre-competitive research which primary aim is to generate scientific and technical knowledge which can be further used for the development of new innovative products and/or improving the sustainability of existing production. These projects will benefit from collaboration efforts and networks.
  	• ***Demonstration / Pilot project:*** Projects with the aim of demonstrating the industrial and economic feasibility, and the sustainability of a concept. • ***Studies:*** These projects, including surveys, feasibility studies, LCA or eco-efficiency analysis, aim at generating knowledge/information allowing stakeholders and decision-makers to make informed choices. • ***Network / Coordination:*** Networks and coordination projects will allow better coordination between stakeholders in a field, interdisciplinary cooperation, exchange of information and coordination between European and Member States level.

	• ***Training:*** Exchange/mobility of researchers, courses, projects influencing curricular programmes in Member States.
Distribution 	Activity funding might come from different resources. While a general overview of available funding sources for different project types is given in Chapter 2.2, the pie charts describe the envisaged distribution of funding sources for each activity. A distinction is made between private or industry funding (dark blue), European Union funding (white) and national funding (light blue). Possibilities for venture capital, if they exist, will be addressed in the text.
Funding amount 	Gives a scale for indicating the required resources for the total duration of the activity 1 stack of coins: < 5 Million € 2 stacks of coins: 5 - 15 Million € 3 stacks of coins: > 15 Million €
Human resources 	Activities require human resources with adequate training and expertise. A blue symbol depicts that sufficient research expertise is or is likely to be available in Europe; a orange symbol means that such a skill base needs to be actively developed for a sufficient number of researchers.
Activities 	The Action Plan activities were selected based on the importance of the issue and the relevance to the overall challenges. It is often the case that other activities of relevance are already ongoing. New projects must build on such ongoing activities to achieve the best value. The puzzle pieces indicate whether significant, related and currently ongoing activities exist within the EU (FP6), at national level, in ERAnets, and/or in other regions of the world. More details of such activities are given in the description for each activity.

Challenge 1: Ensuring that the healthy choice is the easy choice for consumers

Consumer behaviour is a crucial factor in realising the goals that the ETP Food for Life has set itself. In addition to consumer science research supporting each of the other key challenges, the SSRA defines four fundamental areas in which the field of food consumer science should be strengthened to support the innovativeness of the European Food and Drink industry:

1. Developing better and agreed upon measurement in consumer science
2. Developing more integrative models and accounts for consumer behaviour
3. Developing more effective interaction with consumers through communication and public participation
4. Developing effective strategies to induce behavioural change towards more healthy and sustainable lifestyles of consumers

Goal 1. Better and agreed upon measurement in food consumer science

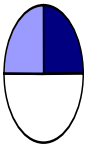
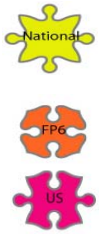
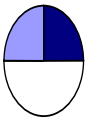
Despite considerable research activity at the national and disciplinary level, the leverage of this consumer science understanding at a European scale is still sub-optimal. This is largely due to the lack of an agreed set of measures of consumer relevant concepts (e.g. human values, personality scales, intake levels etc). This lack of comparability has hampered the field to take best advantage from mining the available consumer understanding data, both leverage across countries/cultures, across disciplines and across stages in the supply chain (eg integration of nutritional epidemiological data and retail scanner data). Also there is a need, and particularly in the health and sustainability area, for measures which do not rely on consumer self report to complement existing attitudinal measures.

Deliverables:

- **Agreed methodology and measurement tool box (cross-culturally valid and sensitive) to leverage food consumer understanding from different cultural and disciplines**
  Full understanding of food choice behaviour at a European scale requires comparability of measurement methods. Currently, there is large diversity in constructs and their measurement, both within and between disciplines and between academic and more applied approaches. Also, cross-cultural applicability of these measures is often take for granted, rather than being systematically explored. There is a need for an agreed measurement tool box allowing evidence-based cross-cultural strategy and richer accounts of the processes underlying food choice behaviour.

- **Pan European mapping of food cultures, based on integrated data sources that better leverage understanding of behavioural patterns and its underlying causes**
  Human food choice comes about as a complex interaction between the consumer, the food products and the context in which choices occur. Although actual food choices are quantified within different disciplines, there is virtually no cross leverage of these different data sources. There is a need to better integrate choice data as currently collected at the point of purchase (e.g. retail scanner data), at the household level (e.g. at the purchase panel data) and at the nutritional level (e.g. epidemiological data). Successful integration of these data sources will build a better understanding of actual food choice behaviour as a target for both marketing and public policy strategies. It is an important tool to accurate map European food cultures.

- **New modelling approaches to understand the discrepancy between attitude and behaviour**
  Much of current consumer understanding is based on what consumers say, rather than do. It is well known that this might lead to social desirability bias where verbal expressions are not an accurate representation of what consumers do. There is an urgent need to complement the consumer science tool box with new methodology that is less sensitive to social desirability bias. Such methods should be largely unobtrusive and observation-based (including rfid tags etc.) and be instrumental in better understanding the discrepancy between what consumers say and do. Insights from neuroscience should make a major contribution to this deliverable.

Action and Timeline 0 — 5 — years	Human ressource	Funding distri-bution	Funding amount	Type of activity	Activities
1. Better and agreed upon measurement in food consumer science					
Agreed methodology and measurement tool box Methodology					
Pan-European food culture mapping from integrated data sources Food culture mapping					
New modelling approaches to understand the discrepancy between attitude and behaviour New modeling					

Goal 2. Developing comprehensive models of consumer food choice processes

Human food choices are under the control of a variety of influences related to the product, the consumer and the context in which choices occur. This is reflected in the wide variety of disciplinary approaches involved in understanding food choice behaviour, which include sensory sciences, natural sciences, psychology, sociology, anthropology, marketing, neurosciences and many more. Each of these sciences has its own worldview (theories and models) on what drives consumer behaviour for food choices and they provide complementary perspectives of food consumer science understanding. However, as currently the integrative approach to food consumer science is still underdeveloped.

Deliverables

- **Pan European multidisciplinary food consumer science resource mobilised**
  Although the various disciplines involved in food consumer science are potentially complementary, the problem is that currently there is too little integration between them, due to lack of exchange, discussion and constructive collaboration. To enhance competitiveness from superior consumer understanding would require that an integrative approach to the field of food consumer science is actively promoted. Due to the lack of critical mass in the area, this can best be achieved by mobilising a pan-European multidisciplinary food consumer science resource. A European Network of Excellence could be an appropriate structure to achieve this.

- **Understanding the fundamental processes of food choice habits in pan-European context**
  Eating / consumption habits are deeply embedded in existing lifestyles and are under the joint control of a wide variety of influences. Eating habits need to be understood in their full complexity to allow evidence-based strategies to change them in more desirable direction. Cross-cultural differences at the European level as well as differences between specific target groups (eg low income consumers) require due attention in explanatory models of food choice behaviour. Existing models of food consumer science are often disciplinary in nature and fall short in taking full account of the various influences. There is a need to build more integrative models, leveraging the various disciplinary contribution, for a richer understanding. Such integrative account should also take due consideration of cultural similarities and differences and focus on food consumption baskets in addition to choices of individual items.

Action and Timeline 0 — 5 — years	Human ressource	Funding distri-bution	Funding amount	Type of activity	Activities
2. Developing scenarios of future European food production and supply					
The pan-European multidisciplinary food consumer science resource mobilised Mobilising resources					
Understanding the fundamental processes of food choice habit in pan-European context Understanding processes					

Goal 3.Promoting effective interaction with consumer groups and consumers directly through communication and public participation

Consumer orientation and consumer involvement are crucial factors in successful marketing and public policy strategies. Effective communication with consumer and public participation are important ways to achieve this consumer “buy-in”. Both should be evidence-based in the fundamental understanding of consumer needs and expectations with regard to such information and involvement. Such understanding should be built in pan-European context with full appreciation of the cultural differences that determine consumer response to alternative communication formats and approaches to public participation.

Deliverables

- **Mapping of consumer needs, expectations, knowledge and attitude with regard to information on food and food production in a pan-European context**
  Crucial in the communication (and education) process is the question what needs to be communicated and how it should be communicated for maximum effectiveness. Different target groups (both in socio-economic and cultural terms) differ in their information needs and capabilities to absorb and internalise information messages. To ensure that communication is not just a technology/policy pull but rather anchored in consumer needs, there is a need for a mapping of needs, expectation, knowledge and attitude in pan-European context. This provides the platform for more effective and tailored communication that constitutes a source of European competitive advantage.

- **A best practice tool box for effective communication with consumers on health and sustainability and the food technologies underlying them**
  In addition to necessary insight into “what” to communicate in terms of message content, effectiveness of communication also depends on “how” it is being communicated. Integrating insight from various disciplines, an evidence based tool box will be developed with proven effectiveness in stimulating informed choices on the part of the consumer in the fields of health and sustainability.

- **Validated models and methods for effective public participation of and engagement with consumers on new developments in food and the food industry**
  Increasingly it is being recognised that food consumers are not just end users of the food products and food technologies, but that they are a crucial stakeholder in the process. There is a need to more closely tie the consumer (and consumer organisations) into the new developments around food, food technology and the food industry more generally. There is a need for validated models and methods as well as best practices on how to most effectively involve and engage consumers through public participation.

Action and Timeline	Human ressource	Funding distri-bution	Funding amount	Type of activity	Activities
0 — 5 — years					
3. Promoting effective interaction with consumer groups and consumers directly through communication and public participation					
Mapping of consumer needs, expectations, knowledge and attitudes with regard to information on food and food production, mapped in a pan-European context Mapping					
A best practice tool box for effective communication with consumers on health and sustainability and the food technologies underlying them Best praxis tool					
Validated models and methods for effective public participation of and engagement with consumers on new developments in food and the food industry Validated models					

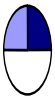
Goal 4. Developing strategies to induce behavioural change in order to improve consumer health and social responsibility (trough healthier food choices)

One of the important challenges in both public and commercial policies on food and nutrition is to induce behavioural change in consumer choices in such a way that long-term personal, public and societal interest is better served by those choices (e.g. better personal diets, public health and well being). At the more fundamental level, much of the public and private policy is aimed at biasing choice away from the instantaneous personal gratification in the direction of long-term personal (eg health) and societal (eg sustainability) benefits given more weight in the decision process. Understanding trade offs in this process provided the evidence base from which more effective strategies for behavioural can be developed.

Deliverables

- **Effective strategies for inducing long terms behavioural change** Effective strategies require the breaking of existing food habits and the establishment of new more health and sustainable habits. This is not easy as food habits are firmly embedded in existing lifestyles and changing/re-establishing new food habits require a joint effort from various stakeholders. More specifically such effort should integrated insights effectiveness of legislation, marketing, education and information, among other perspectives. Development and validation of such strategies should be based on fundamental understanding of food habit formation processes and ways to break those habits for the establishment of more health and sustainable patterns.

- **Understanding how consumers trade off long-term and societal motivations in their food choice decision process**
  Healthy and sustainable food choices focus on the longer-term benefits, some of which tend to materialise at the societal level rather than to the individual consumer. The fundamental insight into how consumers trade off direct personal gratification against the longer-term societal motivations forms an important evidence base for the development of effective behaviour change strategies. Such insight can only be built on an integration of various disciplines such as neurosciences, psychology, sociology and marketing amongst other

Action and Timeline 0 — 5 — years	Human ressource	Funding distri-bution	Funding amount	Type of activity	Activities
4. Developing strategies to induce behavioural change in order to improve consumer health and social responsibility (through healthier food choices)					
Effective strategies for inducing long term behavioural change towards better dietary habits, integrating legislation, education/ information and marketing**.** Effective strategies					
Understand how consumers trade-off long-term and societal motivations in their food choice decision process Understanding					

CHALLENGE 2: Delivering a healthier diet

All goals have the potential to increase competitiveness of European SMEs as well as larger companies. The building up of basic knowledge in the areas of priority would generate patentable innovations, some of which would be suitably exploited by research-type SMEs. This applies especially to goal 1, brain function. Furthermore, generic knowledge built up in these areas of priority would be applicable to reformulate a wider range of foods making them eligible for health claims. This applies especially to goals 2 and 3 with benefits for SMEs producing foods and has great potential for public health improvement. Not only all food producers would be able to benefit from goal 4, understanding consumer behaviour, all kinds of food producers, but also those responsible for public health measures to decrease the burden of diet-related diseases.

Importance of goals

The largest benefit for industry can be realised with successful research on goal 1: Understanding the brain function in relation to diet. However, looking at the benefits to citizen, goal 3 (Understanding the link between diet and metabolic function) would be rated the most important goal. This is because the prevalence of obesity is high but the impact from the research outcome is probably less than the impact that can be expected from studying brain function.

The goals that are described are all long-term goals with final deliverables not to be expected before 2020.

The priorities of the goals were scored as follows.

	0	not relevant/present/applicable
	1	relevant/high
	2	very relevant/very high

Goals: priorities	**Technological dimension**			**Costs**	**Cooperation with industry**			**Impact on health**
	potential to enhance competitive-ness	relevance to SME	priority	M€	FP7	public-private partnership	interesting for SMEs	
1. Understanding brain function in relation to diet	2	1	2	90	2	1	1	2
2. Understanding effects of diet-gut interactions on intestinal and immune functions	1	1	1	70	1	2	1	1
3. Understanding the link between diet and metabolic function (obesity and associated metabolic disorders)	1	1	2	125	2	1	1	1
4. Understanding consumer behaviour in relation to health and nutrition	1	1	1	45	2	0	1	1

Goal 1. Understanding brain function in relation to diet

It is well established that diet can have both a positive and a negative impact on our physical health and performance. Although significantly less scientific data are available, there are clear indications that the same holds true for our mental health and cognitive abilities. Several studies indicate that diet can influence brain and cognitive development *in utero* and in neonates, infants and young children. Food intake can also affect brain function (in all age groups) in terms of cognitive processes, mood-, and brain performance. Reciprocally, brain function can affect components of food intake such as type of food and amount of energy consumed. Although the relationships between brain function and nutrition are still relatively poorly understood, it is generally accepted that the former does impact significantly on overall health and well-being.

Key activities

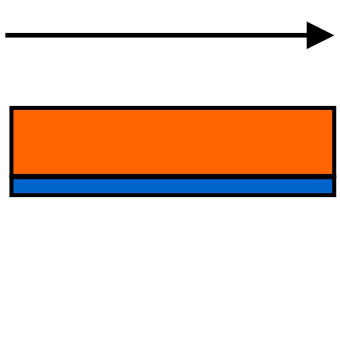
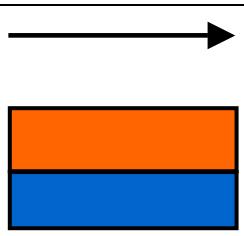
1. To chart the scope of diet and individual nutrients to influence brain health and performance. To interpret these results and maximise the impact, mapping will be required of the underlying mechanisms through which dietary components are capable of modulating brain development, cognitive performance and preventing depression and ageing-associated cognitive decline.

More basic than applied research.
National programmes should be carried out in parallel with EU and other programmes

Required structures, facilities:
Food tables/databases, imaging, isotopes, biobanks, cohort studies

2. To increase understanding of the neural pathways controlling functions such as food intake, hunger and satiety will provide powerful new insights to combat the obesity epidemic.

Required structures, facilities:
Imaging

Understanding brain function in relation to diet						
Action and timeline 0 5 10 15 years	**Type**	**Distribution**	**HR**	**Amount** **1=<10 M€;** **2=10-50** **3=>50**		**Activities**
To chart the scope of diet and individual nutrients to influence brain health and performance. To interpret these results and maximise the impact, mapping will be required of the underlying mechanisms through which dietary components are capable of modulating brain development, cognitive performance and preventing depression and ageing-associated cognitive decline						
						
To increase understanding of the neural pathways controlling functions such as food intake, hunger and satiety will provide powerful new insights to combat the obesity epidemic						
						

Goal 2. Understanding effects of diet-gut interactions on intestinal and immune functions

An optimal immune system is pivotal for a person's health, preventing acute and chronic disorders and determining how the body reacts to and copes with environmental stimuli and physiological and psychological stresses. Food is an important factor able to affect immune reactions in either a negative (e.g. allergy) or positive manner (e.g. prebiotics and probiotics). The immune system is intimately involved in several pathophysiological processes including cancer development. The human immune system controls the so-called innate/native immune functions (such as the intestinal barrier function) and the acquired or adaptive immune functions (like inflammatory regulators).

The intestine, which possesses a metabolic activity equivalent to the liver, is regarded as the key organ able to maintain health and influence resistance to disease and immune function in relation to food. The intestinal tract is the primary site for food intake and is colonised from birth by a microbial community that contributes to food conversion, produces host-active compounds and stimulates a variety of relevant functions, including the immune system. It has proven difficult to define a 'healthy intestine', because of its complexity, the large inter-individual variability and the active interactions between the host, its microbes and the diet.

However, recent applications of innovative holistic systems and subsystems approaches, including metagenomics, have provided tools for determining microbial activity and its impact on intestinal function in health and disease.

An emerging body of knowledge now points towards the benefits of several bioactive food components, including microbes and their constituents, interacting with the immune system and the intestine. There is recognition of the importance of chronically-increased inflammatory activity in the body, partly due to immune deregulation, as a key detrimental factor in the development of obesity-related disorders, chronic inflammatory disorders (including rheumatoid arthritis, chronic obstructive lung disease and chronic inflammatory bowel disease), functional bowel diseases, and the ageing process. It has been demonstrated that diet is able to affect these and other inflammatory processes (not induced by immune activation) by means of, for example, prebiotics and probiotics, fatty acids and antioxidants.

Key activities

1. To enhance the knowledge and study the mechanism of the relation between the immune system and other organ systems such as the brain, the endocrine system and the intestine and their relation to physical activity.

Required structures, facilities:
Food tables/databases, biobanks, cohort studies

2. To study fetal and neonatal nutrition in relation to immune (de)regulation during later life by metabolic/immunologic imprinting.

Required structures, facilities:
Food tables/databases, biobanks, cohort studies

3. To identify and validate minimally invasive biomarkers of the immune system and related systems in order to achieve and accelerate progress. The limited availability of widely accepted and effective pre-clinical model systems for screening purposes must also be addressed to improve mechanistic understanding and stimulate scientific progress, innovation and regulatory decisions.

Required structures, facilities:
Bioinformatics

Understanding effects of diet-gut interactions on intestinal and immune functions						
Action and timeline 0 5 10 15 years	**Type**	**Distribution**	**HR**	**Amount** **1=<10 M€;** **2=10-50** **3=>50**		**Activities**
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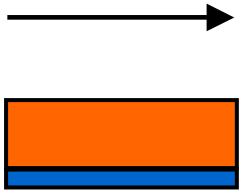						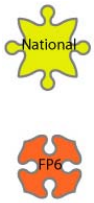
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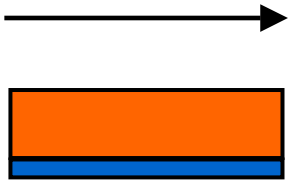						
To identify and validate minimally invasive biomarkers of the immune system and related systems in order to achieve and accelerate progress. The limited availability of widely accepted and effective pre-clinical model systems for screening purposes must also be addressed to improve mechanistic understanding and stimulate scientific progress, innovation and regulatory decisions						
						

Goal 3. Understanding the link between diet and metabolic function (obesity and associated metabolic disorders)

Obesity rates have risen three-fold or more since 1980 in many areas of the world. Currently at least 300 million of the world's one billion overweight adults are clinically obese. Obesity occurs when energy intake is greater than energy expenditure, therefore physical activity, diet-induced thermogenesis and food intake regulation must all be addressed to reduce the prevalence of obesity.

Obesity plays a central role in the metabolic syndrome, which includes hyperinsulinemia, hypertension, hyperlipidemia, type 2 diabetes and an increased risk of atherosclerotic cardiovascular disease. In order to develop preventive strategies it would be important to identify biomarkers (including polymorphisms) of early metabolic changes utimately leading to metabolic syndrome. There is today a growing body of evidence that obesity is associated with a chronic low-grade inflammation, and a focus on better understanding of low-grade inflammatory pathways could be critical in the mechanisms underlying obesity and its complications. However, triggers of the inflammatory process and other related diseases in humans have not yet been clearly identified.

Some of the metabolic alterations linked with ageing, such as decreases of insulin sensitivity, bone quality (e.g. mineral density), and muscle mass (sarcopenia), and increase of body – and visceral – fat are associated with increased systemic inflammatory activity. Dietary measures that could counteract these ageing-related metabolic disorders would offer a real breakthrough in an ageing society.
Furthermore, recent publications indicate a link between obesity and energy-harvesting capacity of gut microbiota, providing new targets for intervention linked to a 'healthy intestine' (see goal 2).

Maternal and post-natal nutrition is not only central to the growth and development of infants but may also condition health later in life (programming/imprinting). The alarming increase in the incidence of overweight and obesity reported in children has renewed interest in determining the influence of the maternal and infant diet on the risk of developing excess fat mass and metabolic disorders later in life. The relationships between early nutrition and increased obesity risk are poorly understood and not well established in humans. Research should deliver dietary recommendations for both mothers and infants and provide the basis for optimising nutrition during the critical period of rapid development both *in utero* and post-weaning.

Key activities

1. Understanding the genetic background of individual metabolic profiles in relation to body weight control and the risk for development of co-morbidities such as type 2 diabetes and metabolic syndrome with increasing weight.

Required structures, facilities:
Food tables/databases, biobanks, cohort studies, standardised protocols, bioinformatics

2. Developing effective food ingredients and dietary strategies to prevent weight (re-)gain.

Required structures, facilities:
Food tables/databases, cohort studies, standardised protocols

3. Defining the effects of diets and nutrients early in life for health outcomes in later years.

Required structures, facilities:
Food tables/databases, biobanks, cohort studies, standardised protocols

4. Tackling the nutrition-related wasting diseases in the elderly population and understanding the role of nutrition in healthy ageing.

Required structures, facilities:
Food tables/databases, imaging, biobanks, cohort studies

5. Developing risk-benefit (disease) models and scenario studies on obesity and on nutrition and healthy ageing.

Required structures, facilities:
Food tables/databases, biobanks

Understanding the link between diet and metabolic function (obesity and associated metabolic disorders)						
Action and timeline 0 5 10 15 years	**Type**	**Distribution**	**HR**	**Amount** **1=<10 M€;** **2=10-50** **3=>50**		**Activities**
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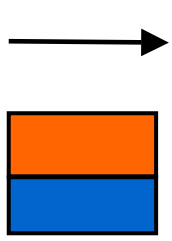						
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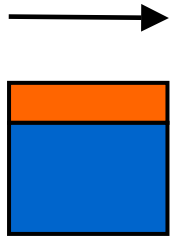
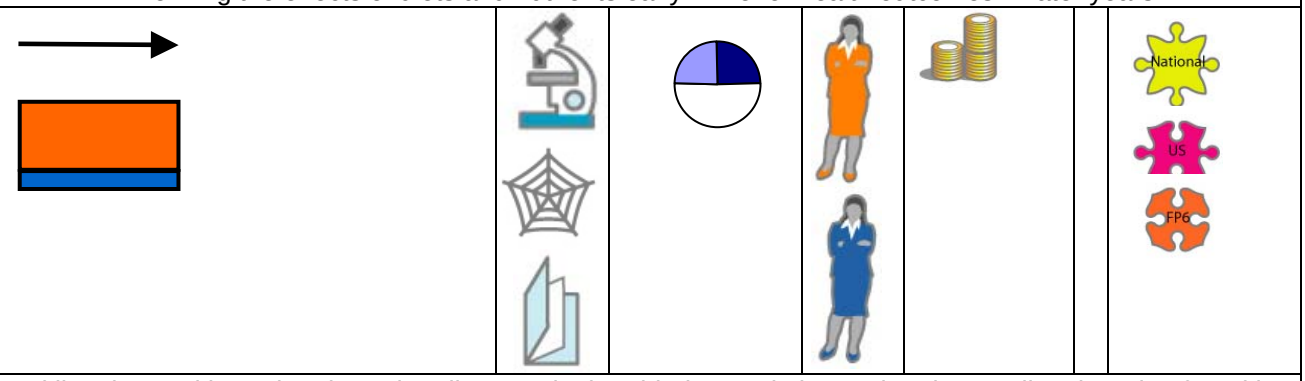
						

Defining the effects of diets and nutrients early in life for health outcomes in later years

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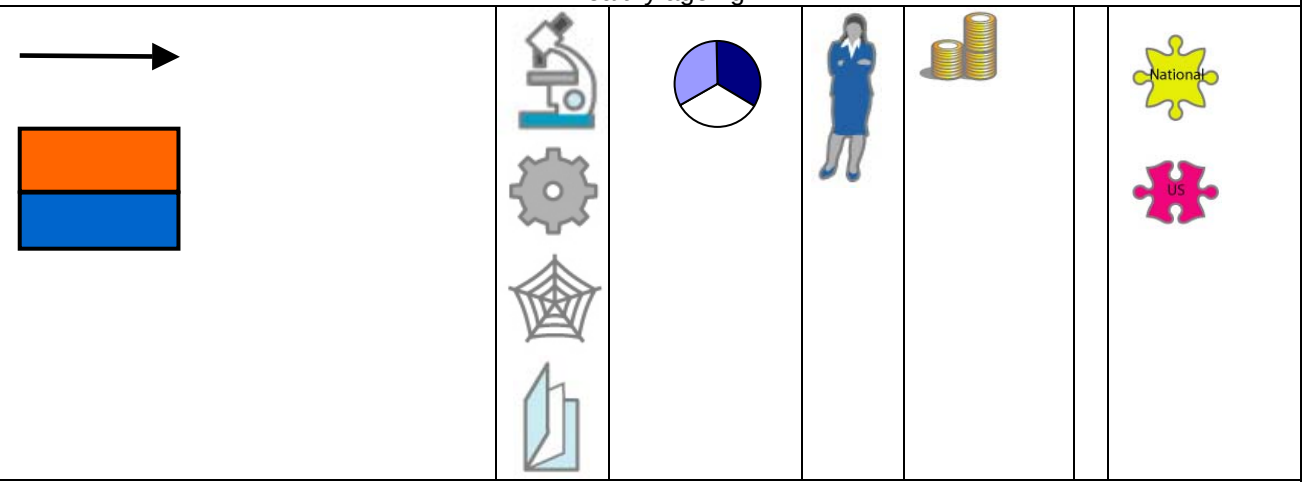
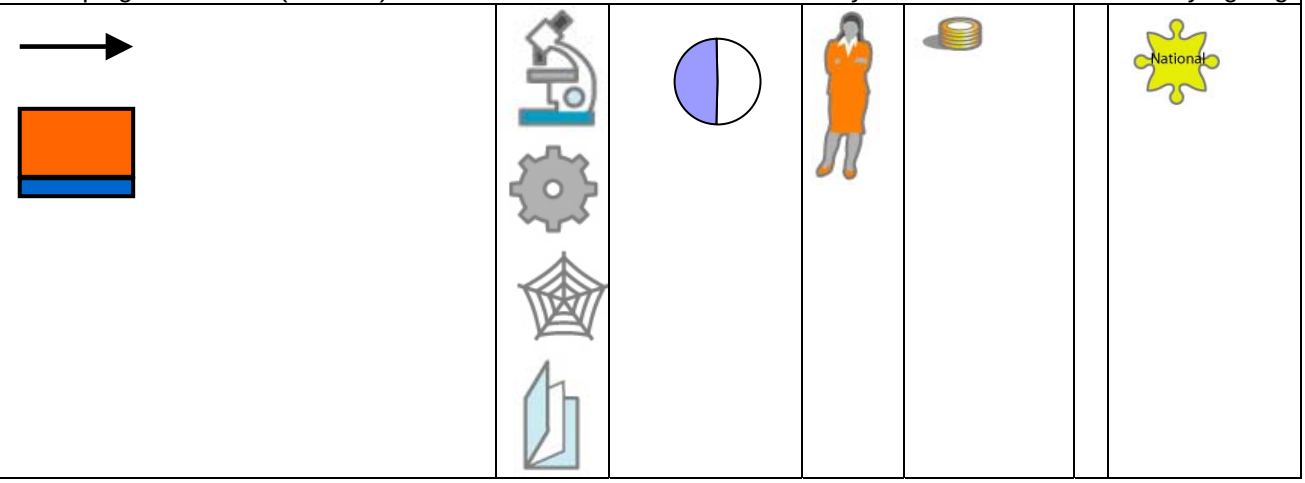

Developing risk-benefit (disease) models and scenario studies on obesity and on nutrition and healthy ageing


Goal 4. Understanding consumer behaviour and effective communication in relation to health and nutrition

The translation of scientific insights into consumer-relevant innovations requires understanding of the consumer's perception and his relation to food, nutrition and health. How can consumers be motivated to move towards a healthier lifestyle and take advantage of the scientific progress within the life sciences? Among other challenges this will require transparent and consumer-aligned communication of the importance of nutrition and the desirability of specific food products being incorporated in healthy eating patterns. Building on a fundamental understanding of how food choice habits are formed, how they can be changed and on the key motivations that trigger or hamper positive behavioural change, intervention strategies are required to break unhealthy habits and develop them into healthier food lifestyles.

In the next decades, breakthroughs may be expected in the fundamental understanding of the biological and cognitive drivers of eating habits and lifestyles particularly from the fields of (nutri-)genomics and cognitive neurosciences. This, together with a better understanding of food-related consumer behaviour, will make it possible to develop product and communication strategies that, by their joint effect, will make it much easier for consumers to live a healthy life.

Key activities

1. Understanding the role of biological determinants in food choice (including the role of genomics and brain functions).

Required structures, facilities:
Food tables/databases, biobanks, bioinformatics

2. Understanding consumer knowledge of nutritional concepts and responsiveness to communication formats, including health schemes (e.g. pyramids etc), health claims, simplified labelling (e.g. sign posting) as well as targeted, more personalised food recommendations (e.g. from advances in nutrigenomics).

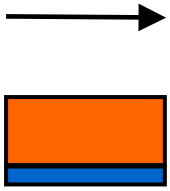
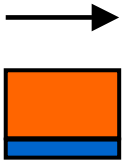
Required structures, facilities:
Food tables/databases, cohort studies, bioinformatics

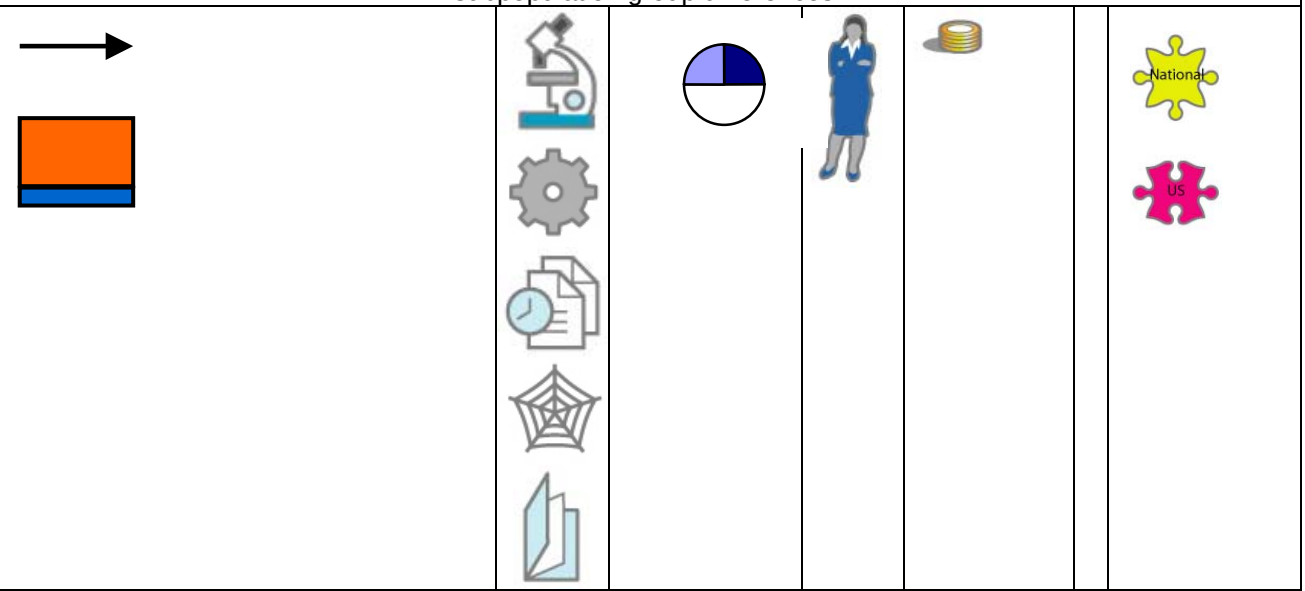
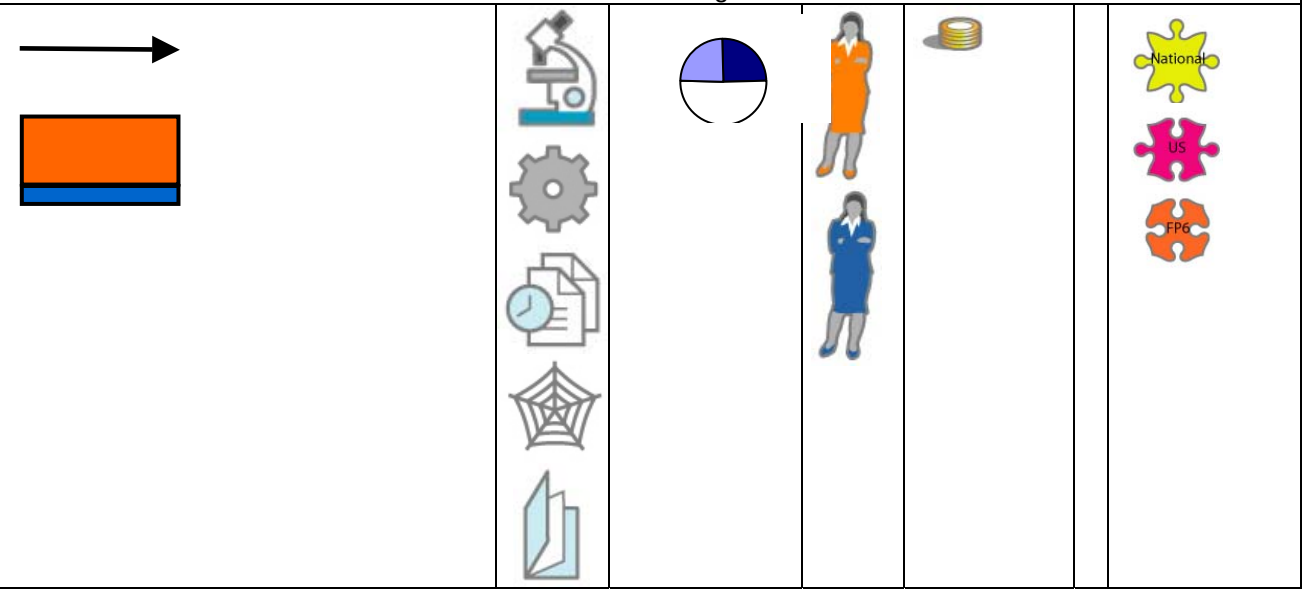
3. Understanding the perception and determinants of a ‘healthy food lifestyle’, analysing the cross-cultural and subpopulation group differences.

Required structures, facilities:
Food tables/databases, cohort studies

4. Understanding the process and key determinants of behavioural change, such as food habit-formation and habit-breaking.

Required structures, facilities:
Food tables/databases, cohort studies

Understanding consumer behaviour and effective communication in relation to health and nutrition						
Action and timeline 0 5 10 15 years	**Type**	**Distribution**	**HR**	**Amount** **1=<10 M€;** **2=10-50** **3=>50**		**Activities**
Understanding the role of biological determinants in food choice (including the role of genomics and brain functions)						
						
Understanding consumer knowledge of nutritional concepts and responsiveness to communication formats, including health schemes (e.g. pyramids etc), health claims, simplified labelling (e.g. sign posting) as well as targeted, more personalised food recommendations (e.g. from advances in nutrigenomics)						
						

Understanding the perception and determinants of a ‘healthy food lifestyle’, analysing the cross-cultural and subpopulation group differences

Understanding the process and key determinants of behavioural change, such as food habit-formation and habit-breaking


Challenge 3: Developing quality food products

The concept of food quality in Europe has changed significantly over the years and is increasingly associated with enjoyment, health and anticipated well-being. Many improvements in process design and process control, as well as in packaging are still needed to improve food quality, functionality, diversity and convenience, given the changes in society and demographic trends, changing consumer needs and lifestyles. Unless appropriate measures are taken to reduce intakes of energy and salt, obesity and lifestyle related diseases will continue to increase to unacceptable levels among EU citizens.

Quality is only part of the food requirements from consumers point of view. The socio-economic environment additionally generates acceptance criteria as an increasingly important part of consumer's decision basis. Furthermore, from individual and societal points of view, there is increasing importance of nutrition, health and performance-related aspects relevant for the future performance of our health care systems.

The creation of *tailor-made food products* that entail consumer preferences, acceptance and nutritional needs will be the governing concept of future food manufacture. This requires a redesign of the way food is presently produced. Food in 2020 will be tailor-made to the specific *Preference, Acceptance and Needs (PAN)* of consumers. Consumer science will deliver reliable data on consumer preferences and acceptances and provide a basis for new product development. Nutritional science will deliver the needs with respect to energy intake and also identify any need to fortify foods. This concept includes industrialized and developing countries equivalently. The PAN concept should evolve in the long term to a completely *reversed engineering approach*, in which the total product development is modelled back through the chain from consumer to raw material. This approach will be based on three major conceptual steps which require interdisciplinary research between consumer scientists, nutritionists, medical experts, (bio-)material science experts and engineers.

The three steps are: (i) Defining consumers' PAN (Preference, Acceptance, Need) profiles based on consumer evaluations in combination with nutritional and medical diagnostics, (ii) exploring functional relationships between PAN characteristics and food structure taking the six orders of magnitude from the macromolecular to the macro-disperse size scale into account and (iii) designing, constructing, scaling and validating the processes which enable to process distinct structures. This is expected to provide functional dependencies between (1) the PAN-related food property profiles, (2) food structure and (3) tailored food processing.

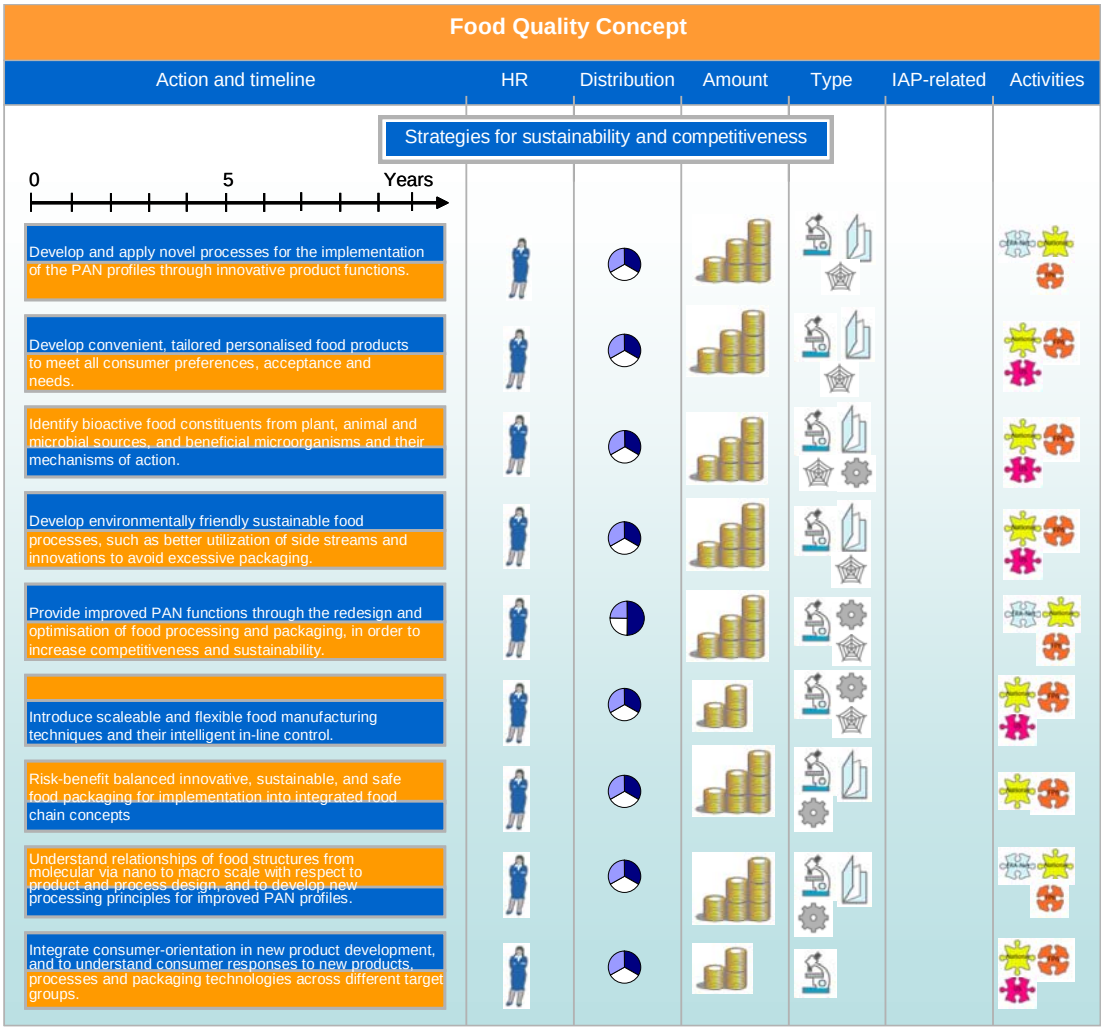
As a consequence of the generic approach for consumer relevant product areas combining PAN-profiling with property-structure-processing relationships, close contacts will need to be established between this ETP and others addressing, for example, textiles and automobiles, which are sectors that have already benefited from minimising processing steps that fail to add value for the consumer. For the same reason, establishing close links with the ERA-Net on Manufacturing is also a priority.

Goal

Wide–spread implementation and use of innovative processes, for the creation of value-added food products, using new marketing concepts, and novel ways of selling products to provide the consumer with *the right type of food at the right time and in the right place* to enhance competitiveness of the EU food industry.

Key activities

The requirements and the time frame for each activity (from research challenge to deliverable) are (also) presented in graphical form in order to allow easy visualisation.



Criteria and tools to provide the consumer with the right type of food at the right time and in the right place, using innovative processes for the design of value-added products, and novel ways for the production and supply chain to create products targeted at consumer needs

In developing and evaluating the technological and economic feasibility of the innovations described, it is crucial to have access to industrial and pilot-scale facilities in order to test new technologies under real or almost real conditions, and improve them while reducing the development time.

- Fundamental research projects and industrial collaborative research, leading to assessment tools and diagnostics for PAN profile evaluation from consumer, nutrition and health science. Models for PAN patterns as a function of quality and well-being factors to produce a diversity of foods for specific consumer groups. PAN relationship to food manufacturing and packaging concepts. Predictive and operational methodologies and toolboxes for PAN patterns.

- Academic research projects with industrial participation for development of i*n vitro* assays and biomarkers to predict *in vivo* functionality of bioactive components. This research will lead to new product functions arising from a) processing via biotechnology, separation technology or nanotechnology b) new ingredients. Furthermore, it will lead to an indepth understanding of and predicting ability of a) impact of food bioactives and beneficial microorganisms on human health, b) effect of food matrix formulation (structure, components) on the activity, delivery and transfer of bioactive compounds and beneficial microorganisms. This research will spearhead the development of foods containing bioactives and microorganisms with beneficial properties aimed at targeted delivery in the gastrointestinal tract.

- Fundamental research projects, industrial collaborative research, leading to an understanding of the dynamics of a) sensory perception from receptor to brain, including cross-modal interaction of the senses, flavour release and structure breakdown b) the gastrointestinal mechanics, nutrient interactions and availability. Improved knowledge and global databases regarding individual, target group and region related variation of PAN profile to composition and structure.

- Academic research projects with industrial participation for development of quantitative methods to assess process-structure-property relationships. The research will lead to an understanding of structure property functions and their relationships with formulation and processing.

- Fundamental research projects with industrial participation, for process optimisation through combinations of new and conventional technologies with respect to process structure property relationships in new and traditional foods. New PAN function-driven sustainable food processing in synergy with new packaging technologies. Point of use processing systems developed for timely delivery of freshly produced personalised food.

- Academic research projects with industrial participation for production, use and disposal of eco-friendly packaging, and tailor-made packaging for perishable, diverse and complex foods such as fresh, living, composite or traditional foods. Novel intelligent packaging including the use of nanotechnology for monitoring food quality and safety during transport, storage and processing, from producer to consumer, such as using tags as miniaturised analytical tools with wireless communication. New active packaging reducing food degradation and for controlled delivery of functional components.

- Academic research projects with industrial participation in food technology enabling environmentally friendly and sustainable production with a special focus on better utilisation of side streams and minimal use of non-renewable and non-biodegradable materials.

- Academic research projects with industrial participation for development of high resolution, spectroscopic in-line sensors yielding complex food structure information and for *in situ* control of process variables, such as high pressure, pH, pulsed electric field temperature. The application of artificial intelligence methods for data mining, pattern recognition and software sensors will be achieved. This will lead to the application of integrated and pervasive sensor networks throughout the food chain recording fluctuations of quality and safety.

- Academic research projects with industrial participation for development of new methodologies for the effective incorporation of consumer understanding into new product development. Quantitative models of how product, process and packaging features affect consumer responses. This research will lead to a regained consumer trust in processed food, in terms of food safety issues and improvement the quality of the food.

- Fundamental research projects, industrial collaborative research for design of new tailor made, personalised foods targeted at individual consumers.

Relevance of the research to small, medium or large enterprises

A major contribution to the competitiveness of the approach combining PAN-profiling with property-structure-processing lies in its interdisciplinarity and its completed bridging from the consumer to manufacturing operations and raw materials. Ultimately, the European food companies will manufacture food products that are much better tuned to consumer wishes and societal demands. Competitiveness of the EU industry will increase on the world market, since methodologies will be developed with general applicability, i.e. they can be applied towards various target groups (age, gender, region, culture) and for different raw materials. This will enable European industry to grow by exporting tailor made food products within Europe, but also to other continents. Large companies will be able to further develop themselves the fundamental research results as obtained by the academic world, whereas SME's will have to be supported in the later stages of the development and validation of the PAN concept by implementation projects. Regional Technology Transfer mediators or knowledge brokers will co-operate with groups of SME's to translate the strategic knowledge into applications. To this end, easily accessible facilities, too expensive for any SME to exploit themselves, such as pilot plants at (contract) research organisations, should be supported as well within the FP7. In addition, the foreseen interdisciplinary training projects will deliver new food technologists that have a sound background in nutrition and consumer science.

A large proportion of European food is produced by small and medium enterprises. Hence, special attention is given to this group of SME's. A lot is still to be gained by optimisation of processes, both in terms of cost reduction and quality improvement. Nevertheless, the large steps forward are expected from the combination of conventional and new technologies, and novel packaging concepts. Novel technologies for the production of traditional foods with fresh appearance yet longer shelf-life, especially produced by numerous SME's, require in depth knowledge of the processing and stability, and the impact on structure/quality. Both food producers and equipment manufacturers will contribute to the development of new techniques and products. When applied successfully, the manufacturers of traditional foods will be able to export over much larger distances than before, leading to an **improved competitiveness and growth of the sector. Producing foods in a sustainable way** will add to the **competitive advantage** of the European small and large companies. With the global awareness of our impact on the environment, sustainable processing will definitely be one of the criteria to compete on at the world market. For SME's to comply with these demands, an integrated approach is required. Because of the complexity of the matter, it is expected that Regional Technology Transfer mediators or knowledge brokers will be required to support SME's with this integration of various research angles. To this end, the European efforts should also deliver interdisciplinary trained people. Again, easily accessible facilities such as pilot plants at (contract) research organisations mediators should be available.

The trend where various bioactive compounds are added to foods to benefit consumer health has been strong during the past decade and in all likelihood it will grow further in the future. Bioactive compounds can be naturally present in the food products, can be added as purified substrates, or are metabolic end products that living organisms (e.g. starter or probiotic bacteria) produce in the product. To fully utilise the health promoting potential of bioactive compounds, more emphasis should be put on research on their targeted delivery, formulation into new types of products with good sensory properties, and the effect of food structure on their delivery and transfer. If living organisms are used as vehicles for bioactive compounds, research emphasis should additionally be put on the optimisation of their production. Possibility of generating highly specialised technologies (e.g. in encapsulation and targeted release) and premium (niche) products will enable the success of innovative industries, also SMEs, in this field.

Define the needs to develop specific training and/or education programs

The interdisciplinarity of the suggested new approach combining PAN-profile related food properties with food structure and food processing requires the networking of consumer scientists, nutritionists, medical experts, (bio-)material science experts and engineers. As a consequence, beside disciplinary training, there is particular need in cross-disciplinary training in order to allow for the building of synapses between the interacting scientists covering the fields involved.

The need for ERA-Nets in areas of research defined as high priority

It is suggested that an ERA-NET in “food property-structure-process relationships (PAN-S-PRO)” is set up bringing consumer scientists, nutritionists, medical diagnostic experts, material scientists and engineers together. The major goal of the ERA-NET: PAN-S-PRO is to identify and develop consumer science based methodologies and nutrition-medicine diagnostics allowing for global consumer PAN profile evaluation. Such PAN profiles will have to be translated into structural aspects with the help of material scientists and finally be coupled with processing mechanisms/methodologies implementing food and chemical engineers expertise.

The ETP has already made a proposal to DG Research for the establishment of ERA-Nets in “Food, Nutrition and Health” and “Food Chain Managements/Sustainable Food Production”. The food quality and manufacturing component of the ERA-Net “food, Nutrition and Health will be implemented.

Investments in infrastructure

The establishment of a European Institute for Food Research is required and the interlinking of existing major food research facilities (e.g. SIK, DIL, TNO, Teagasc, FR, VTT) needs to be implemented.

Challenge 4: Assuring safe foods that consumers can trust

Europe has an absolute necessity for a safe food supply; it is an imperative for health, social, and economic reasons. That the food produced and consumed in Europe is now safer than ever is a dry fact rather than a properly useful statement. In spite of this, recent food safety crises have created a high degree of concern among consumers. Consumer perception has evolved to a high level of awareness and a much-reduced certainty, a combination, which has led to a generalised lack of confidence.

Food safety is a major public health and economic issue for Europe both for foods consumed within the EU and those produced there and exported. The total costs attributable to failures in food safety are notoriously difficult to estimate. These costs should certainly include those associated with the consequence of the diseases themselves but also of loss of product and consumer confidence. For instance, the costs of salmonellosis alone have been estimated to be of order of 2 billion dollars per year for the US. This gives some idea of the economic dimension for a single pathogen. This figure does not take into account the considerable costs associated with the measures which are in place to control this pathogen in the food chain. These include analyses, specific management and hygiene measures, research and surveillance. The economic issues related to food safety are far wider than simple costs of prevention measures *versus* costs of damage otherwise suffered.

In many cases it is far from certain that control measures required by regulators or by distributors and retailers are adequate for the protection of health. 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 but at the same time to ensure competitiveness of the food industry it is essential to have effective and targeted control measures This is one of the 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 in all parts of the EU food industry and at all levels therefore the science applied to support it should respond to the needs of the sector as a whole.

That food safety concerns are more and more centred on the consumer and his or her perception of how safe the food supply is a healthy state of affairs. The food sector has a very clear interest & responsibility in addressing food safety challenges. Properly identified, co-ordinated and executed research programmes will, when successfully communicated, form the basis of this response.

The European food and drink industry's response must be to develop an integrated and holistic approach to food safety. Safety is not guaranteed only by 'safe' product manufacture; the total food chain has to be taken into account. Designing safety into foods requires the integration of our 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 and holistic approach from raw materials to the safe products. At the same time, there should be a focus on those aspects of understanding, development, application/implementation that will have the biggest impacts on food-borne disease alleviation. Such well-focussed research will provide a framework for rapid incorporation into practice in a manner, which will bring maximum impact.

The research broadly follows three lines:

- Improved understanding of hazards and their risks at the different steps in the in the food chain, e.g. the knowledge base needed to support the rational application of control measures and the development of new methods and systems,
- Tools to further secure the food chain, e.g. the development of systems and technologies for continuously improving the safe production and supply of foods.
- Understanding of the human factor i.e. consumer perception of risks and the need for communication

Among the different hazards, contamination of food with pathogens or with the plethora of chemical agents which may be present naturally or inadvertently, present the greatest challenge to the food industry.

There is a major challenge to understand especially biological hazards individually, in combination, and in the context of their multiple environments throughout the food chain. This includes their behaviour in complex ecosystems and (in the case of pathogenic micro-organisms) their interaction with host, both animals and humans. Understanding the hazards should be extended to a full evaluation of the risks resulting from exposure of the consumer to these hazards (risk assessment). Complementary to this, is the evaluation of risks versus benefits of food products, and their nutritional, economic and social significance for the population.

Goal 1. Predicting and monitoring the behaviour and fate of relevant known and emerging biological hazards.

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Knowledge is required about the nature and behaviour of food-borne pathogens and other undesired micro-organisms, to be able to decide on metrics (i.e. food safety objectives, performance objectives, etc), adequate control measures and their validation, and to support risk assessment. It is important for the European food sector that such knowledge is generated, analysed and integrated with information available today. The overall aim being to efficiently and effectively control relevant microbes and to minimize their risk to the extent possible, in line with the national and international standards. To achieve this it is essential that the characteristics and ecology of pathogens and their complex interactions along the food chain are described as fully as possible. This knowledge will reinforce the basis for the development of tools and approaches for control.

Major research challenges

1. Pathogens and resistance; to describe and understand how micro-organisms respond to the various environmental stimuli and stresses which the food matrices represents and to predict the effects and eventual consequences that these might have on their resistance and persistence.

Deliverables

- Scientific data describing the ecological behaviour of priority food pathogens at different stages of the food chain, including primary animal and plant sources; resistance and resistance development will be of particular relevance (**2010**)

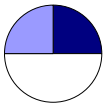
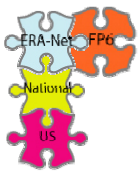
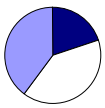
Basic research, together with the involvement of SME as well as the big industry, is necessary to improve understanding of ecological behaviour (growth, survival, inactivation and contamination, matrix effects, matrix and processing effects (including the effects of novel technologies as it is approached in NOVELQ and HIGHQ-RTE FP6 projects), adherence and bio-film formation) and predictive modelling of behaviour in food systems.

The interactions between communities of micro-organisms, including the potential role of non-pathogenic food organisms to modulate the risk of colonisation by pathogenic micro-organisms (this includes links to the genomic analysis of human intestinal microbial communities – intestinal microbiome), needs further investigation to understand their behaviour in the food chain.

Understanding and predicting the risks of resistance development as well as stress responses of micro-organisms in food systems and processing technologies should come from a multidisciplinary approach. There are strong connections with Goal 3 and 4.

- Database on 'omic' description of organisms and microbial communities and factors relevant to ecological behaviour of pathogens (**2015)**

Gathering data concerning genomics, proteomics, and metabolomics of pathogenic micro-organisms is needed to better understand the factors influencing their response depending on the ecological conditions (mentioned above). To build these databases, the development of research projects and coordination networks (e.g. PATHOGENOMICS ERA-NET) is necessary. The achievement of this deliverable will provide useful information for Goal 3.

Action and Timeline 0 5 years	Human resource	Funding distri-bution	Funding amount	Type of activity	Activities
1.1. Pathogens and resistance					
Scientific data describing the ecological behaviour of priority food pathogens at different stages of the food chain, including primary animal and plant sources; resistance and resistance development will be of particular relevance					
Database on 'omic' description of organisms and microbial communities and factors relevant to ecological behaviour of					

2. *Mechanisms and factors of virulence and emergence*; Enhancing understanding of behaviour and virulence traits of food-borne pathogens and the mechanisms of emergence: using epidemiological and typing data, monitoring virulence traits and better describing mechanisms of virulence and emergence of virulence, and the effects of the food chain on these characteristics. Reduce / limit and, if possible, replace animal testing.

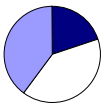
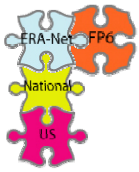
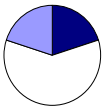
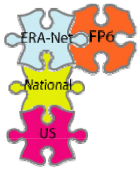
Deliverables

- Biological models for studying virulence and microbial behaviour in infection including; functional mammalian cell culture systems, artificial organs, both cell culture based and mechanical (computer aided). Validated protocols to study microbial behaviour in such infection models (**2015**). Methodology for studying microbial behaviour in these model systems (**2018**).

In order to facilitate studies of the mechanisms of virulence leading to the emergence of pathogens, there is a need to develop alternative biological *in vitro* procedures, replacing animal testing wherever possible. Further developments of current approaches (e.g. IP – PATHOGENCOMBAT) are essential for increasing basic knowledge that will help in the prediction of the emergency of pathogens.

- Use of models to predict emergence of pathogens and describe their characteristics (**2020**).

It is important to understand and predict how microbial co-evolution and other mechanisms can lead to the emergence of new pathogens. To describe pathogenicity at the various stages of the evolution of new pathogens, functional human cell culture systems and other models will meet the requirements for acceptable and high capacity tools to describe their characteristics. This will lead to the recognition of emerging pathogens in an early stage.

Action and Timeline 0 — 5 — years	**Human resource**	**Funding distri-bution**	**Funding amount**	**Type of activity**	**Activities**
1.2. Mechanisms and factors of virulence and emergence					
Biological models for studying virulence and microbial behaviour in infection including; functional mammalian cell culture systems, artificial organs, both cell culture based and mechanical (computer aided). Validated protocols to study microbial behaviour in such infection models. Methodology for studying microbial behaviour in these model systems.					 **EIT** **Lead Market**
Use of models to predict emergence of pathogens and describe their characteristics					 **EIT** **Lead Market**

Goal 2. Predicting and monitoring the behaviour and fate of relevant known and emerging chemical hazards including toxins of biological origin.

Chemical contaminants, as a general category, should include crop protection agents, veterinary pharmaceuticals, persistent organic pollutants (POPs), packaging contaminants, process contaminants like heat-generated toxicants, heavy metals, and biological toxins (mainly mycotoxins) . They represent known and potential health hazards to humans, most commonly by long-term exposure, through the consumption of contaminated foods.

The manner in which these hazards are currently controlled is not optimal for two main reasons: firstly, there is a large knowledge gap as to the importance of specific hazards at the quantities at which they occur in foods, and secondly, detection and monitoring are often complex and expensive.

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

Efficient control of chemical hazards within food safety assurance schemes requires new knowledge about the risks they represent and new tools for their management.

Major research challenges

1. *Data and knowledge on chemical contaminants in food and strategies for prevention and reduction*; generating and interpreting data on the fate of chemicals in the food chain (role of primary production, processing, persistence, biotransformation, destruction, accumulation of metabolites, recontamination) and improving exposure assessments for key potential hazards, including the migration of chemicals from packaging materials and kitchen utensils into food. Such knowledge will be both valuable *per se* and essential to support the modelling activities proposed in goal 3.

Development of preventive measures to avoid biological and chemical contamination in agricultural cultivations, to reduce the formation of heat induced contaminants (preserving sensorial properties) e.g. by using novel food processing and preservation technologies.

<u>Deliverables</u>

- Data on *a)* the dynamics of priority chemical hazards (e.g. structural changes, interactions with other molecules, Process- induced contaminants from inoffensive pre-cursors and migration from packaging (food contact) materials) and *b)* the levels at which they occur in specific product types. **(2015)**.

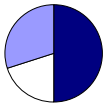
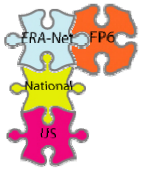
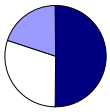
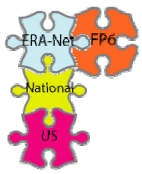
There is increased awareness and concern on potential risks of process induced contaminants (particularly heat-generated contaminants) as well as food-contact materials-related contaminants (e.g. packaging).

Therefore the project(s) under this item should focus on priority chemical compounds identified by public health authorities, e.g. EFSA, WHO, FDA, or those resulting from research challenge 2 of this goal. The results of the study will help to design products, processes where presence of process- induced contaminants is minimised. The results should also lead to improving safety of packaging and strengthening the related legislation.

The project(s) should take into account existing insights from 'Heatox' and the 'CIAA TOOL BOX', and should be carried out jointly with the relevant industries (e.g. food and beverages, packaging industries). It will also make use of highly sensitive analytical techniques and predictive modelling.

- Knowledge on the impact of technological, economical, legislative, climatic and social conditions on agricultural practices (including transport and warehousing the raw material) to support strategies for the management of priority chemical hazards. Examples of technological impact are (biotechnology, energy, water management) **(2015)**.

There is an increased concern of how global warming, economical and social environments (including legislative measures) will affect sustainable and safe food production. Therefore, to be able to ensure safety of raw material up to processing and manufacturing there is a need for knowledge and data on the impact of the above factors on agricultural practices.

Action and Timeline (0 — 5 — years)	Human resource	Funding distri-bution	Funding amount	Type of activity	Activities
2.1. Data and knowledge on chemical contaminants in food and strategies for prevention and reduction					
 Data on a) the dynamics of priority chemical hazards and b) the levels at which they occur in specific product types.					
 Knowledge on the impact of technological, economical, legislative, climatic and social impacts on agricultural practices to support strategies for the management of priority chemical hazards.					

2. *Describing and understanding the effects of chemical hazards in humans*; new approaches to hazard characterization for the determination of chemical risks, including the need to improve the estimation of risks at very low levels of exposure.
    - Identifying chemical hazards and their health effects on humans and determine the levels at which chemical hazards have adverse effect on humans
    - Interaction between toxicants
    - Bioavailability of the chemical contaminants
    - The development of artificial organs and cell culture based experiments to determine toxicological effects in order to limit and if possible replace animal experiments.
    - Gathering and analysis of epidemiological data - special care will be taken to gather and analyse in a population-disaggregated manner including gender.

Deliverables

- Data allowing effective hazard characterization for determining the risks of priority chemical hazards including risks at very low levels of exposure (**2012**). This subject should receive high priority and a first preliminary list of priority chemicals must be established within 2-3 years and reviewed after 5 years.

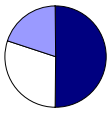
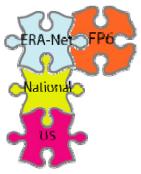
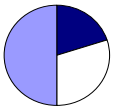
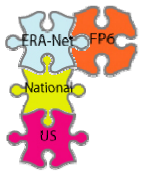
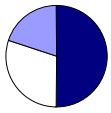
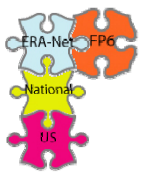
Risk assessment, one of the pillars of food safety management, includes hazard characterization. The project(s) include collection of toxicological and epidemiological data allowing evaluation of the risks of chemicals and their prioritization. It will consider risks associated with the long term exposure of consumers to low levels of contaminants or to a mixture of them. In this project, cooperation with EFSA and WHO (JECFA) is essential.

- A set of well described exposure biomarkers and a subsequent database of epidemiological data organised in a population-disaggregated manner (including gender) **(2018)**

For evidence of exposure there is a need for a well described set of biomarkers. There is little or no knowledge of actual exposure of the general population. Using a set of relevant biomarkers and gather population data, a subsequent epidemiological database (by population subgroups) could be established, analysed, and be available for further elaboration.

- Robust and reliable alternatives to animal testing for key toxicological endpoints, based on artificial organs and cell culture to determine toxicological effects in order to limit and possibly replace animal experiments (**2020**).

There is a great societal concern on the use of animals in toxicological experiments, though the need for toxicological information is recognized. To reduce the number of animals used and eventually replacing live animal testing there is need for robust and reliable alternatives. Renewed attention to *in vitro* and *in silico* testing and simulation is required.

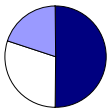
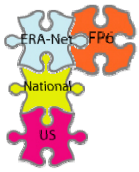
Action and Timeline 0 5 years	Human resource	Funding distri-bution	Funding amount	Type of activity	Activities
2. 2. Describing and understanding the effects of chemical hazards in humans					
 Data allowing effective hazard characterization for determining the risks of priority chemical hazards including risks at very low levels of exposure.					
 A set of well described exposure biomarkers and a subsequent database of epidemiological data.					
 Robust and reliable alternatives to animal testing for key toxicological endpoints, based on artificial organs and cell culture to determine toxicological effects in order to limit and possibly replace animal experiments.					

3. *New methods to support chemical food safety*; development and validation of analytical techniques and sampling plans for chemical contaminants, of non-destructive technologies for the on-line monitoring of chemical residues and for off-line screening based on holistic approach to evaluate the “total toxic charge”, including both targeted and untargeted compounds. This includes novel biomarkers of exposure to key contaminants and analytical tools for multi-residues exposure scenarios

Deliverable

- Validated analytical techniques and sampling plans for priority chemical contaminants including (i) Reference / precision techniques, for research and anticipation, and confirmatory purposes (ii) Rational / accessible and simple techniques for direct field application (iii) In line methods for continuous safety management in food processing. **(2015)**

Testing of raw material and /or food products, be it as preventive measures or verification purposes, remain one of the key measures for management of chemical contaminants. There is a need for more performing methods, including rapid methods for field application, in-line methods for continuous safety management in food processing, and precision/reference techniques for research and confirmatory purposes. For certain chemicals such as mycotoxins, sampling methods are also an important factor and will be addressed in the context of this project (s).

Action and Timeline 0 5 years	Human resource	Funding distri-bution	Funding amount	Type of activity	Activities
2. 3. New methods to support chemical food safety					
Validated analytical techniques and sampling plans for priority chemical contaminants.					

Goal 3. Improving risk assessment and risk-benefit evaluation.

Quantitative risk assessment is the knowledge base which forms the basis for building a food safety strategy. The tools being developed within this area (including predictive modelling) will continue to be 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 adapt to the complexity with which foods are currently being viewed and it is certain that the trend will be towards risk/benefit assessment.

The European Union already possesses, at national and regional level, highly credible public organisations with responsibility for food safety and which are capable of identifying their own R&D needs to support their legislative and control functions. The food industry has a history of healthy ‘antagonism’ with the official ‘food control’ institutions and the rationality in the current legal and control environment has been greatly moulded by this. It is therefore important that the food industry continue to identify and promote its own research into aspects of food safety, which may influence the development, and application of control measures.

The challenges here deal with *Risk* (pertaining to negative effects), *Benefit* (pertaining to positive effects) and *Communication*. European society will need to approach these research challenges in a fully integrated manner. Approaching risk/benefit analysis in a holistic way is the main avenue to evaluating the real impact of the total of a food (or of a diet pattern) to human wellness in its many forms, as an alternative to singling out the toxicology of each molecule. Elements of this overall task are dealt with in other key challenges of this ETP.

The food sector needs to be able to:

- evaluate the risks and benefits associated with the consumption of specific foods, food categories including traditional foods, and based on consumption patterns (knowledge),
- integrate this knowledge into appropriate risk-benefit assessments, and
- communicate this information in an appropriate form to the various stakeholders of the food chain (knowledge and skills).

The overall objective is to build a science and skills base that successfully supports the development and communication of risk-benefit analyses on specific raw materials, food processing, food products, product categories and to develop further knowledge on consumption patterns.

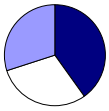
Major research challenges

1. The gathering and generation of relevant data on food composition and consumption patterns including ethnic and traditional foods, where possible in a continuous way building on existing initiatives such as EuroFIR; and on epidemiological, analytical and toxicological / physiological data on chemical and biological contaminants.

Deliverable

- Harmonizing and elaborate existing national databases on food composition and consumption patterns including ethnic and traditional foods **(2010)**.

In order to generate relevant risk benefit assessment it is important to have access to a broad range of data related to food and consumption. This data includes e.g. food composition, consumption patterns, and physiological data, etc. The objective of the project is to build a comprehensive and robust database supporting a future risk benefit evaluation model. Data should be collected and integrated building on existing databases and projects like EuroFIR and Efcoval. Projects should identify gaps in the availability of data and give recommendations on additional research to fill the gaps. The database should be prepared for handling future and (re)emerging risks.

Action and Timeline 0 5 years	Human resource	Funding distri-bution	Funding amount	Type of activity	Activities
3.1.The gathering and generation of relevant data on food composition and consumption patterns					
 Harmonizing and elaborate existing national databases on food composition and consumption patterns including ethnic and traditional foods.					

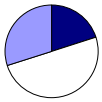
2. Development and validation of appropriate science based quantitative risk assessment tools & models (*in vitro, in vivo, in silico*) based on the generated data for those areas with the biggest impacts on reducing food-borne illnesses

   Refinement of data required for food allergen risk assessment and tools to analyse such data.

Deliverable

- Tools, protocols, including user-friendly software and decision support systems for comparative risk analysis (**2012**)

Comparative risk analysis (CRA) ranks the risks taking into account (amongst others) toxicological, epidemiological factors and the impact on industry. CRA requires innovative tools and protocols to allow the food sector to make decisions on risk management and risk benefit evaluations. It helps to focus on the areas that have the biggest impact on food safety. In these projects user friendly software needs to be developed for risk benefit scenario simulations.

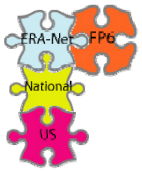
Action and Timeline 0 5 years	Human resource	Funding distri-bution	Funding amount	Type of activity	Activities
3.2. Development and validation of appropriate science based quantitative risk assessment tools & models					
Tools, protocols, including user-friendly software and decision support systems for comparative risk analysis.					

3. The development and validation of scientific approaches to carry out risk versus benefit evaluation along the food chain.

Deliverable

- Validated approaches to carry out risk and benefit evaluation along the food chain (**2015**),

There is conflicting information on risks and benefits of foods consumed and no consensus on how to balance this in decision making. In these projects, a model for ranking benefits is required. Based on the generated data (base) and using the appropriate toolbox (Goal 1 and 2 and deliverables 1 and 2 of Goal 3), a validated and science based quantitative risk benefit evaluation model should be developed.

Action and Timeline 0 5 years	Human resource	Funding distri-bution	Funding amount	Type of activity	Activities
3.3. The development and validation of scientific approaches to carry out risk versus benefit evaluation along the food chain					
 Validated approaches to carry out risk and benefit evaluation along the food chain.					 WHO

4. Development of design tools based on models (see above and see Goals 1 and 2), for the evaluation of the individual and combined effects at every stage of the integrated food chain.

Deliverable

- Validated tools/models/software for the design of safe products and processes **2016)**.

Not applicable yet

Deliverable type:
Timeline: 5 -15 years

Goal 4. Developing tools to ensure security of the food chain.

The aim is to further improve the safety of competitive foods on the market by developing and making available tools for prevention, control, traceability, authenticity and food defence (adulteration and bioterrorism) at appropriate points in operational food chains. This will provide the technologies on which harmonised, focused and cost efficient management activities and safety policies can be implemented. The understanding and knowledge generated from the research needs identified in Goal 1, above, will be employed in the development of technologies presented here.

Detection and prediction of hazards in foods have also advanced considerably in recent years. This has permitted a more precise evaluation and validation of existing and novel technologies, speeding up both their development and 'time-to-market'. The success of the modelling approach to hazard behaviour demonstrates the wisdom of investing in tools which can take on the complexity of such questions.

New techniques for the detection of hazards or their controlling parameters are constantly being sought, an obvious and immediate reason being to improve food safety assurance. However, 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.

Development and agreement on validation concepts and models is a crucial pre-requisite to successful acceptance of the outputs of this type of research and must be addressed in the drawing up of EU-wide initiatives. 'Validation' must not only include technical performance but also consider aspects of regulatory- and consumer acceptance.

Major research challenges

1. Development of technologies for the reduction or the elimination of hazards at the level of primary production.

Deliverable

- Technologies for improving practices in primary production, including breeding and selection of intrinsically safe plants and animals for foods (**2015**)

Understanding (through implementation of Goals 1-3) the occurrence and prevalence of food safety hazards and risks will underpin the need for the development of technologies for the prevention, reduction or the elimination of these hazards at the level of primary production. Knowledge on the behaviour of hazards will help in improving Good Agricultural and Animal Husbandry Practices that should be implemented into primary production (mainly SME's). Technologies include the development of bio-derived and bio-engineered chemicals with enhanced spectrum of action and/or time limited life cycle; plants and animals with traits which contribute to the reduction of chemical and biological hazards; and strategies to prevent colonisation of farmed animals by food-borne pathogens (e.g. competitive exclusion, immunisation). There is a strong link from this challenge to the ETP Plants for the Future as well as to the WG "Sustainable Food Production" in this ETP.

2. Development of novel technologies for the reduction or removal of chemical and biological hazards during processing.

Deliverable

- Robust and flexible processing technologies that assure food safety (**2015**),

Superior modelling and monitoring approaches will allow the food sector to precisely measure the effects of novel technologies on the reduction or elimination of contaminants during processing. Such approaches also have the potential to foster faster acceptance and validation/verification through the regulatory process. This, in turn, will strongly encourage the development of new, more effective and milder processing technologies without compromising food safety or nutrition. Benefit areas include: (a) development of technologies for the screening, sorting, and developing safe raw materials, including the decontamination of 'contaminated' raw materials; (b) advanced multi-hurdle concepts for preservation, active packaging, etc; (c) hygienic design in order to prevent cross- or re-contamination during processing and (d) development and optimisation of alternative technologies to classical heat treatments. Development of rapid and reliable measurement techniques for validating processing technologies (e.g., biosensors, Time-Temperature Indicators - TTIs, etc.) will also be required. Developments in packaging technology will also play a key role in food safety – e.g., active or "intelligent" packaging with safety enhancing properties and ability to reduce or exclude contaminants. The work in this challenge will have strong links to the work in "Food Quality and Manufacturing".

"*Chefmanship*" including the development of 'intelligent' systems for optimal food preparation, guaranteeing (microbiological) safety and preventing formation of heat-induced contaminants, whilst maintaining key sensory and nutritional properties will also be an important aspect of alternative technologies.

3. Development of effective methodologies for tracking and tracing of micro-organisms, contaminants and allergens along the food chain to be incorporated into integrated management systems.

Deliverable

- Validated technologies for tracking and tracing and their integration into management systems **(2012)**

Assuring food safety throughout the food chain requires the development of effective and validated tracking and tracing technologies. In the current climate of security and prospects of bioterrorism, it is even more important to ensure the safety of the food supply. It is expected that methods to demonstrate the integrity of the food supply chain will play an increasingly important role – an example is the use of RFID tagging technology. There is also a necessity to develop improved analytical methods for the detection, monitoring & epidemiology of food safety hazards that can be integrated into quantitative risk assessment procedures and into integrated management systems. This is also linked to superior surveillance and "early warning" systems, which implies links to the work of EFSA and to the activities of the "Food Chain Management" and to the "Food and Health" Groups in this ETP.

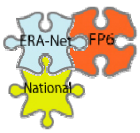
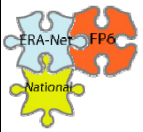
4. Development of new logistic approaches for strengthening safe distribution of foods, including abuse detection and approaches for the prevention of food adulteration and bioterrorism,

Deliverable

- Efficient and safe distribution of foods **(2020)**

Areas of importance include temperature management (e.g., chilled, frozen supply chains; link to "Chill-on in FP6"), integrity of products and shelf-life indicators – such as active or 'intelligent' packaging technologies. Efficient and secure logistics systems combined with robust tracking and tracing systems are necessary to improve and protect against the risk of contaminants in the supply chain. Novel software and hardware solutions for use in the supply chain can help a great deal in this.

Within the distribution system, methodologies for monitoring food security and rapidly detecting tampering and/or adulteration will be critical. It is imperative that these safeguards be developed and be in place throughout the food chain from primary production to the consumer and including both large companies and SME's.

Action and Timeline 0 5 years	Human resource	Funding distri-bution	Funding amount	Type of activity	Activities
4 Developing tools to ensure security of the food chain					
 Improving practice in primary production					
 Processing technologies assuring food safety					  EIT
 T&T technologies					 EIT Lead Market 
 Safe distribution of foods					 

Goal 5. Understanding and addressing consumer concerns with food safety issues.

Despite the fact that, in objective terms, food has probably never been safer before, consumers continue to express concerns with the safety of their food. This has at least partly to do with the fact that consumers do not have direct first-hand insight in the (un-)safety of food products and food production systems. For such assessment they have to rely on information provided by others and the trust / confidence that consumers have in actors and institutions is an important factor in their perceived confidence in the food provision system. It is generally accepted that zero risk is not possible and increasingly the focus shifts towards risk-benefit approaches, which in turn brings new challenges for risk communication practices. An understanding of the way in which consumers perceive risks, and also of the role of various stakeholders and the media in this context, is a prerequisite for successful risk communication.

Major research challenges

1. Identifying and quantifying determinants of consumer trust and confidence in the food supply (including trust in actors and institutions) for an understanding of consumer confidence.

Deliverable

- Determinants of consumer confidence in the food supply chain (**2010**).

The identification and quantification of determinants will take into account the similarities and differences across Europe. The changes over time on the determinants will be monitored and effective communication strategies will be constructed, especially in relation with the development of novel technologies and bio-derived products for safe foods. The different stakeholders involved in food systems should be involved, from the primary producers, processing industry including SME's, equipment providers, distribution, consumers, food safety institutions and agencies, and the specialised media. This work will be done in collaboration with the "Food and Consumers" Working Group in this ETP and with EUFIC.

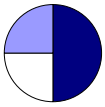
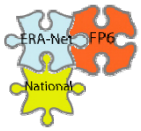
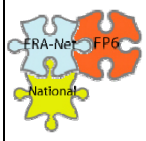
2. Understanding consumers' risk perception of issues, particularly in the context of risk-benefit trade-offs and in the amplification of risk perceptions beyond the available scientific evidence.

Deliverable

- Insights in how public perception of risk develops in interaction between consumers, media and stakeholders, followed by effective communication strategies (**2012**).

The way European consumers perceive risk/benefit issues needs to be addressed, at the same time as understanding how risks have to be communicated to them (when, who, frequency, modality) specifically but not solely in case of incidents or crises.

The development of effective consumer communication strategies and messages on risk related issues (including communication of risk-benefit and cost/benefit analysis and of uncertainties), to the public are important aspects that need to be carried out. This work is to be built on and performed in collaboration with related projects in Europe, including work done by EUFIC.

Action and Timeline 0 5 years	Human resource	Funding distri-bution	Funding amount	Type of activity	Activities
5 Understanding and addressing consumer concerns with food safety issues					
Determinants of consumer confidence					
Insights in public perception of risk					

Challenge 5: Achieving sustainable food production

The recent expansion of the EU brings about an increasing diversity of food production systems of highly interlinked nature. Considerations of sustainability should guide future developments in European food production. To achieve this, synergies must be created between economic growth, environmental protection and fair social conditions by:

1. Illustrating the sustainability of food production and supply in Europe
2. Research on scenarios of future European food production and supply
3. Developing sustainable processing, preservation, packaging and logistic systems
4. Developing and implementing sustainable primary food production
5. Understanding consumers and their behaviour regarding sustainable food production

Goal 1. Progressing the sustainability of food production and supply in Europe

The sustainability of the food production and supply chain in Europe is of primary importance in the currrent process of EU expansion and in the increasing international trade context. In order to face and to minimise the climate change emergencies and all the others environmental effects due to the food production and consumption, a system analysis perspective is essential. LCA is not the only method available to assess the environmental impacts of the food systems, but it is one of the most used. This is basically due to the outcomes it leads to and also to the potential of including in the LCA framework the other “sustainability pillars” - the economical and social dimensions.

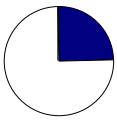
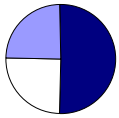
Deliverables

- **Appropiate sustainability indicators developed**

The three pillars of sustainability require the identification, selection and development of sustainability indicators applied on food systems. Such work needs the application of different tools coming from both natural and social –economical science. The creation of a tool box where environmental methodologies (LCA, IO-LCA) etc. leading to environmental indicators could share the informations with economical and social analysis (LCC, TCA, SLCA etc.) is highly required in order to reach this goal. Both applied and basic are needed to assess the food systems in a life cycle perspective in a globalised food market context.

- **System analysis of sustainability performed for a range of regional and sectorial food chains**

The varieties of European regional and sectorial food chains from the northern Europe to the southern mediterranean countries require the developing and performing of system analysis. The different food production chains occurring in different countries with extremely different land and climatic background and different food culture, also in the way to prepare and cook foods, of course could lead to different outcomes in the identification of the sustainability hot spots. It is important, then, to understand the differences between the regional and sectorial food chain in different countries by involving the primary producers, the SME and the big industry throughout the setting of pilot projects necessary to analyze “pilot commodities” and “pilot food chains”.

Action and Timeline 0 5 years	Human ressource	Funding distri-bution	Funding amount	Type of activity	Activities
Progressing the sustainability of food production and supply in Europe					
Appropriate sustainability indicators					
Development of food scenarios based on existing general scenario					

Goal 2. Developing scenarios of future European food production and supply

The future European food production and supply system will be subjected to many changes driven by environmental, economical and social factors. Scenarios of future alternative systems provide insights into the expected consequences of such changes, which will improve the possibilities to take appropriate actions to avoid or adjust to these changes. A number of scenarios have recently been presented for the future European agriculture but scenarios for food production and supply chains are lacking. By developing alternative scenarios, where also sustainability is assessed, the future food chains will be driven to more sustainable solutions.

Deliverables

- **Development of scenario of food production and supply chains based on existing general scenarios**

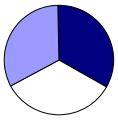
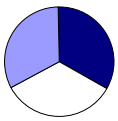
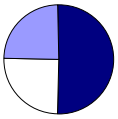
Scenarios on food production and supply systems must be based on existing scenarios for the develoment of the global society, including demographic, social, economic, trade and environmental developments. The consequences on these prospected developments in the scenarios must be translated to possible developments in the European food production and supply chains. Methodology for incorporating assessment of sustainablity in the developed scenarios will be part of this task. Also recently presented scenarios for agriculture will be used as a platform for this task.

- **Elaboration of scenarios for future food production systems illustrating the consequences of different development options**

Scenarios for future European food production and supply systems will be developed where factors affecting the sustainability of these developments will be assessed. A number of "possible futures" will be used for the scenario building , including effects of global warming, of dramatic energy price increase, of major reforms in economic policies (CAP and CFP) and trade agreeements and of social dvelopments, including increased population mobility. The consequences of alternative developments on sustainability will for the basis for identiying improvement potentials and scenarios with improved sustainablity elaborated. This task should be performed in close collaboration with the scenario oriented task in Food Chain Management group.

- **Development of novel and alternative food production systems demonstrating sustainability benefits**

Novel and radically different food production method can present substantial improvements in sustainability, e g by dramatically improving the use of natural resources, e g according to the bio-refinery concept. Such alternative systems are developed in other goals of ETP Food for Life. The task here is to assess the sustainablity of novel food production systems built on these novel concepts in the form of scenarios for the future and to direct the development efforts towards sustainability benefits. Cooperation within the ETP is essential as with other ETPs, especially with the ETP plant for life, ETP Aquaculture and ETP Biofuels.

Action and Timeline (0 — 5 — years)	Human ressource	Funding distri-bution	Funding amount	Type of activity	Activities
Developing scenarios of future European food production and supply					
Development of food scenarios based on existing general sscenario					
Elaboration of scenarios for future food production systems					
Development of novel and alternative food production systems					

Goal 3: Developing sustainable processing, preservation, packaging and logistics systems

Food and beverage industries are the largest manufacturing sector of Europe, thereby determining to a great extent the overall sustainability of the EU industry (in terms of energy efficiency, environmental friendliness and socio-economic impact). A number of topical sustainability-related challenges throughout the entire food chain are to be addressed Europe-wide in the beginning of the 21st Century (in line with the historical world leaders' summits in Kyoto and Johannesburg), whose importance increases due to the ongoing extension of traditional EU food chains into new markets and emerging economies around the globe. In that context, the anticipated ETP activities aim to optimise and dramatically improve the sustainability of the existing food processing, preservation and supply systems, to develop emerging technologies and create novel more sustainable methods, equipment and logistics, which substantially advance the European economy by serving the increasing demands of contemporary society, without compromising the needs of the future generations. Essential measures should be undertaken to achieve a global leadership of Europe in the field by raising professional competence and encouraging a stronger public commitment of scientists, industrialists, food authorities and research policy makers towards sustainability-related issues and project initiatives, which ensure reduced waste of raw materials and products, lower investments and running costs, higher savings of energy and natural resources, and enhanced environmental friendliness.

Deliverables

- **Development and implementation of methods for value chain analysis of entire food chains explicitly incorporating sustainability assessment**

Current techniques to analyse the total food chain are primarily focusing on the end product quality and competitiveness (in terms of throughput and production costs). Simultaneously, it is very necessary to develop suitable methods for complex system analysis, which directly involve sustainability indicators for assessing the entire food chains as a whole, rather than the separate unit operations within the chain. Such an integral approach should inherently encompass several interdisciplinary research fields (where engineering, environmental, managerial, nutritional, market and consumer related aspects are all adequately present) to provide a powerful instrument for ubiquitous value chain analysis during processing, preservation, packaging, storage, transport, distribution and retail of food commodities across Europe. Such tools for integral assessment should be capable of revealing critical chain elements, processes and operations with poor sustainability, which require urgent relevant measures to dramatically improve the existing situation Europe-wide.

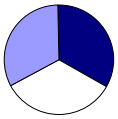
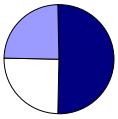
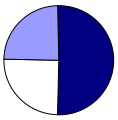
- **Identification of food processing, preservation, packaging and transportation operations with substantial potential to increase resource (energy, water) use efficiency**

Sustainability-improving technologies are considered extraordinary important for both SMEs and large industries in EU member states, accession countries and less favoured regions of Europe. The strategic goal is to strengthen the overall technology level and sustainability of the European food sector throughout the entire chain for processing, packaging, warehousing, distribution, retail and household handling of food commodities by dramatically increasing the process efficiency when spending natural resources (e.g. raw agricultural materials, energy and water).

Research anticipated should identify unsustainable processes and operations within the chains and develop accordingly a number of optimised, emerging and novel food chain technologies, equipment and logistics for environmentally benign and energy efficient manufacturing and handling of a large diversity of foods of plant or animal origin. The huge potential of advanced information, communication and space technologies should extensively be exploited for process simulation and optimisation; intelligent equipment design; continuous food chain traceability; ubiquitous real-time sensing, on-line monitoring and control of food quality and sustainability parameters throughout the chain. Professional competence of EU stakeholders and SME personnel should be enhanced by several training courses on sustainable food technologies and associated regulatory, socio-economic and market issues.

- **Improve utilisation of food raw materials and reduce waste throughout the food chain, including the development of systems for reprocessing to add value to food waste**

Contemporary food chain technologies are far to be optimal in terms of economical use of both raw materials and end products. Large quantities of raw food materials are uselessly lost during post-harvest, post-slaughtering, post-mortem and post-factory processing of plant or animal food, while the restaurant sector, catering services and individual households are continuously generating a huge amount of disposal products. Such sources of unused waste and by-products are major contributors to environmental contamination and need urgent Europe-wide measures for their drastic reduction and recycling. Planned research, development and demonstration activities should therefore focus on advanced technologies to minimise and reuse food waste along the entire chain for food processing, handling and supply (with special emphasis on the primary production and consumption chains). Suitable techniques should be developed for efficient management, reprocessing and complete utilisation of by-products and disposals to add value to food waste and to formulate new environmentally friendly products which are demanded for different applications in the food or non-food sector.

Action and Timeline 0 5 years	Human ressource	Funding distri-bution	Funding amount	Type of activity	Activities
Developing sustainable processing, preservation, packaging and logistics systems					
Development and implementation of methods for value chain analysis					
Identification of food processing, preservation, packaging and transportation operations					
Improve utilisation of food raw materials and reduce waste throughout the food chain					

Goal 4. Ensuring sustainable primary food production in Europe

For primary food production in Europe to comply with changing international trade relations and regulations, climate change and increasing demand for bio-energy, substantial environmental, social and economic adjustments in the production systems will be needed. The competition for natural resources and investments will increase, while society will demand sustainable systems. These pressures impose the need for continued adaptation of current primary food production systems towards more sustainable practices, and the design of novel sustainable systems.

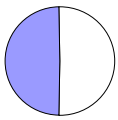
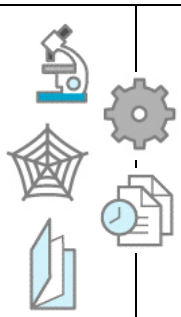
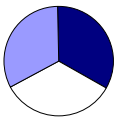
Deliverables

- **Establish a knowledge base to optimise existing primary food production systems and to underpin its sustainable management**

Indicators are required to guide and monitor changes of current systems towards sustainable primary food production systems (crop, livestock and fish). The indicators must be 'location specific' as they have to taking into account the widely differing environmental and socio-economic conditions and their complex interactions that determine the design of the actual production system. Required adjustments towards sustainable practices call for an interactive learning process with (groups of) farmers, researchers and other stakeholders, using both formal (quantifiable) and non-formal knowledge. This knowledge is used to design, test and disseminate appropriate farming systems in such an interactive mode.

- **Identify novel primary food production systems and assess their sustainability**

Radically different food products and production systems can be developed based on innovative concepts and advanced (bio-)technologies. These may dramatically improve the use efficiency of natural resources. Emphasis should be on maximizing the formation of desired products (full-product concept), on fully utilizing any by-products (zero-waste concept), and on optimizing resource flow within the production system (zero-loss concept). Sustainability criteria are an intrinsic component in designing these innovative systems and should be continuously monitored during implementation and adjusted to changing demands. Strong links to other KBBE-ETPs

Action and Timeline (0 — 5 — years)	Human ressource	Funding distri-bution	Funding amount	Type of activity	Activities
Ensuring sustainable primary food production in Europe					
knowledge base to optimise existing primary food production systems					
Identification of food processing, preservation, packaging and transportation operations		 e.g. ERA-Net			

Goal 5. Understanding consumers and their behaviour regarding sustainable food production

Consumer behaviour and food production will change dramatically over the next few decades. The direction of these changes is extremely uncertain, however. The existing trends in socio-economic systems show various key uncertainties, such as the strong contrast between, on the one hand, rapidly increasing global trade and highly developed technological innovation and, on the other hand, slow growth and more diverse, regional technological change. Eventually, both patterns may be sustainable in their own ways, but adaptive learning in the direction of sustainability requires such abstract trends to be specified at the level of behaviour.

Deliverables

- **Analysis of influence of lifestyle trends on sustainability of the food production system**

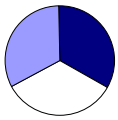
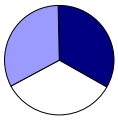
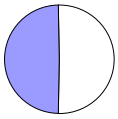
The direction of changes in consumer behaviour and food production depends on the adaptive capabilities of coupled human-ecological systems, which primarily shape the behaviour of individuals. In turn, the adaptive capabilities at the system level are to a certain extent affected by the day-to-day choices of consumers who display similar and consistent preferences for a better quality of life. Environmentally, a diet with more meat exerts a disproportionate pressure on resources. Consumers, in contrast, are increasingly concerned how far their food has been transported and under what conditions animals are kept. Therefore, multidisciplinary research into impacts of lifestyle trends on sustainable diets - explicitly addressing protein foods - is a necessity. Link to food and consumer group.

- **Understanding and modelling of how consumers and consumer groups are prepared to pay for foods produced in a sustainable manner**

Many aspects influence the considerations of the consumer in selecting food purchases. In addition to culinary aspects, health aspects are very important today. However, ethical and sustainability considerations are increasingly influencing purchase decisions. In view of the increasing complexities of food choices, research is needed into value-related purchasing motives and into how sustainability can become a central part of consumer preferences. This will require multidisciplinary research to better understand how preferences are formed and to model how consumers can be informed and encouraged to adopt more sustainable patterns of food consumption. Link to food and consumer group.

- **Analysis of consumer behaviour as affected by socio-economic policy options of sustainable food production**

An interesting novel way eliciting more sustainable patterns of food consumption is to focus on the opportunities offered by local food economies currently arising in metropolitan areas. Such urban food economies may relate restaurants, catering, schools, and shops to local producers, with the concomitant advantage of creating a green buffer zone around the city. Such an approach adds a stimulating and innovative context to more traditional socio-economic instruments, such as labelling at the level of products. A multilevel approach provides more insight into the optimal conditions to involve different groups of consumers. Link to food and consumer group.

Action and Timeline 0 5 years	Human ressource	Funding distri-bution	Funding amount	Type of activity	Activities
Understanding consumers and their behaviour regarding sustainable food production					
Understanding and modelling of consumer behaviour					
Influence of life style trends					
Consumer behaviour affected by socio-economic policy					

Challenge 6: Managing the Food Chain

The **food sector** as a whole is faced with major challenges that arise from changes in the sector's economic and non-economic environments, 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. '**Food Chain Management**' (FCM) provides support for the identification and realization of 'best' concepts for such actions. 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.
Four interrelated strategic **research initiatives** 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:

a) **Consumers** through the provision of quality and diversity in food they can afford and trust,
b) **Food chains** through better transparency for advancements in governance, trust, efficiency, and innovation dynamics,
c) **SMEs** through better integration into the global and regional value chains, and
d) the **sector** through better understanding of the dynamics in those critical success factors that will improve competitive performance and sustainability in times of globalization and change.

Goal 1: Serving Consumer Needs for Affordable Food of Quality and Diversity

The food sector faces three strategic developments regarding its production base that put pressure on its capacity to innovate: They are: a) increasing demand for bio-energy, b) limits in the availability of water, c) diminishing production resources (as, e.g., land for agricultural use), and d) growing world population with changing consumption patterns.

Innovations will be required to serve consumers' need for affordable and trustworthy food without compromises in quality in the long run. New types of efficient and responsive coordinated production, distribution, and communication networks (**logistics networks**) need to be developed that can support changing consumer demands. This may include, e.g., new organizational structures for flexible chain-encompassing distribution and logistics systems that utilize advanced technologies for communication, control, or tracking and tracing, developments in quality preservation through conditioning techniques, new packaging and processing technologies or organizational innovations like parallel chains. The continuous provision of affordable quality food from a decreasing production base will be supported through process improvements involving, e.g., reductions in losses, delivery on demand to avoid over-supply (just-in-time), the efficient integration of new technological developments (in, e.g., production, analytical methods, logistics, or communication) and through a supporting institutional environment. Research on the identification of separable functions in production and trade and on the standardization of interactions will allow the formulation of models for the re-bundling of functions into new types of efficient, flexible, and responsive production, distribution, and communication networks. New and flexible enterprise relations are required that support the re-bundling of functions across enterprise borders for better serving changing consumer needs.

Research Challenge 1.1: Determine opportunities for innovations and improvements in the organization of processes (in production, logistics and management) along the value chain

Deliverables:

1.1.1: Specification of '**best practice'** process organization alternatives that improve the relationship between agricultural production and the retail stage (through, e.g., the reduction of waste) that will allow to identify potentials for further improvements. The analysis of 'best practice' experiences can serve as a basis for suitable process reorganizations and institutional infrastructures for business relationships in food networks on which innovations in technology, manufacturing, plant physiology, organization, and management can build.

1.1.2: Specification of **'hot spots**' in process organizations that will allow improvements in the delivery of food through appropriately focussed developments and innovations and the elimination of development and innovation barriers in processes and institutional environments. Hot spots are inefficient areas in food networks where infrastructural and processual improvements should start.

1.1.3: Specification of a **priority 'landscape'** for the initiation of activities that reduce barriers and support process development, process innovation, and institutional change. The priority landscape builds on the hot spots and contains activities for the improvement of processes and institutional structures in food networks.

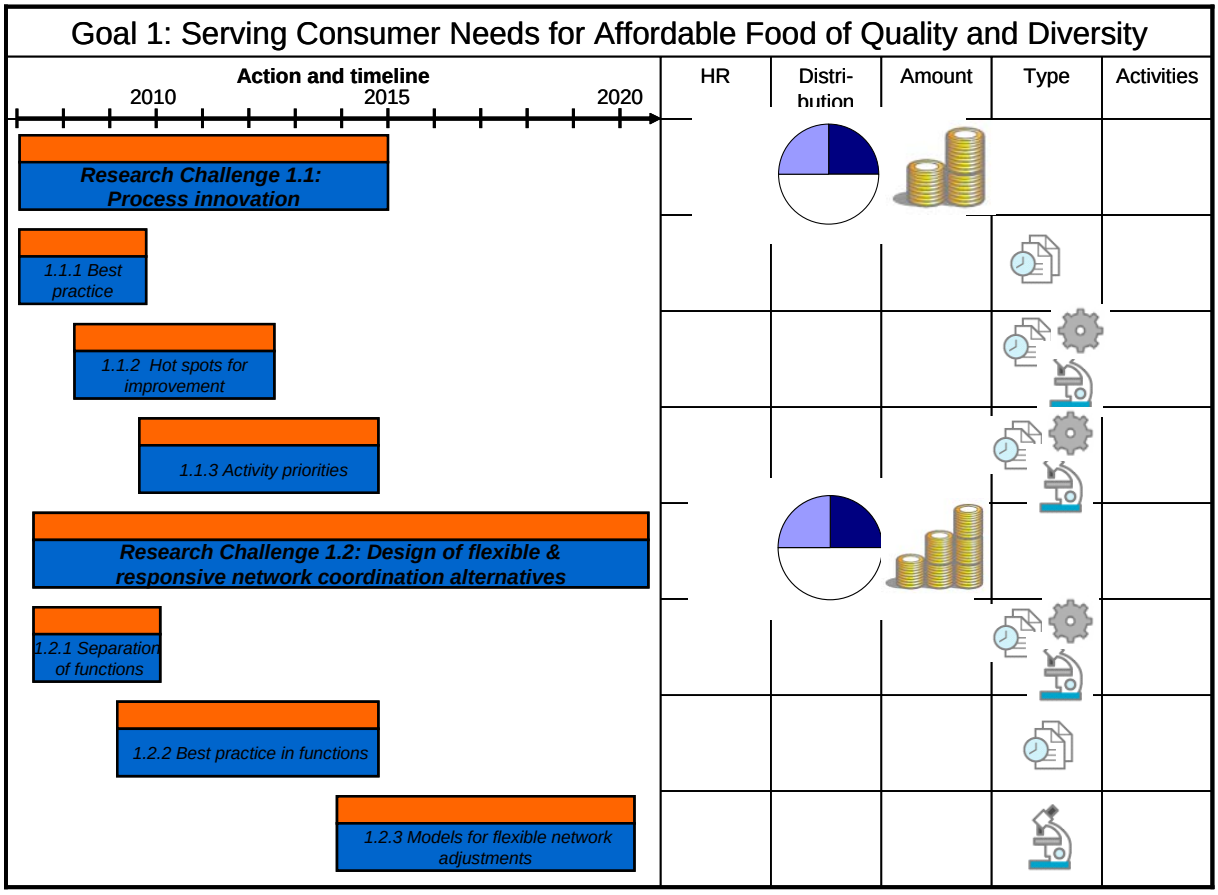
Research Challenge 1.2: Analysis and modelling of organizational network alternatives that combine efficiency and responsiveness to changing consumer demands for quality and diversity (organizational innovation)

Deliverables:

1.2.1: Identification and analytical analysis of **functions** along the food value chain that could be separated for individual process optimization 'in their own right' together with the specification of possible linkages with other functions for the creation of value chains and the formulation of appropriate standards for connectivity. The functionalities could be offered within an enterprise or across enterprise borders and allow enterprises or enterprise groups to easily adapt to new demands by re-bundling functionalities that better serve the needs.

1.2.2: Identification and analysis of **'best practice'** experiences in the realization of separable functions, of major weaknesses in functionalities that ask for developments and innovation, and of regulations or barriers from institutional, legal, cultural or any other environment that might limit the efficient integration of functions into value chains.

1.2.3: Design of generic simulation and optimization **models** that support flexible adjustments of global production and logistics networks in case of changing customer and consumer demands or in case of disruptions in production base, production ability, or delivery and distribution networks.



Goal 2: Serving Transparency Needs for Advancements in Chain Governance, Efficiency, Innovation Dynamics, and Trust

Strategic advancements in the competitive strength of food value chains and their adherence to society's values build on a number of critical success factors, of which 'appropriate' transparency, i.e. transparency that fits the different needs of various stakeholders stands out as decisive. Focused information and communication concepts serving the different transparency needs are the key for the dissemination of knowledge, for innovation, for risk containment, for appropriate cooperation and coordination within the value chain, for appropriate integration of SMEs in chain activities, and for the establishment of trusted relationships between enterprises, consumers and the society.

The ability for tracking and tracing is a pre-condition for the identification of many other food quality issues. Transparency may be served through an **institutional environment** that finds its expression in business norms, technology standards, communication agreements, information networks, codes of practice, legislative frameworks and societal rules. Transparency along the value chain of enterprise relationships and process activities needs to support the objectives of the different actors for improvements in efficiency or flexibility, in the ability to deliver guarantees of various kind, including guarantees for food quality, for food safety or for continuing deliveries in case of failures.

Research Challenge 2.1: Understanding and mapping tracking/tracing and transparency needs of enterprises, chains, and consumers (transparency needs)

Deliverables:

2.1.1: Identification and analysis of **tracking and tracing** needs across enterprise and country borders and specification of contents and standardization needs in content and communication. Specification of the different needs in tracking and tracing that constitute different layers of tracking/tracing quality linked to enterprises (lowest level), products, processes and the information categories attached to those different layers for different products and stages of the value chain. The results allow the delineation of an infrastructure of multiple layers of clearly defined tracking and tracing quality.

2.1.2: Identification and analysis of **'best practice'** transparency experiences (including those with local and regional scope) and the feasibility of transfer to the sector level. Analysis of best practices on different levels of transparency experiences for different products and in different cultures (countries), differentiated for different consumer groups.

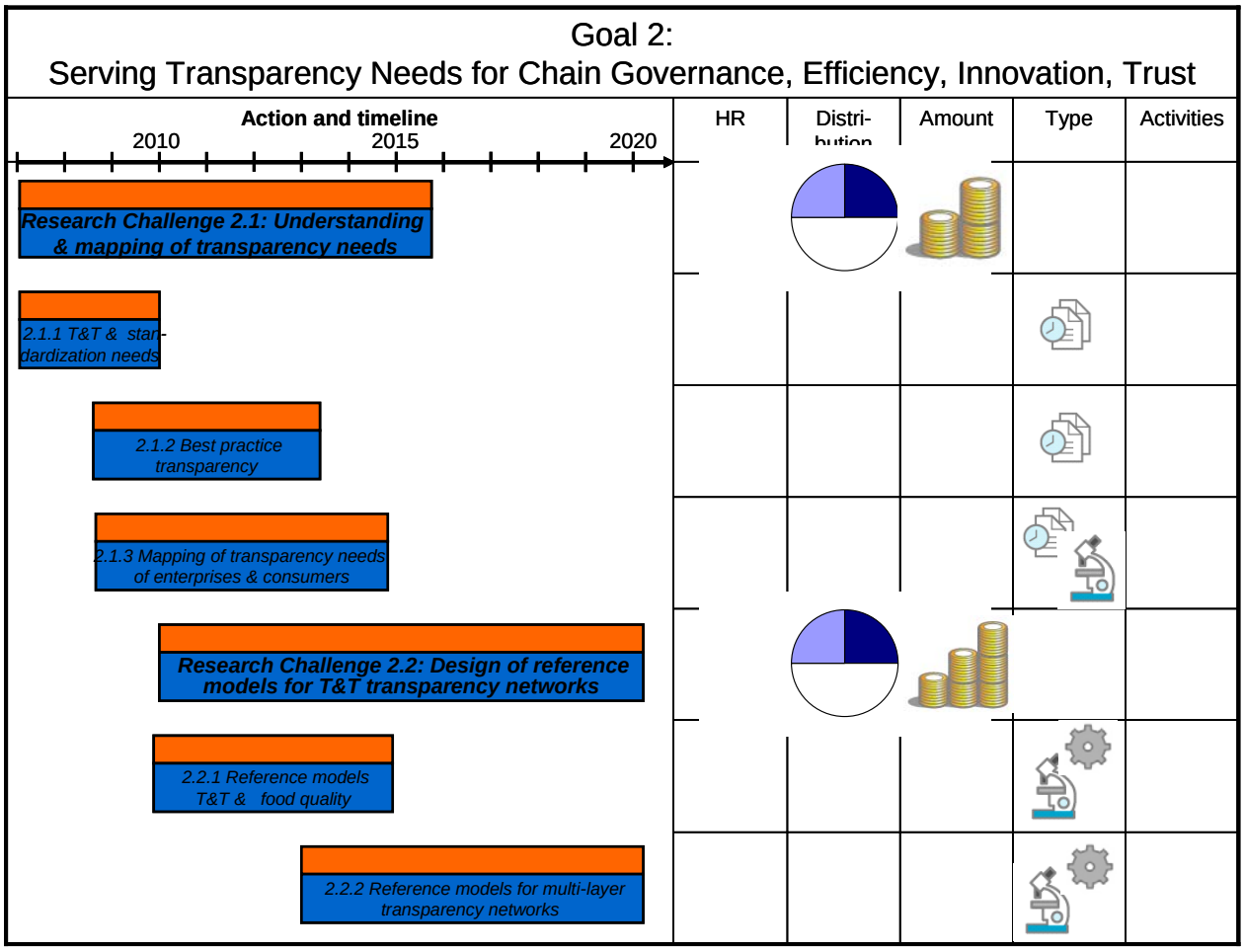
2.1.3: Identification and analysis of a **'transparency map'** that builds on tracking and tracing needs and capabilities, best practice experiences, and analytical approaches and specifies the different layers of transparency needs related to the focus of transparency, the different cultures (countries), the different stages of the value chain, and the different consumer groups and incorporates information on dependencies, priorities, potential implementation barriers, and standardization needs. Identification of information and communication needs (content, timeliness, etc.) that could serve the different transparency interests regarding quality, food safety, and risk containment strategies for trusted relationships. The results will allow the delineation of multiple layers of transparency needs that could be clearly marked, and the identification of deficiencies along the value chain within each of the layers.

Research Challenge 2.2: Design of reference models for tracking, tracing and transparency networks that serve value chains and consumers (system design)

Deliverables:

2.2.1: Reference models for integrated and flexible networks for **tracking, tracing** and **food quality** transparency that serve different user groups and transparency needs, identify organizational, managerial, technological, and economic alternatives, outline flexible development paths and specify suitable information sources. The reference models will, in addition, specify a growth path that allows growth from a first model implementation through linkages (interfaces) with other solutions that might develop. Such an open architecture is a pre-requisite for success.

2.2.2: Reference models for flexible **multi-layer transparency networks** that build on tracking, tracing and quality assurance needs but add transparency layers supporting chain efficiency, chain governance, and innovation dynamics. Includes the identification of suitable (consumer-focused) information clusters (sources of information, information integration, reliability, trustworthiness, usability, etc.) that serve different user groups and transparency needs. The alternatives are characterized by their 'transparency value' (benefit) for consumers and the costs of information generation.



Goal 3: Serving SME Needs for Better Integration into Value Chain Relationships

For SMEs, organizational and managerial **integration concepts** are key issues for improving competitiveness given the complexity of today's and future food markets now and in the future. Food Chain Management support builds on the identification of **integration needs** and **barriers,** and the initiation and management of integration initiatives and SME networks that allow **SMEs** to participate in the food sector's innovation dynamics and to become an integral part of future food value chain developments on a regional and global level.

For SMEs, horizontal integration and the participation in horizontal networks is usually the base on which efficient vertical integration can build. The food sector will need to develop different levels of integration, resulting in a **segmentation of markets**. Integration needs usually have to face **integration barriers**. One needs to understand integration barriers and possibilities to overcome the barriers. Research needs to identify and analyze economically feasible SME cooperation concepts which could serve the most common integration scenarios. An evaluation of potential performance gains and of the innovation support of cooperation alternatives allows the formulation of suitable proposals for realization. Innovation results from the combination of knowledge, the identification of suitable comprehensive utilization concepts (technology, information, management, logistics, marketing, etc.) and their realization in the food sector environment.

Research Challenge 3.1: Understanding integration needs and integration barriers

Deliverables:

3.1.1: Specification of horizontal and vertical integration needs, of barriers for successful realization and of opportunities for policy and the institutional environment to facilitate integration through a reduction or elimination of barriers. Specification of integration needs that allow SMEs to participate in (a) emerging global food value chains or (b) competitive regional chain activities and of the barriers that may prevent SMEs to participate in integration initiatives. Barriers might cover a broad range, including issues like information deficiencies, etc.

3.1.2: Specification of '**best practice**' horizontal and vertical integration concepts, their approach for overcoming barriers and the role of institutional environments. Involves specification of suitable and 'best' integration alternatives that capture the integration needs of SMEs for different food chain scenarios (products, regions, stage of the value chain, etc.) and for integration into global or regional food chain activities.

3.1.3: Specification of **reference models** (blueprints) for suitable organizational integration alternatives (and paths towards their realization) that best cope with potential barriers and possible institutional environments for different food chain scenarios (products, regions, stage of the value chain, etc.), and for their integration into global or regional food chain activities. Involves identification of clusters of activities by policy, institutions, participants, etc. that initiate and facilitate the integration process. The identification builds on best practice experience as well as on an analysis of barriers and their elimination.

Research Challenge 3.2: To model and serve suitable approaches for functional cooperation (e.g. collaborative quality planning) in SME networks.

Deliverables:

3.2.1: Specification of needs and **'best practice'** functional cooperation concepts.

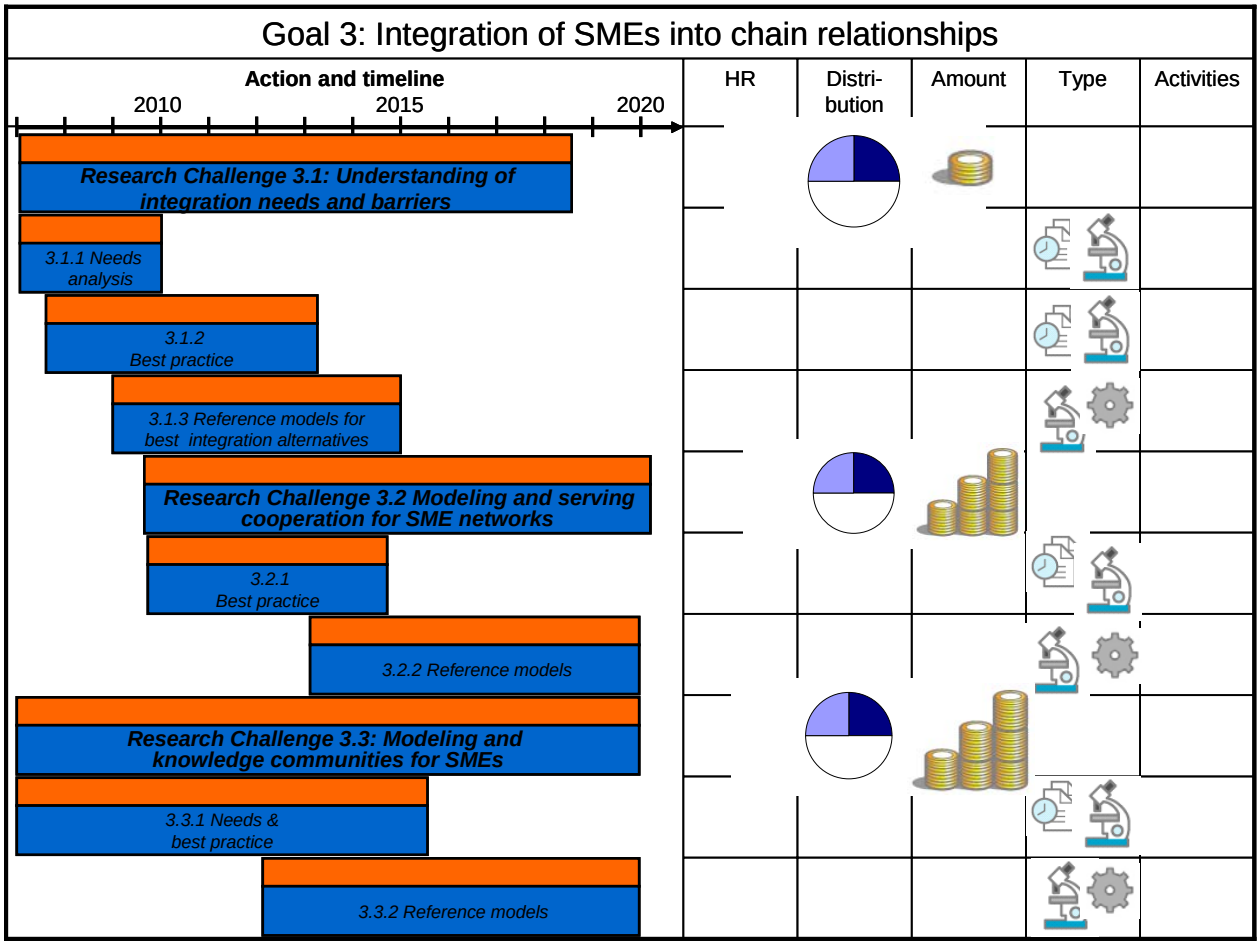
3.2.2: Specification of **reference models** for suitable and 'optimal' functional cooperation alternatives (related to financial feasibility, transition costs, benefits, etc.) for different integration scenarios (as, e.g., institutional environment), different chain relationships (regional, global), and different regions and product lines.

Research Challenge 3.3: To model and serve knowledge communities for SME innovation support

Deliverables:

3.3.1: Specification and mapping of SMEs' **knowledge needs** and **'best practice'** experiences in knowledge exchange regarding issues, dimensions, levels, and priorities in global or regional food chain activities. Involves identification of needs regarding knowledge issues, knowledge dimensions, knowledge levels, and knowledge priorities that together define 'knowledge maps' specifying needs of different product lines and stages of the value chain.

3.3.2: Specification of **reference models** for knowledge generation and dissemination networks that identify sources of knowledge, requirements for their utilization, and organizational, managerial and technological implementation alternatives. The reference models need to specify the growth from core network implementations ('backbone') towards dynamically evolving comprehensive knowledge networks through linkages (interfaces) with other solutions that might develop (open network architecture).



Goal 4: Serving Sector Needs for Better Understanding the Dynamics in Critical Success Factors for Competitive Performance and Sustainability in Times of Globalization and Change

Successful competitiveness and long-term sustainability depend on benefits exceeding costs. The indicators for their determination can vary in times of change as can the critical success factors for performance and sustainability. This reduces the competitive advantage of the established production and distribution organization. A current example is the emergence of competitive bio-energy production.

In determining their long term development paths, enterprises and chains need to find a balance between improvements in their monetary benefit-cost balance to assure general competitiveness in their markets and the society's consideration of the benefit-cost balance to assure acceptance and sustainability. It will be essential to understand the relevance and dynamic developments in those critical success factors and indicators that determine performance from the view point of enterprises, chains and the society.

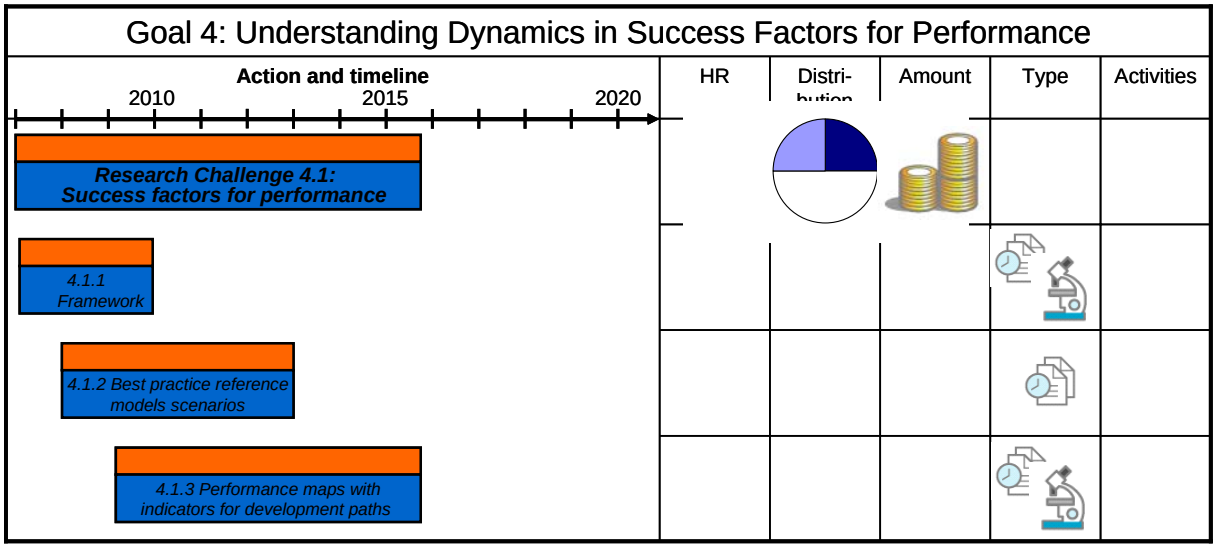
Research Challenge 4.1: Understanding and Utilizing Success Factors for Food Value Chain Performance

Deliverables:

4.1.1: Specification of a dynamic **framework** of critical success factors and performance indicators for performance evaluation of horizontal and vertical organizational alternatives in food value chains, involving the identification of a range of development scenarios regarding the understanding of performance. Will allow for the simulation of the sustainability and competitiveness of different scenarios.

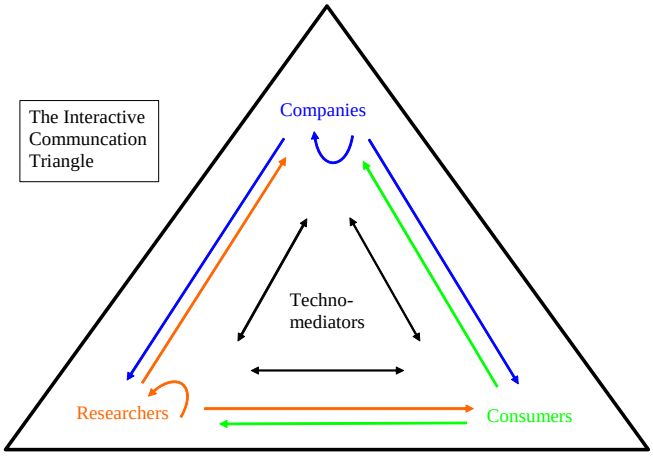
4.1.2: Identification of **'best practice**' reference models for value chain organization and development linked to different performance views (economic, non-economic, etc.) and their development over time. Involves the specification of "norm" development strategies for different scenarios.

4.1.3: Specification of '**performance maps'** that a) link performance indicators to organizational alternatives and organizational development paths derived from (1) 'best practice' reference models as well as from (2) reference models determined through modelling research (challenge 1.2) and b) provide support for decisions on value chain developments.



Communication, Training and Technology Transfer

In order for society, consumers and companies to benefit from the basic aims of the European Technology Platform "Food for Life", it is necessary to improve the competitiveness of the European Food Industry. This requires efficient communications among the three main groups of stakeholders: Food consumers in Europe and the whole world, the food industry, and food research. The interactive communication triangle between these partners will decide about the success and the position of the European Food Industry and their products.
For most interactions of the triangle, the aims can be achieved by establishing efficient and trustworthy communication as information flow directly between and within networks of different stakeholder groups (Communication, Goal 1). However, the food industry, in particular the small and medium sized enterprises (SMEs) have additional particular needs for skills and information. Skilled and trained personnel is essential to face future developments. Therefore provision of skills to support and develop the company's potential for performance and innovation is necessary (Training, Goal 2). The support from mediators to seek and implement knowledge that is new to the company to support and develop the company's strategies and visions (Technology Transfer, Goal 3).



Goal 1: Communication

The communication dimension in the ETP requires a coherent programme of initiatives over time. An effective communication strategy must build trust and confidence; and as the current status of related communication actions show, this is not achieved in the short term and its ultimate impact will depend upon the ETP having, and being perceived to have, an independent position as beneficiary to all stakeholders. Real credibility for the platform will only be gained over the long term, but it is essential to establish a neutral and independent position from the start so that regular communication can be established, optimised and maintained. It must start with providing all stakeholder groups with recurrent occasions to provide and gain information to demonstrate the benefits of openness and trust, and to build the basis for more committing relationships in the longer term.

1.1) Consumer oriented Communication Initiatives

These actions are aimed at securing a steady and continuous relationship with the consumers via the "umbrella role" of the consumers association. It is also aimed at assuring an important societal dialogue with governmental and non governmental bodies with a direct or indirect agenda on the food issue. It is hence vital that a constant system of informative initiatives be in force during the whole duration of the ETP.

This comprises two lines of communication:

1. From consumers to companies: Facilitation of information about the consumers' interests and what the consumers would like the companies to do to support these interests, to the relevant decision makers in companies, who will be able to use this information as commercial opportunities for mutual benefit embracing the information within their strategy for corporate social responsibilities.

2. From consumers to researchers: Facilitation of information about the consumers' interests, why consumers often distrust new developments in the food sector and what the consumers would like the researchers to do to support these interests, to educate the researchers to focus their efforts on technologies and topics that consumers appreciate and that therefore have the potential to become commercially successful.

Objectives:

- ✓ Communication of the corporate identity of the ETP programme and philosophy (2007-2015),

Approach

- in charge of the ETP OC at supra national level;
- second level communication: government and governmental agencies;
- initiatives developed with emphasis on global issues

- ✓ Continuous communication flow from and to consumers via associations and other sources (2015-2020).

Approach

- In charge of National ETP platforms
- Initiatives developed with emphasis on local issues on national level including meetings and conferences
- Aimed at explaining issues of major concern to the end consumer
- Specification of communication areas (food safety & health, consumer preferences, etc.)
- Specification of communication channels (mass media, group communication, ICT design, etc.)

1.2.) Company oriented Communication Initiatives

The dialogue with the companies of the European food industry has to be improved to motivate food companies exploiting research and innovation results. The provision of reliable information and use of new and appropriate communication technologies including direct contact on the national level will establish the ETP and the national platforms as "partners of trust".

Key aims

- o Shattering informative barriers to innovation, especially SMEs
- o Favouring information exchange among companies,
- o Favouring adoption of best practices on the basis of a tutoring approach (Big an medium companies towards smaller ones)

It is vitally important that all participating companies gain clearly identifiable advantages from a newly conceived networking. Information is one of the key benefits of a network. Therefore a successful communication system requires initiatives to be taken at company level. These initiatives should be mostly addressed at reinforcing existing networks by both expanding and qualifying them, building on the existing best practices.

The relevant lines of communication are:

1. From companies to other companies: Exchange of information about common challenges, opportunities and experiences, so the companies can concentrate on developing their unique selling points rather than on solving the same type of common problems.

2. From companies to consumers: Establishment of independent communication lines (not dominated by the narrow commercial interests of individual companies) where companies can explain and discuss with consumer organisations the situation for their enterprises, in particular regulatory constraints that prevent them from meeting the consumers' demands, with the aim to identify joint interests to improve the regulations locally and across the EU.

3. From companies to researchers: Facilitation of information about the problems, opportunities and other issues facing companies, in particular SMEs, which would benefit from research efforts, with particular emphasis on topics affecting many companies and the relation between companies and society.

Objectives:

- ✓ Development and implementation of communication management systems for the use of national Food-SME networks (2007-2010)

Approach

- o Establishment of national contact partners in each European country under the auspices of the national platforms
- o Realising a new ICT system for company networking on national and international level (easy and secure, direct b2b information)
- o Improved interaction and information transfer with the companies (efficient connection between high quality institutions and companies and networks)
- o Inclusion of other stakeholders (funding bodies, innovation suppliers, consumer organisations, research groups)
- o Development of a national platform action plan basis for lobbying, tailored newsletters, consultations with associations, extension programmes, etc.

- ✓ Providing food company relevant content in the form of focused and updated information to food companies (2007-ongoing).

Approach

- o Setting up interesting and essential formats in order to channel useable content for food companies (quality of service providers, brokerage initiatives, etc.)
- o Establish a comprehensive inventory of providers of state-of-the-art data mining for ready adoptable technology based solutions with a secure benchmark facility for companies
- o National and country specific focused distribution and dissemination of exploitable results including comparison of benchmarking data for trans-national service providers

1.3) Researcher oriented communication initiatives

Most researchers see themselves primarily as generators of new knowledge, often perceiving technology transfer as the only need for them to communicate with non-scientists, and even in this context many are not aware of any need to receive information (as mentioned above), only to deliver it. This lack of awareness of even the need for dialogues poses particular challenges for this part of the interactive communication triangle. Researchers have to be motivated to realise, that their success ultimately will be determined by their ability to understand and support the interests of companies and consumers. However, a successful outcome promises greater potential improvements of the competitiveness of both the European food industry and the European food science than most other initiatives of the ETP "Food for Life".

The relevant lines of communication are:

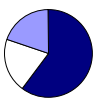
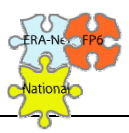
1. From researchers to other researchers: Revision of the academic value traditions for how researchers compete with each other, so the quality of research outputs will be ranked by the benefits they provide for society rather than by how difficult it was to achieve them.
2. From researchers to consumers: Establishment of independent communication lines (not dominated by the narrow interests of specific research communities) where researchers can explain and discuss with consumer organisations the situation for their work, in particular regulatory constraints that prevent them from meeting the consumers' demands, with the aim to identify joint interests to improve the regulations locally and across the EU.
3. From researchers to companies: Establishment of independent communication lines (not dominated by the narrow interests of specific research communities) where researchers can explain and discuss with company organisations the situation for their work, in particular policies, traditions, administrative and other constraints that prevent them from meeting the companies' demands, with the aim to identify joint interests to improve the focus in the academic community locally and across the EU.

Objectives:

✓ Improving communication through revision of the academic value traditions in food science (2007-2015).

Approach

- Reallocation of national research funds to institutions and projects in the food science area to favour those that can document a credible system for incentivising researchers who successfully incorporate the interests of consumers and companies into their research.
- Establishment of support facilities for researchers that are interested to incorporate the interests of consumers and companies but lack the skills and/or time to do it themselves. This can comprise targeted communication events, dedicated communication units, a popularisation service (expert support to rephrase scientific publications for relevant target groups), and may be funded by the above-mentioned reallocated funds.
- Establishment of/link with structured feedback sites (benchmarking facilities) where end users (consumers and companies) can rank the quality of the service they received from research institutions. This ranking may be used by the national research funding agencies as one of the tools used to manage the above-mentioned reallocation.

Action and Timeline (0 — 5 — years)	Human ressource	Funding distri-bution	Funding amount	Type of activity	Activities
1.1. Consumer oriented communication initiatives					
Communication of the corporate identity of the ETP programme and philosophy					
Continuous communication flow to and from consumers via associations and other sources					

1.2. Company oriented communication initiatives					
Communication management systems for the use of national Food-SME networks					
Providing food-company relevant content in the form of focused and updated information to food companies					
1.3. Researcher oriented communication initiatives					
Improving communication by revision of funding allocation principles					

Goal 2: Training

Training is a key component for the extension of knowledge as well as the transformation of knowledge into competitiveness. Effective training and education of food industry personnel is vital for establishing and maintaining the skills base for high quality food production, and any shortages can impede the expansion of successful companies and make it unnecessarily difficult to establish new companies. Given advances in technology and shifting consumer demands, training will increasingly be needed across a career, not just at its outset. The present 'innovation gap' between research and its application must be closed, and via the company oriented communication activities programmes that introduce food production personnel to recent developments and new techniques can be tailored to fill this gap in cases where existing training capacities are insufficient or not optimally utilised.

2.1.) Establishment of the European Foundation for Advanced Technology Transfer and Training, EFAFTTT (2009-2015),

Existing bottom up initiatives taken at sub-sectoral level or in specific countries and regions must be supported by trans-national links to promote best practice, to ensure that resources are targeted towards topics with the best return (for companies) on (public and private) investment and to support rapid responses to new training needs. The advancement of the industry as such needs in the long term a self-fertilizing system based on an original approach to the topics of innovation and sustainable workforce policies. The present time seems to be promising in terms of paving the way to a continental initiative aimed at linking the companies and their workers and technicians to a self made major source of ideas and formats for the exploitation of science based solutions (TT) and the education of prospects professional in the field of food and beverage industry (Training). It must be obvious, that the proposed foundation is neither another training initiative nor a costly experts committee. In the same spirit, it is not an imitation of existing national or European agencies. It would rather be a high level know how enabler or body for the enhancement of technology transfer and training formats. The EFAFTTT is designed as an integrated strategy for the training of trainers and technology transfer specialists at a pan European level, with knowledge and capacity profiles defined by stakeholders and industry through a dynamic participation / consultation process. A full deployed project for the EFAFTTT will be part of the effort in the present IP.

Approach

- Setting up a feasible design for supra national institution acting as a foundation
- Defining its task and activity program to allow the industry to define its needs for better coordination of the existing training capacity
- Defining the way to the accreditation for the European network facilitator diploma for Techno Scientific Mediators
- Setting up a feasible design for a supra national institution acting as a foundation with emphasis on monitoring and tailoring its activities to local and global requirements
- Defining its governance and funding resources
- Defining recruitment criteria for the personnel of the foundation

2.2.) Training agreements taken at European level (European certification at high school/university level) (2010-2020),

A clear common position about the skills of Techno Scientific Mediators has to be achieved. TSMs should become an important resource for the innovation system of the European food industry. It is therefore necessary to establish a well grounded mutually recognised system of certification of the skills of these people.

Approach

- Working on existing best practices to develop a suitable skill based profile of these newly created professional activities based on the outcome from benchmark facilities of existing institutions and analysis of company scorings
- Promotion of creation of national curricula for the training and the subsequent labour market usability of the TSM profile with the aim of the European network facilitator diploma

2.3.) Establishing, updating and improving training facilities for the food industry in over 30 European countries (2015-2020),

As a result of the European Network Facilitator Diploma, the EFAFTTT will provide a number of fully skilled professionals, who will apply their skills on the level of the diverse national countries. However, at present not all countries already possess a sufficient training infrastructure to fully exploit the potentials of the food companies, so a second important role of the EFAFTTT will be to coordinate national training activities to maximise their benefit for the industry. Through frequent cooperation and interaction with the food production personnel, needs for updates, improvement and expansion of each country's capacities will be thoroughly analysed, inspired by documented best practice in the same and other countries, using standards and practices that have proven most cost-effective in places with similar structure of the food industry. Specialised training facilities for skills that require access to dedicated equipment will be shared among neighbouring countries, and will act as a place of encounter for the food industry as well as a source of know how for the uptake of the European food production personnel. However, the primary task is the coordination of the existing institutions to act as the backbone for frequent contact to the food companies, providing external and/or internal training measures in the companies as appropriate for the industry's needs.

Approach

- Defining and sustaining the adoption of national operative training and technology transfer programme inspired by the EFAFTTT guidelines and training providers benchmarking
- Maximising the utilisation of specialised training facilities through trans-national collaboration

Action and Timeline 0 5 years	Human ressource	Funding distri-bution	Funding amount	Type of activity	Activities
2. Training					
Establishment of the European Foundation for Advanced Technology Transfer and Training					
Training agreements taken at European level (European certification at high school/university level)					
Establishing training facilities for the food industry in over 30 European countries					

Goal 3: Improved 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, processing and services. Because the European food and drink industry has a clear need for innovation, a credible partner delivering innovation and its associated solutions should be THE driver for its future success.

3.1.) Techno-Science Mediator Networking Initiative (2007-2015)

'Techno-Science Mediators', TSMs, who will actively promote technology transfer in direct contact to food companies on national levels will be a crucial tool for improved technology transfer activities. These professional scientists, skilled in technology audit and communication, can 'mentor or coach' companies through their adaptation of technologies and innovation. These TSMs will work within the national network and, as part of their practice, they will gather information on both innovation needs from the industry and emerging technologies from research providers. Harnessing this information through a European wide database will provide valuable 'foresight' data for future R&D funding decisions. However, most important for the TSMs will be becoming the "Partner of Trust" of the companies, while gathering the real needs and demands of the mostly SMEs. This programme would also identify appropriate evaluation criteria for assessment of effective technology transfer.

A foreseen two level networking approach of the TSMs is the key concept of improved technology transfer. Through the coordinating function of the EFAFTTT, the know how requested by the European food industry will be made gradually accessible to it, either from existing sources of knowledge or by alerting motivated researchers to create it. Therefore the existing experiences as documented through the benchmarking activities, supported by the communication role of the Mediators will constitute a base of future improvements in this direction. Providing efficient technology transfer requires a thorough understanding of the needs of the food companies and the ability to engage all relevant players of technology transfer including researchers, know how providers and financial supporters.

TSMs must be trained to establish efficient networks of these protagonists around the companies they serve, so that a convincing transfer of knowledge for the benefit of the food industry can be realised. These sub-sector networks must have a strong engagement from the companies and in collaboration with networks of companies in other sub-sectors they will "design" national initiatives taking care of the need of the respective sectors of the food industry.
A strong exchange between the different national networks on European level is also important in order to ensure that the needs of the companies are matched as well as possible with the results of European technology developments and European food research. The implementation of this two level networking strategy has to be performed immediately, so that the ETP "Food for Life" and its´ core research activities will have an impact on the European Food industry.

Approach

- Defining the network environment of the TSM for optimum promotion and benefit of the communication activities (3.1.1.2, 3.1.1.3)
- Establishing a cluster of programme activities in the national countries
- Evaluation and ongoing monitoring of TSM basic programmes using established benchmarking facilities
- Evaluation of potential enlargement of networks to exchange information on international and national level

3.2.) Elaboration of recommendations for successful Technology Transfer on European and national level

It is obvious, that no universal formula for successful technology transfer exists. All aspects of the TechTrans environment and specificities have to be taken into account. As a number of transfer activities have been carried out so far, the ETP wants to learn from their history, their strengths and weaknesses. "Food for Life" will carry out an investigation on success and failures of transfer between research and industry by analysing the characteristics of initiatives that receive high or low satisfaction scores in the benchmarking data provided by the food industry (3.1.1.2) and will elaborate recommendations for how to implement this information by providers of know how, researchers, training institutions etc. in the area of the European food industry. These recommendations are the basis for the Techno-Science Mediator network and will have a crucial impact on the success of the ETP.

Approach

- Analysis of barriers for industrial exploitation of innovation,
- Analysis of the characteristics distinguishing best and worst practice and case studies for establishing new formats for enhanced support of innovation in the food SMEs,
- Evaluation of the effectiveness of SME partnership programmes and standardisation of activities to support them
- Developing a specially dedicated project funding scheme (e.g. in the ERA-Net or others) for enhanced collaboration between the food industry and knowledge providers
- Developing formats for the best use of collective research, marketing and supply chain resource management activities for enhancing innovation at food SMEs

It is clear, that all the mentioned intentions will be carried out side by side with a close exchange of information and results. This shall also lead to the development of coherent results and a complementing approach from the EFAFTTT to the TSM networks.

Action and Timeline 0 5 years	Human ressource	Funding distri-bution	Funding amount	Type of activity	Activities
3. Technology Transfer					
Techno-Science Mediator Networking initiative					
Elaboration of recommendations