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**PROSPECTIVE INNOVATION  
CHALLENGES IN THE FOOD AND  
DRINK SECTOR**

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## **Executive Summary of “Prospective innovation challenges in the food and drink sector”**

This Executive Summary of the sector report “Prospective innovation challenges in the food and drink sector” is a condensed version of the results from the WP 7 in the Innovation Watch Systematic project. The main theme of WP 7 is “PROSPECTIVE VISION OF SECTORAL INNOVATION CHALLENGES”. The reports were organised into 6 main themes. The Executive Summary follows the same structure: 1) Structural features 2) Characteristics of innovation 3) Technologies 4) Demand and market issues 5) Skills and human capital 6) Innovation policy challenges as seen by experts.

### **Structural features**

A challenge that the food and drink sector must relate to is the weaker performance of the sector in an international comparison, showing low productivity and growth rates, slow value added growth and low R&D investments.

The innovation pressure in the sector contributes to a trend towards consolidation. Challenges related to availability of raw material, competition on prices, increased regulation, health and traceability, costs of product and process innovation all contribute to this trend.

The sector is also faced by several regulatory and legislative constraints, often seen as a hampering factor for innovation as it might be difficult to adapt to it in a flexible manner. Rules and regulation often poses a challenge for firms, especially SMEs. If regulations passed are shaped in an SME friendly manner, small companies could benefit from regulatory changes with opportunities to outperform bigger firms.

### **Characteristics of innovation**

The food and drink industry is a low-tech industry, expressed by the R&D expenditure. A challenge for the European industry is that R&D expenditure as a percentage of industry output is lower than for the food and drinks industry’s main competitors the US, Australia and Japan.

Many SMEs in the food and drink industry are embedded in local and regional innovation systems, representing tradition and culture. In order for this part of the industry to become more proactive with regard to innovation, closer connections to consumer demands and national and global trends must be attained together with an upgrading of the human capital in the sector that will make it responsive to such innovation pressure.

Many SMEs are informal innovators with a high motivation to invest in their own business and a strong reactivity to new conditions of their relative markets. Many SMEs hold an opportunistic innovation strategy in order to be least exposed to obsolescence. The challenge is to redirect more SMEs towards a business model centred on the value of technical change and the search and research for new products. In most instances policy makers should put more weight on improving the in-house capabilities of the workforce rather than focusing on R&D activity in order

to increase innovation among SMEs. In-house capability will enable firms to take advantage of the diffusion of knowledge from other firms or sectors. Already approximately half of all innovations in the food and drink sector are not directly food-related. A company that is in a position to incorporate the technological convergence into its business model could benefit from new scientific approaches and consequently from technical opportunities.

Conservatism of food consumers are seen as an innovation challenge by the sector. However, if radical innovations are followed by proper conditions related to price, branding, information and health benefits and sensory qualities of foodstuff, the consumers are not that critical. This suggests that innovation in this sector must be followed by non-technological innovation in order to reach its market goals.

### **Technologies**

Management of the food chain requires cross-disciplinary competences and represents a significant challenge for the future agro-food sector. Performance and trends in consumer, retail and the primary sector all challenges the food and drink industry. The challenge ahead is to find out what transitions and changes that are needed in the different parts of the food chain in order to become a sustainable European food production system.

Food *retailing* is to a larger degree controlling and influencing the food chain with their ability to influence consumers and suppliers. The innovative challenge for food manufacturers is to predict future consumers' needs and requirements and to have the technical capability to engage in interdisciplinary product development processes in order to shift control from the retailer to the producer. The food manufacturer often carries the risk and as such it is of importance that the developers educate themselves as to consumer and market needs as a mandatory part of the food development process. Consumers looking for organic, high quality, healthy and life style products, suggesting innovation potentials. In order to satisfy customers' further needs, producers are to a larger degree compelled to interact with consumers suggesting an intensive use of communication. Non-technological innovations related to communication, training, distributions etc. are likewise important for the sector in order to cope with prospective innovation challenges.

ICT (as a generic technology) is an important part of food distribution and is increasingly being used to improve efficiency in all steps of the production, processing and distribution of food.

There has been argued that a challenge for the food and beverage industry is to how to optimise linkages to the technological developments within pharmaceuticals, chemicals, biotechnology and electronics industry. In order to meet this challenge the sector must engage actively in research networks and pan-European initiatives and build networks especially with the health and technology sector.

A high number of new or modified products are often combined with process innovations. Three very innovative fields in the food industry are in the area of genetically modified organisms, functional food and organic food, representing market opportunities, which, however also experiencing different obstacles and

drivers. A future innovation challenge to the agro-food industry will be to tackle the multiple new scientific approaches and technical opportunities that have an interdisciplinary character. The creation and building-up of interfacing competencies as well as the establishment of new external knowledge and competence networks seems to be of strategic relevance. The target for policy should be to support the advances of the knowledge base of the food industry companies themselves and the *diffusion* of new scientific approaches and technology, and not solely concentrate on stimulating knowledge generation with relevance *for* the food industry.

Issues about ‘quality and manufacturing’, ‘food safety’ and ‘food and the consumer’ are seen by far the most important ones in terms of a strategic vision of the sector, suggesting innovation challenges related to technological competition, both what kinds of technologies needed and where such technological competition will happen. The priorities also express the importance of the vital relationships towards the consumer and of the credibility of the sector.

### **Demand and market issues**

The consumer demands regarding quality and health represent a great constant innovation challenge for the EU agro-food industry that today is represented by cultural diversity, regional specialisation and tradition. A major prospective innovation challenge is to link with other platforms and disciplines in order to get consumer-oriented and consumer-targeted food innovation.

A prospective innovation challenge for the food and drink industry is to predict consumer perceptions, attitudes, preferences and behaviour towards new technologies, specific product methods and dietary regimes incorporated in food innovation.

### **Skills and human capital**

The sector presents unusual characteristics concerning employment due to the higher presence of women and the great share of part-time work. Food and drink companies employ fewer workers with higher education as compared to other industries.

A prospective innovation challenge for the sector is the difficulties in attracting and hiring qualified employees, and the experienced difficulties in filling vacancies in R&D departments. The share of food and drink industries that use training is also significantly lower than in other manufacturing industries. An explanation for that may be the large number of family owned companies in this sector.

### **Innovation policy challenges as seen by experts**

National policy experts’ assessment of innovation policy challenges in the food and drink sector.

In order to address prospective innovation challenges, policy should:

<i>General issues</i>
<ul style="list-style-type: none"> <li>• Raise awareness of innovation and introduce it in policy-planning</li> <li>• Make investments in R&amp;D a priority for the sector to respond to the challenges of food quality and safety as well as healthy food</li> <li>• Improving food safety</li> </ul>

- Lead the sustainable development of a competitive, consumer focused agri-food sector and to contribute to a vibrant rural economy and society. Safe food and higher quality food
- Exploit the concept of agro-tourism to promote local production in the tourism sector and the putt in place a clear policy for agro-tourism

*Technology*

- A major challenge for the small enterprises involved in the processing and packaging of food includes the adoption of the HACCP - Hazard Analysis and Critical Control Point
- Set up support research programmes with higher added values such as functional food
- Encourage innovation/basic innovation approaches in small agro-food industry e.g. in specialized packaging
- R&D on traceability methods and better control of the product

*Skills and collaboration*

- Engage in human resource development in the sector, in particular low-tech SMEs
- Promote partnerships and joint ventures
- Facilitate the diffusion of knowledge and innovation
- Promote technology transfer
- Tightening industry–university relations

*Suppliers, demand and market issues*

- Develop a more extrovert culture that will support the creation of new markets abroad
- Differentiate the products with the development of innovative activities for the satisfaction of the increased consumers ` demands
- Many firms are basically local market oriented, and are not able to reach larger scales and profitability because of limited internal markets
- Promote local brands into international markets

## **Chapter 1. Introduction**

### **1.1 Methodological background to WP 7**

One of the main objectives of the Europe Innova's Sectoral Innovation Watch exercise was to establish a "PROSPECTIVE VISION OF SECTORAL INNOVATION CHALLENGES" in the following 9 industry sectors:

1. Textiles and clothing
2. ICT
3. Food and drink
4. Energy production
5. Machinery and Equipment
6. Automotive
7. Aerospace
8. Biotechnology
9. Chemicals

The main question in WP 7 was what are the main prospective innovation challenges in each sector? The agreed methodology was to carry out a desk-based literature review and to summarise relevant material focusing on agreed themes. The workpackage should also include relevant work from other workpackages of the SYSTEMATIC project. New information for WP 7 was gathered by workpackage 3 "Mapping of sectoral innovation policy"<sup>1</sup>, which carried out a survey to national experts in order to obtain information on sector specific innovation policy measures. A question regarding sector specific innovation challenges was included in the survey in order to address the topics of WP 7.

The main methodology of WP 7 was discussed in the 4<sup>th</sup> workshop and management meeting in SYSTEMATIC (12-13 April 2007). It was agreed that workpackage 7 should focus the literature review on six types of challenges:

1. Structural features and characteristics of relevance for the innovation patterns and modes
2. Characteristics of innovation, e.g. particularities and main modes of innovation
3. Technological challenges
4. Challenges related to the demand characteristics of the sector and market issues
5. Skills and human capital issues

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<sup>1</sup> A survey to national experts was conducted in order to obtain information on sector specific innovation policy measures. The survey work in the then 25 Member States was carried out during the period July– November 2006. The experts were asked to identify innovation policy measures with the labels cluster initiatives, technology platforms, innovation programmes, regulation (legal initiative, technical norm, etc.), competition regulation (regulation on prices, patents, etc.), quality regulation (labelling green public procurement, etc.), fiscal incentive (subsidies, tax benefits, green/eco tax, etc.). In order to be able to address the topic of WP7, a question regarding sector specific innovation challenges was included in the survey.

6. Innovation policy challenges in the sectors as seen by the national innovation policy experts.

The main information sources were:

- The large number of reports and papers written in the Sectoral Innovation Watch project,
- Statistical sources, such as, EUROSTAT R&D and Innovation statistics, EUROSTAT Business Panorama, etc.
- Sector-specific analytical reports, scientific publications
- Foresight practices and scenario-based publications addressing the sectors.

The results were presented at the 4<sup>th</sup> panel meeting in Athens fall 2007. Small adjustments were made as a result of the discussions carried out in each sector panel.

## **1.2 Introduction to the sector**

The 'food' sector (manufacturing of food products, beverages and tobacco)<sup>2</sup> includes processing of the products of agriculture, forestry and fishing into food and drinks for humans and individuals. The European agro-food industry is the largest manufacturing sector in Europe, having a turnover of 810 billion euros in 2004, and employing over 4 million people, the majority in SMEs (99,1% of companies with less than 250 employees)(European Technology Platform, 2005). The food and drink industry transforms 70% of EU's agricultural raw material; it also imports many raw materials and re-exports them after processing. The ability to create value added is the industry's competitive advantage – however necessitating a constant renewal of products and processes at an ever-increasing pace. A prospective challenge is to improve the sector's innovative power. Low productivity/growth rates, slow value-added growth and less R&D investment demonstrate a weaker performance of the sector in an international comparison (CIAA, 2006). Since the EU market is mature, growth opportunities will come either from enhanced value-added goods or from increased exports to rapidly growing non-markets (CIAA, 2006).

## **Chapter 2. Structural features of the sector and innovation activity**

Being among the most important manufacturing sectors in Europe, the structure of the food and drink industry is characterised by fragmentation. Focusing especially on the agro-food sector, it consists on the one hand, of few very large multinational corporations competing on the global market with global brands and a large product range; and on the other, by smaller enterprises often serving local markets concentrating on regional preferences. As much as 95,5% of enterprises in this sector

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<sup>2</sup> *Manufacture of food products, beverages and tobacco (subsection DA)*.: The sector consists of two major activities within the NACE Rev. 1.1 classification: *the manufacture of food products and beverages* (15), and *the manufacture of tobacco products* (16). Food and beverages are further subdivided into nine groups covering meat, fish, fruit and vegetables, fats, dairy products, grain mill and starch products and beverages and, lastly, a group for animal feeds.

have fewer than 50 employees, accounting for 37.1% of total employment. Companies with more than 250 employees account for 52.9% of total value added and accounts for 0.9% all of enterprises in this sector, and 38.8% of total employment in the sector. There has been consolidation in the sector through mergers and acquisitions, as the total numbers of firms was reduced by 5.5% in the period 1999–2000. Prospective challenges related to availability of raw material, competition on prices, increased regulation, health and traceability, costs of product and process innovation all contribute to the trend towards further consolidation.

The structural profile of the food and beverage sector varies between countries, suggesting different innovation challenges. Germany, France and the UK represent the three largest European producers. The large multinationals are registered in the UK, Denmark and the Netherlands, and the sector profile is very different from that found in Italy and Greece where SMEs dominate. Forecasts suggest that large multinationals will progressively dominate these markets through aggressive acquisition strategies.<sup>3</sup>

## **2.1 The large share of SMEs in the sector**

Small and large firms have complementary roles in the sectoral innovation system of the food industry. Small firms, together with new firm formation, are important with regard to giving potential for innovation in a sector, however, facing different obstacles. Large firms more often engage in R&D and patenting activities.

The Food and Drink sector is sustained largely by SMEs, a factor that partly explains the relative slowness with which innovations are pursued (Vision paper, 2006). However consumer demands raise new questions concerning food safety, health effects, sustainable production, social responsibility, animal welfare etc., (Vision Paper, 2006), putting pressure on innovation. The profit that SMEs make on their sales is low, and SMEs are also less efficient in terms of procurement, production, sales and distribution processes (CIAA, 2006).

The current market and competitive environment appears to penalise SMEs in the food and beverage sector as it favours industry concentration with few sophisticated suppliers who have the ability and power to maintain the product lifecycle (vertical integration) – from the input of raw material to the market through modern logistics. Increased competition challenges the least technologically-developed companies, often found among the smallest companies. The smaller firms seem to be increasingly ‘locked out’ technologically – a trend that can be seen as a challenge for the smaller firms in the sector and a challenge that puts pressure on their ability to innovate and change in order to be competitive.

The question is how to stimulate SMEs to innovate and to employ innovations more widely. There is a large population of SMEs, fragmented and unevenly distributed

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<sup>3</sup> The European e-Business Market Watch Sector Report No.1 III/July 2003; ICT & e-Business in the Food, Beverages & Tobacco Industry; European Commission Enterprise Directorate General e-Business, ICT Industries and Services.

among branches and countries, suggesting a dispersion that is difficult to cope with (Vision Paper, 2006 p. 37).

The firms can overcome these hindrances by being innovative in different ways:

- organisational innovations – through increased integration and collaboration with larger companies to reach the market,
- market innovations – by positioning their products in niche markets and by participating in portals and market places in order to gain markets share and reduce costs,

An important task for policy-makers is to achieve a sounder interpretation of the specific problems and to explore the large population of SMEs in more detail in order to come up with more relevant innovation policies.

SMEs must not only be seen a disadvantage for the overall sector development. SMEs represent a force that can make possible radical redirection in an industry. Actually, medium sized enterprises have a much higher degree of adoption of new technologies than the average, often involved in specialised research programmes in really innovative sectors (Vision Paper, 2006 p. 12). Even though SMEs do not have internal R&D departments with many employees with a university degree, and rarely hold patents, they are informal innovators with a high motivation to invest in their own business, and a strong reactivity to new conditions of their relative markets (Vision Paper, 2006 p. 12). SMEs hold a twofold position; an SME may either represent a quantum leap as a really innovative company, or may decide to stick to a minimum and possibly an opportunistic innovation strategy in order to be least exposed to obsolescence (Vision Paper, 2006 p. 24). The challenge is to redirect more SMEs towards a business model centred on the value of technical change and the search and research for new products.

SMEs in the food industry play an important role with regard to employment in more rural areas. They also tend to rely on local industries and local services, often producing specialised regional products of a different nature than those produced by larger firms (Avermaete et al., 2004), suggesting that important components of Europe's highly valued cultural identity is invested in SMEs. Governments have regarded innovations in SMEs as an efficient instrument to decrease the disparities in economic performance between European regions by focusing on enhancing R&D activities in small food firms in rural areas. Avermaete et al. (2004) finds that many innovative firms have no R&D activities, suggesting that policy-makers should put more weight on improving the in-house capabilities of the workforce rather than focusing on R&D activity in order to increase innovation among SMEs.

Due to the large amount of SMEs in the sector and the increased focus on value added, the biggest challenge for the industry is how to engage more firms in innovative efforts by increasing research activity, and how to arrange for knowledge diffusion and technology transfer between firms and related sectors.

## ***2.2 Gazelles in the food and drink sector***

Gazelles are small and medium sized firms that achieve extremely high growth, and that is why the bulk of job creation is ascribed to them (e.g. Schreyer, 2000). These

firms are typically innovative in some way, be it with new processes, novel products, knowledge about the market or enhanced business models. Thus, “high growers” exploit opportunities better than other firms, and therefore outperform the average firm on the market.

The salience of gazelles is a phenomenon that depends on both economic and technological factors (Hölzl and Friesenbichler, 2007), and thus differs with the respective environment the firm operates in. The respective external environment is shaped by an array of sectoral differences. For instance, highly fragmented market structures with comparatively low entry barriers generate room for firms that offer a superior product. Similarly, changes in demand might render old business concepts futile, and companies that are not yet established replace incumbent strategies. Both changes in demand and innovative products are fuelled by technological convergence, which currently takes place in almost all sectors. Wherever change takes place, gazelles can be found exploiting the dynamics of their environment.

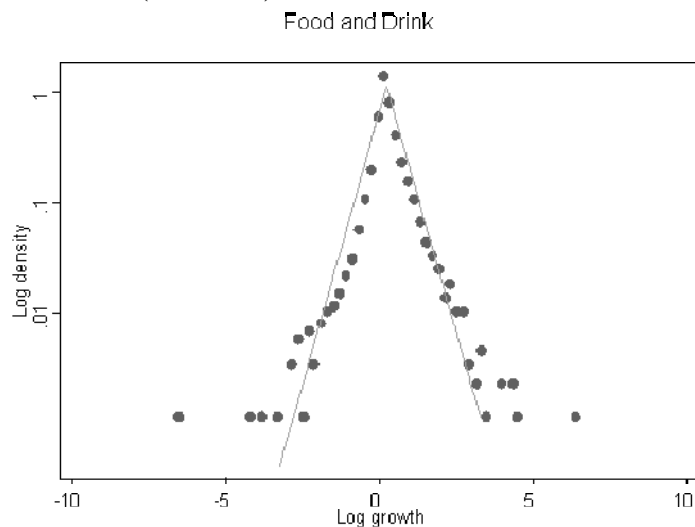
Crucial for growth is both the chance for an SME to compete against large firms and a growing market. Although all Innovation Watch/Systematic sectors exhibit gazelles, they tend to be more likely in younger sectors. Furthermore, not all gazelles are technology driven: many fast growing firms capture market niches and can be considered low tech. This report puts emphasis on innovation driven gazelles, since an analysis of non-innovative gazelles does not seem feasible. We first show a distribution of growth rates, present a gazelle count, and then elaborate structural prospects of gazelles by drawing on Malerba’s definition of sectoral innovation systems, which are defined as systems sharing technologies or the knowledge base, networks and agents, institutions and demand conditions.

### **The distribution of growth rates and a gazelle count**

From a mere statistical point of view, high growth *per se* is remarkable since the finding that most firms do not grow is a stylised fact. The empirical literature on firm growth shows that the distribution of growth rates is well described by a Laplace distribution (e.g. Stanley et al. (1996); Botazzi and Secchi (2007); Reichenstein and Jensen (2005)). This implies that a few companies experience substantial growth while most firms are stable in size.

Using the micro data of the third Community Innovation survey (CIS III), we reproduce these results for the *food and drink industry* for logarithmic turnover growth. Figure 1 depicts the associated Laplace distribution using CIS III micro data for 20 EU countries.

**Figure 1. Logarithmic growth rate distribution of turnover for the food and drink sector of 20 EU countries (1998-2000).**



Source: CIS III micro data, Wifo calculations.

While the average growth rate – expressed by the peak of the triangle - is close to zero, we find a number of outliers on the right hand side, which symbolise firms that exhibit extraordinary high growth. Defining gazelles as the top 10% (5%) firms of a distribution of logarithmic turnover growth (see Hölzl, 2006) for computational details), we found 451 (242) out of 5,363 food and drink firms to be high grows in our sample.<sup>4</sup> This corresponds to a share of gazelles of 8.4% (4.5%) and is consistent with the finding that gazelles exist in almost all countries and all industries over a range of growth indicators, however, often with a slight bias towards the new member states.

The following part discusses the role that gazelles may potentially play in the prospective setting of the future food and drink industry. As a starting point, we discuss industrial characteristics of the sector, and then raise several issues that may affect the appearance of high growth SMEs.

### **SMEs in the food and drink sector**

The food and drink industry (Nace 15) and the tobacco industry (Nace 16) are marked by the dominance of large firms: companies with more than 500 employees account for 0.3% of total firms, but 39.1% of all value added. Small and medium sized firms – 99.7% of all companies – comprise a large proportion of firms in numbers, but account for only 60.9% of value-added.

The industry structure favours large suppliers with a sophisticated supply chain that is able to react to product life cycles, which may change swiftly along with consumer demand. The supply network typically operates modern logistical solutions that are often internationally oriented, making it hard for smaller and locally operating firms.

Productivity increases reduced the number of firms between 1999 and 2002 by 5.5% due to the need for a critical minimum size. SMEs are likely to respond to this

<sup>4</sup> Our sample comprises the entire manufacturing sector plus the primary and tertiary sector industries that can be attributed to the Innovation Watch – Systematic sectors, namely to ICT and energy.

situation in numerous ways. For instance, they might attempt to integrate themselves in the supply chain of large firms. The reduction of the number of SMEs is mainly due to mergers and acquisitions. Smaller firms might also find a niche market that they can operate in, e.g. in the organic or ethnic food market. Furthermore, they might be able to gain market shares by cutting transaction costs through ICT. The ability to do so might be shaped by changes in technologies, regulation and demand.

### **Technology and skills**

The OECD classification classifies the food and drink industry as “low tech” because of its low R&D expenditure. This is also expressed by the sector’s skill level: compared to other industries fewer workers with higher education are employed in food and drink industries.

Currently, the European firms experience growth hindrances due to insufficient human capital endowment, which also poses a problem for firms’ R&D efforts. Thirty per cent of companies experience difficulties filling vacancies in their R&D departments. This lack of innovation in the sector also translates to worse productivity figures than, for instance, in the US (Oleaga et al., 2006).

Large firms, often multinationals, play a significant role in the production of food technology. However, they often rely on external knowledge sources, which already play a great role in the sector’s innovation dynamics (Laizzi and Venturini, forthcoming). In the long run, other innovators such as national firms with precise knowledge about local markets or spin-offs from universities or research institutes with superior technical knowledge could outperform big companies by taking on their competitors’ core competencies (Christensen et al., 1996). By creating knowledge internally, they could acquire a natural advantage in the appropriability of innovation rents.

A precondition that enables knowledge-driven growth is the skill level of the workforce. Well-trained and experienced employees allow firms to take greater part in in-house knowledge generating processes. Further, a highly skilled workforce allows a firm to engage in interdisciplinary product development processes, using results of new trends in consumer, retail and the primary sector.

Furthermore, skills enable firms to take advantage of the diffusion of knowledge from other firms or sectors. Such spillovers from other technology fields – for example, from drugs, chemicals, biotechnology, machinery – already play a significant role: approximately half of all innovations are not directly food-related (Rama, 1996). A company that is in a position to incorporate the technological convergence into its business model could benefit from new scientific approaches and consequently from technical opportunities.

Similarly, significantly improved production methods could create a competitive advantage that allows firms to outperform the market. For instance, if a firm operates sophisticated machinery it might be able to provide improved product quality. Further, better preservation methods that maintain the product’s natural quality through, for example, better stabilisation and decontamination procedures, could increase consumer’s utility and generate a niche market for such products.

## **Regulation**

The pressure stemming from communities and governments to produce safer and more environmentally-friendly products will lead to rules and regulations which have a great impact on the development of novel products in the food and drink industry. This might increase the size of the niche markets, potentially distorting competition in favour of highly specialised SMEs.

Issues that are relevant for policy makers include, for instance, product quality, which again is related to plant or animal diseases (BSE or foot and mouth disease) or production processes (safety of the processes, norms concerning hygiene, etc.), or health issues such as products containing low fat or low carbohydrates (Boudouropoulos and Arvanitoyannis, 1998).

The EU already monitors food safety, animal health, animal welfare and plant health within the EU, and checks food imported from third world countries and contributes to the discussion process of international organisations. Thus, the appearance of currently unknown (animal) diseases or other health issues could affect the existing markets, with substitutes replacing existing product lines. Due to the creative destruction type of competition, regulations relevant to the introduction of new products have a cataclysmic impact on industrial structures. Typically, large firms benefit more often from regulatory changes. However, if regulations passed are shaped in an SME-friendly manner, small companies could benefit from regulatory changes with opportunities to outperform bigger firms. Yet, even if technological convergence and regulations initiate innovations, customers' preferences certainly play a crucial role in innovation success and firm's performance. For instance, other than in the US, genetically modified food did not find a mass market in Europe. Especially innovations in the field of biotechnology, heavily rests on consumers' preferences. Moreover, customers might prefer local products, which could decrease international competition.

## **Changing customers' preferences**

Hence, customers' preferences are crucial sources of innovation, and a number of factors could play a role in shaping future demand. These include changes in the demography and the socio-economic environment, busier lifestyles of many customers, increased awareness about the relation between health and nutrition, environmental and safety concerns, as well as changing demand patterns due to migration and the emergence of ethnic food (Oleaga et al, 2006; Boudouropoulos and Arvanitoyannis, 1998).

Changes in the multi-faceted demand patterns are typically best perceived by retailers. These comprise consumer perceptions, attitudes, preferences and behaviour towards new technologies, or dietary regimes. Co-operation between producers and retailers in the innovation process might create idiosyncratic success factors that are vital to firm growth, such as the ability to predict changes in demand immediately. Yet, collaborations are only possible in niche markets, perhaps where technology plays a major role, since large retailers often satisfy demand for new products themselves.

Being able to offer the right product on time is not the only success factor. The ability to make use of non-technological innovations related to communication, training,

distribution networks etc. can turn out to be crucial in order to benefit from the first mover advantage stemming from market knowledge.

### **2.3 Characteristics of larger enterprises in the sector**

Large companies account for just 0.99% of all food and drink enterprises but provide 52.2% of the turnover 53.8% of the value added and 38.7% of the employment. The turnover generated by medium-sized and large firms showed much higher growth rates than of firms with fewer than 50 employees (Data and Trends, 2006). Studies show that the larger the size of the company, the larger the propensity to foster innovation, and until now, large firms and multinational firms have played the main role in the production of food technology. The large investments in advertising and marketing in launching new products by these firms prevent smaller firms from undertaking product innovations.

Types of innovation carried out by firms say something about the decision-making priorities of firms. When it comes to major product innovations (an area of critical investment and costly), the share of firms taking part in this is increasing by firm size (Vision Paper, 2006 p. 20). Product innovations are especially important due to the establishment of new economic branches, and for opening up the possibility of creating new goods or differentiation of mature goods – and the link between new products and new technological paradigms – as opposed to process innovation (cost-cutting, labour-saving). This tells us that size is a determining factor with regard to how much companies invest in these activities: small firms must choose, *medium* sized firms are more balanced and emerge as the prototype of innovators in the food industry.

Large companies are large investors in R&D and often have a wide range of research interests; they spend money on several different research programmes in various research areas (from product design to packaging, from IT to biotechnology etc.)(Vision Paper, 2006 p. 12). Non-food innovations are important drivers of innovation in the industry, especially the multinationals (often conglomerates), and generate a great number of inventions in biotechnology, machinery, chemicals etc. (Von Tunzelmann, 1998).

Innovations by multinationals are produced in the country of origin, suggesting that external knowledge sources in the national innovation system are of importance. Other sources of innovation input are suppliers of equipment and related services, competitors and consumers.

### **2.4 What characterises innovation in the food sector**

The food sector's value added has grown less than the average for the manufacturing sector in recent years. Labour productivity in the food, drink and tobacco sector has grown less than the total manufacturing sector. The growth of the food and beverage industry is dependent on its capacity to innovate. Important components of competitiveness in the sector are product differentiation, marketing and packaging.

The food and beverage industry is considered a low-tech industry according to the OECD classification by level of R&D. In 2004, the EU-15 R&D intensity, expressed as the R&D expenditure in the food and drink industry as a percentage of industry output, was 0.24%, being below the spending by the food and drink industries of its main competitors (US 0.35%, Australia (0.40%) and Japan (1.21%). Nestlé was the world's biggest R&D investor in 2005, followed by Unilever. The food sector ranks 15<sup>th</sup> in the industrial sectors by aggregate R&D from the global top 2000 companies.<sup>5</sup>

There is, however, a substantial level of diverse innovation activity in the sector, much linked to small changes in products and processes. According to Von Tunzelmann & Acha (2004) the sector is moving away from incremental innovation.

One challenge with regard to more radical innovations in the food and beverage industry is linked to the conservatism of food consumers. When specific conditions are met (price, branding, information and health benefits and sensory qualities of foodstuff), the consumers are not that critical to radical innovations (Van Kleef et al., 2002; Verdurme, Gellynck & Viaene, 2003). The sector is classified as a scale-intensive sector according to Pavitt's innovation' taxonomy; it is characterized by large firms, process innovation, tacit knowledge and entry barriers to appropriate innovations. The sector has also been characterized as supplier-dominated, focusing on process technology and related equipment, turning to suppliers of equipment for imitation and technology transfer.

The food and drink industry faces a high number of regulatory constraints as regards its processing activities and the resulting processed food. Regulatory frameworks and legislation can have lasting consequences on industry's activities and perspectives, and it may be difficult to adapt this to a rapid technological change in a flexible manner (CIAA Reflection Paper, 2006). Biotechnology is one of the most promising drivers of innovation and growth in the food and drink sector. In Europe, however, uncertainty over the regulatory framework and insufficient public acceptance has driven many R&D investors away from biotech projects for agricultural applications. EU food legislation has developed considerably to respond to growing concerns regarding food safety, information and fair market conditions, resulting in increased administrative burdens and compliance costs for firms, seen as a factor that hampers innovation for the food and drink industry.

## **Chapter 3. Technological development and innovation challenges**

### ***3.1 The food chain and technology development***

European food and drink industry firms must compete in an integrated food chain that is subject to considerable change where a change in one element of the food chain affects the other elements. So, performance and trends in consumer, retail and primary

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<sup>5</sup> CIAA, 2006. "Data and Trends of the European Food and Drink Industry", p. 20.

sector challenges the food and drink industry (CIAA, 2006). Management of the food chain requires cross-disciplinary competences and represents a significant challenge for the future agro-food sector (ETP, 2005 p. 12). The exerted pressure of global challenges affects some players more than others.

**Table 1. The food chain**

Agriculture and fishing	Food and beverage manufacturing	Distribution and warehousing	Wholesale	Retailing/ Food service	Consumer
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It is important to note that the links between the agricultural sector and food and beverage manufacturing are greatly affected by the developments to the Common Agricultural Policy (CAP). Following periods of abundant supply there is no certainty that the primary sector has the ability to supply the food and drink industry with the appropriate quantities and supply (CIAA, 2006). Non-food uses, including energy, have already increased demand for EU agricultural products.

Food *retailing* to a larger degree controls and influences the food chain with its ability to influence consumers and suppliers (Lang, 2003), helped by the consolidation in the branch. The food and drink industry is exposed to pressure from the increasingly concentrated and globally active retail sector (CIAA, 2006), calling for action to find a more balanced framework for the relations between suppliers and retail. The global grocery market is now dominated by a few companies. Retailers are continuing to exert pressure on the food and drink industry in an attempt to pass price pressure on the suppliers (CIAA, 2006).

The food chain in Europe has undergone a change in control from the producer to the retailer (Van Trijp & Steenkamp, 1998). Product developers rely heavily upon retailer customers for market information and in practice, few actually draw upon other sources as suppliers, consultants, research organisations or trade journals, and consequently, retailer involvement in product development has become increasingly important for food product success (Knox et al., 2001). Since it is the manufacturer that carries the risk and not the retailer, it is of importance that the developers educate themselves as to consumer needs and the market as a mandatory part of the food development process (Stewart-Knox & Mitchell, 2003). Food manufacturers should not be afraid of creating new innovative products; the innovative challenge is to have knowledge of consumer requirements and to have the technical capability to engage in interdisciplinary product development processes.

The shift from supply-driven to demand-driven markets, with the consumers interest in quality and variety, the final criterion for a successful market introduction necessitates adopting the consumers' point of view at every stage of product development, processing and marketing (the 'fork-to-farm' perspective); consumer demands will drive the R&D and innovation needs (ETP, 2005 p. 13).

When it comes to product innovations in the sector, consumers are increasingly looking for organic, high quality, healthy and life style products, suggesting innovation challenges for the industry. In order to satisfy customers' further needs,

producers are compelled to interact with consumers to a larger degree suggesting an intensive use of communication.

Non-technological innovations related to communication, training, distributions etc., are similarly important for the sector in order to cope with prospective innovation challenges. ICT (as a generic technology) is an important part of food distribution, and is increasingly being used to improve efficiency in all steps of the production, processing and distribution of food. Further, the use of ICT and e-business will open up new channels for marketing and distribution of niche products that advances business operations and contributes to creating competitive advantages. To improve eco-efficiency in manufacturing, food safety and sustainable development are important.

Integration along the supply chain, upstream and downstream, is a trend in the industry. In order to improve internal processes and in order to interact with partners along the value chain, intensive use of ICT is needed. In the sector, ICT use needs to be further improved in order to raise efficiency at all stages in the production, processing and distribution of food. A prospective innovation challenge, especially for SMEs is to make progress in the use of communication technologies.

Transitions and changes in the different sectors of the food chain are needed if the sector is to become a sustainable European food production system. The challenge ahead is to find out what transitions are needed in what parts of the value chain in order to reach this goal.

Many firms are dependent on innovations developed in other more advanced industries: non-food innovations account for 45 to 50% of the innovation usable in this sector (Rama, 1996). It has been argued that a challenge for the food and beverage industry could be linked to the technological dependence the industry has towards the drug, chemicals and biotechnology industries owing to the new challenges posed by the 'functional foods revolution' (Wilkinson, 2002). The production of these kinds of foodstuffs includes the use of biotechnology and genetic modification, and represents the potential for disruptive technologies in the food sector. The use of these technologies has started a debate that is far from over in Europe. When it comes to genetically-modified food, a high proportion of European consumers is very suspicious, and as such is perceived as an innovation challenge for the industry.

Other sectors that have perceptible influence on the food and beverage (enabling sectors) are sectors such as electronics. The innovation challenge for small firms and low tech firms is to access new and advanced technologies leading to innovations (especially radical innovations such as functional foods and genetically modified food). In order to access new developments in R&D, new technologies are important.

R&D expenditure for advanced technology in the food and drink sector requires investment that many individual firms have difficulties in financing on their own (CIAA, 2006). In order to meet this challenge the sector must engage actively in research networks and pan-European initiatives. In order to be competitive in the long run, the food and drink industry must build networks especially with the health and

technology sector and optimise clustering in the knowledge and innovation chain (ETP 2005, p. 33).

Prospective innovation challenges in the food and drink sectors are also related to pressure from communities and governments to produce safer and more environmentally-challenging innovation efforts, both with regard to innovation processes and products.

### **3.2 Emerging technologies and sciences**

Innovation activities in the food industry are mainly demand-oriented, resulting in a high number of new or modified products which are often combined with process innovations (Menrad and Blind, 2004). This section will look into three very innovative fields in the food industry, suggesting areas developing disruptive technologies.

Genetically modified organisms (GMOs) and derived novel food products, represent new developments in the area of food production and food processing. However, an intensive public debate is proceeding globally concerning the safety of genetic engineering and derived novel foods. In the EU, there is still a pipeline of R&D activities related to agricultural and food GMOs. However, EU publication intensity in plant biotechnology grew significantly below average compared to other fields of biotechnology (Reiss and Dominguez Lacasa, 2003). According to research carried out by Lhereux et al. (2003), EU companies have dropped R&D related to GMOs in the last four years. The main obstacles perceived for GMO-related innovation activities were related to:

- the unclear legal situation in the EU
- high costs and time requirements for safety testing
- low consumer and user acceptance of GM products
- uncertain future market perspectives.

The EU regulatory framework is said to have played an important, largely negative, role for the development of GMOs in the EU the last decade, being described as slow, bureaucratic and leading to extraordinary costs (Menrad and Blind, 2004, p. 10).

Functional Food is intended to provide additional benefits to consumers by preventing nutritional-related diseases and increasing physical and mental well-being (Menrad and Blind, 2004, p. 11). The 'functional' ingredients positions Functional Food in a transitional zone between food and pharmaceuticals and, as such, to differing regulation regimes. Due to the novel character of functional food, questions arise concerning (Menrad and Blind, 2004, p. 12):

- the safety and efficacy of such products
- the required testing and monitoring methods
- their impact on consumers' nutritional behaviour
- institutional procedures and responsible authorities.

The market for Functional Food has developed faster and to larger markets in the USA compared to the EU. In the US, the market for Functional Food is estimated to 15-20 billion US\$, equal to 2% of the US food market. The EU sales amounts to a

market share of below 1% of the total EU food and drinks market. Germany, France, the United Kingdom and the Netherlands represent the most important markets for Functional Food. Future market estimations assume that the market share for Functional Food will increase considerably the coming years, with a market estimation of 3 to 5% in the next ten years. Functional Food has a growth potential, but it will be represented by a multi-niche market with a high number of limited product segments, and very few high-value product categories (Menrad and Blind, 2004, p. 13). The most important innovation drivers are:

- scientific and technical developments in nutrition-related research,
- the interest of food companies to participate in growing segments of an almost stagnant food market,
- consumers' interest in innovative products supporting their health and well-being.

Multinationals and food ingredient suppliers will have potential with regard to challenges in the R&D and marketing processes; however, SMEs will only have limited possibilities in these fields.

Organic food represents another market opportunity for food producers. The conversion to organic agriculture includes high technical, market-related and financial risks for farmers, suggesting the need for additional financial incentives – as have been implemented in the EU. There is a fast-growing demand for organic products in the USA and EU (Menrad and Blind, 2004, p. 16). The future growth of the organic market depends, among other things, on:

- clear and reliable standards for organic products must be developed with corresponding consumer information
- increasing sales in conventional supermarkets.

A survey among EU food manufacturing firms assessing the current framework in the EU and its impact on innovation activities (Menrad and Blind, 2004, p. 19), showed that the regulations relevant for the introduction of new products in the food sector have more negative and less positive impacts than for the rest of the sample.

A future innovation challenge to the agro-food industry will be to tackle the multiple new scientific approaches and technical opportunities that have an interdisciplinary character. SMEs are not well prepared for these developments. The creation and building-up of interfacing competencies as well as the establishment of new external knowledge and competence networks seems to be of strategic relevance (Menrad and Blind, 2004, p. 20).

Another innovation challenge for the food industry is that the political and regulatory framework conditions in the EU often fail to keep pace with the scientific and technical discoveries or developments on the demand side (Menrad and Blind, 2004, p. 20). The uncertainty and non-harmonised regulatory conditions impedes innovation activity and may result in loss of market opportunities.

In the interdisciplinary-oriented fields of the food industry (like Functional Food) the institutional organisation and administrative responsibilities impede innovation

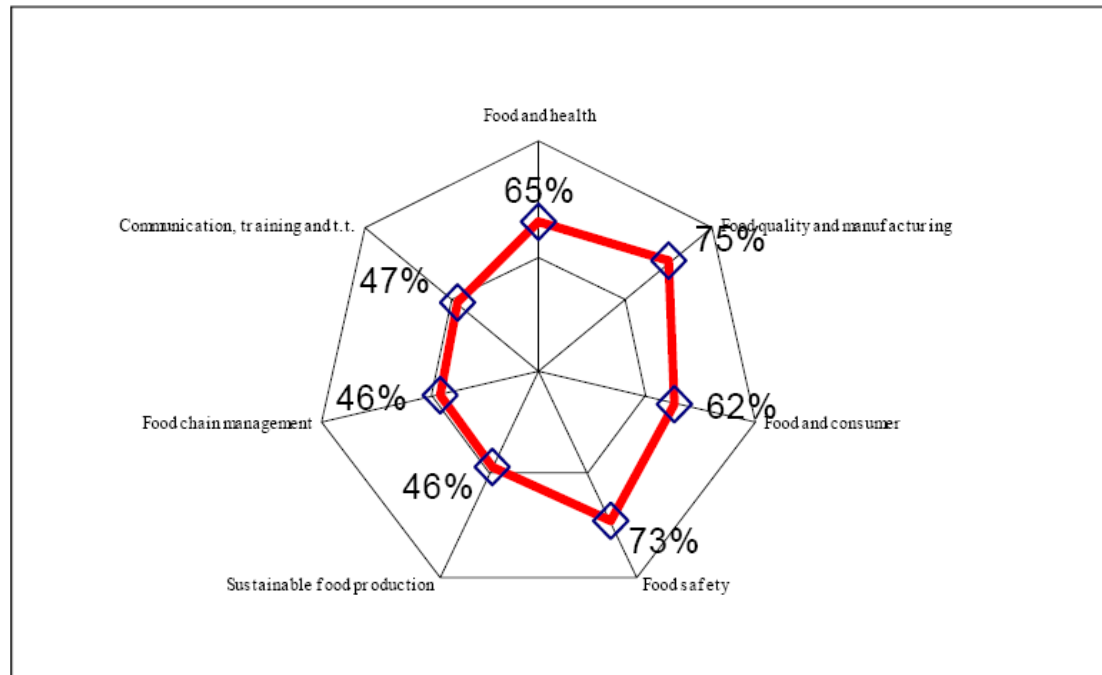
activities (represents differing authorities etc.), and as such, these scientific and technical innovations require organisational changes.

According to Menrad and Blind (2004, p. 21), the creation of interfacing competencies is one of the most relevant tasks for SMEs in order to carry out innovation in the future. The additional target for policy should be to support the *advances of the knowledge base of the food industry companies themselves* and not solely concentrate on stimulating knowledge generation with relevance *for* the food industry. Political activity should be targeted more strongly on the diffusion of new scientific approaches and technologies in the food industry than exclusively on the support of knowledge generation (op. cit.)

### **3.3 Pillars of the European Technology Platform 'Food for life'**

In order to map the scientific areas where companies would like to concentrate their strategic vision for the sector as a whole, the Vision Paper (2006) has carried out a survey of companies to see what priorities they have between seven different scientific pillars of the European Technology Platform 'Food for life'. The results showed that issues about 'quality and manufacturing', 'food safety' and 'food and the consumer' are seen by far as the most important in terms of a strategic vision of the sector. These priorities suggest the potential innovation challenges related to technological competition, both the kinds of technology needed and where such technological competition will happen. The priorities also express the importance of the vital relationships towards the consumer and of the credibility of the sector. The preference 'food and the consumer' may express the importance of consumer science to the decisions of companies.

**Figure 2. Pillars of the ETP – Food for life.**



Source: Vision paper, 2006 p. 24.

Food safety is a priority issue for government, industry academia, and the consumer. Most of the novel processing technologies promise safer food without sacrificing naturalness and nutritional benefits. In this respect, proper validation of a range of alternate and novel technologies are needed (ETP, 2005, p. 25). The micro-ecology of food itself is a rapidly developing field which makes great use of modern technologies to describe the complex interactions occurring in food. Process innovations are only one element in guaranteeing safe food; the total value chain of food processing must be taken into account. Sustainable food production also puts pressure on technological development in order to make novel processing technologies that are more environmentally friendly than current alternatives.

The food chain is complex and ‘key’ drivers for the effective management of the food value chain are dependent on generic and applied information and communication technologies in order to develop and exploit food chains and networks. Important research topics for the future will consequently be in the fields of:

- 1) Technical science (i.e. early implementation of new generation of information- and communication technologies),
- 2) Business administration (i.e. business organisation, quality-, risk- and innovation management),
- 3) Institutional and industrial economics,
- 4) Industrial engineering and production management, and
- 5) Social science (i.e. Social aspects of trans-national networking activity).

The agro-food industry recognises its role in the prevention of life-style related diseases (obesity, coronary and heart diseases and type 2 diabetes). However, this is a new and comprehensive area which requires a new and innovative concept as well as

substantial and targeted R&D investments (European Technology Platform (EPT), 2005 p. 8). The prospective innovation challenge for the sector is that there are no effective drivers for large R&D investments in the industry since the sector comprises mostly SMEs that do not invest heavily in R&D and that large companies tend to focus innovation efforts on marketing. According to the EPT for food (2005), national governments and the EU have contributed further to a fragmentation by not supporting breakthrough science because their focus has centred on the 'safety of food' aspect.

In order to respond to an increasing demand for healthy eating, considerable resources will need to be invested. A challenge in this respect is also related to the price sensitivity of food items; restricting what the agro-food industry actually can deliver (ETP, 2005 p. 11), new products must fit the needs, lifestyles and incomes of consumers.

Cross-sectoral innovative efforts are important in order to generate a competitive agro-food industry. A key innovation challenge is to create and support constellations of industries that, together with the agro-food industry, could innovate more effectively and utilise knowledge that could be applied in the food sector (such as the manufacturing sector, pharmacy, health insurance sector etc. (ETP, 2005 p. 9)). A challenge in the sector is to improve innovative processes; blending of technology could be a strategy in this sector. A prospective challenge is then to identify these technology areas in order to assure industrially relevant research projects.

Although the quality of Europe's basic science is comparable to that of the USA and Japan, Europe falls behind in its ability to translate results into innovative breakthroughs.

## **Chapter 4. Demand side and market issues**

### **4.1 Market trends**

The future market of the agro-food industry will be influenced by what, when, where and with whom we consume, and how we prepare our food (European Technology Platform, 2005 p. 6).

The EU-25 is the world's largest exporter of foodstuffs (share of global export 20%) and the number two importer. One important challenge to this is that R&D intensity remains lower in the EU than in the other economies, accounting for 0.24% of food and drink industry output.<sup>6</sup>

According to the Innovation watch/SYSTEMATIC scoping paper for Food (Oleaga et al., 2006), other food production markets face considerable expansion, particularly in Latin America and Asia. The trade balance with these countries has worsened

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<sup>6</sup> CIAA, 2006. "Data and trends of the European Food and Drink Industry", p. 18.

significantly, resulting in a decline (-3.8%) in EU exports for the first time in a decade. The United States is by far the number one customer for EU food and beverages products, accounting for more than one fifth of total EU exports, followed by Brazil, Switzerland and Russia. In order to ensure market access to third countries by preventing or eliminating trade barriers, along with tariff liberalization efforts, DG Enterprise makes use of the following instruments:

- Regulatory convergence with trade partners and the promotion of international harmonization efforts (e.g. Codex Alimentarius Standards, HACCP principles): this will help reduce the cost of complying with third country regulations.
- The Agreements on Sanitary and Phytosanitary Measures (SPS) and on Technical Barriers to Trade (TBT) of the World Trade Organisation: these instruments are being managed and developed as far as possible to eliminate existing barriers and to prevent the emergence of new trade barriers.

In 2005, trade with the Commonwealth of Independent states (CIS) grew rapidly, and other major regions such as the Mediterranean countries and the Andean Group registered the highest growth rates for imports in 2005. Imports from most of the emerging countries have increased over the last 5 years. The ASEAN countries had an impressive growth rate between 2000 and 2005 of 66%. Exports to China increased by 24% in 2005. The emerging countries are undergoing considerable expansion, especially Latin America and Asia, where the Brazilian and Chinese food production recorded double-digit growth rates (16% and 22% respectively) from 2001 to 2004.

Four sectors stand out in terms of trade with non-EU countries; beverages, dairy, meat processing industries, and various food products. Meat, dairy and starch products recorded a weak performance with regards to exports. However, within these categories, value-added products such as cheese or processed pork meat continue to record significant sales to non-EU markets.

Imports also registered a steep rise in 2006 as import rates of most of the EU key partners doubled compared to those reached in 2005.

In 2005, households spent on average 12.4% of their expenditure on food and non-alcoholic beverages, having declined during the last 10 years declined by 2 percentage points.

## ***4.2 The Food and drink industry and the consumer***

A decline in consumer spending on food has led to sharper competition in the food processing and retail sector and a strong pressure towards offering more diversified arrays of products, suggesting innovation potentials. However, to respond to consumer demands is seen as an innovation challenge in the sector. The rapidly changing preferences of consumers (the desire for healthy and safe food together with classic motivations like pleasure, culture, basic nutrition and 'tradition') favour an alert, flexible and competitive food industry (Vision Paper, 2006). Consumer demands have

many facets and are complex to relate to. Important factors that influence consumer's demands are:

- 1) Demographic and socioeconomic changes (fewer children, having children late etc.),
- 2) Busier lifestyles,
- 3) Health, nutrition and safety,
- 4) Environmental and ethical concerns (ethnic foods),
- 5) Food values, cultures and eating habits.

The consumer demands regarding quality, health, safety and diversity gives a market place that represents a great and constant innovation challenge to the EU agro-food industry that today is represented by cultural diversity, regional specialisation and long standing tradition.

A major prospective innovation challenge for the food and drink industry is to get consumer-oriented and consumer-targeted food innovation, through establishing a critical mass of resources and linking with other platforms and disciplines (ETP, 2006 p. 17). How is the industry to provide the consumer with the type of food that the consumers like at the right time and in the right place at the right cost? That is a major innovation challenge for the industry over the next one to two decades. New technologies can make an important contribution here, such as innovative processes, value-added products, new marketing concepts, novel ways of selling products and novel ways for the production and supply chain to co-operate (ETP, 2005 p. 22).

Within the EU, the number of people aged over 80 years is estimated to increase by over 30% over the next 50 years. This suggests that the food and drink industry must produce innovative foods, high in nutrition and that will improve the quality of life and add years to life.

Other important target groups that need to be understood with regard to food choice and dietary habits in order to make the European food and drink industry more competitive are children, ethnic groups and disadvantaged consumers. A prospective innovation challenge for the food and drink industry is to get consumer perceptions, attitudes, preferences and behaviour towards new technologies, specific product methods and dietary regimes incorporated in food innovation (ETP, 2005 p. 24). The challenge will be to find appropriate and improved methodologies to do this.

### **4.3 Other factors affecting the market**

Other challenges regarding market and competition concern liberalisation of agricultural trade. This has led to more volatile raw material process and food firms looking for more international providers. In the negotiations with WTO, it was agreed in 2004 to abolish all forms of agricultural export subsidies and to substantially reduce trade-disordering domestic support in agriculture.

Other challenges are related to the pressure on producers as a result of ongoing restructuring in retailing (especially in the supermarket segment). The challenge is

related to non-competitiveness and if such restructuring hinders the pursuit of objectives regarding diet and health.

Mega brands (products available throughout Europe) are controlled by larger players such as multinationals in order to achieve dominant positions and better exploit the EU market. This, together with an increased segmentation of markets with new regional and global producers, is seen as a challenge for the industry.

## **Chapter 5. Skills and human capital**

The food, beverages and tobacco sector presents unusual characteristics concerning employment as there is a higher presence of women and the large proportion of part-time work. Food and drink companies employ fewer workers with higher education compared to other industries. The industry has difficulties in hiring qualified employees, and 30% of companies experienced difficulties filling vacancies in their R&D departments (CIAA, 2006). The share of food and drink industries that use training is also considerably lower than in other manufacturing industries.

The Food, Drink and Tobacco sector share of employees with higher education is far from the manufacturing average. In order to improve knowledge in the food industry, training and education of personnel is important as transfer of knowledge is not only realised in development of products and processes. By exploiting educational programmes that introduce students and food production personnel to the most recent developments and techniques, the gap between research and its application can be narrowed (ETP 2005, p. 31).

Non-innovating SMEs are differentiated from innovators on the basis of the skills of the workforce (Avermaete et al., 2004 p. 481); innovative firms have a higher number and a higher proportion of qualified technical staff. Similarly, the managerial and professional staffs were positively related to innovation. Further, investment in know-how, measured through training expenditures and marketing costs, was positively and significantly related to innovativeness.

The current innovation policies are still largely inadequate to give a decisive spin to innovation in the industry (Vision paper, 2006 p. 33). A better toolbox is needed in order to get interest from the industry. The preferred methods are related to potentially 'quick wins' and 'immediately implementable actions' i.e. those products of a continuous and incremental attention to innovation.

## **Chapter 6. Summary of innovation policy challenges as seen by experts**

Included in the interviews carried out in Workpackage 3, was a question to the expert what they perceived as the main innovation policy challenges today. This section presents national policy experts' assessment of innovation policy challenges. The issues reflect different national perspectives and concerns. In the table below we have listed the different issues according to main themes.

National policy experts' assessment of innovation policy challenges in the Food and drink sector:

<i>General issues</i>
<ul style="list-style-type: none"> <li>• Raise awareness of innovation and introduce it in policy-planning</li> <li>• Make investments in R&amp;D a priority for the sector to respond to the challenges of food quality and safety as well as healthy food</li> <li>• Improving food safety</li> <li>• Lead the sustainable development of a competitive, consumer focused agri-food sector and to contribute to a vibrant rural economy and society. Safe food and higher quality food</li> <li>• Exploit the concept of agro-tourism to promote local production in the tourism sector and the put in place a clear policy for agro-tourism</li> </ul>
<i>Technology</i>
<ul style="list-style-type: none"> <li>• A major challenge for the small enterprises involved in the processing and packaging of food includes the adoption of the HACCP - Hazard Analysis and Critical Control Point</li> <li>• Set up support research programmes with higher added values such as functional food</li> <li>• Encourage innovation/basic innovation approaches in small agro-food industry e.g. in specialized packaging</li> <li>• R&amp;D on traceability methods and better control of the product</li> </ul>
<i>Skills and collaboration</i>
<ul style="list-style-type: none"> <li>• Engage in human resource development in the sector, in particular low-tech SMEs</li> <li>• Promote partnerships and joint ventures</li> <li>• Facilitate the diffusion of knowledge and innovation</li> <li>• Promote technology transfer</li> <li>• Tightening industry–university relations</li> </ul>
<i>Suppliers, demand and market issues</i>
<ul style="list-style-type: none"> <li>• Develop a more extrovert culture that will support the creation of new markets abroad</li> <li>• Differentiate the products with the development of innovative activities for the satisfaction of the increased consumers ` demands</li> <li>• Many firms are basically local market oriented, and are not able to reach larger scales and profitability because of limited internal markets</li> <li>• Promote local brands into international markets</li> </ul>

## Chapter 7. Summary of prospective innovation challenges

**Prospective innovation challenges related to the structural features of the sector:**

- The sector has a relatively large share of SMEs and the prospective innovation challenge for these firms would be to relate to all the different challenges found in the different parts of the value chain, from the availability of raw material, how to relate to increased regulation, continually demanding customers questioning food

safety, health effects, sustainable production etc., all factors putting pressure on existing innovation activity in SMEs, their existing knowledge base and their ability to engage in own knowledge generating processes or link up with other firms or institutions for these matters.

- A prospective innovation challenge is to redirect more SMEs towards a business model centred on the value of technical change and the search for and research in new products.
- A prospective innovation challenge is the improvement of the in-house capabilities of the workforce of SMEs in order for firms to take greater part in knowledge generating processes and to take advantage of knowledge diffusion and technology transfer from other firms or sectors.
- A prospective innovation challenge for policy makers is to properly address the fragmentation of innovation challenges as can be seen among the sector's SMEs with regard to all the sub-branches and countries they represent.

### **Technology – generic and disruptive**

- Prospective innovation challenges for the food industry are related to the conservatism of the consumers and regulatory frameworks, hampering the introduction of more radical innovation (i.e. types of functional food, genetically modified food and the general introduction of biotechnology).
- A prospective innovation challenge is to supply the sector with the appropriate quantities and supply of agricultural products from the EU.
- A prospective innovation challenge is how food and drink manufacturers cope with the increased pressure from retailers that exert price pressure on the industry. Who is to take the price pressure and what types of innovation measures are needed in order to cope with them?
- A prospective innovation challenge for the industry is how to cope with the need of cross-disciplinary competences in order to manage the food chain.
- A prospective innovation challenge for the industry is related to the ability to educate themselves as to consumer needs and of having the technical capability to engage in interdisciplinary product development processes, suggesting also an intensive use of communication (ICT solutions).
- A prospective innovation challenge for the sector is to properly access networks especially with the health and technology sector in order to optimise clustering in the knowledge and innovation chain.
- A prospective innovation challenge with regard to new opportunities with relation to GMO, Functional Food and organic food are the existing regulatory framework and that it does not keep pace with the scientific and technical discoveries/developments on the demand side.
- In order to address the three most important scientific pillars of the European Technology platform (quality and manufacturing', 'food safety' and 'food and the consumer'), the potential innovation challenge for the food industry is to map the kinds of technologies needed and where such technological competition or innovations will occur.
- A prospective innovation challenge is to develop generic and applied information and communication technologies in order to develop and exploit food chains and networks: (1) Technical science (i.e. early implementation of new generation of information- and communication technologies); 2) Business administration (i.e.

business organisation, quality-, risk- and innovation management); 3) Institutional and industrial economics; 4) Industrial engineering and production management; and 5) Social science (i.e. social aspects of trans-national networking activity).

- The prospective innovation challenge for the sector is that there are no effective drivers for large R&D investments in the industry since the sector comprises mostly SMEs that do not invest heavily in R&D, and that large companies tend to focus innovation efforts on marketing.
- A future challenge is the creation and building-up of interfacing competencies as well as the establishment of new external knowledge and competence networks.
- A prospective innovation challenge is to create and support constellations of industries that together with the industry could innovate more effectively and which utilise knowledge that could be applied in the food sector. The challenge is then to identify these technology areas in order to assure industrially relevant research projects.

### **Demand side/market issues**

- A prospective innovation challenge for a sector that is represented by cultural diversity, regional specialisation and long standing tradition is how to provide the consumer with the type of food that the consumers like (perceptions, attitudes, preferences and behaviour towards new technologies, specific product methods and dietary regimes incorporated in food innovation) at the right time and in the right place at the right cost.
- New market possibilities are especially linked to GMOs, Functional Food and organic products, however posing several types of challenges for the industry in order to realise its potential.

### **Skills and human capital**

- A prospective innovation challenge for the food industry is that companies employ fewer workers with higher education as compared to other industries.
- A prospective innovation challenge related to the current innovation policies is to get a better toolbox in order to address the skills needs of the industry and to get interest from the industry towards existing policy initiatives.

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