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Production-Consumption Models and Knowledge Dynamics in the Food and Drinks Sector

1. Introduction

Until the 1970s the development of the economic and social systems through which food and drinks were grown, processed, marketed and sold was an uncontested productivist modernisation project based on growing mass markets for standardised products. Neo-Marxist researchers already in the 1970s presented a criticism of capitalist 'food commodity systems' and 'agro-industrial complexes' using analytical concepts in line with the 'agrarian questions' problematic of classical Marxism (Watts & Goodman 1997). However, since the beginning of the 1990s the prevailing industrial agro-food model has been subject for a much broader criticism and public debate. Food related issues like obesity, health, life-style related deceases, food safety, environment protection, animal welfare, effects of gene modified organisms on nature and humans, decline of rural economies, protection of regional culinary traditions, global imbalances in food supplies, principles of international trade policies, are all subjects for intensive political and ethical debates.

Furthermore, also in economical business terms the dominating industrial food model recently is challenged by the emergence and growth of a variety of new food markets, supplied by new types of businesses models and networks, emphasising other definitions of quality than price, efficiency and standardisation. Despite their limited economic weight these new food markets and business models represent important directions for the future development of the food and drink (F&D) sector.

Two emerging business models seem to be relevant alongside the mainstream, industrial food model: the 'alternative' and the 'functional' food models. 'Alternative' food covers different products with rather fuzzy, symbol-laden qualities such as organic, local, speciality, high-quality, slow, and fair trade food. Alternative food producers emphasise the abandonment or at least a reduced use of production inputs stemming from the industrial model of farming and food processing and generally rely on traditional, often artisanal technologies. Functional food represents almost the opposite science-driven strategy of taking advantage of new biotechnologies and other advanced technologies in designing and producing food and drinks products with specific health, diet and nutritional benefits for consumers. Hence, the knowledge bases and knowledge dynamics of 'industrial', 'alternative' and 'functional' food networks seem to have significant differences.

The chapter is organizes as follows. Section 2 describes the overall structures and change processes in the sector. Section 3 presents a theoretical framework for studying the emerging new food production-consumption models, depicts the main features of the three different food models, and outlines the typical innovation efforts and responses within the models. Section 4 looks at the specific knowledge categories and dynamics in the different models. A short conclusion is provided in section 5.

2. Overall structure and trends of the sector

2.1 Structural characteristics of the F&D sector

The F&D sector is here defined as the food and drinks manufacturing industries at 2-digit level of the NACE-Rev. 1, i.e. DA15. Sometimes also a broader term, the 'agro-food sector/industry' is used, including the whole food supply chain from agricultural and fishery activities to distribution and retailing.

The F&D sector is the largest manufacturing sector in EU. In 2005 it accounted for 14% of total turn-over, 12% of total value-added, and 13% of total employment in manufacturing (CIAA 2006). The activity of the F&D sector is less cyclical and more stable than manufacturing in general, due to the relatively static demands for food products. In general, however, employment in the industry is declining in Europe due to increased competition from low-income countries, technological development and restructuring initiatives of companies.

Four manufacturing industries dominate the sector: meat products accounts for 20%, dairy products for 16%, beverages for 15%, and 'various food products' including bakery, chocolate and confectionary products, pasta, and baby food for 26% of total turnover (CIAA 2006). The industry of 'various food products' has experienced the highest growth rates during the last 15 years (CIAA 2004). In terms of export figures, the beverages industry -including wine production- is the most important, in 2003 accounting for 31% of all EU food and drink exports (CIAA 2004).

The sector encompasses a diverse range of companies from multinationals such as Nestlé (the largest in Europe) with around 250.000 employees and a variety of product lines and production units, to micro family businesses employing only the owner and maybe a few family members and manufacturing only one product category. According to CIAA (2006), 99% of total 282.600 companies in Europe were SMEs with less than 250 employed and accounting for 61% of total 3.8 million employees and 48% of total 836 billion € turnover in the industry.

The sector is more labour-intensive than manufacturing as a whole. However, the labour productivity varies widely by country and the disparity has increased further with the accession of new Member States. Labour productivity also varies highly by size of companies - the largest companies have the highest productivity.

Despite the ongoing processes of globalisation of food supply chains by which supplies of raw materials, ingredients, and processed products increasingly are transported and distributed over long distances, the F&D sector still has a highly dispersed localisation pattern in which rural areas plays an important role. Moreover, in at least 10 EU countries the sector is ranked as the number one manufacturing sector in terms of turnover (CIAA 2006) and thus plays a significant role in maintaining industrial activities throughout Europe.

2.2. Trends and drivers of change

The main drivers of change in the sector are:

- New consumer demands
- Supply chains restructuring
- Technological development
- New regulation and policies

2.2.1. New consumer demands

Consumption of food and drinks is a central element of the cultures and everyday life of people all over the world. Eating and drinking plays a decisive role in the basic social and cultural rituals, traditions and communicational patterns within families, ethnic, territorial and religious communities and other social groups. Markets of food and drinks products are

strongly interconnected with specific needs and occasions of customers' everyday and festive life. Despite a relatively big persistency to change of such consumption patterns and food cultures, overall growth in incomes and trends in societies, cultures and life-styles are changing the demands of food and drinks. In the following a number of consumer trends affecting food markets are briefly described.

Demographic changes
The European population is expected to decrease from 455.2 million in 2005 to 431.2 million in 2050, while the share that is aged over 60 years will increase (EMCC, 2006). This limits the potentials for growth but also increases the demands for products designed to match special nutritional needs for elder people.

New lifestyles and family patterns
The development towards longer working hours, more leisure activities, and more families with two working parents has increased the demands for semi-prepared, convenience food mainly in the form of fresh or frozen products rather than traditional dehydrated and canned food products (EMCC, 2006). Also eating out (food services and catering) is a fast growing market. In 2000, half of the amount spent on food in USA was spent on eating away from home while the share in most European countries was less than a third but growing (Millstone & Lang, 2004).

Food safety
Boosted by e.g. the BSE crisis 1996, the foot and mouth disease 2001, and the avian flu in Europe 2006, consumers have become very aware of safety of food. For example, a 70% drop in poultry consumption was seen in Italy after the avian flu in 2006.[1] Other more local safety problems are contaminated food bacteria such as salmonella, campylobacter, and E. coli. The sector experiences severe mistrust from consumers that expect industry and governments to come up with solutions.

Healthy living
Consumers are increasingly concerned about problems related to obesity, nutrition, food related diseases, and the effects on human health of gene modified organisms (GMOs). Such concerns have increased the demands for, for instance, organic food (KPMG, 2000). Despite increased awareness of obesity and health, European consumers (compared to American) are still sceptical regarding GMOs and use of biotechnology in farming and food processing (Keynote, 2004). Also regarding health issues, consumers expect industry to come up with solutions.

Sustainability
Consumers are increasingly aware of not only qualities of the food products as such but also of issues related to the production processes and globalisation of supply chains such as environmental impact of production and distribution, degradation of local food cultures, animal welfare, safety, fair trade, and working conditions.

Growth in niche markets
Food markets are increasingly segmented and specialised in the direction of, for instance, ethnic food, organic food, vegetarian food, and local food, and this specialisation trend gives opportunities also for small food producers.

2.2.2 Supply chain restructuring

The food supply chain consists basically of four links: 1. producers (farmers, fishermen, and other suppliers), 2. processors (manufacturing industries), 3. retailers, and 4. consumers. The relationships between these four links and the dynamics and power structures that rule the

[1] Confederazione Italiana Agricoltori at http://www.meatprocess.com/news/ng.asp?id=65866.

actions of actors, are under fundamental change these years (Hornibrook & Fearne 2005). According to Folkerts & Koehorst (1998), the food supply chain is reversed from a production-driven (product push) chain with little coordination and loose relationships between the individual links towards a market-driven (demand pull) chain with strong upstream, vertical coordination mechanisms between the individual links.

One of the main factors, driving this chain reversal and shifting the power balance from food processors to retailers, is the ongoing concentration in the retail link through which a relatively small number of supermarkets chains have gained an immense importance in distribution and sale, and thus in the food supply chain as a whole. In 2002, supermarkets held the dominating position in sales of food with 62% of total sale in USA and 56% in Western Europe (Regmi & Gehlhar, 2005), and in most countries such sales figures are to a large extent results of only a handful of huge retail companies. According to Millstone & Lang 2003, estimations from UK tell that half the food consumed by 57 million mouths is purchased in just 1.000 stores.

The central role of supermarkets for sale of food gives them negotiating power to influence suppliers' prices and in general to define the standards for product qualities, safety and traceability, environmental impact, terms of delivery, etc. The Electronic Point of Sale barcode scanning system allows supermarkets to minimise their stocks and to order from suppliers only as is required and calculated on the basis of actual sales figures. Thereby supermarkets exert an enormous power over the food supply chain that has changed from an economic system of 'selling what is produced' to one of 'producing what is sold'.

2.2.3 Technological development

Automation of plants/processes and new technologies are paving way for more efficient forms of production and development of new products. Mergers and acquisitions in the sector lead to increased investments in ICT tools to coordinate uniform data exchange across multiple production sites.

Key new technologies in the sector are:

- Biotechnology
- New ICT tools for information sharing
- E-business solutions
- Radio frequency identification
- Robotics and sensor technologies
- Nanotechnology

Such technological development impacts on the workforce demands. The overall decrease in employment will continue in coming years, however, some jobs shift into services like customer services and logistics. There is increasing demand for more skilled types of labour including specialists in legislation, engineering, microbiology, people with broader competences in reporting, communication, marketing etc. In the lower end of the workforce there is need for qualifications relevant to quality control and food safety.

2.2.4 New regulation and policies

The sector has historically been heavily embedded in national and regional agro-food policy and institutional frameworks regulating the agricultural production, R&D and innovation activities, education and training systems, working conditions, food safety control etc. More recently, the international level of regulation has become highly important, reflecting the increasingly global character of the agro-food economic system as well as of the publicly debated problems and challenges. Relevant international regulation initiatives include:

- International trade liberalisation: facilitating market access, reducing export subsidies, import barriers, and domestic subsidies.
- EU enlargement: for old EU states EU enlargement means increased competition but also new markets.
- The 2004 reform of the EU Common Agricultural Policy (CAP): Policy instruments are moved from price and production subsidies to more comprehensive farmer income support linked to performance with respects to environmental standards, food safety, animal welfare standards, land use standards, etc. In combination with globalisation, i.e. elimination of external trade barriers, this means increased competition and lower sales prices for food industry in particular for segments closest to agriculture such as sugar processing and dairies.
- EU and national legislations on food safety and hygiene standards are among top issues of political agenda, boosted by e.g. BSE crisis 1996, foot and mouth disease 2001, avian flu in Europe 2006. National and EU initiatives are launched to increase consumer confidence. They affect all links in the food supply chain by requiring procedures to ensure that illnesses are not transmitted, food products traceable and procedures documented.
- EU environmental regulation regarding pollution, emission and disposal of waste, animal bi-products, energy and resource savings etc.
- EU animal welfare regulation sets requirements and standards for breeding and transportation of living animals.
- EU certification and labelling schemes for protection of food and drinks with a recognisable geographic origin, i.e. the Protected Designation of Origin (PDO) and the Protected Geographical Indication (PGI).
- The EU LEADER programme for development and economic diversification in rural areas embodies the 'New rural policy paradigm' that often is emphasised as an important political framework supporting the emergence of 'alternative food networks' (Marsden 1998; Marsden et al 2000; van der Ploeg 2000; Renting et al 2003).

Implementation of the multifaceted range of new regulation demands in the food sector adds to costs in relation to administration and documentation as well as to investment in new equipment, adaptation of existing facilities to comply with requirements to hygiene standards, emission controls etc. In general, large companies with administrative, technical and financial resources are better equipped than SMEs to implement the legislative requirements, while micro firms are often exempted from regulations. Many food firms in the new EU member countries struggle to survive due to EU requirements and are subjects for acquisition by western firms. For example, according to EMCC (2006), only 127 of 1513 meat processors in Poland in 2004 were licensed to export to EU and no more than 1000 were expected ending up complying with EU safety regulations.

3. Business responses to drivers of change

3.1. Emergence of new food production-consumption models

In many respects, including applied knowledge and technologies, the food sector is too diversified to describe and categorise as one homogenous type of economic activity with only one way of responding to changes in market conditions. Indeed, in terms of economically important indicators like production outputs, turnover and employment a paramount part of the food sector belongs to what is often analysed under the designation of the 'conventional' food industry (Sonnino & Marsden 2006; Morgan & Murdoch 2000; Green & Foster 2005). However, one crucial driver of contemporary change in food markets is the so-called 'quality turn' of consumers in western countries (Goodman 2002; Goodman 2004; Ilbery & Kneafsey 2000; Hindrichs 2000; Harvey et. al 2004), that has given rise to the emergence and growth of a variety of new food markets based on differentiation of the products from mainstream, industrial 'cousins'.

In turn, this development has provoked a discussion in academic literature about the question of a possible paradigm shift in agro-food systems, mainly with a point of departure in the proclamation of the rise of an 'alternative' food production-consumption model and mainly stemming from rural sociology and economic and cultural geography (see for instance Marsden 1997; Marsden 1998; Murdoch et al. 2000; Watts & Goodman 1997; Watts et al. 2005; Renting et al. 2003; Ilbery & Kneafsey 2000; Ilbery et al. 2005; Hein et al. 2006; Hinrichs 2000; Winter 2003; Sonnino & Marsden 2006)
In order to understand and describe contemporary changes in agro-food economic systems such as the 'turn to quality' among consumers and food businesses, a growing number of agro-food scholars apply *convention theory* (Murdoch & Miele 1999; Murdoch & Miele 2004; Renting et al. 2000; Murdoch et al. 2000; Ilbery & Kneafsey 2000; Lindkvist & Sánchez 2008). According to convention theory, related to actor-network theory, supply chains of farmers, processors, retailers, consumers, public authorities, R&D organisations, etc. are considered as "network configurations, formed through processes of negotiation between differing entities and discursive formations" on the basis of differing "repertoires of justification" (Murdoch & Miele 2004). Hence, convention theory emphasises that development, production, marketing and consumption of food is part of social and cultural discourses and interactive practices through which conventions regarding quality are constructed and justified. This, for example, could be the specific criteria for labelling products as 'organic' or 'local'. By looking at the conventions of quality that define food production and consumption systems, we are able to identify important keywords useful for specifying the categories of knowledge, technologies and learning processes prevailing in such systems.

Most scholars studying contemporary food networks seem to agree on the significance on the following quality conventions, originally suggested by Thevenot et al (2000):

- 'Market worth', which evaluates worth based on the price, profitability, or commercial value of products in a competitive market;
- 'Industrial worth', which evaluate goods according to standards of technical efficiency and reliability;
- 'Civic worth', which refer to the worth of goods in terms of their general societal benefits;
- 'Domestic worth', which are largely based on trust and involve goods which can draw upon attachments to place and traditional modes of production;
- 'Inspiration worth', which refers to evaluations based on passion, emotion or creativity;
- 'Public opinion worth', which refers to the recognition and opinion that customers give to trademarks, brands, and packaging; and
- 'Green' or 'environmental worth', which considers the general good of the collective to be dependent upon the general good of the environment.

Due to clearly identifiable differences in knowledge dynamics we will here look at three competing food production-consumption models, emphasising different combinations of the above listed quality conventions and with differing – though definitely not separate and contrary - knowledge and technology bases:

- *'Industrial food'* in which the distinctive conventions of quality and competitive factors are price and efficiency and in which synthetic knowledge is decisive.
- *'Alternative food'* in which domestic, green and inspiration qualities are crucial and in which symbolic knowledge plays a crucial role.
- *'Functional food'* emphasising health and nutritional effects and in which the core knowledge base is analytical.

These food models do not define non-overlapping segments of businesses and may not be useful in categorising individual firms in all their activities and product lines. For instance, companies like Nestlé, Unilever and Kraft rely on brands of industrial commodity products but increasingly also engage in organic ('alternative') as well as functional food markets.

Rather the suggested models represent ideal types of food production and comsumption. The crucial factor lying behind the categorisation is not necessarily connected with physical and tangible differences in products and productions as such but rather with the somewhat fuzzy and socially constructed conventions of quality that is targeted in the development, production, marketing and consumption of 'industrial', 'alternative' and 'functional' food products.

The very emergence of alternative and functional food can be considered a business response to the changing production and market conditions in the sector outlined above. Alternative and functional food networks are two emerging production and business models that presently play rather insignificant roles in the total agro-food economy but nonetheless represent important directions for the future development of the food sector and already today heavily influence innovation efforts of mainstream, industrial producers in 'greener', 'healthier' and other directions.

In the following the three food models are described in more details. A particular focus is on those types of innovation efforts and responses to the drivers of change, outlined above, that characterise the models.

3.2. The Industrial food model – characteristics and responses to change

Green & Foster 2005 highlight the following characteristics of the industrial food model that well describe the close relations between the production and consumption dimensions emphasised by convention theory: Industrial food is based on raw materials produced by use of industrial agricultural practices exploiting advanced breeding techniques and major inputs of chemical fertilisers and pesticides, is transport-intensive, requires high-energy processing based on Fordist production technologies and organisational principles, relies on modern retailing systems and demands high-tech kitchens at the end of consumers.

Among the different qualities that are embedded in products, price is the main distinctive quality on the basis of which industrial food products are produced, marketed, and purchased.[2] Other qualities related to market performance and industrial efficiency such as products' durability, safety and hygiene standard, seasonal uniformity and geographical accessibility, however, are important too.

A number of factors such as increased liberalisation of trade policies (not least relevant for firms closest to agriculture like sugar producers, dairies, and meat producers), increased competition from low-income countries, the growing power of supermarkets, and technological developments, all together intensifies the competition among industrial producers on price factors. This in turn enhances their focus on economics of scale and increases the advantages of large-scale technologies and distribution systems.
This, in turn leads to accelerated restructuring in form of:

- Internal rationalisation and productivity raising initiatives (automation of production, optimisation of logistical infrastructure, energy savings etc.)
- Acquisitions and mergers to gain economics of scale and expand markets.
- Horizontal partnerships between food processing firms for delivery of supplies to retailers.
- Outsourcing and re-localisation to low-income countries to focus on core competences and cut costs.

However, industrial food is not solely produced and consumed on the basis of efficiency and price factors. According to CIAA 2006, the targets for product innovation widely recognised

[2] As pointed out by DEFRA (2006), from the point of view of consumers' purchasing it is maybe more correct to say value-for-money instead of price.

as central by the F&D industry (CIAA, 2006) are qualities like 'pleasure', 'taste', 'sophistication', 'exotism', 'fun' and 'convenience', i.e. sensory and/or social attraction factors.[3] And in terms of *product innovation*, developing attraction factors such as taste, flavour, convenience and aesthetic aspects of the packaging, is the main response of industrial food producers to survive in their markets.

Having said this, it must be emphasised that industrial food producers have to balance attraction factors with price and efficiency factors when deciding whether or not to introduce a new product or technology. Firms with specialised products are not in the same degree dependent on price factors and can, in the extreme case, focus one-sidedly on attraction factors.

Due to new regulative requirements and growing consumer awareness of environmental aspects of food production, *green* conventions of quality also are increasingly important concerns for industrial food producers. These concerns are reflected in adaptation and development of less polluting and resource-demanding processing technologies, for instance through use of new types of ingredients and additives as well as IT and sensor systems for controlling of processing. Awareness of green quality conventions are also reflected in firms' communication, PR and marketing strategies, that increasingly put priorities in specifying the raw materials and technologies used, the efforts of reducing the environment impact, the environment-friendly principles and values of the business, etc.

A similar background in the need of responses to new regulation and market demands is seen in relation to safety and hygiene issues, which can be classified as a quality convention linked to industrial efficiency and technical reliability of products. As in firms' responses to green demands from regulation and consumers, the focus of responses to safety issues is not only isolated working tasks and processes in the individual firm but the whole supply chain in which it takes part. Information systems for documentation of fulfilment of quality standards in production, storage and distribution and demand for traceability of foodstuff along the whole supply chain is of central importance for EU and national safety legislation as well as for the so-called Hazard Analysis And Critical Control Point (HACCP) certification that international supermarket chains have introduced and increasingly force their suppliers to comply with (Flynn et al 2003).

Finally, the quality convention of 'public opinion' also has increasing importance. The segmentation of markets and consumers' general mistrust in the sector due to a number of recent food scandals as well as their growing concerns for the environment and healthy living challenge manufacturers to adjust and dedicate their products to diverse customer groups as well as to more strategic, interactive forms of communication and PR. For this they need to develop closer contact with customers to get information on market developments and spotting trends. Among the more innovative methods of building stronger and more trust based relations to consumers is through electronic web-dialogue, e-logistic distribution systems, and, maybe more relevant for small firms, direct sales.

The most frequently used strategy to ensure consumers' loyalty and trust, especially exploited among the large MNCs that in many respects dominate industrial food production-consumption networks, is the traditional one of product brands connecting certain features of the product with certain consumer lifestyles and aspirations by use of marketing tools such as images and positioning in advertisements. Branding is a strategy that reflects the situation of industrial food production confronted with many complicated and multifaceted quality demands and through which firms try to integrate a number of quality conventions such as in-

[3] As noted by Murdoch & Miele (2004), the importance of inspiration and attraction factors in industrial food, as well as the social equality advantage connected with their affordable prices, is often neglected in Marxist political economy analyses of agro-food systems that analyze and explain the popularity of industrial food by use of concepts like "fetichism" and "alianation".

dustrial efficiency and reliability, and inspiration, green and civic qualities in one brand, one logo etc. Branding, however, can also be risky. The value of a brand can quickly erode if associated with a scandal or just with a negative consumer trend. In such cases firms need to refocus their brand. A successful example of this is Nestlé's recent change of its brand from a baby to a nutrition focus (CIAA 2006).

3.3 The Alternative food model – characteristics and responses to change

What is here grouped in one cluster of 'alternative food' in fact consists of several types of food networks with differing main convention of quality like for example, 'organic', 'local', 'high-quality', 'speciality', 'slow food', and 'fair-trade' food. The emergence of all these strongly symbol-laden and often premium priced types of food is subject for a huge and fast growing body of academic literature often using 'alternative food networks' as a common designation (e.g. Marsden et al 2000; Parrott et al 2002; Renting et al 2003; Ilbery et al 2005; Watts et al 2005; Sonnino & Marsden 2006; Hein et al 2006, Testa & Massa, 2008).

The emerging alternative food networks represent a number of artisanal, entrepreneurial, social, and territorially embedded business responses to growing public concerns about issues like environmental sustainability, health and food safety, degeneration of territorial food cultures[4] and decline of traditional agro-food economies in rural areas.

Producers of alternative food respond to new customer demands through differentiating their products from mainstream food commodities by claiming providing 'alternative' qualities. These might stem from the raw materials, the production methods, the distribution channels, or the principles for trading and payment of suppliers applied by the individual company or by the whole supply chain in which it takes part. This alternativeness results in those specific qualities that, according to the socially constructed conventions of quality prevailing in the production-consumption networks, are defined as attractive. This could be *inspiration* factors like better tastes and richer eating/drinking experiences (in particular emphasised in speciality products), *domestic* factors like preservation of gastronomic and culinary traditions and support to local economies and supply chains (emphasised by producers of local/regional food products), *green* qualities such as less pollution of the environment, more animal-friendly breeding methods, and healthier products (the primary focus areas of organic producers), or *civic* qualities such as socially more fair payment principles and economic structures (in focus for 'fair trade' networks).

Nowadays, a common feature of producers of alternative food is the abandonment or at least a reduced use of production inputs stemming from the industrial model of farming and food processing. For examples, this could be no/less use of pesticides and gene modified organisms in the growing of crops, no/less chemical additives added in processing, no 'mistreating' of natural raw materials by use of industrial process technologies as in homogenisation of milk, etc.

Instead of standardised, generic commodity inputs from global, industrial agro-food systems, alternative producers tend to rely on - in risk of oversimplifying the findings from a number of research case studies (see for instance Ilbery & Kneafsey 2000; Ilbery et al 2005; Hindrichs 2000; Hein et al 2006; Parrott et al 2002; Murdoch et al 2000; VIFU 2006b; Testa et al. 2008) – local culinary traditions and knowledge, more dedicatedly grown and processed commodities, small-scale artisanal processing technologies in which human senses are used for surveillance and quality control, and distribution systems that are local or otherwise alternative to

[4] For example, the 'slow food' movement started in Italy in 1986 as a response to the opening of the first McDonald restaurant in Rome which was seen as a threat to traditional Italian eating habits (Murdoch and Miele 2004).

international supermarket retailers such as direct sales, local retailers, tourist sites, and delicatessen shops - all together signalling that products are handled with human care and attention.

The terms 'alternative', 'local', 'organic', 'fair trade' etc. as well as the ways companies differentiate themselves according to diverse definitions of 'alternativeness' is indeed ambiguous and open for symbolic meanings and values rather than based on objective, scientifically measurable criteria such as specific requirements for hygiene standard or calorie content. This ambiguity is an important part of the reasoning behind applying convention theory in explaining contemporary trends in the food sector. How to define 'organic food', 'local food', 'slow food' etc. are continuously negotiated in the social networks of farmers, processors, retailers, consumers, distributors, researchers, public authorities, politicians etc. that constitute the production-consumption system.

One of the strategies for 'fixation' of the quality convention which can be regarded as a form of protection of intellectual property rights similar to the use of brand trademarks or patents is setting up certification schemes and formal criteria for achievement of such regarding particular types of products. This could be government or industry-defined labelling schemes for organic products, EU's schemes for protection of food and drinks with a recognisable geographic origin, the Protected Designation of Origin (PDO) and the Protected Geographical Indication (PGI), or supermarkets' introduction of private label brands to guarantee, for instance, certain health, safety and environmental standards or fair trade principles.

A number of analyses (Parrott et al 2002; Marsden et al 2000; Ilbery et al 2005) have found big differences throughout Europe in firms' use of EU's PDO and PGI certificates. 75% of products granted a PDO or PGI certification in 2001, originated in peripheral, rural areas of the Southern and Mediterranean countries of France, Italy, Portugal, Greece, and Spain while only very few firms in Northern Europe such as UK, Netherland and the Nordic countries had applied for and attained certification.

Parrott et al (2002) provide two possible explanations of the varying popularity of territorial certification schemes - a cultural-institutional and a structural-economical. The cultural-institutional is related to the meaning and values, primarily prevailing in Southern Europe, attached to the territory as a combination of culture, history, tradition, production process, terrain, climate, and local knowledge systems, and captured by the French concept 'terroir'. The EU certification schemes earn much of their reasoning and legitimacy in this concept (Watts et al 2005). Parrot et al. also hypothesize the existence of two contrasting European food cultures: a 'southern' with a wealth of local and regional food specialities and a functional, commodity-driven 'northern'.

The structural-economical explanation highlights the different economic structures and level of industrialisation of the agro-food sectors in rural areas of southern respectively northern Europe. For small and technologically less-advanced farms and food processing firms in south the PDO and PGI schemes seem to offer attractive new market opportunities and access to urban consumers while they represent less attractive opportunities in rural areas of northern Europe, characterised by an industrialised, technologically advanced and volume-oriented agro-food sector as well as by less rich – or maybe rather, not primarily *locally* defined - culinary traditions to exploit commercially.

Many alternative food firms and networks have been innovative in exploiting new technologies like ICT and the internet in new forms of interactive sales and distribution channels where food and drinks are purchased on the internet by customers and delivered directly to their door. Another innovative strategy regarding distribution and sale is opening of the manufacturing site for tourists and other visitors and to provide it with, for instance, a shop for direct sales, exhibition facilities, and possibilities of guided visits. Thus, parts of the alternative food sector develop *inspiration* factors through a sector shift towards tourism and take

advantage of the trend towards increased importance of storytelling in the emerging 'experience economy'.

Alternative food producers - and especially producers of local and regional food - often emphasis the local supply and knowledge base, i.e. *domestic* qualities. It is often stated in the rapidly growing literature on alternative food networks that these can be seen as efforts to re-establish territorially embedded food supply chains and thus, as a re-localisation countertrend to the de-localisation trend in industrial food provision systems (Marsden 1998; Winter 2003; Morgan & Murdoch 2000; Watts et al 2005).

However, there are indications that alternative products increasingly are sold via conventional retail systems and that supermarket chains are increasingly aware of the sales potentials of more standardised types of alternative products like organic dairy, meat and vegetables products (Hein et al 2006; Ilbery & Maye 2006; Key Note 2004; ACNielsen 2005; Commission of the European Communities 2004). More generally, there is an increasing attention in research on alternative food networks about the question to what extend and in which ways alternative products and productions in fact are alternative and not just complementary to industrial food products (see for instance Sonnino & Marsden 2006 and Watts et al 2005).

3.4 The Functional food model – characteristics and responses to change

Functional food (or nutraceuticals) can be broadly classified into products, naturally containing health-giving active ingredients, those fortified with extra levels to those already present, and those enriched with active ingredients not normally contained in them (Keynote 2004).

According to Menrad (2003), in Germany functional food products have mainly been launched in markets for soft drinks, confectionary (e.g. chewing gum for dental hygiene), dairy, bakery, breakfast cereals, baby food and cholesterol lowering spreads. The biggest product category on the European market for functional food is presently gut health products in particular drink yogurts.

Compared to the artisanal, low-tech and somewhat 'return to nature' strategy employed by the diverse range of alternative food networks, functional food represents a 'forward to science' strategy. Functional food represents a science-driven model of food provision where new genomic and microbiology knowledge as well as bio- and nanotechnologies are used in design and production of products. The critical convention of quality defining functional food markets is related to health and nutritional effects of products, i.e. specific technical functionalities of the products which can be placed under the quality convention of 'industrial worth'.

Hence, functional food does not entail a total break with the industrial food model (Menrad, 2003).. On the contrary, as noted by Green & Foster (2005), functional food "is still based on high outputs in agriculture and processing within internationally-organised production and trade."

The importance of economics of scale factors (industrial efficiency) is clearly mirrored in the fact that the companies, driving the emergence of functional foods, to a large extent are large MNCs such as Unilever, Nestlé, Danone, Kellogg, Novartis, and Quaker Oats, or national category leaders within, for instance, the dairy or ingredient sectors. Such companies have the needed financial resources, the R&D departments and the in-house expertise in nutrition and food technology to accomplish the long and demanding process of developing and marketing functional food. According to Menrad (2003), the costs of product development and marketing of functional foods by far exceed the costs related to development and marketing of traditional food products. In addition to product development there are often huge costs and long-

lasting procedures related to achieving proof of efficacy of functional food through clinical tests such as intervention studies with high numbers of consumers/patients.

Besides qualities related to product functionality and industrial efficiency, *green* quality conventions related to environmental sustainability are also important for the emergence of functional food, however interpreted and followed very differently compared to alternative food networks. The functional food model takes seriously the criticisms of the environmentally-destructive nature of modern high-productivity agriculture and claims to solve environmental and human health problems by using new genomic knowledge and 'smart' biotechnologies with less negative environmental side-effects.

Contrary to the alternative food model, however, the claim of green qualities and promotion of environmental sustainability seems to cause problems rather than growth potentials. Consumers, particularly in Europe (Menrad 2003; ACNielsen 2005; EMCC 2006; Gehlhar & Regmi 2005), generally have a negative view on the use of gene modified crops and ingredients in the agro-food sector (while they are positive in relation to use in production of pharmaceutical products) and have fears about the effects on nature as well as on humans.

This situation means that winning bigger market shares might be a fight 'up the hill' for functional food producers and that public opinion and marketing initiatives will be crucially important. Contrary to alternative food products that often seem to carry 'symbolic capital' in terms of green, inspiration and domestic qualities positively evaluated by major consumer segments, functional food need targeted and strategic public information and marketing campaigns to gain a positive evaluation among consumers. Opinion leaders in the field of health and nutrition issues like medical doctors, dieticians and other nutritional advisors, is a major target group for such campaigns (Menrad 2003). On the other hand, the trends towards healthy-living and the demographic development towards more aged people are in favour for functional food.

Finally, maybe unexpectedly considering the emphasis of functional food on their technical functionality in terms of health benefits, several studies indicate (e.g. Key Note 2004; Menrad 2003; Cooke, forthcoming) that also *inspiration quality factors* like taste, flavour, convenience, and packaging, are important for consumers of functional food.

Table 3.1 sums up the main characteristics of the three models of industrial, alternative and functional food including their typical strategic responses to overall changes in food markets.

Table 3.1. Characteristics of food production-consumption models

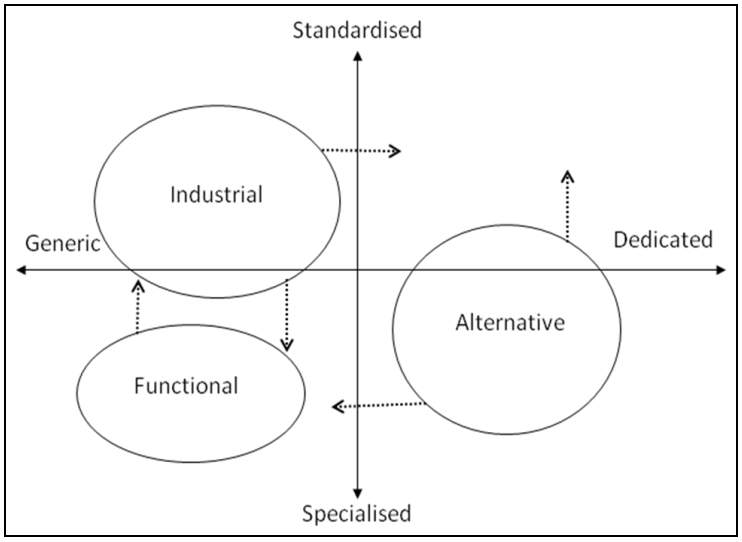
	Industrial	Alternative	Functional
Quality conventions	- Price/profitability - Industrial efficiency (e.g. safety, durability, accessibility) - Inspiration (taste, convenience) - Brand (public opinion)	- Domestic (gastronomy, culinary heritage, traditional production methods) - Green - Inspiration (taste, eating experience)	- Industrial efficiency and functionality in terms of health, well-being and nutrition - Green/sustainability - Inspiration (taste, convenience)
Drivers of change	- Increased price competition - New customer demands (safety, green, convenience) - Supermarkets growing power - Regulation (safety, environment, working conditions)	- New customer demands/market opportunities - Regulation (New rural development policy)	- New bioscience and biotechnologies - New customer demands/market opportunities

Responses	- Improvement of efficiency (profitability, safety, organisational restructuring) - Environmental initiatives - Targeted marketing, branding, communication - Creating inspiration factors (taste, convenience)	- Creating inspiration factors (taste, freshness, tourism-related) - Creating domestic factors (artisanal methods, local gastronomic traditions) - Development of green factors - Marketing and public opinion initiatives (certification of products, close consumer relations, dedicated sales and distribution systems, storytelling)	- Improvement of technical functionality of products - Improvement of efficiency of technologies
Dominating type of firms	- MNCs - Traditional SMEs	- Entrepreneurial micro firms	- MNCs - Science-driven SMEs
Core technologies	- Large-scale industrial process systems - ICT systems (control, documentation, management, logistics etc.)	- Small-scale artisan technologies - Local production methods - Internet communication and distribution systems	- Biotechnology (outsourced to suppliers) - Large-scale industrial processing systems
Spatial organisation	Global, dispersed location	Rural networks	Urban clusters
Regulation and policy framework	- Liberalisation of world trade - Protectionism (EU CAP and national agricultural policy) - EU legislation on food safety and environment	New EU rural policy (CAP reforms and LEADER from sector to territory focus, geographical and organic certification schemes)	- Public health and obesity campaigns - Legislation and public debates on gene technologies and DNA patents

In Figure 3.1 below, the three food production-consumption models are represented in the framework of Storper & Salais (1997), described in the introduction of this book. The arrows indicate directions of main innovation efforts as responses to customer needs and show how the three models tend to "inspire" each other. As an example, the large international Danish brewery, Carlsberg, recently opened a high-quality micro-brewery and visitor centre, Jacobsen Brewhouse, in order to regain the market shares lost on the domestic market to the many micro-breweries emerging in Denmark.[5] In the alternative food model innovation efforts are carried out to standardise products and technologies without losing the dedicated product qualities which differentiate them from mainstream products (for instance via certification), i.e. entering the standardised-dedicated *Market Worlds of Production.* Other development efforts within the alternative food industry are directed towards market expansion via developing more generic products. This strategy implies broadening of customer bases and sales through larger scaled distribution channels like supermarket chains. In the long run this might compromise the dedicated product profile that initially was the competitive advantage of most alternative producers.

Figure 3.1. The three food production-consumption models and main directions of innovation placed in 'Worlds of production' of Storper & Salais (1997)

[5] See http://www.jacobsen.com/core.html



4. Knowledge Dynamics

In this section we will look more systematically on the knowledge characteristics and knowledge dynamics prevailing in the F&D sector. As described in the previous section, the three models of industrial, alternative and functional food emphasise different combinations of quality conventions and this has implications for the categories of knowledge searched for, developed and applied.

4.1 Analytical knowledge

An early embryonic food innovation system developed already in the 19th century on the basis of analytical types of knowledge explored within chemistry, thermodynamics, physics, plant biology, pharmacy and medicine. These bricks of analytical knowledge were exploited in development of those industrial agricultural and processing technologies and machine systems that are today considered mature and standard. In the decades after World War II the knowledge dynamics in the agro-food sector were primarily related to optimisation and diffusion of well-known technologies and Fordist production principles (Green & Foster 2005). Today, exploration of analytical knowledge plays a less important role in the R&D efforts of the food sector.

However, some changes towards science-driven knowledge dynamics and technological innovation have occurred recently. One of these changes is caused by the introduction of bioscience and genomic knowledge in development of new agricultural, ingredient and food processing technologies. This analytical category of knowledge allows development of, for instance, new seed types both through genetic engineering and traditional breeding methods enhanced by a better understanding of crops' molecular biology.

This new bioscience analytical knowledge is driving the emergence of the functional food sector (Asheim & Coenen, 2005). Through in-house R&D or partnership research with universities or biotech firms, mainly large food companies engage in exploration and codification of new bioscience knowledge as well as in examination of product possibilities and market potentials (innovation of new products, technologies and ingredients). After a complicated process of testing and qualifying new products to market entrance, the resulting knowledge is exploited and applied in large-scale processing and distribution systems.

The future prospects of examination and exploitation of bioscience analytical knowledge are widespread for major parts of the agro-food sector, not least for what we here designate as the industrial food model. While the technical and certification features of the more pragmatic parts of the 'organic' strategy could incorporate a bioscience-driven strategy, this is however not the case regarding the 'bio-regionalist' parts of the organic movement.

4.2 Synthetic knowledge

The manufacturing processes in the sector are performed mainly by use of traditional chemical and mechanical technologies through which agricultural raw materials and commodities are processed into food or drinks for household consumption or into semi-manufactured goods for use in other parts of the sector.

The knowledge used is practice-oriented, combining disciplines such as chemistry, biology, physics, pharmacy, and engineering, and applying different sorts of industry-specific technical knowledge (Asheim & Coenen, 2005).

Due to the increasing challenges concerning environmental effects, obesity and fatness, public health care costs, safety, etc., the focus of food research and educational systems has been broadened during the last couples of decades to cover not only manufacturing processing but the whole food chain from 'soil to table' (ATV 2003). As an effect, public and private food research of today also engages in social sciences and humanities for instance regarding social and cultural phenomena and changes. Still, nature science and technical research are principal and dominant not least in terms of expenditures and number of researchers as illustrated by Menrad (2004) in a study on the German food research system.

Development of basic food manufacturing technologies mainly consists in incremental innovations that optimise the efficiency and reliability not least in terms of increasing economics of scale and decreasing inputs of labour. These innovations are primarily accomplished through knowledge examination and exploitation in the form of in-house R&D of mainly large companies within the industrial model as well as R&D activities of private industry research centres and public agro-food universities, R&D centres, consultancy and control institutions etc. From these often very large private and public research organisations, new innovations diffuse into the sector through imitation, adaptation, and knowledge transfer systems.

The relevance and use of such synthetic types of engineering knowledge is typical to the industrial model but is also crucial for the alternative and functional food industry. For instance, development and local adaptation of modern organic production methods relies on examination and combination of diverse forms of synthetic knowledge.

4.3 Symbolic knowledge

Although certainly not always consciously acknowledged and professionally exploited by individual firms, symbolic type of knowledge has fundamental and widespread importance in the food sector, for instance related to creation of inspiration qualities. Cooking encompasses a clear element of artistic activity where tacit and codified knowledge about raw materials and processing techniques are combined in preparing food with, for example, an 'appetising appearance', a 'delicate taste', a 'crispy texture' and a 'bright flavour'. Description of foods and drinks is usually equipped with a huge vocabulary of associative and value-laden words and expression, wine being the ultimate case. Also the importance of chemical additives, giving food or drinks a more attractive colour, texture, or flavour is an indication of the value of symbolic knowledge. Without tacit or codified symbolic knowledge a producer of food or beverages would not survive in the market in the longer run. This is the case for both indus-

trial, alternative and functional producers but is absolutely crucial for alternative food businesses for whom the opportunities of selling premium-priced products are connected with certain perceived product qualities additional to similar standard products.

This indicates the inter-connectedness of knowledge of producers and consumers. By consuming and preparing food and drinks consumers achieve the tacit knowledge needed to evaluate its qualities. And by consumers' purchasing of particular products and not other, producers achieve information about consumers' tastes. Yet, pure sales figures only provide limited and often rather superficial information and codified knowledge about consumers' actual preferences. Closer contacts with consumers such as face-to-face meetings are needed for successful product innovation. Participation on trade fairs as well as diverse forms of market research methods can facilitate such meetings and provide invaluable inputs to innovation of products, markets and distribution.

At a more general level, Asheim et al (2006) emphasise the central importance of 'buzzing' for creation of symbolic knowledge, i.e. learning through social interaction in professional communities, learning from youth/street culture or 'fine' culture and interaction with 'border' professional communities. Knowledge about food and drinks indeed seems to be an excellent example of this. Private dinners, restaurant visits, shopping, social parties and celebrations, dialogue with customers and suppliers at fairs, professional interaction and networking etc. are all part of food and drinks producers' provision of symbolic knowledge.

Symbolic knowledge is not only needed in development of food and drinks products but also in packaging, marketing and advertising of products and more generally in communication and public relations to customers, suppliers and other stakeholders. The recent emergence and growth of food products, marketed and branded with designations like 'alternative', 'local', 'high-quality', 'organic', 'functional', 'fair, 'fast', 'slow', 'discount' etc., is an indication of food and drinks products' increasingly symbol-laden dimension that firms need to target and hit very precisely in advertising and communication. Business consultancy firms are crucial complicit actors in developing communication, marketing and advertising strategies of major parts of the sector.

Main characteristics of knowledge in the F&D sector are indicated in Table 3.2 below.

Table 3.2 Knowledge characteristics of food production-consumption models

	Industrial food	Alternative food	Functional food
Core knowledge category	Synthetic (Symbolic)	Symbolic (Synthetic)	Analytical (Synthetic)
Important knowledge dynamics	- Exploitation of synthetic knowledge (productivity rising initiatives) - Exploitation of symbolic knowledge (product development & marketing) - Examination of synthetic knowledge (implementation of regulation)	- Examination and exploitation of symbolic knowledge in product development & marketing (e.g. - Exploitation of synthetic knowledge on artisanal production technologies - Examination and exploitation of synthetic knowledge in dev. of modern 'alternative' prod. systems	- Exploration of analytical knowledge (codification of bioscience) - Examination of analytical knowledge (potentials and feasibility of biotech) - Exploitation of synthetic knowledge on industrial production systems
Learning methods	- In-house R&D - Public R&D transfer - Interaction with up- and downstream partners	- Local networking - Public R&D transfer - Dialogue with consumers	- University/science partnerships - In-house R&D

External sources for knowledge	- Supermarkets - Technology suppliers - Public/semi-public institutions (R&D, consultancy and control) - Marketing consultants	- Network partners (horizontal/ vertical) - Customers (e.g. tourists)	- Universities and research institutions - Ingredient suppliers

5. Conclusions

This study has outlined the overall structural features, the main drivers of change, the corresponding typical firm and network responses, and the basic characteristics of knowledge dynamics prevailing in the F&D sector. The analysis has illustrated that despite its mature and traditional character, the sector is experiencing thorough processes of change due to a number of reasons such as new consumer demands, globalisation, the growing power of retailers in the supply chains, technological development, and introduction of new safety and environmental regulation. As responses to changing markets and competition conditions, new 'alternative' and 'functional' business models are emerging in competition with the mainstream 'industrial' food model. The three food provision models emphasise different conventions of food quality and hence, have different knowledge bases and dynamics.

The study has illustrated that the sector encompasses a multifaceted spectrum of knowledge dynamics including

- laboratory-based exploration and codification of advanced types of analytical, bioscience knowledge
- plant-floor examination and testing of synthetic knowledge on new manufacturing equipment and methods that are more friendly to the environment and safer for workers and consumers
- socially and culturally mediated exploitation of symbolic knowledge on local culinary traditions in development of new products and distribution channels appealing to the ever more demanding consumers.

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