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EURODITE WP3 SECTOR STUDY
Knowledge dynamics and quality conventions in the food and drink sector

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Abstract:

This case study outline the overall structural features, the main drivers of change, the corresponding typical firm responses, and the basic characteristics of knowledge dynamics prevailing in the food and drinks sector. The analysis illustrates 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 market and regulation conditions, a number of new business models and production-consumption networks are contemporarily emerging in competition with the conventional food industry characterised by, among other things, tough price competition, large-scale manufacturing and distribution systems, and increasingly global supply chains. Two emerging food provision models are included in the analysis alongside the mainstream 'industrial' food model, namely the 'alternative' and the 'functional' food model. Despite their insignificant roles in the total agro-food economy, the emerging 'alternative' and 'functional' food networks represent important directions for the future development of the food sector and already today influence innovation efforts of mainstream producers. The three models of industrial, alternative and functional food emphasise different combinations of quality conventions. The qualities of conventions underlying the three models have implications for the categories of knowledge searched for, developed and applied. By applying a convention theoretical approach it is possible to better understand and describe the variety in the food and drinks sector regarding prevailing knowledge categories and dynamics, responses to demands of change, spatial organisation and linkages etc. The three suggested food production-consumption models belongs to – in the terminology of Storper & Salais (1997) - three different *Worlds of production* characterised by differing though not totally separate and contrary knowledge bases. The study illustrates that the food and drinks sector encompasses a multifaceted spectrum of knowledge dynamics covering all parts of the applied 2-dimensional matrix of three knowledge categories (analytical, synthetic, and symbolic) and three knowledge phases (exploration, examination, and exploitation).

1. Introduction

This study on the food and drink manufacturing sector is one of seven sector case studies carried out as part of the EU 6th Framework research project, EURODITE, 'Regional trajectories towards the knowledge economy'. The purpose of the case study is to investigate the following aspects of the food and drink sector:

- overall drivers of change,
- typical industry and firm responses to drivers of change,
- types of knowledge and knowledge dynamics applied in these responses,
- geographical and spatial dimensions of knowledge creation and diffusion.

To provide a comprehensive and empirically evidenced analysis on these issues is an ambitious goal considering the variety of the food and drink sector in terms of product categories, technologies, business and innovation models, spatial configurations, regulative systems, etc. The primary target here is more modest, on the basis of a review of existing research literature, data and other relevant material, to outline the main structural characteristics of knowledge dynamics in the food and drink sector. As a structuring conceptual framework for this analysis, commonly applied in all seven EURODITE sector studies, we use a categorisation of knowledge into three epistemic types, namely *analytical* (scientific), *synthetic* (engineering), and *symbolic* (artistic), as well as a three-stage conceptualization of knowledge dynamics through phases of *exploration*, *examination* and *exploitation*.

This categorisation of knowledge in three types is developed by Professor Bjørn Asheim and his colleagues at Lund University who define the main characteristics of the three knowledge categories the following way (Asheim et al 2006):

> "The analytical knowledge base comprises (predominantly scientific) knowledge that is geared to understanding and explaining features of the (natural) world. The synthetic knowledge base refers to the (predominantly engineering) knowledge involved in the design and construction of solutions to human problems which is often instrumental, context specific and practice related. The symbolic knowledge base deals with the creation of cultural meaning through transmission in an affecting sensuous medium." (Asheim et al 2006)

The body of literature about the food and drink sector is huge and multifaceted and derives from many disciplines such as science and technical engineering, agro-economics, business economics, economic and human geography, rural development, sociology, and anthropology. The vast majority of food research as well as most of the public and private food research institutions deal with specific sub-sectors and branches like meat processing or dairies or it focuses on specific issues like product and technology innovation, supply chain management, logistics, marketing, hygiene, safety, nutrition, environmental effects, culinary heritage and gastronomy, etc.

Despite the substantial food research there is close to a total absence of research explicitly concerning and systematically investigating knowledge and knowledge dynamics. This maybe reflect the special feature of food and drinks products that ties them to tradition rather than change and that allows them, contrary to products from most other sectors, to be marketed by use of catchphrases such as 'A product from the old factory' and 'Like grandma made it'. The main target for innovation of foods and drinks is typically not connected with tangible product functionalities or technological advancement which can be measured by using objective

scientific indicators. Rather, the main product innovation targets, widely recognised by the food and drink industry (CIAA, 2006), are fuzzy product qualities like 'pleasure', 'taste', and 'convenience', i.e. qualities that are evaluated according to socially and culturally embedded traditions and norms.

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. Thus, a significant part of the knowledge about food among producers as well as consumers is tacit and collective and thereby, in the terminology of Halkier (2006), 'encultured'. In reference to the overall conceptual design of the EURODITE project, in which the significance of a number of 'contexts' for creation, use and diffusion of knowledge is investigated, we can say that production of food and drinks are closely embedded in *Society and culture* as a framing and structuring knowledge context.

In many respects, including the applied knowledge and technologies, the food sector is too diversified to describe and categorise as one homogenous type of economic activity. 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). This mainstream segment of the food sector is characterised by use of raw materials produced through industrial agricultural growing and breeding technologies, large-scale manufacturing systems, Fordist principles of production, and distribution via global logistical systems and supermarket retailers.

However, one significant development within the European and global food and drinks markets in recent years has been the emergence and growth of a variety of new food markets based on differentiation of the products from their standardised, industrial 'cousins'. This differentiation is made by claiming that products are produced in accordance with other definitions - or conventions - of 'quality' than the ones generally used in mainstream food production. Despite their economic limited weight these new food markets and emerging business models represent important directions for the future development of the food and drink sector and already today force producers of mainstream products to innovate competitive products in 'greener', 'healthier' and other directions.

Due to clearly identifiable differences in knowledge dynamics particularly two emerging business models seem to be of relevance to include in this analysis alongside the mainstream, industrial food industry, namely 'alternative' and 'functional' food networks. 'Alternative' food covers a variety of different products with rather fuzzy, symbol-laden qualities such as organic, local, speciality, high-quality, slow, and fair trade food, and are subject for a growing number of research publications (Marsden 1998; Murdoch et al 2000; Parrott et al 2003; Renting et al 2003; Ilbery & Kneafsey 2000; Ilbery et al 2005; Watts et al 2005; Hein et al 2006; Hinrichs 2000; Sonnino & Marsden 2006). Alternative food producers commonly 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 artisan technologies. Functional food (or nutriceuticals) 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.

After a brief description in the following section 2 of the overall structures and change processes in the European food and drink sector, section 3 presents a convention theoretical framework for studying food production-consumption networks and depicts the main features of the three different models of 'industrial', 'alternative' and 'functional' food. Section 4 looks at the specific knowledge categories and dynamics applied in the food and drink sector. Section 5 contains the conclusions and outlines some further perspectives of the study.

2. The European food and drink sector – an overall characterisation

2.1. Structural characteristics of the food and drink sector

In this study the food and drink sector is defined as the food and drink manufacturing industries at 2-digit level of the NACE-Rev. 1, i.e. DA15. Sometimes also a broader and less well-defined term, the 'agro-food sector/industry', is used indicating that agricultural and fishery activities as well as a range of related manufacturing and service industries are included.

The food and drink 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 stabile 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 most important, in 2003 accounting for 31% of all EU food and drink exports followed by 25% of the various food products (CIAA 2004).

The food and drink 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 1% large companies with +250 employees account for 39% of employment, 52% of turnover and 54% of value-added and their economic weight in the sector as a whole are increasing. Thus, big companies are leading in terms of value-added in production and R&D efforts, while in terms of employment small and medium-sized firms have a dominant position.

The food and drink 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 supply chains by which supplies of agricultural and fishery raw materials and semi-manufactured products increasingly are transported over long distances, the food and drink 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 and thus plays a significant role in maintaining industrial activities throughout Europe (CIAA 2006). The dispersed location pattern is due to several reasons:

- Natural, climatic and logistic restrictions on the primary sector's production of raw materials and on the distribution of processed F&D products. These restrictions favour local/regional specialisation in agriculture and short distances between the agricultural and the processing parts of the agro-food system.
- Distinctive territorial differences in food and drinks consumption patterns and customer preferences. Closeness to customers and territorial embeddedness in distinct food cultures including supply and distribution networks are important factors for achieving market knowledge needed in development of products.
- The technologies applied in most part of the sector are traditional processing systems based on knowledge easily transferable to all types of regions including rural and peripheral areas without strong R&D profiles and institutions.

2.2. Drivers of change

The main drivers of change in the European food and drink sector can be grouped this way:

- New consumer demands
- Supply chains restructuring
- Developments in market structures
- Technological development
- New regulation and policies

2.2.1 Consumer demands

Consumption of food and drinks products 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 rituals, traditions and communicational patterns within families, ethnic and religious communities and other groups and thus, is an important part of individuals' socialisation and identity formation. The markets of food and drinks products are strongly interconnected with specific needs and occasions of customers' everyday and festive life. For instance, convenient breakfast products like cereals and instant coffee are related to busy morning routines while alcoholic products in most cultures are integrative elements of celebration and stress-free evening occasions. As noted by Earle (1997), innovation in the food industry is characterised by combinations of technological innovation with social and cultural innovation, through which firms on the one hand respond to new customer demands stemming from changes in family structures, labour markets, demography etc. and on the other hand sometimes influence the social and cultural life of customers, for instance their shopping, cooking and eating habits.

Indeed, such food cultures are increasingly trans-national and affected by processes of internationalization. For instance, many product categories are increasingly sold through

international supermarket chains and thus have become integrated part of international food consumption patterns. However, this does not necessarily mean that local food cultures substantially are becoming homogenised. As Askegaard & Madsen (1998) point out, cappuccino has become an accepted coffee drink in many countries but it is not drunk the traditional 'Italian way' only in the morning, and the fact that hamburger restaurants are found global-wise does not indicate that eating a burger is or means the same all over the world. Local eating habits seem to be rather persistent to change and probably also in future will continue to differ despite globalisation of markets and supply chains and despite improvements in logistical systems.

Nevertheless, growth in incomes and overall 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 demographic structures in European countries are changing. The European population is expected to decrease from 455.2 millions in 2005 to 431.2 millions in 2050, while the share of total population 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 European countries like France, Germany and UK is less than a third but growing (Millstone & Lang, 2004). Lash & Urry's (1994) general notion about contemporary capitalism that competition increasingly shifts from "use-value of products" to "sign-value of brands" is also applicable in the food sector. However, the increasing demand of food with high value-added goes hand in hand with a rising price-consciousness and thus with rising demands of cheap discount food.

Growth in niche markets

Food markets are increasingly segmented and specialised in the direction of, for instance, ethnic food, organic food, vegetarian food, regional food, discount food, and functional food. These segments in market demands, however, are not linked to clearly identifiable segments in population as individual consumers might purchase convenience food in discount stores during the working week and fresh organic food commodities for prepared meals in weekends (EMCC, 2006). The trend towards product specialisation gives opportunities also for small food producers.

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

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

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

Another consumer trend affecting the food markets is increased concerns about problems related to obesity, nutrition, food related diseases, and the effects of gene modified organisms (GMOs) on human health. Such concerns have made consumers more aware of healthy living and increased the demands for, for instance, organic and functional foods (KPMG, 2000). Despite increased awareness of obesity and health issues, European consumers (compared to American) are still rather sceptical regarding GMOs and use of biotechnology in farming and food processing (Keynote, 2004). Also in this field, 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 (environmental impact, waste management, transport-intensive distribution, delocalisation of food economies, animal welfare, safety, fair trade, working conditions etc.) However, customers' awareness of sustainability is not always reflected in their purchase in which price is often the determining priority.

2.2.2 Changes in supply chains

The food supply chain consists basically of four links: 1. producers (farmers and other suppliers), 2. processors (which is in the focus of this case study), 3. retailers, and 4. consumers. The relationships between these four links and the dynamics and power structures that rule their actions 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 supermarkets are operating a strategy known as Efficient Consumer Response (ECR) targeted integration of every element in the complex food supply chain of farmers, manufacturers, logistical operators, whole sellers etc., and thereby maximising efficiency. A crucial technology enabling supermarkets to follow this strategy is the Electronic Point of Sale (EPOS) barcode scanning system that 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 sector that has changed it from an economic system of 'selling what is produced' to one of 'producing what is sold'.

The central role of supermarkets for sale of food gives them negotiating power to influence and press suppliers' prices and in general, to define the standards for the quality, safety and traceability of products and ingredients, environmental aspects of production processes, terms of delivery, electronic systems (EDI) used for documentation and payment, etc.

One way supermarkets exert and further expand their influence over the food supply chain is through introduction of so-called private label products – products manufactured for sale under the brand of the retailer, not the manufacturer. According to Fearne & Dedman (2000), 45% of all sales in European supermarkets relate to such private label products while in other parts of the world including USA, according to Millstone & Lang (2003), the percentage is typically less than 5% and sales still dominated by brand name products. Private label popularity challenges the famous brands. Brands in the middle of premium and economy (retailers' own labels) will suffer and risk brand erosion.

Introduction of private label products can be seen as a response to intensified competition among retailers in meeting customer preferences regarding, for instance, prices, certain product qualities or environmental, social and ethical responsibilities, based on a strategy of vertical co-ordination to gain control over upstream suppliers (EMCC, 2006). Competition among retailers forces them to 'below cost campaigns' putting further pressures on suppliers' prices.

In a broader perspective, not only focusing on private labels, competition and consolidation in the retail sector leads to new types of global agreements between worldwide retail groups and large food suppliers with strong brands consisting of higher prices for collaboration on global promotion, supply chain initiatives, data sharing, international pricing tiers etc.

2.2.3 Developments in market structures

The growing power of retailers in the supply chain leads food processors into new forms of partnerships and horizontal integration to regain some of their lost power. Horizontal integration by development of supply chain partnerships, i.e. arrangements between buyers and sellers that, unlike value chain integration, leave the operation and control of the two parties independent, is central to transformation of the food industry (EMCC, 2006; Fearne & Dedman 2000; Gehlhar & Regmi 2005). Main drivers of supply chain partnerships are the competitive food retail environment, the increased focus on food safety and supply chain integrity, and rationalisation of the supply base (Fearne & Dedman 2000).

More global competition and liberalisation of trade policies - not least relevant for firms closest to agriculture like sugar producers, dairies, and meat producers – as well as retailers' growing power lead to pressures on prices. 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.[2]

[2] Gaining economics of scale advantages by market expansion is not the only driver of acquisitions. According to Regmi & Gehlhar 2005, the globalisation strategies of large MNCs are mainly built on acquisitions of food firms abroad rather than on increasing their exports. By actively producing and being present in foreign markets (rather than exporting their

- 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.

2.2.4 Technological development

Key new technologies in the food and drink sector are:

- Biotechnology for health, nutrition, safety, eating quality, sustainable production methods etc.
- ICT tools needed for information flows between links of supply chain to promote efficiency by reducing administrative workloads. Also vital for safety and demands for traceability. Tools for monitoring manufacturing processes, improving quality management and ensuring compliance with environmental standards. Integration of ICT in supply chain to collect information on customer behaviour and improve production planning and development of new products.
- E-business solutions allowing direct sales to customers (B2C), and thereby circumventing influence of retailers, providing information about market trends and closer contact with customers to gain loyalty. EDI systems are widely used because powerful retail and wholesale groups require digital transactions. According to EMCC (2006), 19% of firms in food sector use e-business for procurement and 8% for direct sales. Prices of EDI have decreased recently allowing use in SMEs.
- Radio frequency identification (RFID): a new electronic barcode system. Radio frequency/ICT based tools support improvement of production planning and development of new products, facilitate information about consumption, give customers access to product information in shops, offer benefits in logistics and supply chain management including greater transparency in supply chains (individual production units can be traced from producer to customer and back). Main driver for RFID use is regulatory demand for traceability and demands from large supermarket chains, as well as growing consumer demand for better product information.
- Robotics and sensor technologies: Generally robotics is a big challenge for the food sector. It is difficult for robots to perform the needed tasks, so hazardous, manual work is still needed. Sensors have many possible applications in monitoring and controlling processes, providing information for adjusting production inputs.
- Nanotechnology is a new step in the technological development with potentials for improving storage life, designing taste, appearance, consistency, nutritional properties of food. Nano-sensors in packaging could indicate product conditions like temperature, storage life etc.

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

Technological development impacts on the workforce demands. The overall decrease in employment will continue in coming years, however, some jobs have shifted into business service like customer application services and logistics. There is increasing demand for more skilled types of labour including specialists in legislation, engineering, microbiology, people

products) they get closer contacts to consumers and improve their chances of successfully meeting local consumer preferences when developing new products.

with broader competences in reporting, communication, marketing etc. In lower end of workforce there is a need for qualifications relevant to quality control and food safety.

2.2.5 New regulation and policies

Not many economic sectors are subject for public debates and discourses as well as regulative requirements to the extent experienced by the food and drink sector. Issues like obesity and health, life-style related deceases, food safety, environment protection and sustainability, 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, and principles of international agricultural and trade policies are all subjects for extensive political and ethical public debates. The public debates and demands for change regard not only the products as such, like their nutritional value, but also the sustainability and reliability of the whole food supply chain from 'soil to table', including safety and hygiene standards, environmental impact, quality and traceability of raw materials, as well as social aspects in relation to working conditions and global trading principle.

The food and drink sector is historically embedded in national and regional agro-food policy and institutional frameworks regulating, for example, agricultural production, R&D and innovation activities, education and training systems, working conditions, and food safety control. More recently, also the international level of regulation and policy 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 are:

- International trade liberalisation: facilitating market access, reducing export subsidies, reducing domestic subsidies.
- EU enlargement: increased competition but also new markets for old EU states - opportunities and threats at both sides.
- EU Common Agricultural Policy (CAP) 2004 reform: policy means are moved from price and production subsidies to more comprehensive farmer income support (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 legislation on food safety and hygiene standards: 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.
- EU certification and labelling schemes for protection of food and drinks with a recognisable geographic origin, the Protected Designation of Origin (PDO) and the Protected Geographical Indication (PGI).
- EU LEADER programme. This EU 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).

- Quality standards such as the recently published ISO 22000 standard and the Hazard Analysis And Critical Control Point (HACCP) food safety certification set up by international retailers, defining in-house quality control and documentation procedures of food suppliers to ensure safety.

The food and drink sector is subject to more regulation than most other sectors adding 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 many new 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 produce to EU and no more than 1000 were expected ending up complying with EU safety regulations.

The main effects of new policies and regulative requirements can be described as:
- more global competition not least for firms closest to agriculture
- accelerated restructuring in form of rationalisation and outsourcing to cut costs
- mergers and acquisitions to expand markets
- higher vulnerability of effects of diseases and public scandals due to growing firm size and trade
- strengthened segmentation in sector - trend towards very large and very small players while SMEs are squeezed
- many complicated regulative demands can act as entry barrier especially in new EU member states making them target for acquisition of MNC
- increased demand of more skilled labour.

3. Quality conventions and production models in the food and drink sector

3.1. Convention theory

Structural characteristics of the food and drink sector such as a product-based statistical industry classification of activities are very general and not useful in identifying and categorising the knowledge and technology bases prevailing in the food sector. The product category of firms and thus their affiliation to specific industrial branches only to a limited degree determines their technologies and knowledge dynamics. For instance, the type of knowledge needed to continuously develop, produce and market cheese products is not the same for a dairy producing and distributing cheese commodities on a European market of 450 million consumers and for a dairy, producing high-quality speciality cheeses sold locally or on international niche markets.

Quite an alternative and more promising approach to categorise technologies and knowledge bases in the food sector than use of structural characteristics and statistical industry classifications is to look at different definitions, criteria - or conventions - of quality on the basis of which firms develop, produce, market and distribute their food and drinks products and on the basis of which consumers evaluate and choose particular variants of food products. According to convention theory, related to actor-network theory, food 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) – or "orders of worth" (Thevenot et al 2000). 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 might be able to specify some keywords and guiding principles for identifying the types of knowledge, technologies, learning processes and spatial configurations prevailing in such systems.

Very interesting attempts have recently been made to apply convention theory on studies of economic systems and networks related to food and drinks (see for instance Murdoch & Miele 2004; Thevenot et al 2000; Renting et al 2000; Murdoch et al 2000; Ilbery & Kneafsey 2000). The existing research contributions mainly consist in sketching out basic theoretical and conceptual definitions for analysing the social construction of quality conventions and the possible relations between such quality conventions and the practical organisation and operation of food sector businesses[3]. Yet, the research provides only limited empirical evidence about the implications of specific quality conventions on the knowledge types and dynamics of firms and networks.

The number of possible conventions of food quality is indefinite but some are more successful than others in influencing the directions and standards for economic activity. Most scholars studying contemporary food networks seem to agree on the significance on the following quality conventions – or modes of justification – originally identified 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.

Other conceptualisations of convention theory such as the one of Storper & Salais (1997) can also be used as framework for categorisation and analysing current food production-consumption networks. According to Storper & Salais, the accomplishment and coordination of any particular economic activity depends on socially defined conventions, a common context, an agreed set of points of references between the involved persons – a buyer and a seller, a manager and a group

[3] See for instance the interesting case study made by Murdoch & Miele (2004) about 'Fast' and 'Slow Food cultures' that illustrate how the organisational, technological, and architectural principles of McDonalds restaurants reflect a combination of the quality conventions of 'industrial efficiency' and 'civic equality'.

of employees, etc. Storper & Salais outline four bundles of conventions, *Worlds of production*, that derive from combinations of two principal dimensions found in any particular configuration of production. In one dimension, products are either 'standardised' and thus, produced and marketed by use of widely diffused technologies, or they are 'specialised' and relying on restricted forms of know-how, technologies and distribution systems. In the other dimension, products are either 'generic', i.e. product qualities are well-known for customers and allow sale on anonymous mass markets, or they are 'dedicated' and oriented towards particular customers and relying on stronger, interpersonal, trust-based market relations.

By combining this conceptual framework with the above list of quality conventions significant for food production-consumption networks, we can identify, for instance, a standardised-generic world of production mainly configured by 'market' and 'industrial' quality conventions, and a specialised-dedicated world of production, shaped by conventions of quality like 'ecological/green' and 'domestic'. We will return to Storper & Salais' worlds of production in the end of this section.

We suggest defining the following three types of food production-consumption models, emphasising different combinations of the above mentioned quality conventions and with differing – though definitely not separate and contrary - knowledge and technology bases as well as spatial configurations:

- '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 central role.
- 'Functional food' emphasising health and nutritional effects and in which the knowledge base is analytical.

These segments of the food and drink sector do not refer to official industrial classifications and do not define non-overlapping segments of individual firms. In fact they 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 segments represent ideal types of production and business models prevailing in the food and drink sector. The crucial factor lying behind the segmentation 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 three segments might relevantly have been given other names. What we refer to as 'industrial food' is often in literature analysed under the designation of 'conventional' food (see for instance Morgan & Murdoch 2000, Sonnino & Marsden 2006; Green & Foster 2005). However, labelling a food production-consumption model 'conventional' gives little meaning in a convention theoretical approach and would not be informative in specifying its distinctiveness, except maybe pointing to the fact that it represents the predominant model of development in terms of production outputs, turn-over and employment. For instance, the functional food market in Europe is estimated to represent only about 1% of the total food market (Menrad 2002). As mentioned in the introduction, 'alternative' and 'functional' food networks are to be considered

mainly as two emerging production and business models that play insignificant roles in the total agro-food economy but nonetheless represent some important directions for the future development of the food sector and already today influence innovation efforts of mainstream producers.

Furthermore, 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 within, in particular, human geography and rural sociology, 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).

In the following the three food provision models are further described.

3.2. Industrial food

Green & Foster 2005 highlight the following characteristics of industrial food networks that well describe the close relations between the production and consumption dimensions emphasised by convention theory: they are based on raw materials produced by use of industrial agricultural practices exploiting advanced breeding techniques and major inputs of chemical fertilisers and pesticides, they are transport-intensive, requires high-energy processing based on Fordist production technologies and organisational principles, they relies on modern retailing systems and demands high-tech kitchens at the end of consumers. In the conceptual framework of Storper & Salais (1997) introduced above, industrial food networks belongs to the standardised-generic world of production in which products are standardised and generic types of commodities sold on anonymous mass markets and in which the needed technologies are widely diffused.

As described above, ongoing industrialisation and globalisation of the agricultural and food processing sectors, increased competition from low-income countries, the growing importance of supermarkets in the food supply chain, technological developments, etc. 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.

Thus, 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.[4] Other qualities related to market performance and industrial efficiency such as products' durability, safety and hygiene standard, seasonal uniformity and geographic/spatial accessibility, however, are important too.

Due to the emphasis on price and efficiency factors, a central response of industrial food processors to current changes in markets and framework conditions is accelerated internal and external restructuring. As mentioned in section 2, such restructuring can take a number of forms such as internal process rationalisation, acquisitions, partnership arrangements, outsourcing and re-location.

[4] 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.

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 as central by the food and drink industry (CIAA, 2006) are qualities like 'pleasure', 'taste', 'sophistication', 'exotism', 'fun' and 'convenience', i.e. sensory and/or social attraction factors. As noted by Murdoch & Miele (2004), the importance of inspiration and attraction factors for production and consumption of industrial food, as well as the civic equality advantage connected with their affordable prices, is often neglected in political economy analyses of agro-food systems and thereby they often have difficulties in explaining the popularity of industrial food. 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 communication, PR and marketing strategies, 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 target their products to diverse customer groups and to more strategic 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 industrial 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 Alternative food

The emerging alternative food networks represent a number of naturalist, artisan, 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[5], and deterioration 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 having 'alternative' qualities. These might stem from, for instance, 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 (emphasised in particular 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 and regional products), *green* qualities such as less pollution of the environment, more animal-friendly breeding methods, and healthier products (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).

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.

[5] 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).

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 in industrial food production, is setting up certification schemes and formal criteria for achievement of such regarding particular types of products such as 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. In particular the latter example, illustrates how certain powerful actors in the network (in this case retailers) can dominate such negotiations and define the criteria for achieving the quality stamp of certification.

The varying quality conventions, production principles, organisational forms and territorial linkages of different alternative food networks should not be neglected (Parrot et al 2002; Sonnino & Marsden 2006; Renting et al 2003). However, a common feature of producers as well as consumers of alternative food – at least as they commonly are operating for the time being - 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 fertilisers, 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, no bird cages for chickens, less transport-intensive supply and distribution systems, etc.

In stead 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) – local culinary traditions and knowledge, more dedicatedly produced raw materials, small-scale artisan processing technologies in which human senses are used for surveillance and quality control in certain crucial phases, and distribution systems that are local or otherwise alternative to 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.

Many alternative food firms and networks have indeed been innovative in exploiting new technologies like IT 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 to open the manufacturing site for tourists and other visitors and provide it with, for instance, a shop for direct sales, exhibition facilities, and possibilities of guided tours and taste samples. Thus, parts of the alternative food sector develop inspiration quality factors through a sector shift towards tourism and take advantage of the trend towards increased importance of storytelling in the growing 'experience economy'.

Alternative food producers often emphasis - and producers of local and regional food obviously more than any other product quality - 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 of industrial food provision systems (Marsden 1998; Winter 2003; Morgan & Murdoch 2000; Watts et al 2005). The new economic spaces which some of the emerging alternative food networks inhabit carries the promise of a food economy which is relatively more embedded into the territory and characterised by closer and more trust oriented relationships between producers and consumers.

However, the local supply base and the short supply chains often highlighted in analyses of alternative food networks (Renting et al 2005; Kneafsey et al 2003; Ilbery et al 2005) are sometimes debatable, in particular regarding the group of speciality products such as ethnic food and specialty products like beers from the many emerging micro breweries. As noted by Ilbery et al (2005), conceptualizations of short supply chains sometimes ignore important upstream dimensions of the chain itself and assume that the starting point is the suppliers to the food processing link without taking into account the supplies to the suppliers. Besides, the term 'local' that is often used in food marketing holds flexibility for interpretation. Kneafsey et al (2003) define local as "the shortest and simplest route from field to plate. In some cases a set distance defines this. In all cases a self contained local trading area, with close contact between all parties and few middlemen". According to a consumer panel interviewed by and refereed to in Testa et al (2006), a 'local product' is one "coming from a defined place, which is grown, bred, produced in that place". This ambiguity in definition allows for opportunistic behaviour among producers, for instance in not telling all the truth about all of the supplies, which can jeopardise consumers' trust in the short supply chain and thereby their loyalty to the products.

Furthermore, the reliance on small-scale manufacturing systems and alternative distribution systems such as direct sales or internet-based ordering and delivery arrangements causes some debate about the proclaimed environmentally friendly profile of organic and local products. For instance, The Economist (2006) points to the fact that the small quantities that characterise production, distribution and purchasing of alternative food compared to industrial, large-scale food systems might lead to an increase in the total transport kilometres of the food products.

Regarding the downstream distribution channels 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).

This question is part of a broader debate about the market and growth potentials of alternative production-consumption systems. Although producers of alternative food and drinks due to certain attraction, domestic, green or other quality factors can often get premium-prices for their products they have to take account also of efficiency factors to survive in the market in the longer run (Murdoch et al 2000). This comes the more truth, the higher the ambitions for growth.

To compromise on attraction, domestic and green product qualities by developing industrial efficiency factors, however, is not always in focus of alternative food networks. According to recent empirical studies of the production outcomes and perspectives of organic farming on the

global level, carried out by Cornell University in New York and referred to in Politiken February 13 2007, one of the constraints for actually solving global problems of hunger and environmental degradation of land and natural resources by use of organic production methods might be a rigid interpretation of the ideal principles of organic farming (e.g. a total abandonment of pesticides), followed by 'organic hawks'.

Besides, a number of analyses of alternative food networks (Ilbery and Kneafsey 2000; VIFU 2006b) have found that alternative producers often pay little attention to customers' definitions of quality in their efforts of innovating products and technologies and have small spending on marketing and advertising. Instead they rely heavily on quality definitions that they, as entrepreneurs, have constructed themselves, however not in isolation but usually through interaction and exchange of experiences in their professional networks.

Ilbery and Kneafsey (2000) provide an interesting study about how producers of speciality food in South West England construct and market the quality of their products. The study applies a conceptual understanding of quality consisting of four factors: Achieving Certification (e.g. organic label or EU PDO/PGI certificates), Establishing association to local area of production), Ensuring specification of products and technologies, and Generating attraction in products. When asked about the importance of these four groups of factors the producers emphasised the two latter of generating attraction (e.g. taste, texture, flavour) and ensuring specification (branding and story-telling about factors like the exquisite raw materials, the authenticity of recipes, the small-scale workshop and process technology, the entrepreneur's personal quality judgement, artisan skills and careful hands-on involvement and controlling). Neither achievement of formal certification of the products nor establishing association with the local area was regarded a particularly important indicator of quality by this group of food producers.

This finding obviously reflects the fact that the selected producers made speciality products that were not necessarily connected with the locality of production. However, it might also reflect that the fuzzy and contextual character of quality perceptions also includes a geographical dimension. For instance, a number of analysis (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, originate 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 which both illustrate the importance of contextual settings for conventions of quality. The one 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) and the negotiations preparing the EU legislation displayed tensions between the food traditions and the related institutional structures of the northern and southern EU countries. According to Parrott et al 2002, the negotiating position of southern EU countries was that "producers, or in the majority of cases, representative institutions or inter-professional organizations have registered public collective brands, 'owned' by the organization rather than an individual or corporation", and that "these associations have been more attuned to, and in

turn, have promoted traditional, and typical regional foods", while the north, again quoting Parrots et al 2002, "has, by and large, developed a legal system of protection and marketing centred around privately-owned brand trademarks and a functional approach to food governance in which quality of foodstuff is determined more by matters of public health and hygiene than by organoleptic properties". The authors thus 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 second explanation of Parrott et al 2002 on the geographical differences in the use of territorial product certificates is closely connected with the first and highlights the different economic structures and modernisation processes of the agro-food sectors in the rural areas of southern respectively northern Europe. For the generally small and technologically traditional farms and food processing firms in rural areas of southern Europe, that have not in the same degree as the agro-food sector in northern Europe been affected by agricultural industrialisation and economic restructuring, the PDO and PGI schemes seem to offer attractive and strategic market opportunities. Via the PDO and PGI certificates these firms gain new channels of access to modern, urban customers with purchasing power and growing interest in 'local quality' food. The EU certifications might represent strategically 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.

In summing up the characteristics of alternative food networks it is tempting to state, in line with Murdoch et al 2000, that they represent a 'return to nature' strategy. Nonetheless, it would be wrong to designate the alternative food model as solely retrospective and driven by nostalgia. The emergence of entrepreneurs and firms in alternative food markets in most cases seem to be driven, besides the usual search for income and profit, by an urge to find sustainable *future* solutions to a number of contemporary environmental, health, ethical, social and cultural problems connected with global industrial food systems. However, one of the main questions regarding the potentials of the alternative food sector to achieve more than marginal market shares and to change more radically the global agro-food system is whether the sector, on the basis of some sort of definition of 'sustainability', will be able to develop more efficient, large-scale production, marketing and distribution systems. In the above mentioned conceptual framework of Storper and Salais (1997) this means to develop products, technologies, and markets in the directions of either the standardised or the generic worlds of production that characterise industrial food provision.

3.4 Functional food

Functional food 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).

Compared to the artisan, 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 or nutriceuticals represent a science-driven model of food provision where new genomic and microbiology knowledge as well as bio- and nanotechnologies are used in design of products with targeted health, nutritional or well-being effects for the consumers. As

noted by Green & Foster (2005), the functional food model "takes on the notion of foods as a way of delivering health-care". Hence, the critical convention of quality defining functional food markets is related to health and nutritional effects, i.e. specific technical functionalities of the products which can be placed under the quality convention of 'industrial worth'.

Functional food does not entail a total break with the industrial food model. 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. It continues the strong 20th century emphasis of the industrial/modern system on high output and low labour agriculture (…) and thus continues the focus on producing large quantities of food for rapidly expanding urban populations." Also regarding distribution and sales, functional food mainly follows the channel of mainstream industrial food through volume-oriented supermarket chains (Menrad, 2003).

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 higher numbers of consumers/patients.

Functional food products are not homogeneously representing all food and drink industries. 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 containing the probiotic lactic acid bacteria *Lactobacillus casei Shirota*, originally developed by the Japanese company Yakult Honsha.

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 in providing opportunities for specific health and well-being effects for the consumers as well as more efficient agricultural and processing methods 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. The general mistrust to the

ability of public authorities and the food sector to solve serious environmental, safety and hygiene problems of modern agro-food systems (as demonstrated by the BSE scandal in Britain in 1996) has contributed to public scepticism to science itself and to a policy culture based on scientific expertise more generally (Ilbery & Kneafsey, 2000).

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 so much 'symbolic capital' in terms of green, inspiration and domestic qualities that producers usually pay only little attention on marketing and advertising (the products sell themselves), functional food need more 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 1 sums up the main characteristics of the three models of industrial, alternative and functional food, emphasising different combinations of quality conventions and representing different strategic responses to overall drivers of change in food and drinks markets. The spectrum of responses of firms in the sector, differently engaged with by the three production-consumption models, can be grouped as follows:

- Improvement of efficiency qualities (product, process and organisational innovation)
- Creation of inspiration/attraction qualities (product and process innovation)
- Creation of domestic qualities (product and process innovation)
- Development of green/environmental qualities (process innovation)
- Enhancement of public opinion qualities (market innovation)

An aspect of the food and drink sector of interest in this EURODITE case study, however not empirically analysed and evidenced in any systematic manner, is the spatial/territorial configuration of the three food production-consumption models. As indicated in Table 1 the three models have very different spatial organisation and geographical linkages. Industrial food production and distribution systems including their knowledge and technology bases are increasingly based on global supply chains and widespread infrastructures, allowing a dispersed location pattern of firms in both rural and urban areas. The location patterns of both alternative and functional food production seem to be geographically much more restrained in certain areas with specific regional advantages or traditions.

Due to the local resource basis and the special demands to the agricultural raw material inputs that usually characterise alternative food production, this form of production is primarily located in certain rural areas close to farmers able to supply the needed specific product qualities – such as freshness or a certification of geographical origin. Also of importance for alternative food firms - obviously in particular for local/regional food processors - is local networking,

cooperation and experience exchange regarding for instance, raw material supplies, technologies, marketing, distribution systems etc.[6]

Due to the exploitation of advanced new sciences and technologies and thus to the dependency on close partnership relations to universities and research centres, the development and production of functional food is mainly restricted to and institutionally embedded in a few urban/metropolitan clusters world-wide such as Saskatoon/Canada, Helsinki-Turku/Finland, Skania/Sweden and Wageningen-Nijmegen/Netherlands.[7]

In Figure 1 the three food production-consumption models have been placed in Storper and Salais' *Worlds of production*. The industrial food model is characterised by standard and well-known generic products, widely diffused technologies and distribution through anonymous mass markets. The bioscience technologies applied in functional food production are specialised and restricted to only a few mainly large companies while the products are generic and sold mainly on mass markets via supermarket distribution channels. The alternative food model, at least in its present form, mainly operates in specialised-dedicated worlds of production in which products are specialised and provided qualities additional to mainstream products and in which relations between producers and customers are more trust-based and interpersonal.

The arrows inserted in the figure going from the circles of the industrial and alternative models, indicate directions of main innovation and renewal efforts as responses to new customer demands. Producers of industrial food increasingly tries to develop more dedicated products and marketing strategies by emphasising domestic, inspiration or green qualities but without losing the efficiency of standardised production and distribution technologies. In the alternative food model innovation efforts are carried out to standardise products and technologies and expand on the markets without losing the dedicated product qualities which differentiate them from mainstream 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 and change it in the direction of generic products.

[6] Often such networks of alternative food producers encompass participants from other sectors like tourism and transportation. Marketing of traditional, local food is typically an integrated part of branding and marketing of the region for tourism and, in more generally terms, of economic development efforts of many rural areas.

[7] See Cooke (forthcoming) for a detailed description of the mentioned agro-food bioregions.

Figure 1. Food production-consumption models placed in 'Worlds of production' of Storper & Salais (1997)

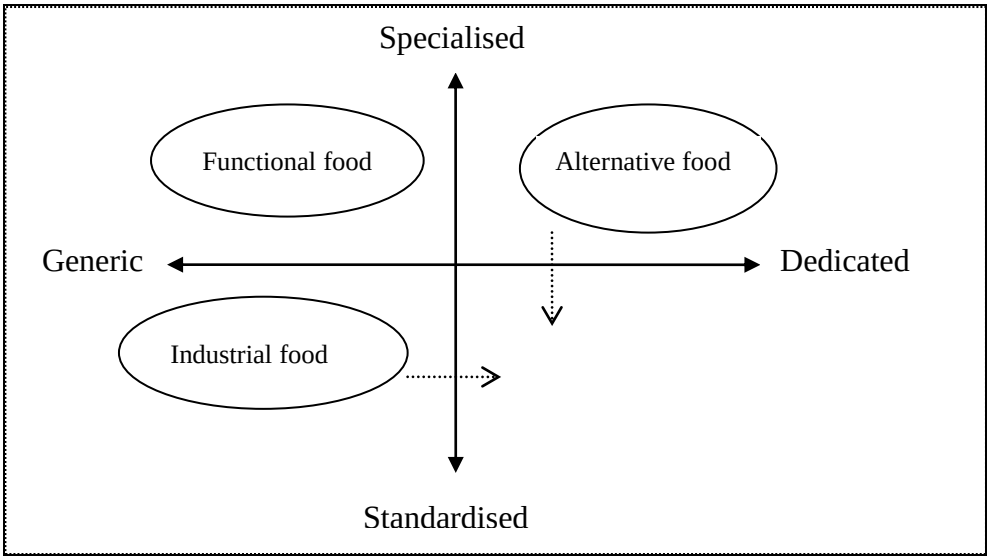

Table 1. Characteristics of food production-consumption models

	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/new markets - Regulation (New rural development policy)	- New bioscience and biotechnologies - New customer demands/new markets
Responses	- Improvement of efficiency (profitability, safety, organisational restructuring) - Environmental initiatives - Targeted marketing,	- Creating inspiration factors (taste, freshness, tourism-related) - Creating domestic factors (artisan methods, local gastronomic traditions)	- Improvement of technical functionality of products - Efficiency of technologies - R&D partnerships with universities and science

	branding, communication	- Development of green factors - Marketing and public opinion initiatives (certification of products, close consumer relations, dedicated sales and distribution systems, story telling)	systems
Dominating type of firms	- MNCs - Traditional SMEs	- Entrepreneurial micro firms	- MNCs - Science-driven SMEs
Technologies	- Large-scale industrial process systems - IT and logistical systems	- 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	Rural networks	Urban clusters
Regulation framework and driving policy discourse	- 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

4. Knowledge characteristics and dynamics in the food sector

In this section we will look more systematically on the knowledge characteristics and dynamics prevailing in the food and drink sector. As mentioned in the introduction we apply a categorisation of three epistemic types of knowledge, analytical/scientific, synthetic/engineering, and symbolic/artistic as well as a three-stage conceptualization of knowledge dynamics through phases of exploration, examination and exploitation.

The main characteristics of the three knowledge categories are defined in the following Table 2, copied from Asheim et al (2006).

Table 2. Knowledge base typology (after Asheim et al, 2006)

Analytical	Synthetic	Symbolic
Innovation by creation of new knowledge	Innovation by application or novel combination of existing knowledge	Innovation by recombination of existing knowledge in new ways.
Importance of scientific knowledge often based on deductive processes and	Importance of applied, problem related knowledge (engineering) often through	Importance of reusing or challenging existing conventions

formal models	inductive processes	
Research collaboration between firms (R&D department) and research organisations	Interactive learning with clients and suppliers	Learning through interaction in the professional community, learning from youth/street culture or 'fine' culture and interaction with 'border' professional communities.
Dominance of codified knowledge due to documentation in patents and publications	Dominance of tacit knowledge due to more concrete know-how, craft and practical skill	Reliance on tacit knowledge, craft and practical skills and search skills

As described in the previous section, the three suggested models of industrial, alternative and functional food emphasise different combinations of quality conventions and represent different strategic responses to overall drivers of change in contemporary food and drinks markets. The different qualities of conventions underlying the three models seem to have clear implications for the categories of knowledge searched for, developed and applied.

4.1 Analytical knowledge

The food and beverages industries are highly related to agriculture and together they comprise a mature and well-established agro-food sector. In many mainly Northern European countries mechanisation and industrial production technologies and principles were introduced in agriculture and manufacturing of food and drinks already in the first phase of industrialisation in the nineteenth century, facilitated by establishment of national science and educational institutions dedicated to agriculture and food processing. In Denmark, for instance, the Agricultural University in Copenhagen was founded in 1856 and the dairy oriented Agricultural Research Laboratory in 1883 as parts of national innovation policies to boost industrialisation and developing an export oriented agricultural sector (Lundvall & Borras 2005). Thus, although the food sector of today is less R&D intensive than most other manufacturing sectors it very early was part of an institutionalisation of formal science, education and technology supporting organisations and formed some of the earliest embryotic examples of what much later were designated 'Innovation Systems'.

These early innovation systems were founded on the basis of analytical types of knowledge, explored within chemistry, thermodynamics, physics, plant biology, pharmacy and medicine, and examined and exploited in development of those industrial agricultural and processing technologies and machine systems that we now consider mature and standard. In the decades after World War II the knowledge dynamics in the agro-food sector were primarily related to expansion, 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 represents a radical jump from the 'Monsato-type' of genetic modification which used genome knowledge linked only to changes in the use of agrichemicals. The better understanding of the genetic design and pathogenicity of plants and animals also allows improvements in crop protection and animal breeding technologies with less destructive effects on the environment than conventional agricultural methods.

This new bioscience analytical knowledge is driving the emergence of the functional food sector.[8] 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 production-consumption model. While the bioscience-driven strategy readily could incorporate the technical and certification features of the more pragmatic parts of the 'organic' strategy, this is not the case regarding the 'bio-regionalist' parts of the organic movement.

Another field of exploration of analytical knowledge, expected to affect the future production and marketing of food, is connected with research on the human brain and sensory system and regards topics such as how human perceptions, tastes and aspirations are formed during eating and drinking and more generally through diverse forms of socialisation mechanisms (CIAA 2005). This research could be extremely important for solving some of the obesity and health problems observed in modern societies.

4.2 Synthetic knowledge

The manufacturing processes in the paramount part of the food and drink sector are performed by use of traditional chemical and mechanical technologies through which agricultural raw materials and commodities, usually supplied with diverse additives, are processed into food or drinks for household consumption or into semi-manufactured goods for use in other parts of the sector.

As a knowledge basis for rational operation and continuous trimming of such manufacturing processes, the food sector has, contrary to most other economic sectors, its own scientific and educational discipline of bromatology rooted back to the first wave of industrialisation. Bromatology deals with, among other things, agricultural raw materials, food processing techniques and technologies, taste perception and the human sensory system, chemistry and additives, microbiology and perishability of food, human nutrition, safety risks and hazards, quality and hygiene control procedures, etc. Bromatology constitutes a typical practice-oriented

[8] See Asheim & Coenen (2005) for a case study on the analytical knowledge basis of the functional food cluster in Skania/Sweden.

synthetic knowledge base, combining disciplines such as chemistry, biology, physics, pharmacy, and engineering, and applying different sorts of industry-specific technical knowledge.[9]

Due to the increasing complexity of societies and of questions and challenges concerning environmental effects, obesity and fatness, public health care costs, safety, etc., the focus of bromatological 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, food research and education of today also engage 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 the basic 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 as well as R&D activities of private industry research centres and public agro-food universities, R&D centres, and education, consultancy and control institutions. From these often very large private and public research organisations, new innovations diffuse into the sector through imitation, adaptation, and knowledge transfer systems.

R&D efforts of private and public research centres are increasingly related (and often resulting from demands from new regulation) to issues in focus of public concern such as safety and hygiene standards, reduction of environmental effects, organic farming methods, and more animal friendly agricultural production methods. However, optimisation and improvement in the efficiency of processing technologies is still a core area of R&D activity. These R&D fields represent examination and exploitation of synthetic types of 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 food or beverage producer would not survive in the market in the longer run - an assumption that according to a number of studies (Key Note 2004; Menrad 2003; Cooke (forthcoming)) also holds for functional food products which one might expect would be less sensitive for symbolic inspiration elements.

[9] See Asheim & Coenen (2005) for a case study on the synthetic knowledge basis of the food industry in Rogaland/Norway.

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 or customers in the retail link 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 food and drink sector.

Main characteristics of knowledge in the food and drink sector are indicated in Table 3 and 4 below.

Table 3. Knowledge characteristics of food production-consumption models

	Industrial food	Alternative food	Functional food
Main knowledge category	- Synthetic	- Symbolic	- Analytical
Knowledge phase	- Examination (implementation of regulation, trial-and-error in product introductions) - Exploitation (productivity rising initiatives, symbolic knowledge in marketing)	- Examination of 'alternative' distribution systems - Exploitation of traditional production technologies - Exploitation of symbolic knowledge	- Exploration (codification of bioscience) - Examination of biotech potentials
Learning method	- Supply chain interaction - In-house R&D - Public R&D transfer	- Supply chain interaction - Networking/cooperation - Public R&D transfer	- University/science partnerships - In-house R&D

			- Supplier interaction
External sources for knowledge	- Retailers/ 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

Table 4. Knowledge in the food and drink sector

Categories Phases	Analytical	Synthetic	Symbolic
Exploration (Search, including Research)	- Bioscience - Human perception & taste formation - Animal welfare (zoology)	- Gene technology (GMO) - Human nutrition/health - Chemistry (ingredients) - Population surveys (health and diseases)	- Experimental cooking (aesthetic and sensory aspects of food) - Market analyses (social/cultural trends, ethics etc.)
Examination (e.g. trialling, testing, standard-setting or benchmarking)	- Clinical test/trial of ingredients and process technologies (health, nutritional, and environmental effects)	- Test/trial of safety and hygiene aspects of products & processes - Test/trial of reintroduced traditional production methods e.g. organic - Development and adaptation of 'new' distribution systems e.g. internet based or direct sales - "Social engineering" (education and training of workers e.g. regarding hygiene and safety)	- Dialogue & interaction with consumers/customers - Marketing & Communication strategy
Exploitation (Commercialisation of innovation, sale on market, or socially useful & used)	- Commercialisation - Industry information and education campaigns	- Commercialisation of new products, processes, distribution systems - Supply chain and logistics management	- Design, branding and story telling - Sales, communication and PR management

5. Conclusions and perspectives of the study

This case study has outlined the overall structural features, the main drivers of change, the corresponding typical firm responses, and the basic characteristics of knowledge dynamics prevailing in the food and drinks 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 market and regulation conditions, a number of new business models and production-consumption networks are contemporarily emerging in competition with the conventional food industry, characterised by price competition, large-scale manufacturing and distribution systems, and increasingly global supply chains. Two emerging food provision models have been included in the analysis alongside the mainstream 'industrial' food model, namely the 'alternative' and the 'functional' food model. The three food provision models emphasise different conventions of food quality on the basis of which firms develop, produce, market and distribute their food and drinks products and on the basis of which consumers evaluate and choose particular variants of food products. Despite their insignificant roles in the total agro-food economy, the emerging 'alternative' and 'functional' food networks represent important directions for the future development of the food sector and already today influence innovation efforts of mainstream producers.

By applying a convention theoretical approach it has been possible to better understand and describe the variety in the food and drinks sector regarding prevailing knowledge categories and dynamics, responses to demands of change, spatial organisation and linkages etc. The three suggested food production-consumption models belongs to – in the terminology of Storper & Salais (1997) - three different *Worlds of production* characterised by differing though not totally separate and contrary knowledge bases. In an overly simplistic conclusion we can say that synthetic, engineering type of knowledge is decisive for accomplishment of the restructuring initiatives of increasing efficiency and implementing new safety and environmental regulation that are dominant in 'industrial' food production; that symbolic knowledge plays a crucial role for development, production and marketing of the added attraction factors of premium-priced 'alternative' food and drinks products; and that analytical bioscience knowledge is driving the emergence of new types of 'functional' food products and technologies with specific health, diet and nutritional benefits for consumers and with big potentials for exploitation throughout the agro-food sector.

The study has illustrated that the food and drinks sector encompasses a multifaceted spectrum of knowledge dynamics covering all parts of the 2-dimensional matrix of knowledge categories and knowledge phases applied in the sector study (Table 4). The observed knowledge dynamics range from laboratory-based exploration and codification of advanced types of analytical, bioscience knowledge, over examination and testing of new manufacturing, information and distribution technologies and systems that are safer for workers and consumers and more friendly to the environment, and to socially and culturally mediated appropriation of symbolic knowledge exploitable for revitalisation of traditional regional food cultures as well as for creation and marketing of new products and packaging appealing to the ever more demanding consumers of modern societies. However, the variety of technical, social and cultural knowledge processes is not reflected in the huge research literature about the food sector in which there is a scarcity of

studies explicitly focusing on knowledge dynamics. This is unfortunate considering the sector's economic weight and centrality for the health and well-being of humans as well as of nature and environment.

Finally, together with agriculture the food and drinks sector is one of the few economic sectors still providing rural areas a role in the increasingly global and city-centred knowledge economy. Hence, also for the future prospects of rural communities and economies, further studies on the mechanisms, sources, and relations through which knowledge about sustainable production and distribution systems for healthy and competitive food and drinks products is created, applied and diffused, could be helpful. Such studies should take into account the potentials of developing new and more balanced urban-rural relations connected with the growing markets for high-quality, dedicated food products, produced and distributed via shorter supply chains and via stronger and more trust-based relations between producers and consumers. Developing the food and drinks sector of rural areas is an important driver for achieving the objective of territorial cohesion that recently has become a high priority of EU policy.

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