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**Market-Based Process and Product  
Innovation in the Food Sector:  
A Danish Research Programme**

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# Market-Based Process and Product Innovation in the Food Sector: A Danish Research Programme

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*This note informs about the Danish MAPP research programme, a collection of 15 research projects aimed at making product and process innovation in the food sector more market-based. The programme, which has an interdisciplinary base, but is geared towards marketing applications, is concerned with the organization of the innovation process, the interaction of consumer and producer criteria in product development, the assessment of long-term developments in the market environment and the role of the distribution system in product innovation. Innovation in both primary production and processing are considered.*

## 1. The Danish Food Sector

The food sector has traditionally been an important part of the Danish economy. The reasons can, among other things, be found in the geographic, geological, and climatic conditions, where Denmark with its long coastal line, its flat and fertile landscape and mild winters, has excellent conditions for a large primary sector. Some indicators of the importance and size of the Danish food sector can be found in table 1.

Table 1: The Danish food sector's production, export income, and employment in absolute and relative terms (figures for 1989)

	<b>production</b> (bill. DKK/percentage of total production)	<b>export income</b> (bill. DKK/percentage of total export income)	<b>employment</b> (in 1000 persons /percentage of total number employed)
<b>Primary sector</b> (excl. forestry)	61 bill DKK 4.8%	49 bill DKK 24.0%	147 th.p. 5.6%
<b>Food and beverage industry</b>	103 bill DKK 8.2%		86 th.p. 3.3%
<b>Total food sector</b>	164 bill DKK 13.0%	49 bill DKK 24.0%	233 th.p. 8.9%

Source: Danmarks Statistik

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Denmark has approximately 2.5% of the total world market for produce. Comparing this with the fact that Denmark's GNP only amounts to approximately 0.5% of the world's GNP, this underlines the sector's large national and international importance. The importance for the Danish economy, especially the balance of payment, can also be seen in that the Danish food sector's net foreign exchange income in 1989 amounts to approximately 28 bill. Dkr., whereas the net foreign exchange income for the economy as a whole was only 10 bill. Dkr.

For the past years, however, the food sector's - especially the primary sector's - relative economic size has decreased. This fact, plus the turbulence that prevails in EC agriculture and fishing policies, has entailed major structural changes, mainly in terms of mergers and acquisitions, and has spurred a heated debate on in which direction the Danish food sector should move in the future.

On the one hand, there is the view that Denmark has natural resources which give it an advantage in primary production, and that Denmark, together with Holland and Sweden, tops the list of efficiency in the primary food sector, measured as the value of production and export income relative to the number of people employed. Also, it is argued that it makes sense to build on Denmark's long tradition with a large and sound primary sector.

On the other hand, it is pointed out that the largest part of the net foreign exchange income in the food sector comes from the food processing industry, even though the primary sector accounts for a larger part of the food sector's total production value. It is also argued that the skills and resources which result in competitive advantages on markets for raw produce may be transient, and that it is crucial for the Danish food sector to develop another type of skills and resources, the type which is concerned with understanding customers and markets, and which typically requires transaction-specific investments (Madsen, 1990).

It is on this background that, for a number of years, there has been a call for more research and development in the Danish food sector.

## **2. Research and Development in the Food Sector**

Table 2 summarizes private and public research and development efforts in the Danish food sector. It should be noted that especially the figures for public R&D are subject to some uncertainty.

Compared to 1985, the industry's research and development efforts relative to production value have grown from 0.24 to 0.53%, i.e., have more than doubled. This must be seen in the light of the relatively low level of R&D expenses that existed until 1985. In 1985, countries like Sweden, Holland, West Germany and Great Britain all had a higher R&D investment level, relative to production value, than did Denmark. Generally, however, the R&D level in the food sector is still low, both in Denmark and comparable countries, when compared to other sectors of the economy. This is shown in table 3.

Table 2: Expenses for research and development in the Danish food sector in 1989

	<b>Food and beverage industry</b>	<b>Public sector</b>	<b>Total</b>
<b>in mill DKK</b>	544*	144	688
<b>as % of total food production value</b>	0.53	0.14	0.67

\* 368 mill. DKr. are spent on intra-company R&D, and 176 mill. DKr. are spent on R&D bought from, e.g., engineering consultants, technological service institutions, and trade research institutes.

Source: The Danish Ministry of Education, Research Department, 1990 and the Academy for Technical Sciences, 1991.

Table 3: Selected industries' intra-company R&D investments in percent of value added (figures for 1987)

<b>Industry</b>	<b>Denmark</b>	<b>Sweden</b>	<b>UK*</b>	<b>Japan*</b>	<b>Germany</b>
<b>Food and beverage</b>	1.1	1.8	0.9	1.7	0.5
<b>Pharmaceutical</b>	15.7	35.0	19.4	12.7	19.6
<b>Machinery</b>	5.1	11.6	2.4	4.1	5.7
<b>Electronics</b>	8.3	19.1	17.3	13.4	12.1
<b>Transport</b>	2.3	14.6	3.7	10.1	7.0

\* 1986 figures

Source: OECD's Research Bank and the Danish Ministry of Education, Research Department, 1991

Relating these figures to the discussion in the preceding section, one can see that the R&D intensity in the food sector is low world-wide, relative to other industries, but generally increasing, due to a belief that R&D and the skills and resources it possibly creates will be of increasing importance for the international competitiveness of the food industry. On this background, the Danish State has started the Research and Development Programme for the Danish Food Sector.

### **3. The Research and Development Programme for the Danish Food Sector**

In 1990, the Danish government launched the *Research and Development Programme for the Danish Food Sector* (known in Denmark as the *FØTEK* programme), in order to strengthen the international competitive position of the Danish food sector. Over a period of 5 years (1990 to 1994) the programme will place 525 mill. DKr. (about 75 mill. US \$) at the disposal of researchers in the public and private sectors. The food industry is expected to match the government contribution with a corresponding investment of another 525 mill. DKr. An important aspect of the organization of the programme was to further cooperation between public, i.e. university-based research, and research in the private sector. Documenting such a cooperation is usually a prerequisite if a food company wants to apply for funds in connection with a research project.

The FØTEK research programme is meant to fund research in the following areas:-

- Quality
- Health and Nutrition
- Production Technology
- Marketing, Consumer Behaviour and Preferences

While the main thrust of the research programme is decidedly on funding technological research, it has been possible to convince the public decision-makers that marketing research will be a necessary and important complement to the technological research. This can be regarded as a major breakthrough in establishing the importance of the social and economic sciences as a necessary companion to successful technological research.

Four major research programmes have been established under FØTEK. Three are of a technological nature and one, the MAPP programme, will take care of the marketing-oriented research. The rest of this note will describe the MAPP programme.

### **4. The MAPP Programme**

#### *4.1. General Orientation*

MAPP stands for *Market-Based Process and Product Innovation in the Food Sector*. It builds on the conviction that successful innovation in the food sector requires an integration of technological and marketing research. As stated above, these two research fields have been too isolated from each other, which has had two consequences: The technological research has led to product developments that the market did not want, while marketing research often

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has led to specifications of consumer wants without giving directions as to how these can be filled by competitive products.

It is not so difficult to find examples of new product development fiascos which were due to a limited understanding of market and customers. Three Danish examples will highlight the issue.<sup>1</sup>

*Smør 40.* This product, which was launched by *MD Foods* on the Danish market in 1989, was an attempt to give consumers a low-calory butter - a product which contained only 40% of the fat content of ordinary butter. The emphasis on health and healthy food products in the public debate, supported by market research, were the basis for product development. Also, while the market for spreadfats is generally declining in Denmark, sales for traditional butter products were going down at a faster rate than sales for margarine and minarine products. MD Foods is renowned as a producer of dairy products, and especially butter. In this way, Smør 40 can be regarded as a brand extension strategy - to enter the market of low-calory, health spreadfats, where MD Foods had not previously operated, by drawing on its good will as a producer of butter and other dairy products.

In spite of an extensive marketing effort, Smør 40 reached only a very small market share and was taken off the market in the spring of 1991. A possible explanation for the disappointing sales figures was that the product tried to please two segments at the same time. The *butter segment* perceived Smør 40 as a butter of lower quality, a “watered down” version of real butter (the product actually contained three times as much water as real butter), which could be used as a bread spread, but not for cooking and frying. For the *margarine and minarine segment*, Smør 40 was an animalic product, which this segment (rightly or wrongly) regards as unhealthy. Smør 40 was therefore a compromise product which did not really appeal to either of the segments.

*Tomato with improved sliceability.*<sup>2</sup> This product was, after considerable product development, launched by the biggest Danish retailing chain in the mid-eighties. Market research had shown that a considerable share of the buyers wanted a tomato with a better sliceability. As a solution, a tomato was developed which had four chambers, instead of the usual three chambers, which made the tomato more sliceable - in an “objective” sense. The product was no success. The reason was that, for consumers, “sliceability” is something they judge in the shop by feeling the tomato. A four-chambered tomato does not feel different from a three-chambered one. Only when you actually slice it will the difference be noticeable. When, however, not the actual slicing matters, but the feel of the product in the shop was the issue, then a distribution system assuring freshness would have been the solution, rather than a different product. This example illustrates nicely the problem of translating consumer preferences into technological specifications.

*Free-range eggs.* Since the mid-eighties, Danish consumers have had the option of buying free-range eggs (*skrabeæg*). These eggs are from hens which, among other things, have about twice as much room than the legal requirement. The price is 25% higher than for normal eggs.

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<sup>1</sup> We thank Erling Jelsøe for helpful comments on these examples.

<sup>2</sup> We thank Hanne Hartvig Larsen for pointing this example out to us.

The product was launched as a result of increasing discussions about animal welfare, and of studies showing that consumers would be willing to pay a higher price for more “ethical” eggs.

The market share of free-range eggs in Denmark is under 10% now, which is considerably below expectations. Here, like in many other instances concerning sales of organic or ecological products, it seems that the willingness to pay higher prices expressed in survey studies leads to an overestimation of the actual willingness of consumers to pay price differentials. In addition, it is uncertain to which extent consumers actually perceive free-range eggs as being more ethical than ordinary eggs, or which product attributes consumers specifically would expect from ethical eggs - if they are interested in “ethical” products at all. 100% more space than the legal minimum is still not very roomy - it actually corresponds to 7 hens per square meter, so the hens are by no means actually “free-ranging”. It may thus well be that the perceived improvement in animal welfare is small compared to the perceived price differential. It should also be noted that *ecological eggs* are on the market as well. These eggs, from hens with considerably higher animal welfare, are considerably more expensive and have a small market share.

All three examples show a lack of understanding of the consumer. All three examples also show the difficulties of translating perceived consumer needs into a product specification. There is, therefore, an increasing consciousness in the Danish food sector for the importance of research on market-based product innovation.

#### 4.2. Theoretical Foundation

We regard market-based process and product innovation as a possible source of competitive advantage. The research programme’s general theoretical framework tries to provide that link.

A business can be said to have a competitive advantage in relation to competitors on the same market, if it has an enduringly better performance, in terms of ROI or other performance measures, than these competitors.

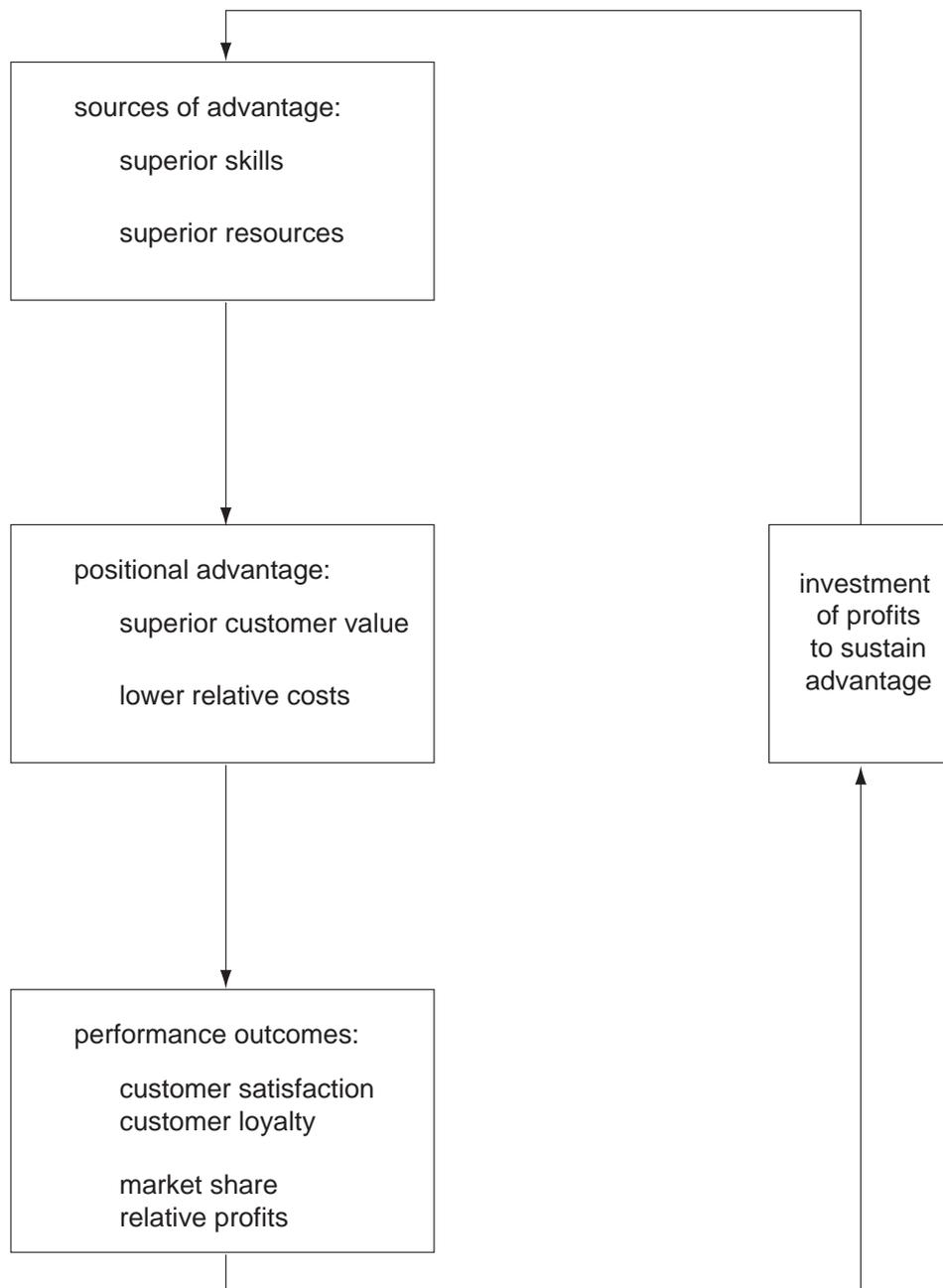
Several writers (Day & Wensley, 1988; Petersen, 1991; Porter, 1980) have argued that causes of difference in performance within a market can be analysed at various levels. The immediate causes of differences in performance, these writers argue, can be reduced to two basic factors: the *value which customers perceive in the products/services offered*, and the *costs incurred in creating this perceived value*. The more value customers perceive in a market offering relative to competing offerings, and the lower the costs in producing that value relative to competing producers, the higher the performance of the business. Hence, businesses producing offerings with a higher perceived value and/or lower relative costs than competing businesses can likewise be said to have a *competitive advantage* in that market.

It should be noted that value and costs can be both positively and negatively related, and that they can influence profits or other performance measures in various ways (Luchs, 1988; Phillips et al., 1983). Higher perceived value can allow a price premium, thus increasing ROI, but at the same time preventing high market share. In this case, it can also be expected to be associated with higher costs, even though, in some markets, producing high quality may

lower costs because of less waste. But higher perceived value can also lead to an increased market share, which can lead to decreased costs, resulting in a higher ROI as well. Alternatively, high market share may be reached by low prices, based on low costs.

While the relationship between perceived value, relative costs, and performance is hence rather intricate, we can retain the basic statement that these two variables are the cornerstone of advantage, since both of them, everything else equal, will be monotonously related to performance.

Figure 1: The creation of competitive advantage (from Day & Wensley, 1988)



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The perceived value created, and the costs incurred, will depend on the business's skills and resources, which thereby become second order determinants of differences in performance. This relationship is shown in figure 1, which can be used to discuss the role of market-based process and product innovation (see also Johnes & Snelson, 1990).

We define a *market-based product innovation* as a product which results from combining skills and resources in such a way that buyers perceive a lasting improvement of the relationship between price and value, relative to competing products.<sup>3</sup>

A number of features of this definition should be noted:

- A new product addition is, according to this definition, a *market-based product innovation*, when customers perceive it as creating more value for money, in comparison to competing products. Thus, a product, which the business itself perceives as an innovation, need not necessarily be a *market-based innovation* in this sense. Also, products which customers perceive as new, but not as leading to more value for money, may be called innovations (as is done in most of the innovation literature, e.g. Rogers, 1986; Van de Ven, 1986; Zaltman et al., 1973), but not *market-based product innovations*, because they will not result in positional advantages on the market, (O'Hare, 1988).
- Depending on how radical the innovation is, the competing products which form the basis for comparison will change. In the case of a small, incremental change, resulting in a marginally higher value, the product innovation will still compete with the same products as the previous product. The more radical the innovation is, the more the market actually served will change, and hence also the products with which the innovation competes.
- Market-based product innovations need not necessarily be based on physical changes in the product. An established product can be perceived as an innovation, when, because of changes in other parameters of the marketing mix, customers perceive it to be better value for money. This holds especially for a lasting price reduction, which often goes hand in hand with a process innovation, cf. below.
- A new product may be a market-based product innovation for some members in the vertical chain, but not for others. Thus, a product may be an innovation for retailers, because it may be easier to stock because of different packaging, while the same product may not be perceived as an innovation by final consumers. *Market-based product innovation* can thus be based on an analysis of the wants of the various members of the vertical chain.
- Exporting an existing product to a new market will be called a market-based product innovation, when that product, on this market, will result in a better perceived price-value relationship than competing products may offer. In this

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<sup>3</sup> We thank Hanne Harmsen, John Kjeldsen and the other members of the MAPP research group for helpful comments on this and the following definition.

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case, skills and resources are combined not to create new physical products, but to discover potential markets to be served, and to extend logistics, distribution, and communication to the extent necessary to actually serve that market. A new product which allows entry into a market not previously served, e.g., because legal requirements could not be met, will *not* be called a market-based product innovation, if the buyers in that market do not perceive the product as being superior to existing products.

A product innovation, according to the proposed definition, results from a new combination of existing skills and resources. Accordingly, a *market-based process innovation* can be defined as *investing in skills and resources in such a way that it becomes possible to enact market-based product innovation in the sense above and/or to lower costs in producing perceived value*.

Again, several features may be noted:

- In many cases, process and product innovation will go hand in hand, since product innovation may necessitate an investment in skills and resources.
- A process innovation does not necessarily refer to production processes. Establishing new procedures for new product developments, enacting vertical cooperation with suppliers, or establishing sales subsidiaries on export markets in order to get a better understanding of these markets and/or reduce transaction costs may all be process innovations, since they may reduce costs and/or contribute to future product innovations.
- While a product innovation is always geared towards creating more customer value for money, a process innovation may also be geared towards reducing costs.
- *Market-based process innovation* does hence entail, just as market-based product innovation, an analysis of value perception of customers. In addition, however, it usually necessitates an analysis of competitors. An investment in skills and resources to reduce *relative costs* will usually require an understanding of competitors' skills and resources and competitors' costs. In addition, an analysis of competitors' skills and resources, and the way they are used to create customer value, will be helpful in finding those skills and resources which to invest in, to further market-based product innovation in a way which will lead to *sustainable* competitive advantage.

In our view, market-based process and product innovation is, hence, the kind of innovation which will lead to competitive advantage. This is the common thread for the research projects in MAPP. Three kinds of general questions can be derived from the general framework just presented:

1. *How do consumers perceive value in food products?* Are there general tendencies in the perceived importance of product attributes, like, e.g., an emphasis on healthy and natural products? How do these attributes relate to product choice? What is the relative importance of

physical attributes, process characteristics, and other extrinsic attributes? How do consumer preferences translate into physical product characteristics, and vice versa? How is consumers' value perception affected by, e.g., cultural factors? By changes in living conditions and life style?

2. *How are market developments perceived and turned into decisions about developing skills and resources?* To which extent do food companies perceive the trends which affect consumer value perception, and the tendencies in competitors' ways of creating value? How do food companies combine their perceptions of market tendencies with their perceptions of internal skills and resources into a market strategy? Which skills and resources will have the highest leverage for creating competitive advantage? How can the transfer of information between the market and the company, and information handling within the company, be improved?

3. *What impact has the vertical structure on innovation as a source of competitive advantage?* What is the relative importance of value perception of consumers and retailers for producer success? What is the relative importance of innovation in the primary sector and in the food industry? Can vertical cooperation improve innovativeness?

Obviously, no single research programme can possibly provide answers to all these questions. However, it is expected that the 15 research projects presented in the next section will come up with at least some relevant answers.

## **5. The MAPP Research Projects**

As mentioned above, MAPP consists of 15 research projects, which can be grouped according to the three major questions just listed (researchers responsible for these projects are named in parentheses; addresses of the participating institutions can be found on the inner cover).

### *5.1. Projects on How Consumers Perceive Value in Food Products*

*Product quality and consumer preferences: Assessing the optimum design of food products* (Kai Kristensen, Suzanne C. Grunert & Hans Jørn Juhl, The Aarhus School of Business, Carsten Stig Poulsen, Aalborg University Centre). The first object of this project is an integration of a socio-economic analysis of consumer preferences with technological sensory analysis, in order to explain and forecast the choice of food products. The second object is to develop a set of computer-based tools for measuring and modelling market response to new products.

*The consumer as an agent in relation to research and development in food technology* (Erling Jelsøe, Roskilde University Centre). The project focuses on how consumer objectives can play a more active role as a basis for the planning of research and development in food technology. The aim is to determine the conditions that strengthen the consumers' possibilities for active formulation of needs and priorities. Specific studies will determine consumer objects that are operational in relation to the planning of research and technology.

*Households' choice of food stuffs with different levels of preparation* (Jens Bonke, University of Copenhagen). The goal of the project is to study to which degree income, relative prices, occupation and working hours affect the allocation of time and money for food consumption. Furthermore, the connection between owning various household appliances and the extent and nature of household production will be studied. The results will enable to forecast how the demand for food products with different levels of preparation will develop in relation to the development in socio-economic key factors.

*The cultural dimensions of food consumption and the implications for strategy formation and implementation in small and medium-sized Danish companies* (Dominique Bouchet, Søren Askegaard, Per Østergaard & Tage Koed Madsen, Odense University). How culture and its importance for food consumption can be interpreted and analysed, is the project's first main problem. The other is how information on cultural factors can be utilized in the product innovation process. The latter part will be analysed through a number of case studies in Danish organizations.

*Controlling processes of production to guarantee process characteristics demanded by consumers of food products: Paradigms and Danish experiences* (Esben Sloth Andersen, University of Aalborg). The project focuses on the integration of standardization and certification in the product innovation process. There are many demand-relevant qualities that are not part of the product itself, but characteristics of primary production: eggs from farm hens, produce from low-pollution areas, ecological/biodynamic produce. The project sets out from the Danish tradition for control all the way through production and distribution. The aim of the project is to show, how process characteristics of food products can be defined, controlled, certified, and communicated.

*Product innovation and packaging in the food industry - environmental consequences and consumer reactions* (John Thøgersen & Tino Bech-Larsen, The Aarhus School of Business). The consequence of the growing environmental awareness for the consumer's acceptance of new highly processed food products is analysed. The potential conflict between a product innovation strategy, which builds on the development of time-saving highly processed products that usually involve intensive packaging, and the tendency towards greater environmental awareness which is followed by a demand for natural products and less packaging, is the starting point for the project. The tendencies will be mapped out and the consequences for product innovation analysed.

*Assessing the sales potential for a new food product to be launched on home or foreign markets* (Anne Martensen, Copenhagen Business School). A new model developed for the purpose of forecasting sales for a new consumer product is tested with a number of food products. The model is based on data obtained partly from preference and buying intention surveys and partly from marketing plans.

## *5.2. Projects on How Market Developments are Perceived and Turned into Decisions About Developing Skills and Resources*

*Identification of key success factors* (Klaus G. Grunert & Charlotte Ellegaard, The Aarhus School of Business). The project is based on the notion that on each market there is a limited

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number of key success factors, in terms of business skills and resources, which explain differences in customer perceived value and relative costs. The project aims at identifying how such key success factors are perceived by decision-makers, and validating these perceptions by confronting them with more objective measurements.

*Innovation capability as a key success factor* (John Kjeldsen, Klaus G. Grunert & Hanne Harmsen, The Aarhus School of Business). The object for this project is to analyse the informational basis for obtaining competitive advantages through product innovation. The main hypothesis is that not only an organization's capability to gather relevant external information, but also its capability to interpret and integrate it with internal information strongly influences innovation capability. There is no point in developing a new product just because there is an unsatisfied demand on the market, if the organization's strategy and internal resources do not match up with the opportunity.

*Strategic planning and innovation capability in the Danish food sector* (Morten Kvistgaard & Kirsten Plichta, Copenhagen Business School; Ole Rasmussen, Biotechnological Institute). The aim of this research is to analyse how Danish food companies translate perceived market developments into needs for technological research and development, how they relate such needs to business strategy, and how they want these needs to be filled. Special attention will be given to detect the most important technological bottle-necks, how they relate to market demands, and how research can remedy them.

*Flexible manufacturing in the Danish food-processing industry - how to integrate management, marketing, and technology* (John Kjeldsen, The Aarhus School of Business). The goal of this project is to identify, from a market point of view, central decision problems and consequences of the introduction of flexible automation in the manufacturing process. This may create a basis for the development of an appropriate way to carry out strategic and technological decisions concerning flexible automation in the Danish food industry and in general. The project is divided into three phases:- 1. An analysis and an evaluation of flexible automation as an important competitive factor in the market for industrially manufactured food products. 2. The identification of central problems and consequences for the organizations in connection with the introduction of flexible automation. 3. An analysis of how the organizations have changed their marketing efforts after the implementation of FMS.

*Prototyping in the Danish food industry* (Preben Sander Kristensen, University of Aalborg). This project is concerned with utilizing, from the producer's point of view, the market knowledge which resides in the retail sector. Results from earlier research have shown that prototyping - i.e. a food producing company giving a retailer new product prototypes to test market reactions - is a common tool in the innovation process. Market information is obtained both quickly and inexpensively and the information adds to the difficult process of transforming consumer preferences into product qualities and vice versa. This technique will be illustrated in the project.

*Market surveillance systems for the food sector* (Klaus G. Grunert & Karen Brunso, The Aarhus School of Business). Building on several of the other projects, the aim here is to assemble key information about long-term trends in the marketing environment, and to provide aids in how they can be interpreted and converted into strategic alternatives. A market

surveillance system shall thus be established, which allows the detection of trends in, e.g., consumer lifestyle, competitors' competitive capabilities, distribution systems, and cultural factors relevant for the sales of food products. The system shall be applicable to several export markets in parallel.

### 5.3. *Projects on the Impact of the Vertical Structure on Innovation as a Source of Competitive Advantage*

*Primary producers and product innovation in the food sector* (Villy Søggaard, University Centre of Southern Jutland). Innovation in the primary sector could provide a promising strategy for the Danish food sector, because it represents both continuity and change in the strategy pursued by the sector in the past. Such a strategy, however, possibly calls for a reorganization of the relations between the primary producers and the manufacturing industry. Various aspects of the relation between the primary producers and the manufacturing industry will be compared and studied in this project.

*The role of the distribution system in the innovation process* (Hanne Hartvig Larsen, Copenhagen Business School). With increasing concentration in the retail sector in most European countries, and with the accelerating use of new information technology, it becomes increasingly difficult to obtain access to the outlets' shelves. The project aims at an identification of the threats and possibilities that various types of distribution systems involve and which must be heeded throughout the innovation process in order to avoid failure. On the basis of these elements, strategies are formed for the integration of the needs and demands of the distribution sector in the innovation process.

In addition, the projects *Controlling processes of production to guarantee process characteristics demanded by Consumers of food products: Paradigms and Danish experiences*, and *Prototyping in the Danish food industry*, which have been described above, also involve aspects of vertical cooperation in the context of product innovation.

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