ANNEX C8

PITA Project: Policy Influences on Technology for Agriculture: Chemicals, Biotechnology and Seeds

Danisco monograph

Annex C8

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Introduction to the PITA Project

Technological innovation in the agrochemical, biotechnology and seeds industries and in associated public sector research establishments (PSREs) has the potential to deliver more socially and environmentally sustainable farming systems and to improve the quality of life of citizens in Europe. This is particularly true of farms on the most fertile land. However, although policies developed in different areas may all aim to improve the quality of life, in practice, in their influence on company and PSRE strategies, they frequently counteract one another and so attenuate the desired effect.

Market-related factors also influence decision making in industry and PSREs, the most important for this project being the policies of food processors and distributors and also public attitudes and opinion, which often set more demanding standards than those of national governments and the EU.

The PITA project (see Project Structure) is developing an integrated analysis of policies and market-related factors relevant to the agrochemical, biotechnology and seeds sectors. The core of the project is an investigation of the impact of these factors on the strategies and decision making of companies and PSREs and the downstream implications of these decisions on employment, international competitiveness and environmental benefits. The final outcome will be feedback of our conclusions to policy makers and company managers.

The range of policies and other influences studied includes:

- policies to stimulate innovation in the agrochemical, biotechnology and seeds industries;
- purchasing policies of food processors and distributors;
- policies for international trade liberalisation;
- policies for the regulation of industry and farming (for environmental protection and public health and safety, particularly for pesticides and biotechnology);
- agricultural and farming support policies, particularly for crop production;
- policies to promote environmental sustainability and wildlife biodiversity in arable farming areas;
- public opinion and attitudes.

The overall aim of the project is to contribute to the development of sustainable industrial and farming systems and an improved quality of life by encouraging the development and uptake of ‘cleaner’ technology for intensive agriculture. Its objectives are:

- to develop an integrated analysis of policies and market-related factors relevant to technological innovation in the agrochemical, biotechnology and seeds sectors, to study their interactions and to develop hypotheses about their impact on strategic decision making in industry and PSREs.
- to study the influence of policies and market-related factors on innovation strategies in the agrochemical, biotechnology and seeds industries and PSREs, and their impact on decisions about product development, levels of investment and location of investment.
- to study the outcomes of the industry decisions investigated under objective 2, in their effects on employment, on international competitiveness and on their potential to deliver environmental benefits.

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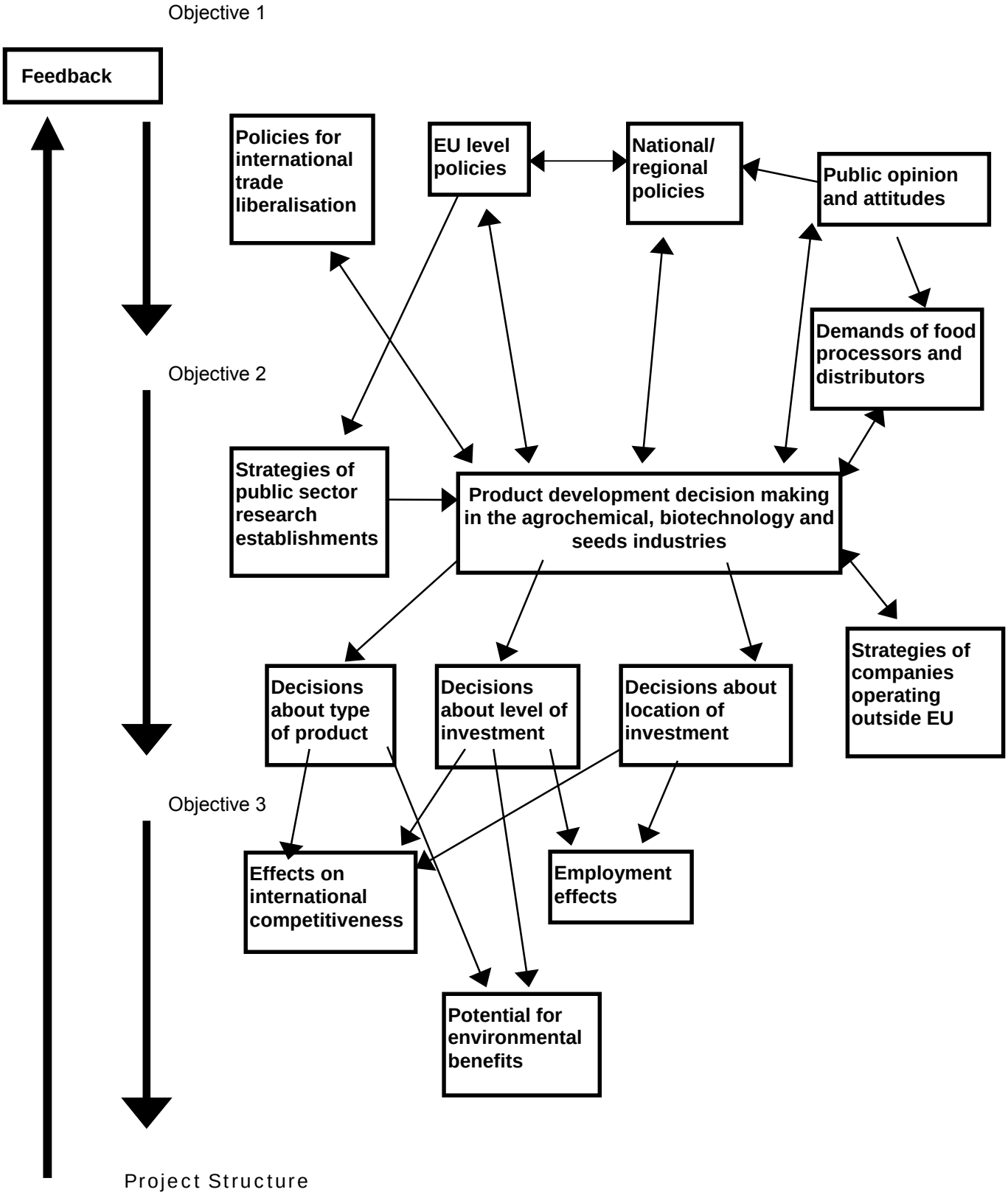

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1. Introduction

Products: Emulsifiers, ingredients, flavours, proteins, sweeteners, flexible packaging

Core business areas: food ingredients, sugar/sweeteners and flexible packaging

Non-core businesses: Foods, distillers, corrugated packaging, fish feed, animal feed

Market area: global

Customer base: the food industry, the primary sector.

Employees: approximately 16,000 worldwide

Data in this report was collected during 1999. This was quite a turbulent year from Danisco's perspective. The company merged with Finnish Cultor and Danisco purchased Sidlaw, a leading European supplier of flexible packaging. Towards the end of the year Danisco, like other biotechnology companies, was adversely affected by the increasingly negative attitudes to biotechnology in Europe during 1999, e.g. in terms of declining share prices. The picture presented below should be seen in the light of these rather turbulent conditions.

The first part of this report introduces the company, its history, its organisational structure, its subsidiaries, and its financial performance. The company's innovation strategy and its assessment of policy impact on innovation is presented in the remainder of the report and forms the basis for the tentative conclusions drawn.

1.1 History

The Danisco group was established in January 1989 by a merger of Aktieselskabet Danisco (Danisco plc), Aktieselskabet De Danske Spritfabrikker (Danish Distillers plc) and Aktieselskabet De Danske Sukkerfabrikker (Danish Sugar plc).

Danish Sugar was founded in 1872 by the Danish financier C.F.Tietgen, who also co-founded Danish Distillers in 1881. C.F.Tietgen was one of the leading industrialists of his day, and he was involved in a wide range of activities (trade, banking, food processing, etc.). Danisco is an abbreviation of *Dansk Handels- og Industri-Compagni,* i.e. The Danish Company of Trade and Industry[1]. The company was separated from Danish Distillers in 1934 as an independent limited company, and formed on the basis of a number of activities of Danish Distillers. As mentioned on Danisco's website, "these companies significantly influenced the industrial development of Denmark for over 100 years, each of them succeeding in gaining leading positions in Denmark within their original business areas".

Today Danisco is a major international supplier to the food industry. Core business areas are food ingredients, sweeteners and flexible packaging. Corrugated board packaging is also an important business area and Danisco is active in some areas of the European food and beverage markets.

[1] This was before companies had started focusing on core activities Tietgen – like Stanley Morgan, John D. Rockefeller, and other 19th Century business traders ruthlessly pursued a policy of monopolisation within the banking sector, within the slaughterhouse industry, within the Great Northern Telegraph Company, and (of course) within the sugar sector (see e.g. Lange, 1977, 1980).

1.2 Structure of Danisco

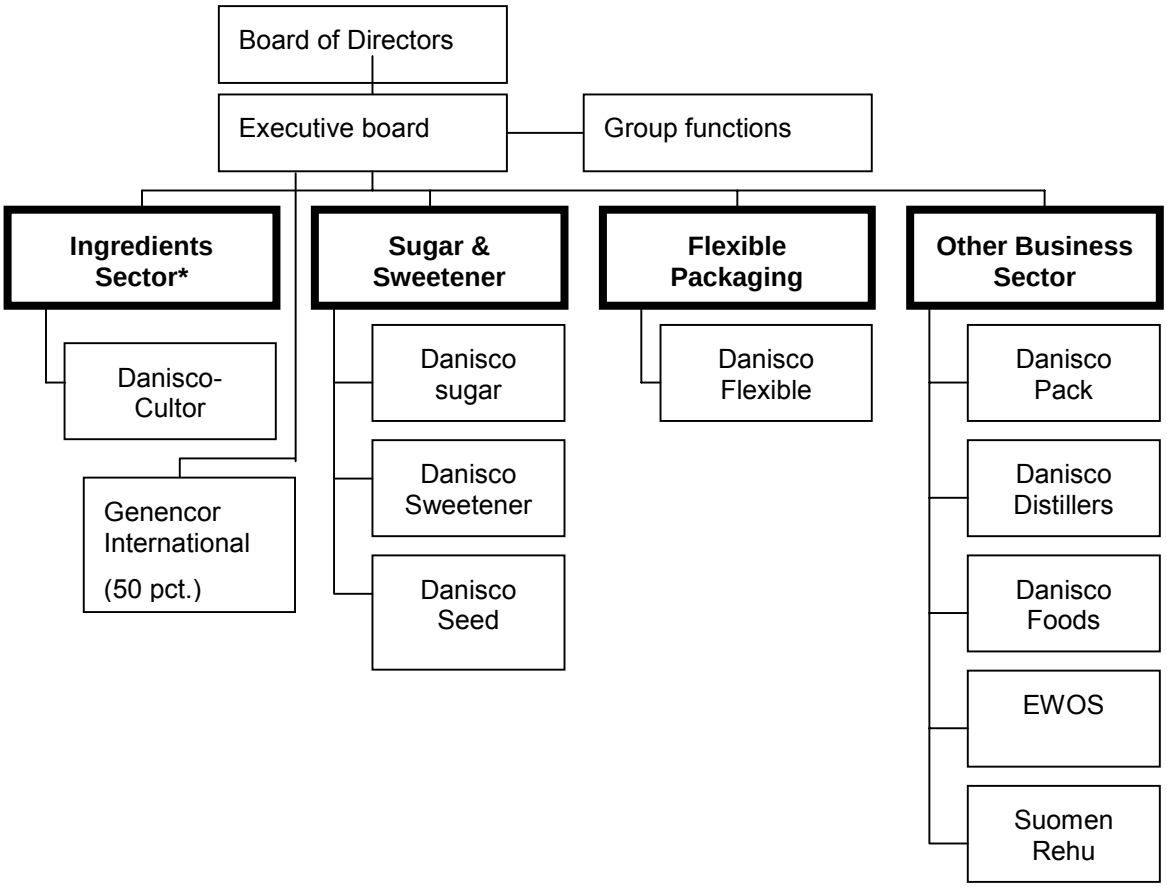

Figure 1 Danisco's internal structure

* Danisco Biotechnology is a sub-unit within Danisco Ingredients. Moreover, this sector has set up a number of regional innovation centres as explained in the text.

In March 1999, Danisco and Cultor announced a merger between the two groups. The merger was described by Danisco's CEO, Mr Alf Duch Petersen, as "a close to perfect match". The vision was to establish a "world class supplier to the global food industry" within Danisco's three core business areas and to obtain synergies in terms of improved market positions, exploiting cross-selling opportunities due to complementary product ranges, pooling R&D, combining marketing and distribution organisations, and saving costs.

The 'closeness' of the match is due to similarities in the histories of the two companies. Cultor was founded in the early twentieth century as a merger of a number of smaller sugar companies in Finland and subsequently expanded into other business areas (e.g. food ingredients) just as Danisco did. Similar linkages between primary production and processing can be found within other companies (e.g. Nestlé and Eridiana Beghin Say)[2]. Whereas some

[2] I wish to thank Stéphane Lamarié for drawing my attention to these examples. In general, vertical linkages between primary production and processing have often been 'organised' either in the form of vertical integration (as with agricultural co-operatives) or in terms of various forms of contract production. This may be explained by the structure of transaction costs within these sectors (see e.g. Ollila (1989) or Søgaard (1994)).

of these have spun off their seed activities, Danisco has cultivated the linkages between raw materials and processing, e.g. by having production plant close to key raw materials.

With a turnover in 1997/98 of DKK 18,802 m (≈ ECU 2,500 m) the Danisco group is Denmark's 9th largest company in terms of market value, and is larger than any companies in the food sector. As explained below, Danisco does not see itself as part of the food sector.

The organisational structure of The New Danisco is set out in the diagram above. The group has traditionally been organized in four sectors – Ingredients Sector, Sugar, Packaging, and Other Business (to be divested). The reasons for divesting these activities are presented in Section 2 below. Danisco does not produce agrochemicals, but it is active in the production of seeds, especially for sugar and fodder beet as well as peas, sunflowers, and oil-seed rape.

The Food and Beverage Sector (now included in the 'Other Business Sector') consisted of Danisco Foods and Danisco Distillers. Danisco Foods produces frozen vegetables, ready-made meals and auxiliary products such as salads for the European market.

The Sugar Sector has traditionally been subdivided into Danisco Sugar and Danisco Seed. With a near-monopoly position in important markets, the sugar sector has been described as the 'cash-cow' of the company[3]. After the merger between Cultor and Danisco, a separate Sweeteners Sector has been formed. This sector accounts for about one third of the group's revenues.

The Ingredients Sector has specialised in the production and marketing of food ingredients (stabilisers, emulsifiers, flavours, enzymes, etc.) and has set up five regional innovation centres in various parts of the world. These activities are clearly complementary to those of Cultor Food Science and they are now located within the Danisco-Cultor Sector. Danisco Biotechnology, which is responsible for biotechnology R&D, is a sub-unit in The Ingredients Sector. The Ingredients Sector is expected to grow substantially in future due to very high international growth rates in markets for functional food ingredients.

The Sugar and Sweeteners Sector is particularly relevant from the PITA perspective. Danisco's sugar activities have historically been closely related to the production of sugar beet, which is now located in Danisco Seed – a subdivision of the Sugar and Sweeteners Sector. According to its home page, "Danisco Seed breeds, produces and markets high-quality seeds, first and foremost for sugar beet, but also for fodder beet, oil-seed rape, peas and sunflowers. All products are marketed under the trademark MARIBO ®. Trial and breeding activities are conducted partly in Denmark, partly in the United Kingdom, Germany, France, Italy, Spain, Austria and Poland."

Danisco Seed has traditionally been oriented towards the EU market, but now has considerable markets in Eastern Europe, the USA and Canada. The export share (in terms of turnover) of Danisco Seed is over 80%. While the turnover of this division has been stagnant in Western Europe it has been doing quite well in Eastern Europe, where it has a very strong market position.

The Danisco group intends to focus on three core business activities: ingredients, sugar and sweeteners, and flexible packaging, organised within the three first sectors of Figure 1. Other non-core business activities (Danisco Pack, Danisco Foods, Danisco Distillers, Suomen Rehu and EWOS) will be divested. To give an impression of the composition of Danisco's activities the distribution of net sales by business sector is given in Table 1.1

Table 1.1 Net sales by business sector 1997/98, DKK million

	DKK million	Per cent
Ingredients Sector	3,375	18.0
Sugar sector	6,467	34.4

[3] A cash-cow is a large but mature product with relatively high rates of return, cf. Kotler 1997:72

Packaging sector	5,657	30.1
Food & Beverage Sector	3,445	18.3
Elimination of inter-sector net sales	-142	-.8
Total	**18,802**	**100**

Source: Adapted from Danisco reports and accounts 1997/98

1.2.2 Danisco subsidiaries

Danisco has a large number of subsidiaries throughout the world. (Table 1.2)

Table 1.2 Countries where Danisco has production facilities and/or sales units

Region	Countries
European Union	Austria, Belgium, Denmark, Finland, France, Germany, Holland, Ireland, Italy, Portugal, Spain, Sweden, United Kingdom
Rest of Western Europe	Norway, Switzerland
Eastern Europe	Croatia, Czech Republic, Estonia, Poland, Slovakia, Yugoslavia
North America	Canada, USA
Latin America	Argentina, Brazil, Chile, Colombia, Mexico
Rest of the world	China, Japan, Malaysia, Singapore

Source: Adapted from Danisco reports and accounts 1997/98

The activities of Cultor are not included in Table 1.2. Cultor is active in a large number of countries both in Europe, the United States, and China. Table 1.3 shows the relative significance of activities in various regions of the world. With over 75 per cent of net sales and more than 90 per cent of assets within the EU, Danisco is heavily dependent on developments in the European Union.

Table 1.3 Distribution of sales and assets by region

Region	Sales 1997/98		Assets, total	
	DKK million	pct.	DKK million	pct.
Denmark	4,642	24.7	10,136	49.0
Other EU countries	9,750	51.9	8,762	42.3
Rest of Western Europe	1,250	6.5	311	1.5
Eastern Europe	810	4.3	119	.6
North America	923	4.9	523	2.5
Latin America	547	2.9	676	3.3
Rest of the world	914	4.9	169	.8
Total	**18,802**	**100**	**20,696**	**100**

Source: Adapted from Danisco reports and accounts 1997/98

Of special interest from a PITA perspective is the geographical distribution of activities within seeds and biotechnology. Danisco is not active in the production of agrochemicals.

Table 1.4 Danisco Seed subsidiaries

Name of subsidiary undertaking	Country
Danisco Seed UK Ltd.	United Kingdom
Danisco Semences, S.A.	France
Danisco Semillas S.A.	Spain
Danisco Seed Italia S.p.a.	Italy
Danisco Seed Austria Gesellschaft mbH	Austria
Danisco Seed GmbH	Germany
Maribo Seed International, ApS	DKK
Danisco Seed Poland Sp.z.o.o.	Poland

Source: Adapted from Danisco reports and accounts 1997/98

Table 1.4 presents Danisco's subsidiaries within the seeds industry. All subsidiaries are European and are owned 100% by Danisco. With the exception of Danisco Seed Poland, all are located within the European Union. Danisco Seed has a relatively strong market position in Canada, however, and has expanded into the former Soviet Republics of Ukraine, Russia and Belarus.

1.3 Financial Performance

According to Danisco's financial report, "the 1998/99 accounting year was [generally] characterised by difficult trading conditions as a result of the global economic situation. Other contributory factors were the rainy summer in Western Europe and the exceptionally aggressive competitive environment in the corrugated board market. In the core business areas Danisco Ingredients was affected by increases in the prices of certain special raw materials and Danisco Sugar by a decrease in sugar-exports due to the crisis in Russia. Danisco Flexible saw a difficult year owing to problems in the restructuring of production in Denmark and tough competition.

Nevertheless, net sales, excluding the effect of acquisitions, were maintained. The operating profit before implementation of IAS 22 was also sustained at the 1997/98 level, in part helped by one-off income from disposals (DKK 83 million net). Undertakings acquired during the accounting year contributed around two per cent of the operating profit.

Seventy seven per cent of net sales was generated outside Denmark. Net sales of undertakings acquired during the year totalled DKK 711 million (DKK 975 million). Disposals reduced net sales by DKK 122 million.

Commenting on the accounts, CEO Alf Duch-Pedersen said:

'Considering the difficult market conditions which have characterised a number of our markets, the results are satisfactory. But now we must move on, in particular with leveraging the potential synergies of the merger between Danisco and Cultor.'

During 1993/94 to 1997/98 the average profit margins of both the Ingredients and Sugar Sectors have been around 15 per cent p.a. while the profit margins of both the packaging and food and beverage sectors have been considerably lower (5-7 per cent p.a.). In both sectors this was due to intense price competition. Despite this, both the packaging and food sectors have seen increasing net sales. In June 1997 Danisco Foods acquired Dutch Fri-d'Or, which has specialised in the production and development of frozen potatoes.

Within the sugar and sweetener sector, the production of sugar is dominant. In the preliminary statement of results for 1997/98 Danisco sugar reported net sales of DKK 6,134 million, most of which (more than 70 per cent) was sold in Denmark, Sweden, and Germany.

2. Organisational goals and innovation strategy

2.1 Overarching goals of the company

Danisco, like other companies, pursues a hierarchy of goals. Starting from the top, the following quotes define rather clearly what Danisco sees as the ultimate aims of its activities:

> "Danisco constantly strives to increase the company's market capitalisation and to give shareholders a competitive return on their investment in the group. An important prerequisite for this is a good relationship with other stakeholders, including customers, employees, suppliers and the societies in which Danisco operates."
>
> Danisco creates value, 1999

In its reports and accounts for 1998/1999, the group's focus on creating value for its stakeholders is explained:

> "Danisco wishes to create value for our stakeholders, i.e. shareholders, customers, employees, suppliers and society. Our shareholders are the most important single group of stakeholders and consequently Danisco's main aim is to create value for the shareholders through efficient operation of the group's undertakings. However, it is also the opinion of Danisco that value creation for shareholders in the long term requires that other stakeholders be taken into account. The group therefore finds it important to be in touch with and attentive to the wishes of these stakeholders."
>
> (Reports and Accounts 1998/99: 25)

Thus the interests of stakeholders other than shareholders are taken into account *in so far as* this is in the long-term interests of shareholders.

The booklet *Danisco creates value*, emphasises that managers and employees should "think as owners rather than as employees, confirms this impression. Management instruments promoting such thinking include employee shares, bonus schemes, share options and other incentives." (Danisco creates value, p. 7). In order to achieve the goals mentioned above Danisco has defined 5 financial targets:

1. to achieve an operating profit corresponding to a return of at least 15 per cent on the average invested capital,
2. to maintain an operating profit of at least 10 per cent on net sales,
3. to ensure an appropriate cost of capital and sufficient available liquidity,
4. to achieve an average annual growth in earnings per share of 10-12 per cent, and
5. to achieve net sales in the accounting year 2000/2001 at a level of DKK 25 billion as a subsidiary goal for company growth."

Growth is a very prominent goal for the corporation: "Danisco wants continuous growth and mainly within the core business areas. The growth will take place organically and through acquisitions. The group maintains as a subsidiary goal net sales in the accounting year 2000/2001 at a level of DKK 25 billion. Danisco expects to be able to finance the growth up to the 2000 on the basis of the present capital structure."

2.2 Company strategy

As mentioned in Section 1, Danisco is seeking to realise these objectives by focusing its activities on three core business areas: Ingredients, Sugar and Sweeteners, and Flexible

Packaging. The company wishes to obtain the critical mass needed to become a leading 'one-stop supplier' within all the three core business areas, i.e. to be so large and diversified within these fields of activity that customers need no other suppliers than Danisco. Within Food Ingredients, the company claims to be the leading supplier at global level (Danisco, Reports and Accounts 1998/1999: 24), and it is a leading supplier in Europe within Sugar and Flexible Packaging.

Biotechnology R&D is applied across the biological areas of the company oriented to rather different market needs. For example, Danisco Ingredients (now: Danisco-Cultor) is an important supplier in the rapidly growing market for functional ingredients: flavours, stabilisers, enzymes, emulsifiers, and various mixtures of emulsifiers and stabilisers. The aim of this Sector is to defend and improve its position as a one-stop supplier of functional ingredients through organic growth and acquisitions. Management has set growth rate targets of no less than 20 per cent per year in all markets. Research and Development are extremely important in attaining this goal. World-wide, Danisco Ingredients has set up five innovation centres to be close to its customers.

The acquisition of companies with a complementary product range is one important element in realising the strategy of becoming a one-stop supplier. Another element is product innovation to keep up with competitors. For example, in 1997/98 the Ingredients Sector spent some 5% of its turnover (DKK 163m ≈ ECU 22m) on R&D. This Sector claims to have the widest product portfolio of all suppliers of food ingredients. The Danisco-Cultor Sector has acquired 50% of American-based Genencor in an attempt to establish a strong platform for itself in biotechnology. Genencor is active e.g. in the processing of corn and seeds, in textiles, animal feed and food products.

Development costs of the three sugar divisions amounted to DKK 45 million – about 0.7 per cent of net sales. In comparison, Danisco Seed had research and plant breeding costs of DKK 108 million – or some 26 per cent of net sales (DKK 408 million). In other words, the seeds sector appears to be extremely R&D intensive.

Up until now, the bulk of the biotechnological R&D conducted by Danisco has been input trait biotechnology, but the company is increasingly focusing on output traits, e.g. the development of genetically-modified yeast in the Ingredients Sector together with Danisco Food, Danisco Seed has been involved in the development of frozen peas and has developed a model enabling Danisco to adapt new peas to consumer wishes more easily and systematically. This project has been carried out in collaboration with a number of public research institutions (The Danish Institute of Agricultural Sciences, the MAPP Centre, the Royal Veterinary and Agricultural University, and the Research Association for Processed Foods and Vegetables).

Table 2.1 Environmental releases of GMOs, Denmark
Summary notifications received up to 20 August 1999

Common name	Main trait	Company	Number of releases
Fodder beet	glyphosate tolerance	Danisco Seed	2
Fodder beet; Sugar beet	glyphosate tolerance	Danisco Seed	4
Fodder beet; Sugar beet	glyphosate tolerance	Maribo Seed	2
Maize	glufosinate tolerance	Hoechst Schering AgrEvo A/S	1
Oilseed rape	glufosinate tolerance; male sterility/fertility restoration	AgrEvo A/S	1
Potato	alteration of	Danisco Biotechnology	1

	carbohydrate composition; alteration of starch biosynthesis	Danisco Ingredients Danisco A/S	
Potato	alteration of starch biosynthesis	Danisco Biotechnology Danisco Ingredients Danisco A/S	1
Potato	alteration of starch biosynthesis	Danisco Biotechnology Grindsted Products Danisco A/S	1
Potato	alteration of starch biosynthesis; increased storage	Danisco Biotechnology Grindsted Products Danisco A/S	1
Potato	downregulation of amylose synthesis; increased storage	Danisco Biotechnology Grindsted Products Danisco A/S	1
Potato	downregulation of amylose synthesis; increased storage	Maribo Seed in Danisco A/S	1
Potato	oligogalacturonate lyase synthesis	Department of Physiology Carlsberg Laboratory	1
Potato	virus resistance (potato virus Y)	Landbrugets Kartoffelfond Danish Potato Breeding Foundation	1
Spring Oilseed rape	glufosinate tolerance; male sterility/fertility restoration	Plant Genetic Systems NV; The Royal Veterinary and Agricultural University	1
Spring Oilseed rape	glufosinate tolerance; male sterility/fertility restoration	The Royal Veterinary and Agricultural University	1
Sugar beet	frost tolerance; glyphosate tolerance	Maribo Seed A/S	1
Sugar beet	fungal resistance; glufosinate tolerance; virus resistance	Maribo Seed A/S	1
Sugar beet	glyphosate tolerance	Danisco Seed	8
Sugar beet	glyphosate tolerance	Maribo Seed	1
Sugar beet	glyphosate tolerance	Maribo Seed	1
Sugar beet	glyphosate tolerance	Maribo Seed in Danisco A/S	1
Sugar beet	virus resistance (rhizomania – beet necrotic yellow vein virus)	Maribo Seed in Danisco A/S	1

Source: Joint Research Centre, European Commission

Together with Monsanto and DLF Trifolium, Danisco Seed has developed a Roundup-ready fodder beet[4], (Table 2.1). A gene from a soil bacterium has been added to make the beet tolerant to Roundup. "In Danisco's opinion correct usage of transgenic plants in connection with farming certain crops is not only warrantable, but also offers considerable advantages, not least to the environment" (Danisco, Reports and Accounts 1997/98, p.8). The fodder beet was originally approved by the Danish authorities, and in 1997 the Danish Minister for the Environment submitted to the EU Commission that an application for marketing the beet be approved. However, with the imposition of an EU moratorium on genetically modified food products the approval of this application has been deferred. One concern of the companies behind the genetically modified beet is that alternatives (maize) could outperform fodder beets in the European markets.

Danisco's R&D strategy is not publicly available, but some of its central elements can be inferred from the interviews, from the company's commercial activities, and from available documents such as the annual reports. In the following we shall focus on the way in which the company seeks to reconcile market needs with technological developments on a long-term basis.

The company sees the use and development of biotechnology, not least within the Seeds Sector, as a key element in its long-term R&D strategy. Several reasons have been advanced for this commitment to biotechnology, but the following are probably the most important.

- World demand for food will be growing substantially in consequence of population growth as well as rising incomes over the coming decades. Modern biotechnology is seen as absolutely key to meeting this demand in ways which are environmentally benign.
- In the long term it will not be possible to keep genetically modified American products out of the European market.
- With competitors using advanced biotechnological methods of production, Danisco must follow suit to avoid "ending up in the same situation as car manufacturers trying to sell cars without airbags and ABS brakes".

Thus, the building of competencies and technological platforms within this field of activity is seen as essential to long-run competitiveness.

Being close to customers is an essential element of Danisco's innovation strategy. For example, Danisco Ingredients has set up regional innovation centres to be close to its customers in different parts of the world, networked globally to facilitate the exchange of knowledge.

The tensions between customer demand and technology push is most clearly visible, perhaps, in connection with the production of genetically-modified food products. As will be shown in Section 4 below, the Danisco representatives generally found consumer scepticism about genetically-modified products unwarranted and tended to distance themselves from the small but growing organic farming sector in Europe.

Nevertheless, Danisco Sugar has decided to introduce organic sugar in the Danish market. Organic sugar is sugar made from organically grown sugar beets. "We've monitored developments in the organic produce market and consumer wishes in Denmark very closely. And we now believe there is a good basis for selling organic sugar." Whether or not the product turns out to be successful in the market, it clearly is an example of the market-oriented philosophy of Danisco's innovation activities.

Another important element in bridging the gap between technology drive and demand pull factors in the long term is to incorporate consumer concerns into the organisation's basic value system. As will be expanded on in Section 5 below, Danisco "respects the fact that development, production and trade influence the environment; … invests in developing

[4] The Agricultural Council and the National Forest and Nature Agency, the National Institute for Plant Breeding, and the Agricultural Advisory Centre have also been involved.

environmentally friendly products and processes by using cleaner technology [and] will, by making regular technical improvements and providing training and motivation, create a safe environment for our employees." Finally, "Danisco communicates environmental objectives, initiatives and results, internally and externally." (Danisco's annual report for 1997/98).

3. Decision-making on R&D

3.1 R&D decision-making

Major strategy decisions on R&D are made by the management of each division (Sector), along with, for example decisions on developing a particular seed, for example.

Danisco Biotechnology, is responsible for supplying biotechnological R&D on a non-profit basis to all Danisco divisions. All its activities are decided on and paid for by the individual divisions. Danisco does not have any centralised 'corporate research', due to its divisions being active in rather different business areas. The divisions are also free to purchase R&D outside *Danisco Biotechnology.*

Minor (operational) decisions on the choice of specific technical solutions are made by the R&D Department, which also decides which tests are to be made. Such decisions are informed by inputs from the sales unit or members of the R&D staff. Sales units will work out information on important market trends, policy developments, and competitive positioning of the company in the international market.

As a result of this relatively centralised approach to decision-making within each Sector, conflicts of interest are suppressed but such differences may still exist among sector managers, and conflicts sometimes arise over who should carry out the research and development activities within or outside the organisation.

3.2 R&D strategy

The interviewees were reluctant to go into detail concerning R&D strategy but some central strategic elements emerged during the interviews.

From Danisco's perspective, the most important problem to solve in the long run is to feed the rapidly growing world population in an environmentally sustainable way. This will require a substantial increase in global food production. The challenge is to reconcile the needs for higher efficiency and higher productivity with the need for more environmentally benign methods of production. The use of genetic modification is seen as essential to resolving this dilemma.

In contrast, organic farming is thought to represent a return to pre-industrial farming methods. While it was conceded that organic farming could be environmentally benign in some respects, it was not believed to bring the increases in productivity and efficiency needed in future.

It was specifically mentioned that customers often fail to understand that the food surpluses of the EU are quite small when compared to the annual production and consumption of food products. These surpluses serve to stabilise markets, which would otherwise be subject to random fluctuations in supply depending on weather conditions. If agricultural productivity had not been growing steadily with the industrialisation of farming methods since World War II, the world would have seen far more comprehensive food shortages and problems of starvation than it has.

According to interviewees, Danisco has tried to take account of public concerns by seeking to be as open as possible. For example, the tests conducted on genetically modified beet can be followed on the Internet and a large number of tests have been conducted to make sure new products are safe and to reassure the public as well as the regulatory system of their safety.

The relationship between new and existing technical solutions is complicated. It is not always a question of *balancing* the exploration of new technical solutions (such as 'clean technologies') against the exploitation of traditional ones. In many cases new products – or modified products – add some valuable properties to existing ones, properties which may enable the company to sell an existing product in new markets, for instance.

To the extent that new products outperform existing ones, the creative destruction involved may detract from the incentives to develop something new, but often the market synergies between new products and existing ones are dominant: New products and new technical developments achieved by the company itself rarely make existing resources redundant, but allows the company to employ its resources in a more profitable way.

4. The general impact of policies on innovation

> "You will not see substantial changes in our activities in direct consequence of policy decisions made in Denmark or the EU. We may have to face the fact that some of our products cannot be sold within the EU, but we shall then have to go somewhere else."

Danisco has been active in biotechnology for a number of years. As shown in Table 2.1, the company has a large share in the environmental releases of GMOs in Denmark. Many of these have been conducted to develop beet with glyphosate (Roundup) tolerance, and since the late 1980s Danisco and Monsanto have co-operated on developing Roundup-ready sugar beet, and with Monsanto and DLF-Trifolium, Danisco has developed a Roundup-ready fodder beet. Unlike Monsanto, Danisco does not produce agrochemicals and does not stand to gain from increased sales of Roundup, so we asked about Danisco's motivation for undertaking this line of R&D.

> "The incentive ... emanates from the fact that – when 'protected' against competing herbs - non-resistant plants are themselves affected by the pesticide. This reduces yield. With herbicide-resistant plants doses can be reduced, and more toxic herbicides can be avoided. Roundup is not poisonous to animals, and is friendly to the plant's surroundings – except for its competing plants. Therefore, by growing herbicide-resistant crops the farmer reduces spraying expenses and obtains a higher yield. This is the ultimate source of profit, which the seed producing company has to share with the farmer."

In 1997 the three companies applied for permission to grow and sell this beet. The Danish Ministry of the Environment conducted a risk assessment, and in October 1997 the Minister recommended approval of the application by the EU Commission. However, at the time of writing it appears that the approval will be blocked by the moratorium.

According to Mr Claus Christiansen, *Danisco Biotechnology*, Danisco's overall strategy is affected only marginally by policy measures at national or EU level. The main reason for this is the company's increasingly global scope.

> "With sales in all continents we have to accept that there are differences across the world. Our market opportunities in some areas may be limited for a while, of course, but this is something we shall have to live with…. Obviously, if this type of research were to be prohibited altogether within the EU, we should have to consider what to do, but this is not at issue. A moratorium within the EU preventing us from making field experiments would [5]play only a marginal role to us… Had we developed something we should like to produce, we could do so outside Europe."

[5] The interview was made before the *de facto* moratorium was imposed. The precise nature of the '*de facto*' moratorium is somewhat uncertain. According to Danish authorities, the 'moratorium' applies only

Secondly, political changes are thought to have a very short time perspective ("two to three years") – far shorter than the long-term strategic perspective of the company.

> "The moratorium may prevent us from marketing genetically-modified products for a number of years, but there is no reason why this should affect our research. New products will be developed and kept in a waiting position until the moratorium is lifted again – by which time they will have been tested commercially in other parts of the world"

Finally, the bulk of Danisco's activities are oriented towards the business-to-business segment.

Although the Dossier confirms that Danisco is indeed present world-wide (Table 1.3), more than 75 per cent of Danisco's sales are in EU markets (Table 1.3). More specifically, all subsidiaries of Danisco Seed are located in Europe. This may change, of course. As mentioned in the Dossier, Danisco Seed has a strong market position in Canada and is expanding in the former Soviet Republics of Ukraine, Russia and Belarus.

Still, one would expect Danisco as a whole to be sensitive – if not vulnerable – to changes in EU markets. This expectation is supported by financial analysts who believe that the share prices of Danisco and other biotechnology companies may fall as a result of the EU moratorium on genetically modified products.

Also, the argument that new products will simply be in line for the EU market has been questioned by Aksel Nielsen, managing director of DLF Trifolium. He believes that maize could easily outperform fodder beets in the European market, if the genetically-modified beets cannot be marketed for another three years: "If we are stopped for the next three years, the maize people will have every opportunity to overhaul us and destroy our market position"[6].

Danisco was asked more specifically about the impact of individual policies, labelling, patenting, science, technology and innovation, and environmental policy.

4.1 Labelling

The demand for labelling was accepted as fair.

> "We all want to know what we buy. For obvious health reasons this applies to food products as well. I do not think industry has any problem whatsoever with consumer declarations."

Moreover, labelling was not expected to have any major impact on consumer demand. For example, it was mentioned that a genetically modified tomato has been marketed for some years in the UK without problems.

However, the customer's interpretation of the information conveyed by a GMO label was feared to be somewhat uninformed or distorted.

> "As a technician one finds oneself in a schism between the warning signals that come up and the practices to which they refer. This *does* represent a problem. ... You are not allowed to produce radioactively radiated food products in Denmark,

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to marketing permissions and not to field experiments, but this interpretation was said to be disputed. In the so-called Article 21 Committee five countries (France, Greece, Italy, Luxemburg and Denmark) are capable of blocking marketing permissions. However, *any* Member country would – formally – be able to overrule such a decision in the Council of Ministers. In this case the marketing permission would apply throughout the European Union. This latter possibility was considered improbable, though, due to political pressures not to force marketing permissions on other member countries against their will.

[6] *Børsen*, August 3, 1999

> which is irrational. Radiation kills micro-organisms, which prevents putrefaction. The scare image you convey is one of ever-lasting strawberries. Consumers don't like that – but they have no reservations against preserving food in their own freezer."

When asked to explain this paradox, Mr Christiansen argued that irradiated foods arouse connotations of nuclear power. Similarly, genetically-modified foods are associated with

> "the F word: F for Frankenstein Food. Until we get rid of the F word, we shall not have a general acceptance of biotechnology".

Christiansen expressed as his opinion that this image will fade away – "but this is going to be a very slow, long-term process. " One reason for this, he explained, is that biotechnology is seen by many as an American technology, despite substantial European contributions.

Recently, the leading Danish supermarket chains[7] (like supermarkets in other countries) have joined forces to be able to enforce a label on genetically-modified food products. Danisco's comment was that:

> "... we are mainly – and increasingly – focussing on the business-to-business segment. We are not directly faced with the customer. Therefore, our way of thinking differs from that of the supermarkets, who are anxious not to lose customers. The Danish retail climate is one of unyielding price competition – no other parameter really seems to count. Their profit margins are small, and they do not want the labelling issue to become a competition parameter."

To sum up, Danisco's attitude to labelling was somewhat ambivalent. The demand for labelling was seen as reasonable, and the expectation was that the opposition to genetically modified foods would gradually fade as customers realised "the economic benefits on their side of the fence". Due to popular scare images of genetically modified food products (the "F word"), it was feared that labels could be misinterpreted. Despite this, labelling was not expected to have a strongly negative impact on sales.

4.2 Patenting

The changes of the EU patenting regime were seen mainly as an adjustment to changes within the WTO. Danisco would like to see "a more robust international system of regulations implemented on a continent by continent, or trade bloc by trade bloc, basis. The national stages are terribly expensive." Changes in the European patenting system did not affect Danisco's strategy in any way, however:

> "There has always been a patenting system, and we have always aimed for the best possible protection of what we had made. ... The current rules are not all that important, therefore. We have an idea of how far we can get, and this is what we aim at. Nor do we spend more on patents because the European system has changed: we have some knowledge we wish to protect, and we spend whatever is needed to do so."

In the Danish debate it has been argued that European companies might find it attractive to locate their biotechnological research activities in the United States due to the superior protection of intellectual property rights under American legislation. Danisco dismissed this view, however. Even in the absence of any patent protection in Europe, biotechnology companies would have to be present in the European market to prevent competitors from

[7] The Federation of Danish Consumer Co-operatives (*FDB*), Danish Supermarkets (*Dansk Supermarked*), and the Associated Grocery Stores (*DSK*) are behind this initiative. The three chains account for more than half of the Danish market.

exploiting their knowledge in this market. Patenting therefore was not seen as important in terms of affecting company strategy.

4.3 Science, technology and innovation

Danisco has participated in the FØTEK programmes and found them worth while. It was stressed, however, that "the academic world is far removed from the world of practical production".

> "FØTEK 1 was characterised by very large projects with a lot of rodomontade and bulging budgets. But nearly all projects were far removed from the companies. FØTEK 2 was largely carried out within the Food Centre (*Levnedsmiddelcentret*). And we don't really know what FØTEK 3 is going to be like."

A comparison was made with Danisco Biotechnology's relationship to other divisions:

> "Unless we make sure we are attending to *their* needs on a continual basis, they'll most likely dismiss our ideas. In all likelihood, we would end up with an unsaleable product. Not *necessarily* because no one would want to buy it, but also because 'not invented here' exists within all sorts of organisations. This also applies when a company and a university co-operate."

Danisco's presence in these programmes does not hinge on their output in terms of new products or processes. "In reality we are present … to provide an alibi for funding the universities". The company's long-term commercial incentive for this is to support the building up of competencies within biotechnology.

> "Do not think I am saying that these programmes are no good, for they certainly are. There is a grain of salt in what they are working with, and university people develop their skills within these areas. When private companies employ these people, there is an inflow of knowledge which is very important."

In conclusion, public science, technology and innovation programmes are seen as important, not primarily because of their direct output in terms of new products or processes, but mainly due to the competence building to which they give rise.

4.4 Environmental Regulation and Consumer Confidence

Danisco has an internal Department of Environment and Energy, and its factories are obliged to prepare green accounts. It has a policy of developing environmentally friendly products and processes and it operates an environmental soft-ware system.

Environmental issues are therefore being taken seriously by the company. However, its discourse on environmental protection departs significantly from more popular versions of environmentalism, particularly, that of the organic farming sector. For example, organic farmers are not allowed to use genetically modified seeds for fear of adverse environmental consequences. In contrast, Danisco believes that "correct usage of transgenic plants in connection with farming certain crops is not only warrantable, but also offers considerable advantages, not least to the environment" (Danisco, Reports and Accounts 1997/98, p. 8).

Danisco argued that "You will not see substantial changes in our activities in direct consequence of policy decisions made in Denmark or the EU". However, the respondent warned against the social consequences of such policy decisions, adding that:

> "Denmark and the EU – by cutting themselves off from an important business area – [could] end up having to import its products without being able to produce them at home... A continued development of organic farming could eventually make

> Europe unable to feed its own population. This could lead to increasing food prices and a declining standard of living in Europe.[8]"

When asked to what extent this scenario hinged on the development or non-development of biotechnology, he answered:

> "I see the reaction to gene technology as part of a wider reaction to industrialised farming in general. People want a different sort of agriculture with undocked pigs curling up their tails, going about rooting in the soil, getting tapeworms and other diseases."

Danisco is not opposed to public regulation of biotechnology in general, however. In fact Danisco's representatives accepted the view that a credible European regulation might positively contribute to public acceptance although Mr Christiansen felt that politicians were "playing ostriches":

> "It is important that our politicians understand these issues and choose to be on the right side of the barricades. They should understand that this [the development of biotechnology] is a significant social development; they should assume responsibility for sanctioning it; and they should make sure it actually takes place. Considering the very substantial amounts of public money invested in biotechnology programmes, etc., this, in a way, is what they have done. It seems completely bizarre, therefore, that they fail to commit themselves publicly and explain what *in fact* they think about this. In this respect politicians have failed to meet their obligations."

The frustrations voiced above may be seen to reflect a political dilemma: Biotechnology programmes are supported by the political system in turn to support Denmark's interests as an advanced food exporting nation, but at the same time this system has to be attentive to widespread public concerns about the hazards of biotechnology.

Figure 5.2 illustrates this dilemma.

4.5 Company discourse on environmental issues

In Danisco's Annual report for 1997/98 it is stated that

- Danisco respects the fact that development, production and trade influence the environment
- Danisco invests in developing environmentally friendly products and processes by using cleaner technology.
- Danisco will, by making regular technical improvements and providing training and motivation, create a safe environment for our employees.
- Danisco communicates environmental objectives, initiatives and results, internally and externally.

Danisco recommends that "environmental management be based on the international standard ISO 14001. In some cases it may be relevant also to apply the EU's environmental management system, EMAS". The Annual Report states that Danisco factories in Denmark prepare green accounts every year.

Danisco operates its own environmental software system, DEMS (Danisco Environmental Management System), processing data on energy consumption, waste, emissions, etc., thereby enabling the company to set targets for the various Sections at factory level.

Environmental objectives are not the only non-commercial concerns of the stakeholder philosophy. Thus, in its Annual report Danisco states that

[8] The respondent emphasised that these were his own views, not those of the company.

> ".. The growing interest in the role of companies in society naturally leads Danisco to want to work long term with such issues. The issues will be given priority now and in the years ahead through the formulation of policies, implementation of actions and reporting on goals and their achievement. The most important stakeholders in an ethical/social context are our employees, customers, suppliers and organisations. It is of vital importance that Danisco has an intimate knowledge of the demands of our stakeholders which in particular concern:

- human rights
- employee conditions
- social responsibility

> These are the areas – their scope and content have yet to be defined – in which Danisco wants to formulate clear policies. In the years ahead the group's reports on ethical and social issues will be included in the annual report in order that our stakeholders may follow the developments in Danisco also in this area." (Annual report 1998/99, p. 25)[9]

5. Analysis and conclusions

According to the interviews reported above, Danisco feels that it can remain relatively unaffected by policy measures at national or EU level, and that the European Union may have to pay a high price for its reservations against biotechnology.

In view of the fact that 75 per cent of Danisco's sales are within the EU, the claim that there will be "no substantial changes in our activities in direct consequence of policy decisions made in Denmark or the EU" is not altogether convincing. As mentioned in section 4, Danisco's partner in developing glyphosate-tolerant beets, DLF-Trifolium, has expressed serious concerns that maize may get a competitive lead due to the European moratorium. Also, independent financial analysts expect Danisco's share prices to decrease in response to this development.

Moreover, considering the present size of the organic sector in Europe, the threat of a continuing development of organic farming making Europe unable to feed its own population may appear somewhat alarmist.

It is conceivable, however, that Danisco's *strategy* will remain unchanged provided the *de facto* moratorium is lifted in a few years. In other words, Danisco remains committed to a long-term technological trajectory based on biotechnology and genetic modification. The group expects this technological trajectory to dominate in the future, and it cannot afford not to develop its competencies within this field of activity.

According to one interviewee:

> "Our competitors will continue to develop their products along these lines, and we have to follow suit if we are to stay in business. In the long term we do not think it will be possible to keep American products away from the European markets, and we cannot afford to risk ending up in the same situation as car manufacturers trying to sell cars without airbags and ABS brakes."

The interviewees accepted that safety concerns are legitimate, but clearly felt that such concerns had been given their due with the extensive programme of field trials since 1992.

[9] As an example of the company's commitment to such issues, Danisco Sugar is taking part in a project aimed at improving health and safety at the work place. (Danisco Magazine, No.1.1999)

As mentioned above, a strong emphasis was placed on long-term competence building within this field of activity.

In view of the small scale of organic farming in Europe, the strong reactions to organic farming were somewhat surprising. As mentioned, the popular support for organic farming was seen as a reaction to industrialised farming methods in general. The image of organic farming was a somewhat nostalgic, technologically regressive one of “undocked pigs curling up their tails, going about rooting in the soil, getting tapeworms and other diseases.” In contrast, biotechnology was seen as the main source of precise, environmentally benign, productivity enhancing methods of production for the future.

In a sense, these conflicting discourses reflect two different perspectives originating at opposite ends of the food chain. *Danisco Biotechnology*, for example, produces R&D for divisions supplying the primary sector, whereas the image of pigs merrily rooting in the soil would be appropriate for the marketing of free range pork for urban customers.

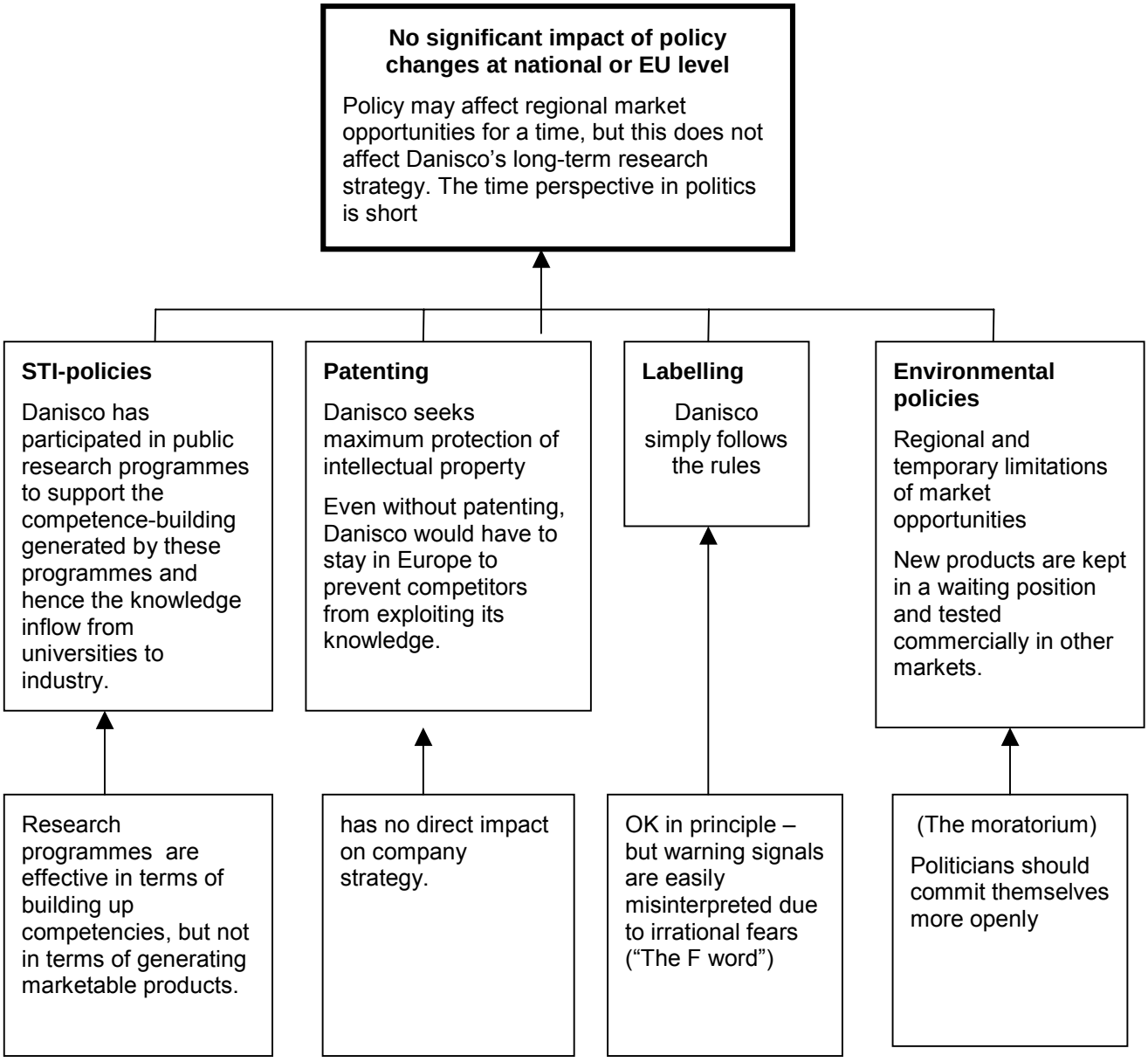

Figure 5.1 Summary of policy influences on strategy

The gulf between the mainly technical discourse underlying Danisco's research efforts and the political and market logic to which the company must respond was obviously frustrating. Consumer fears were dismissed as irrational, and politicians were thought to be playing ostriches.

It was emphasised that Danisco is not opposed to labelling; customers have a right to know what they buy. But the uninformed public was feared not to understand the labels rationally. Customers were thought to associate irradiated foods with nuclear power and perceive genetically modified foods as Frankenstein food.

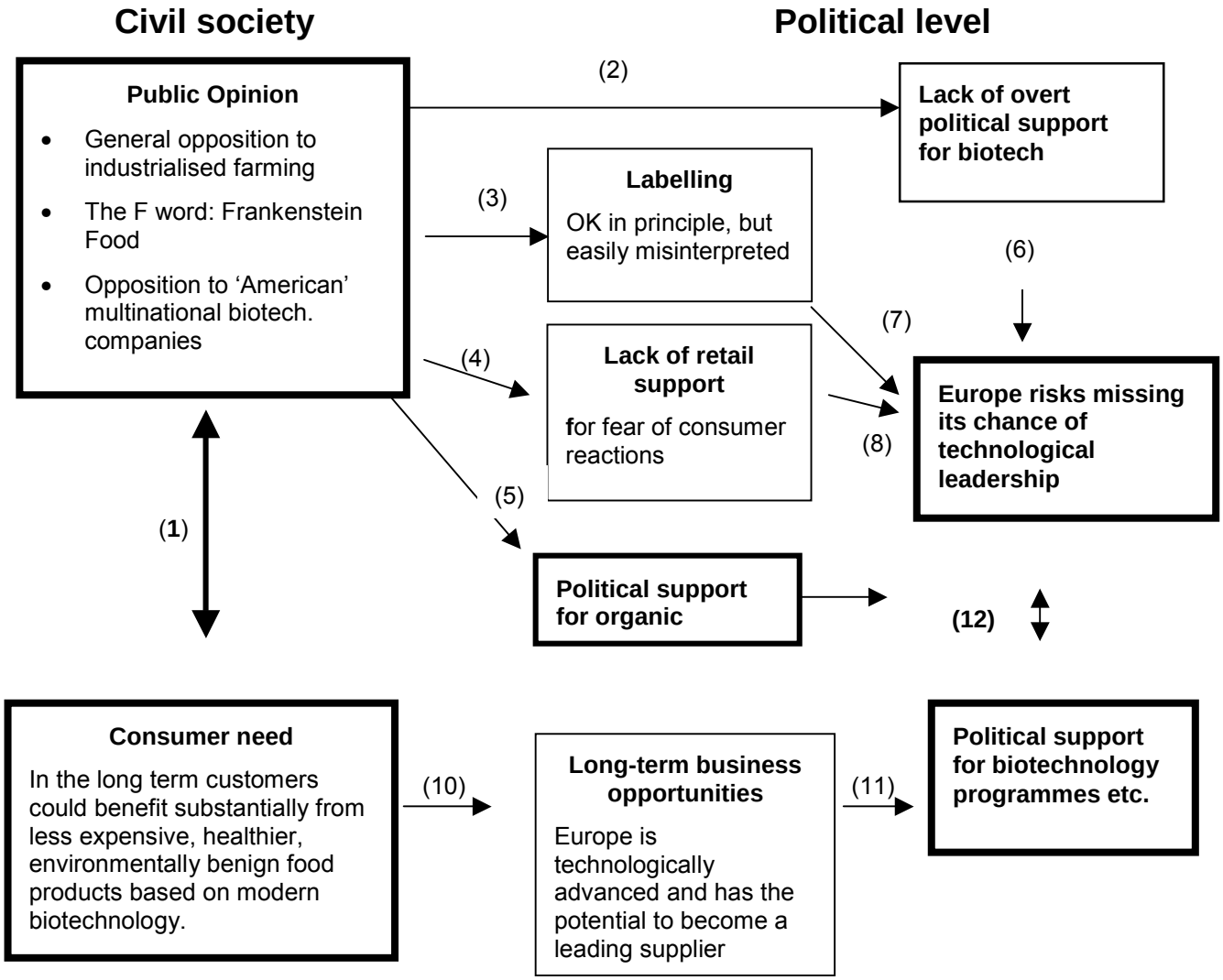

Figure 5.2 The European Dilemma

Figure 5.2 shows how the basic tension between public opinion and Danisco's perception of consumer need leads, in their view, to policy inconsistencies. Due to the generally sceptical or negative public opinion concerning biotechnology, there is a lack of political support for biotechnology in Europe (arrow 2).

From Danisco's point of view labelling is liable to be misinterpreted in these conditions, and retailers are afraid of supporting the introduction of genetically modified food product (arrows 3 and 4). At the same time the reaction to modern, industrialised farming methods leads politicians and consumers to support the development of organic farming – which was not thought to be sufficiently productive to feed the world in the future (5). Due to all of these factors, Europe risks missing the opportunity to become a technological leader– in spite of the consumer need, the long-term business opportunities and the political support for biotechnology programmes etc. (arrows 10-11).

Hence, the underlying tension between (what Danisco sees as) genuine consumer need and public opinion translates into tension at the political level between support for biotechnology projects etc. motivated by concerns for long-term competitiveness and a very tight regulatory environment.

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