Quality Assurance and Pork Exports : a Case Study in Denmark

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Cahiers d'économie et sociologie rurales, n° 65, 2002

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Assurance qualité et exportations de viande porcine : l'exemple du Danemark

Résumé – La structure et le système d'assurance qualité mis en place au sein de l'industrie porcine danoise ont largement contribué au succès de cette dernière dont les exportations ne cessent de croître à l'intérieur comme à l'extérieur de l'Union européenne. Le système qualité danois intègre des critères aussi différents que la sécurité alimentaire, la qualité de la viande, le bien-être animal et l'impact environnemental. Un premier niveau de qualité est garanti par une gestion du producteur au consommateur de tous les porcs danois ; d'autres niveaux de qualité, plus élaborés, répondent aux demandes spécifiques de certains marchés-cibles.
Le long passé coopératif explique une organisation intégrée verticalement ainsi qu'une extrême concentration de l'industrie de l'abattage. Pratiquement toutes les exploitations livrent leurs porcs à l'une des trois coopératives chargées de la transformation, et ces trois entités sont elles-mêmes réunies au sein d'une structure commerciale unique. Cette structure permet d'obtenir des standards de qualité uniformes pour toute l'industrie et de répartir les primes à la qualité aux différents niveaux de la filière. La gestion et le contrôle de l'assurance qualité nécessitent une coopération entre les secteurs public et privé. Enfin, pour concevoir une stratégie future, l'industrie porcine danoise doit satisfaire des exigences en apparence contradictoires : d'une part, équilibrer les coûts supplémentaires liés à une plus grande qualité, d'autre part, obtenir une qualité uniforme avec une plus grande différenciation du produit.
C'est cette combinaison, exceptionnelle, d'éléments sociaux et structurels qui rend bien improbable l'imitation du système porcin danois.

Mots-clés :
assurance qualité, stratégie industrielle, viande porcine, Danemark

Quality assurance and pork exports : a case study in Denmark

Summary *– The Danish pork industry's structure and quality assurance are examined to understand the key elements contributing to its success, as measured by the ability to compete in multiple export markets both within and outside the EU. Quality assurance includes food safety, meat quality, animal welfare, and environmental impact. A basic level of quality is guaranteed through farm to table management for all Danish pigs, but some export markets require additional quality elements. The industry is cooperatively owned and vertically integrated, which makes it easier to monitor quality and to provide price incentives for quality throughout the chain. Quality assurance is managed and monitored through cooperation between industry and government. The Danish pork industry faces two trade-offs in designing future strategy: a) balancing added costs with added quality and b) balancing uniform quality with additional product differentiation. Although other exporting countries are facing increased pressures to assure quality, the unique combination of social and structural elements embodied in the Danish pork system will make it difficult for other countries to achieve the same degree of quality assurance.*

Key-words:
quality assurance, industry strategy, pork, Denmark

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This research was supported by the Illinois Council on Food and Agricultural Research and by the European Union Center at UIUC.

SYSTEMS to manage and assure quality are increasingly used in international food product trade (Caswell *et al.*, and Hooker, 1998). Quality assurance improves product quality, reduces variation, improves internal processes, simplifies links between different parts of the value-chain, shows compliance with regulations, and enhances responsiveness to customers (Mazzocco, 1996). Quality assurance is becoming more important as consumer demands evolve in global markets (Regmi, 2001).

The Danish pork industry provides an interesting example of quality management and assurance. In this paper, the Danish pork industry's structure and quality assurance are examined to understand the key elements contributing to its success, as measured by the ability to compete in multiple export markets both within and outside the European Union (EU). Denmark is one of the world's largest exporters of pork, and exports 80 percent of total pork production. Other pork exporters produce at lower cost, but Danish exporters distinguish their pork based on food safety, eating quality, environmental aspects, and animal health. Denmark has succeeded in meeting evolving demands for quality both within and outside the EU. This study examines the key elements that contribute to quality assurance in the Danish pork industry. An important motivation is to learn whether the Danish system can be reproduced in other countries.

The Danish pork industry is unique in the combination of the following aspects (Agriculture and Agri-Food Canada, 1997):

- Cooperative ownership of processing, which may provide incentives for compliance with quality and safety standards;
- Dependence on export markets with extensive quality requirements, which creates consciousness of quality issues and their importance for the success of the entire industry;
- The Danish government's role in assuring quality and safety through the enforcement of regulations;
- Quality assurance is tailored to individual importing countries' specifications.

The paper begins with an overview of the Danish pork industry's competitive position in world markets, followed by a description of the industry structure and quality assurance. We then turn to an analysis of the key elements contributing to quality assurance and the strategic decisions facing the Danish industry. Unless otherwise noted, the information in this paper is based on direct interviews with industry participants in 1999 and on industry documents. To protect the confidential-

ity of the interviews, respondents and individual firms are not identified in the quotations used below.

DANISH PORK IN WORLD MARKETS

Denmark exports a large volume and variety of pork products all over the world, including live pigs and sows, carcasses (fresh/frozen), primal and sub-primal cuts, by-products, as well as canned and processed food (Danske Slagterier, 2002). In 2001, Denmark exported 1,549,975 tons of pork for a value of nearly 29.9 billion DKK (7.44 DKK = 1 euro per 6/30/01). About 62 % of export volume are sold within the EU and 36 % are sold to non-EU countries (Table 1). The major markets in the EU are Germany, United Kingdom, France and Italy. Outside the EU, the major markets are Russia, Japan, and the United States (US). In 2001, Denmark's exports to non-EU countries made it the third largest exporter in world markets outside the EU, after Canada and the US (USDA, 2002a and USDA, 2002b). If exports to other EU countries are included, then Denmark is the largest pork exporter in the world. Japan is the world's largest importer of pork, and Denmark competes directly with Canada and the US in the Japanese market. During the 1990's, Denmark and the US each provided 20 to 25 percent of Japanese imports (Fabiosa and Ukhova, 2000).

Table 1. Exports to Major Destinations from Denmark, 2001

Destination	Quantity ('000 tons)	Share (percent)
Germany	314	20
United Kingdom	301	19
France	80	5
Italy	137	9
Other EU	134	9
Total EU	966	62
Russia	107	7
United States	52	3
Japan	230	15
Other Non-EU	195	13
Total Non-EU	584	38
Total	1,550	100

Source: Danske Slagterier, 2002a

Denmark's pork industry is unusual in its ability to participate in both markets within and outside the EU. Outside of the EU, the major competitors, Canada, US, and Brazil, all have lower feed costs, which are

a primary element of production costs. The Common Agricultural Policy raises these costs for Danish producers, and as a result, the Danish industry receives export restitution payments (about DKK 109 million in 2001). Within the EU, Denmark competes with the Netherlands, France, and increasingly with Poland, but has been able to expand its export volume (USDA, 2002b). In the view of the Danish industry participants, this success is due to the ability of the Danish pork industry to meet quality demands in multiple markets both within and outside the EU. Next, we discuss how quality is assured in Denmark and how this quality assurance differs from that of other major exporters.

STRUCTURE OF THE DANISH PORK INDUSTRY

In Denmark there is a long tradition of cooperative ownership dating back to 1880, which has resulted in an integrated structure including production, slaughtering and processing (Danske Slagterier, 1996). More than 90 percent of all pig meat is produced in cooperative plants, owned by the producers. Although the number of cooperatives was once very large, mergers and acquisitions over time have resulted in today's three big slaughterhouses. The slaughterhouses are Danish Crown, Steff-Houlberg and TiCan, which together have 22 slaughter units. In 1998, 20,000 pig producers supplied more than 19 million pigs to the three slaughterhouses. All three are members of the umbrella organization Danske Slagterier (Danske Slagterier, 1996) [1].

Producers contract with one slaughterhouse for delivery of all their pigs. The producer can change slaughterhouses only with advance notice, normally at least one year. The company is required to take all the producer's pigs at all times, as long as they fulfill the quality parameters (Danske Slagterier, 1996).

On a weekly basis, the three slaughterhouses, organized via Danske Slagterier, agree on a weekly base price for delivered hogs, which is the same for all farmers in Denmark. This price is based on the export price received by the slaughterhouses during the previous week, and return per carcass. Thus, the producer price for pigs follows the product prices with a 1 to 2 week lag. The base price is given for pigs weighing between 64-78 kg, with deductions in price for weights above and below. The basic quotation for meat percentage is at 59 percent dressed carcass yield, below which there is a deduction and above which there is a bonus.

[1] Danish Crown and Steff Houlberg merged in October 2001 into one company. In 2002, Danish Crown took 94 percent of the total slaughter and TiCan took the remaining 6 percent.

A yearly bonus is also given to the slaughterhouses'members at the end of each year. The bonus is paid to the farmers based on volume delivered during the year and the slaughterhouse's yearly profit. If the producer sells product elsewhere during the year, the yearly bonus is forfeited. The bonus represents 5 to 10 percent of a farmer's annual income from selling pigs, which provides substantial incentive to honor the contract.

Several public and private institutions work together in the Danish pork industry to improve productivity and quality. The two farmer organizations, the Farmers Union and the Danish Family Farmers Union, fund and manage a National Committee for Pig Breeding, Health and Production (NCPBHP) and the National Advisory Service (NAS). The NAS gets information from the NCPBHP to improve the advice they give to the pig producers. The pig producers and the slaughterhouses both pay a levy, which is related to the number of pigs that they slaughter, in order to finance the umbrella organization, Danske Slagterier. This organization funds the Danish Meat Research Institute. The Danish government works in close cooperation with Danske Slagterier and funds research in the industry. The government inspects the feed companies, the farmers, and the slaughterhouses.

QUALITY ASSURANCE IN DANISH PORK

Denmark is well known for having high food safety and good quality assurance, which contribute to high quality food and healthy animals (Andersen, 1998; Bager *et al.*, 1995; Jensen, 1994). Quality has several dimensions, including food safety, technical quality, including carcass uniformity, meat quality and weight; animal welfare, and environmentally-friendly production. Tables 2 through 4 give an overview of the complexity of Danish quality assurance at the producer, slaughterhouse, and processor levels.

At the Farm Level

Pig producers manage several aspects of quality that are monitored by different parties (Table 2). Government veterinarians monitor food safety and animal health. In herds under the Specific Pathogen Free (SPF) system, specific animal diseases are controlled (mycoplasmal pneumonia, pleuropneumonia, pig dysentery, atrophic rhinitis, mange, lice, and Aujeszky's diseases). Feed-stuff is regulated by the government to control for salmonella and the breeding stock is controlled by the industry. The breeding system assures uniformity for the entire industry. The aspects of eating quality affected by breeding and feeding are lean percentage, IMF (intra-muscular fat), PSE (pale soft exudative) incidence, and taste.

Table 2. **Overview of Danish Pork Industry Quality System**

	Farm level	Slaughterhouse	Processing
Common QA	Governmental audits, SPF (25 % of the herds)	HACCP Own control	HACCP Own control
What is monitored?	Food safety Eating quality Welfare Nutrition Environment	Food safety Eating quality Welfare Nutrition Environment	Food safety Eating quality Nutrition Environment
How is it verified?	Vets audit farm records	Vets audit the own control twice a year + Continuous checks and visual inspections Individual carcass inspection	
Incentives	Monetary incentives	Mandatory incentives and Competitiveness incentives	

Animal welfare is controlled by the industry and by law. The most important aspects of welfare are housing, treatment during rearing, transport time and handling. Environmental regulations also apply to waste management at the farm level. These include how much land each farmer must operate or have access to for manure spreading, storage capacity for waste, and measures to prevent nitrogen in ground water.

The slaughterhouses examine the pigs on delivery, especially with regard to technical quality (weight, meat quality, eating quality). Producers receive a premium for higher quality meat and a price deduction for lower quality, based on carcass weight and dressing percentage. For some producers the contract between the slaughterhouse and the producer contains additional quality specifications, especially animal health. In addition to the price incentives for quality, there are also negative incentives for food safety violations. If, for example, antibiotic residues are found in random samples taken at the slaughterhouse, the government penalizes the farmer and the slaughterhouse will also impose fines.

In Danish Slaughterhouses and Processors

The food safety aspects monitored during slaughter and processing include physical hazards, microbiological hazards, and chemical hazards (Table 3). The physical hazards are prevented through visual inspection of all animals, absence of trichinosis, supervision of cleaning, and sanitation. The microbiological hazards control includes salmonella and trichinosis. The chemical hazards are monitored by a surveillance program for residues of antibiotics/chemotherapeutics, hormones, pesticides and heavy metals in both animals and fresh meat. Hormones and growth promoters are forbidden. Eating quality is enhanced by measures in transport, lairage, stunning and carcass chilling. Animal welfare is preserved through measures in transport, lairage, and stunning. Nutrition

is improved through product characteristics, such as leanness and salt content. Finally, environmental impact is minimized by reducing water and energy consumption, recycling of all waste products, avoiding unnecessary contamination of waste water, and pre-treatment of waste streams at the source whenever possible.

Table 3. **Danish Pork Industry Quality Assurance Responsibilities and Methods**

	Who is monitoring?	Farmers	Slaughterhouses	Processors
Food Safety	Danish government, industry, individual firms	Diseases, Medical use Mycoplasmal pneumonia, pleuropneumonia, pig dysentery, atrophic rhinitis, mange, lice, Aujeszky's diseases, use of antibiotic and growth promoter	*Physical hazards*: Visual inspection all animals, scanning with metal detectors *Microbiological:* Salmonella program, absence of trichinosis *Chemical hazards*: Surveillance program for residues of antibiotics/ Chemotherapeutics, hormones, pesticides and heavy metals in both animals and fresh meat Hormones and growth promoters forbidden, Supervision of detergents and sanitizers	Physical, microbiological, and chemical hazards similar to the slaughterhouses
Eating Quality	Industry (DS), EU regulations	Breeding (lean percentage, IMF, PSE)	Transport, lairage and stunning	Processing (chilling)
	ISO 9002*	Feeding (lean, fat quality, taste)	Processing (chilling)	
Welfare	Industry (DS), law (EU) (liability)	Housing (area), treatment during rearing, transport time and handling	Transport, lairage**, and stunning (carbon dioxide)	
Nutrition	Industry (DS) ISO 9002*	Breeding, feeding	Product characteristics (leaner products, less salt)	Product characteristics (leaner products, less salt)
Environ-ment	Law (Danish and EU), Industry	Land in relation to number of pigs, spreading, storage capacity, nitrogen in ground water	Minimizing the water and energy consumption Recycling of all waste products Avoiding unnecessary contamination of waste water	Minimizing the water and energy consumption Recycling of all waste products Avoiding unnecessary contamination of waste water
	ISO 14004*		Pre-treatment at source whenever possible	Pre-treatment at source whenever possible

* Only two firms use ISO certification (see Table 4).
** The time spent in pens before slaughter.

In Denmark at least five kinds of management systems are used in quality assurance: ISO 9002, ISO 14004, own control, Hazard Analysis Critical Control Points (HACCP), and official control. The ISO 9000 family of standards relates to quality assurance; the ISO 14000 family of standards relates to environmentally friendly production practices (ISO, 2002). Within these sets of standards, specific standards like 14004 or 9002 indicate the level of auditing and certification achieved. The ISO system describes what the company will do and how it is going to be done. ISO is a documentation system that can be applied to any industry, and certifies that a system is in place which conforms to ISO standards. ISO certification is carried out by an independent third party. In the Danish pork industry, ISO 9002 certification deals with management responsibilities, contract review, design control, purchase control, traceability, and inspection[2] ISO 14004 provides additional documentation of procedures that relate to the environment.

« Own-control » and HACCP are two very similar systems that focus on food safety. Own-control includes HACCP, which was mandated by Danish law to be implemented by January, 1998. According to Danske Slagterier, own-control incorporates: « *specific hygiene criteria that must be followed, frequent inspections, action plans in case the criteria are not followed, method of reporting which gives details of the quality control tasks and its result (inspection, reports, and log-books)* » (Danske Slagterier, 1996). The own-control approach of identifying control actions and carrying out monitoring is very similar to the HACCP approach. The difference between the two systems is that HACCP emphasizes management principles that lead to process redesign (Mazzocco, 1996).

Table 4. **Differences in Danish Pork Processing Firms'Quality Assurance Goals**

	Firm A	Firm B	Firm C
What kinds of QA?	HACCP Own control ISO 9002 ISO 14004	HACCP Own control ISO 9002	HACCP Own control
Focus	Food safety	Documentation, Reliable quality	Continuous Improvement
Motivation	Highest possible quality	Customer, (Food safety)	Customers, Food safety
Market advantage	Reliable system Access	Internal efficiency	Reliability

All of the three slaughterhouses have own-control and HACCP systems (Table 4). Two of the three have ISO 9002; only one of the three has ISO 14004. Table 4 shows how the focus, motivation, and market advantages differ somewhat among the three companies. The relative importance of safety and documentation seems to explain why compa-

[2] The ISO 9002 standard was replaced by the ISO 9001 standard in 2000.

nies A and B have adopted more extensive verification of their quality assurance.

The private and the public quality and safety assurance systems interact and overlap (Table 5). If a company has HACCP, own-control and ISO, they need two separate inspections, one from the government and one from a third party. In addition to the official and third party audits, the importing buyers from United Kingdom, Japan and the US come to Denmark and review the plant process and documentation. In other words, there are sometimes as many as three separate entities monitoring Danish pork production: 1) the Danish government; 2) third party certifying firms (ISO); and 3) the importing firms.

Table 5. Division of Quality Responsibility between Processing Companies and Government

Quality Control		
Company responsibility (Third party organization)		Veterinarians responsibility (Government)
ISO	Own HACCP	Individual carcasses inspection Official regulations
Other quality aspects than food safety	Mainly food safety but also other quality aspects	Food safety

Denmark's degree of quality assurance differs markedly from other major pork exporters. In the US, all processing plants must have HACCP systems in place due to federal regulations, but only one firm had ISO 9001 type certification in 1999 (Unnevehr *et al.*, 1999). There is little regulation of food safety at the farm level; US hog herds in some regions have salmonella incidence as high as 65 percent (USDA/APHIS, 1997), whereas over 95 percent of Danish hog farms are free of salmonella (Danske Slagterier, 2002b). Canada began a nationwide program in the late 1990's to assure quality for several aspects of hog production, especially use of antibiotics (Unnevehr *et al.*, 1999). This program is not as extensive as the quality control measures followed in Denmark and its implementation lags behind already well-established procedures in Denmark.

ANALYSIS OF STRATEGY FOR THE DANISH PORK INDUSTRY

Quality assurance is the Danish pork industry's strategy to obtain success in a very competitive export market. This section analyzes the key elements of this strategy and the trade-offs among alternatives. The key elements include vertical integration with cooperative ownership, systems to manage quality assurance, and product differentiation. The key trade-offs arise when balancing costs and returns in quality assurance and product differentiation.

Vertical Integration and Cooperative Ownership

A high degree of vertical integration improves quality assurance because it is easier to reward quality in all stages in the channel. Each company controls every part of the value-chain. According to one respondent at a processing company, quality assurance throughout the chain adds value to the product:

« The whole system in Denmark is made on that you can count on the quality of the raw material. Their customers, slaughterhouses and the veterinarian system audit the farmer. The feedstuff is audited and has to be produced to a specific standard. The whole chain is covered. That is the most important step and part of quality... that is a part of the trust all our customers have in the Danish system and in us, hopefully » (Respondent and representative for a big processor in Denmark).

There is uniformity in quality which is also the result of the cooperatively owned, vertically coordinated structure:

« The advantage we have is that we can, to a large extent, make uniformity in the whole country, without that each company has to sit down and make their own quality assurance » (Representative from Danske Slagterier).

The cooperative structure also influences quality assurance in a positive way through the price structure for quality differences among pigs. Better quality results in greater customer satisfaction and sales, and the resulting profits are given back in the form of bonuses to the farmers. The profit bonus strengthens the cooperative owner structure.

There are also costs associated with what the Danish industry has given up in exchange for this simplification. There are trade-offs between an atomistic, competitive sector and an integrated, cooperative structure in the flexibility and choices available to an individual firm. There is a basic set of rules each firm has to follow, and firms cannot do things differently without sacrificing the Danish industry's uniform product image. The flexibility that is lost relates to losing the opportunity to reward individual slaughterhouses and producers that, for example, deviate from standards to reduce costs. When the industry institutions made the choice to compete on quality, the industry indirectly decided for the individual firms that all of them were going to compete on quality and not, for example, on cost.

Quality Assurance Choices

The Danish pork industry wants to have a gap between their quality and the competitor's quality in order to better satisfy customers. In a competitive world other countries want to decrease or eliminate this quality gap. The high leverage strategy for the Danish industry is to maintain a quality gap with their competitors in order to keep their market share.

Thus, the industry must continue to develop the quality differential, which means continuous innovation in quality. Next we discuss how the industry must balance the costs of quality improvement with the benefits. We can identify three issues related to the management choices made in quality assurance: customer focus, the complementary role of government regulation, balancing costs and competitiveness.

A number of the respondents said that quality for them is what quality is for the customer. For example, Japan needs special tailor-made cuts, for technical reasons to fit in the « machinery ». The Danish industry makes sure that Japanese importers get meat cut exactly the way they want it. Another example is how the Danish pork industry tries to adjust to the demands from United Kingdom retailers. As one respondent put it: *« It is the retailer (meaning in the United Kingdom) that has the power and runs the discussion »* (Representative for the umbrella organization). Another example is the Danish industry's adoption of HACCP systems in response to new US regulations requiring HACCP.

On the industry level, it is important to consider how much to rely on government monitoring and how to ensure no « free riders » on the industry's reputation. That is, the industry as a whole benefits from the product image, but if individual producers cut costs by avoiding quality or safety standards, they ruin the quality image for the entire industry. Government monitoring is focused on food safety, which is why firms might want to have a quality system like ISO 9000 dealing with other aspects of quality. The government and the industry work closely together in order to unify the industry. For example, when implementing the salmonella program the industry started the procedure, and when just a few producers who didn't follow the new rules were left, the industry turned to the government for help to get these last producers in the program.

Finally, balancing costs and returns in quality assurance is crucial. Or, as one respondent put it:

« You can make extremely safe food but nobody can afford to buy it » (Representative for Danske Slagterier).

A company can adopt a large number of quality assurance measures and assure each part of the process, but if it is not efficient and if nobody can afford to buy, it does not help the company to be competitive. An example is that company B tried to require ISO for pig production. It was too expensive and they could not charge the customers this additional cost. There was no market for ISO certification at the farm level.

Future Product Differentiation

In Denmark, product differentiation goes from soil to table and may include characteristics such as the breed, animal welfare, and how the meat is cut. In Germany they demand a heavier pig with more fat, and

pigs for this market are slaughtered a few weeks later. The United Kingdom has high demands for animal welfare, so Denmark produces a «happy» pig for the United Kingdom market. The domestic market is widely diversified, with many different methods of production. The so-called «multi»-pig goes to all other markets.

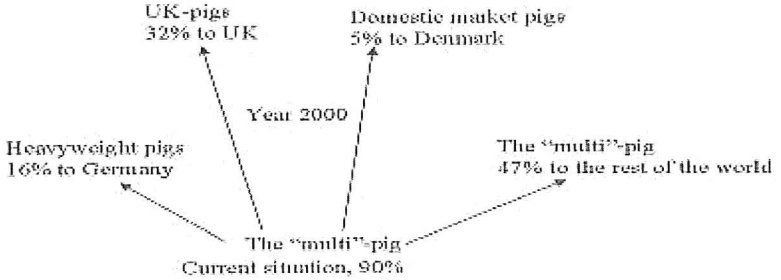
This industry representative describes the market pressure for product differentiation:

«Different markets have different demands. We are selling in all these 100 countries or more. Despite all of these demands, we basically have only one pig – the multi-pig.... This has changed a little the last 3 to 4 years. Now we have started to do four different pigs. It is the United Kingdom-pig, the German pig, the multi-pig and the domestic pig» (Representative Danske Slagterier).

In other words, Denmark has responded to differences in quality preferences among countries.

The general product differentiation strategy for year 2000 for Firm C is pictured in Figure 1. In the year 2000, from Firm C, 16 percent of production is expected to go to Germany in the form of a heavyweight pig, 32 percent is expected to go to the United Kingdom market in the form of the «happy» pig demanded in the United Kingdom, 5 percent is predicted to be distributed in the domestic market, and the remaining 47 percent is available to the rest of the markets, the latter two in the form of the multi-pig. This picture is representative for the industry as a whole.

Figure 1. Differentiation Strategy for Firm C in Year 2000

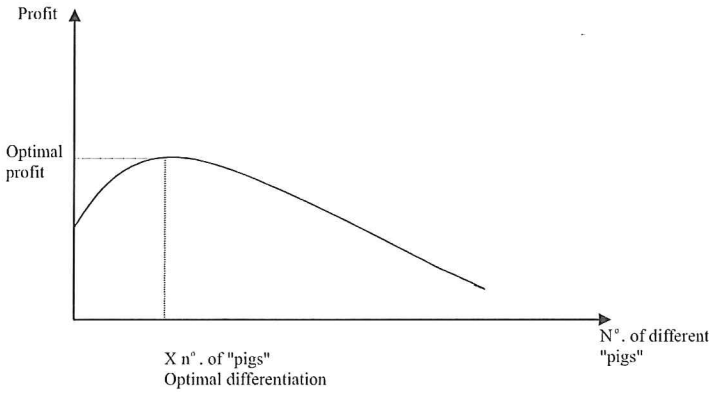


Source: Firm C

The most critical decision for the Danish pork industry and for each individual company is how far to take product differentiation. One of Denmark's competitive advantages is uniformity of quality. There is a trade-off between uniformity and differentiation. At the industry level the issue is to make sure that the Danish standards do not interfere with specific product differentiation. So far this has not been the case since the product differentiation goes beyond the basic guarantees and adds additional quality, not contradictory quality. One possible danger in the future is that newer demands will conflict with the basic quality guarantee.

There is a benefit cost comparison in the firms each time a new « kind » of pig is differentiated (Figure 2). For each new product there is a minimum scale, so the market must be a certain size. The price the firms get for their producs in that market have to cover the new costs associated with the new product. But there is also another dimension to take into consideration, the total number of different kinds of pigs/products. Marginal costs rise with the number of different kinds of quality that are produced. At the moment there are four different systems, and it is not clear how many more might be feasible.

Figure 2. Optimal Level of Differentiation in Danish Pork Production



These quotes show what the Danish firms consider in product differentiation:

« Important right now are the United Kingdom-pigs. They would like to have a certification on this EU norm, EN 45011 thing. {EN =Europe Norm} This they want {in} some markets. Our next discussion is do we want this {in} all markets. If we start to do it {in} one market we should do it {in} all markets otherwise it breaks some of our principles. We sell a lot in the EU... now it is just a demand in United Kingdom » (Representative from Danske Slagterier).

« But if the market is too small or the need too strange even {company C} sometimes says no or demands a higher price » (Company C).

The quotes show that Danish firms have to decide whether they should satisfy all of the specific demands from customers, and that in doing so they have to evaluate the benefits in terms of price and market access.

CONCLUSIONS AND IMPLICATIONS FOR OTHER EXPORTERS

This case study found three key elements in the Danish pork quality assurance strategy.

• First, the coordinated production system plays an important role in controlling quality. The integrated structure makes it easier to monitor

that products meet high standards and to provide incentives to produce a high quality product. The industry subscribes to a minimum standard and works together for a unified product image.

- Second, in Denmark, the degree of quality assurance management followed is quite high in comparison to other exporters. Private systems to control, assure, and certify quality have been widely adopted in the Danish industry. The government works together with the companies to assure certain aspects of quality, such as food safety.

- Third, product differentiation has been an important part of the Danish strategy to meet evolving customer demands both within and outside the EU. This aggressive use of product differentiation combined with a high level of quality assurance may explain the unique ability of Denmark to compete in pork markets both within and outside the EU.

There are two important trade-offs for the Danish pork industry in the future: a) differentiation *versus* uniformity and b) cost *versus* quality assurance. The way the Danish industry balances these trade-offs will have great impact on their future success. It is hard to produce highly differentiated products responding to numerous customer demands and at the same time products with high uniformity. Similarly, the next trade-off, between quality assurance and its associated costs, depends on how much customers are willing to pay. This includes decisions about how intensively quality is managed and which verification systems are adopted.

Is there potential for replication of the Danish pork system, or its components, by other countries or groups? Some of the attributes of the Danish system which yield lessons for others include:

- government involvement and regulation can raise the quality standard for all producers;

- on farm quality assurance is an important part of quality assurance for the entire pork chain;

- greater vertical integration can lower costs associated with quality assurance.

Will other exporters be able to replicate the Danish system? There are indications that demand for quality assurance is becoming more important in other exporting countries. In particular, the number of hogs produced under contract is rising in the US, in part due to greater demand for quality assurance (Martinez and Davis, 2002). The percentage raised under contract increase from around 10 percent in 1993 to around 70 percent in 2001. Cooperative producer ownership to fund dedicated processing plants is also on the rise, although still small relative to the total market. Thus, the trend towards greater vertical integration and increased quality assurance exists in other countries, such as the US, but lags far behind the established systems in Denmark.

The individual technical components of quality management in the Danish system can be replicated by others. However, the interaction of the system components is difficult to replicate, especially in the presence of social constraints (*e.g.* value of « independence », or adversarial relationships among channel members). Thus, the cost of establishing new structures to assure production at similar quality standards is likely to be higher in other countries. For the immediate future, Denmark will likely continue to be unique among the world's pork industries.

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