The Relationship between Supply Chain Coordination and Quality Assurance Systems: A Case Study Approach on the German Meat Sector

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Paper prepared for presentation at the 110th EAAE Seminar 'System Dynamics and Innovation in Food Networks' Innsbruck-Igls, Austria
February 18-22, 2008

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Abstract

The German meat industry faces a high demand for food safety and traceability. After several meat scandals in the recent past, efforts have to be made to regain consumer trust and to assure access to export markets. Apart from a few niche markets, there is no focal company in the German pork supply chain which efficiently coordinates food chain information, harmonizes the multiplicity of different IT systems or takes on professional public relations in charge of the whole sector. In cases of food crises, essential up- and downstream information slowly flows across the supply chain which hinders both seamless traceability and the harmonization of production processes between the various stages of the supply chain. This contribution focuses on the opportunities for more efficient coordination based on spot market environments. With reference to the theory of organization economics, a case study of the QS Qualität und Sicherheit GmbH as the leading certification scheme that addresses the German meat industry was carried out. Several non-classical certification activities which fall within the scope of coordination were identified with QS. Based on the assumption that the company continuously improves the coordination of the supply chain, there are opportunities for the meat sector as a whole which are pointed out in the conclusion.

1 Future challenges of supply chain coordination

The image of the German meat industry is currently being shaken by ongoing negative headlines. About 23 scandals associated with meat products have been revealed since 2005 (Dittberner, 2007). As customers are increasingly alienated, a demand for higher food safety is being voiced by both the government and, especially, NGO's, such as consumer associations, Greenpeace and Foodwatch. Additionally, there are new requirements for improved coordination of food chain information emanating from the EU regulation 854/2004/EC which became effective at the beginning of 2008. Latest experience shows that the practical implementation of the required measures such as, for example, the risk based carcass meat inspection or the seamless flow of food chain information reaches the limits of the current sector organization. Efforts have to be made to achieve a seamless traceability through a more efficient coordination of receiving and issuing, salmonella monitoring, meat inspection, animal transport, feed, and drug application data.

Research on organization economics reports on a general trend towards open information sharing in sophisticated supply chains (Lee et al., 2000: 626; Kulp et al., 2003: 95; Li, 2002: 1196 f.). Thus, some industries already turned away from general distrust towards a more cooperative behavior. Business globalization and the ability to efficiently communicate via IT have forced these changes (Lazzarini et al., 2001; Kulp et al., 2003: 95).

However, this general change to cooperative data communication has not occurred in meat supply chains. According to the legal requirements, every production stage is only obliged to record product information one step up and one step down, respectively. Referring to empirical studies, the willingness of primary producers to spend more time on data recording and transmission is rather low (Jahn et al., 2003: 12). One reason for the generally reserved willingness to share information across the supply chain may be that there is hardly any incentive to establish transparency. On spot markets farmers and livestock dealers but also processors and meat wholesalers sometimes even benefit from the obscure marketing channels since competitive advantages are also achieved by means of opportunistic behavior. All in all, it seems to be difficult to accomplish a sustainable environment for inter-stage communication under the given conditions.

If information sharing across non-contractual systems is to be realized, a high level of commitment and trust is required between the business partners. Bad preconditions in this respect were measured empirically in both the German (Bahlmann et al., 2007) and international meat supply chains. For example, lack of cooperation and distrust were found in the UK (Palmer, 1996; Simmons et al., 2003), New Zealand (Clare et al., 2002) and Canada (Brocklebank, 2004).
At this point, it seems that current requirements on supply chain coordination can hardly be managed on spot markets without a coordinating facility. Since there is no indication for a basic organizational change towards more intense vertical integration and the emergence of a focal company in Germany, we decided to focus on facilities that are not directly involved in the production process but closely connected to the members of the supply chain.
Certain certification standard owners, such as the German QS Qualität und Sicherheit GmbH are promising to meet the requirements on supply chain coordination. Hence, the aim of this contribution is to investigate the ability of QS to take on pivotal coordination functions that will consequently lead to the establishment of trust, collective problem solving, coherent information flows as well as professional public relations and crisis management in meat supply chains.
As the objective requires the understanding of inter-organizational structures and trade-offs, we first present a general overview of the German pork industry and then turn to a literature review on supply chain coordination. Subsequently, we provide insight into the empirical design and the methodological framework before coming to the main section in which a case study of QS is carried out. Finally, we list the effects that specifically designed certification schemes such as QS may have on the performance of the German red meat sector.

2 The German pork industry: production, marketing channels and business organization

With a net production of 4.6 m tons of pork in 2006 (ZMP, 2007), Germany is the leading pork producer of the European Union and the third largest producer in the world (FAO, 2007). At the same time, the total pig herd size has reached an all-time peak of 26.8 m (ZMP, 2007). Analyses of foreign trade show that since 2005, Germany has developed from a net importer to a net exporter of pork (ibid.). As the per capita consumption has faltered to around 54 kg since the year 2000 (ibid.), the export business is of particular importance for the future competitiveness of the German meat industry.

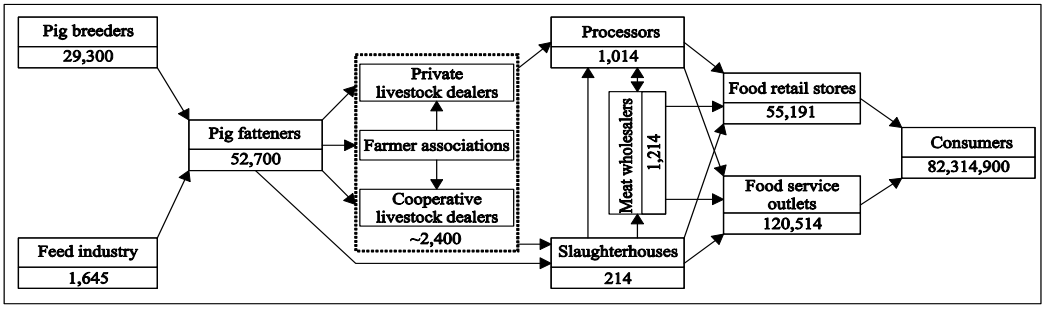

Figure 1. Supply chain of pork production in Germany
Slaughterhouses counted from a minimum of 20 employees; data of the meat wholesale, feed industry, food service, livestock dealers and farmer associations of 2005, other data of 2007
Sources: Metro (2007); ZMP (2007); BVL (2005); Destatis (2007)

The structure of the pork supply network is relatively complex due to the traditionally high degree of labor division (cf. Figure 1). Additionally, a major part of the German slaughter pigs is produced and dealt with by short-term contracts. Pig farmers, for example, generally buy their input factors (piglets, feed) and sell finished pigs on spot-markets.
Specific to the German market is the intermediate tier between farmer and slaughterhouse level. More than 90 % of the farmers in north-western Germany market their slaughter pigs to a total of 2,400 marketing agents, such as private and cooperative livestock dealers as well as farmer associations (Traupe, 2002). They generally take on the function of logistic service providers and act on their own behalf. In terms of information flows and traceability, livestock dealers are also assumed to be pivotal gatekeepers in meat supply chains. For fear of disintermediation they have a strong interest in concealing information about their suppliers.
From an economic point of view, whether the structures described above build a sustainable framework for pork production is frequently discussed. On the one hand, some researchers argue that a re-organization of the pork supply chain is essential to stay competitive against global organizations (Windhorst, 2004; Bhuyan, 2005). In contrast, other studies question whether the intense integration of supply chains is really a panacea (Bretzke, 2006). A report about the German pork sector finally alludes to the efficiency of market transactions for the main part of the sector. Based on the approach of transaction cost economics, Schulze et al. (2007) arrive at the conclusion that the advantages of the current market organization can generally not be outweighed by more intense supply chain integration. Basically, the non-specified production and the efficiency through competition argue for a less hierarchical system.
While the theoretical discussion still persists, there is no conceivable organizational change from the spot market to more intense vertical integration in practice. Based on the following literature review, we will investigate alternative solutions to cope with the increasing requirements of coordination in spot market environments.

3 Literature review on supply chain coordination

On the basis of the most common definition (Malone and Crowston, 1994) we understand coordination as the “management of dependences” with a special consideration of inter-organizational communication and information flows.
In recent years, coordination mechanisms have frequently been discussed as key factors in the improvement of the overall supply chain performance (den Hengst and Sol, 2001; Simatupang et al., 2002; Zhao et al., 2002; Brocklebank, 2004; Hammer, 2006; Housein, 2007). In the literature on organizational economics, it is argued that improvements of supply chain coordination

can lower operation costs, increase consumer value and consequently gain a higher total chain value (Kulp et al., 2003: 92). In contrast, conflicting business objectives and a lack of transparency may hinder efficient coordination (Chopra and Meindl, 2007, Sahin and Robinson, 2002: 507).

The approach of Rudberg and Olhager (2003) provides evidence that a market configuration dealing with multiple organizations and multiple sites on each organization is the most complex environment. This configuration is particularly pronounced in the meat supply chain. Here, the number of farmer suppliers exceeds those of the slaughterhouses by far. Hence, an extended model has to be developed in order to give a holistic view on the coordination processes in this sector.

Based on operational and organizational perspectives, Simatupang et al. (2002: 293) analyzed four modes of coordination: logistics synchronization, information sharing, collective learning and incentive alignment. In our approach, the factor, logistics synchronization, is extended to market harmonization since the coordination problems in inter-firm networks are beyond synchronization (Rudberg and Olhager, 2003: 36). Furthermore, we agree with various researchers who assume an interrelation between coordination and communication (den Hengst and Sol, 2001; Weigand et al., 2003; Storer, 2006). Therefore we have added communication as the fifth dimension of our model. The following sections provide a closer investigation of each item in order to achieve a more fragmented perception of the coordination processes.

Single plants and vertically integrated systems are hardly faced with the problem of information, process and commodity alignment, because a system owner generally aims at a global optimization of the total chain value (Simchi-Levi et al., 2004: 111 ff.). However, non-contractual supply chains and inter-organizational networks have special requirements for synchronization and **harmonization** (Simchi-Levi et al., 2004: 111; Rudberg and Olhager 2003). The basis of inter-stage co-operation can be provided by means of industry standards and an appropriate framework for coordinated networking.

From the viewpoint of information economics, **information sharing** counteracts opportunistic behavior, facilitates supply chain coordination, helps in dealing with market uncertainty, achieves contractual clarity and reduces adverse selection as well as moral hazards (Simatupang and Sridharan, 2001). The access to upstream and downstream information furthermore enables retailers and suppliers to adapt to supply problems and market changes more rapidly (Simchi-Levi et al., 2004: 101). To date, information sharing in supply chains causes much less transaction costs than approximately 20 years ago. State of the art information systems which are based on internet protocols (WebEDI) provide cost-efficient methods of electronic information sharing (Füzesi and Herdon, 2007: 4). Thus, even highly complex supply chains with a high share of small and medium sized enterprises can improve the utilization of information (Wolfert et al., 2007). However, technology is only one side of the coin. Even though EDI may achieve tight data integration, substantial human intervention is still required to harmonize business processes and systems amongst the trading partners (McLaren et al., 2002: 352).

Assisted by appropriate inter-organizational framework conditions, the coordination of knowledge between stages can result in **collective learning**. This enables a partner's skills to make ongoing improvements and ideally leads to tacit capability (Simatupang et al., 2002: 299), innovation and a system-wide cost reduction.

Incentives may be classified as material or non-material factors that influence the extrinsic and intrinsic motivation of the supply chain facilities to provide expected actions. Traditional incentive schemes aim at local cost optimization within a short-term perspective rather than at increasing the actors' awareness for global chain profitability (Simatupang et al., 2002: 298; Simchi-Levi et al., 2004: 111). This, however, is what is intended by **incentive alignment**. According to Ba et al. (2001), incentives are necessarily required if actors are expected to accept efforts to provide true and accurate information to other parties of the supply chain.

Inter-stage **communication** aims at mutual adjustment and thus, can be accepted as a mechanism of coordination (Weigand et al., 2003). Aligned communication on the spot market is a challenge to both the business-to-business (B2B) and also the business-to-consumer (B2C) perspectives. Thus, even public relations are a sub-category of coordination. Although there is a goal conflict between (the costs of) communication and business efficiency, it seems to be impossible to manage dependences without communication (ibid.). In this context, the appropriate coordination and complexity reduction of communication processes seem to be paramount.

At this point, it is arguable which solutions of meat chain coordination have to be considered for the practical application. There are quite different international approaches

- Forward integration of farmer cooperatives in Denmark (Danish Crown)
- Backward integration of meat processors in the USA (Smithfield)
- Vertically aligned industry associations in The Netherlands (Productschappen)
- Supply chain leadership of the food retail in the UK (Tesco, Sainsbury)

Thus, the most classical institutions to take on supply chain coordination are farmer-cooperatives, processors, food retailers and industry associations. These stages are more or less likely to meet the requirements for market power, spreading, holistic view, flexibility, closeness to business partners and organizational structure.
In the German meat industry, there is a strong competition on every stage of the supply chain. Neither food retailers nor processing companies or farmer associations dispose of sufficient market power to take on the role of a comprehensive supply chain coordinator or to set industry standards. Industry associations, such as the Verband der Fleischwirtschaft (VDF) rarely interfere with everyday business and only have a partial view of the supply chain.
While the existing approaches to supply chain coordination generally refer to the interaction of classical coordination authorities, other institutions with an originally different scope disappear from sight. Within this approach we decided to carry out a case study of the QS Qualität und Sicherheit GmbH. The company has developed into the most important certification scheme of the German meat sector and provides a quality management system that covers nearly all involved tiers of the supply chain.

4 Empirical design and methodological framework

As a result of the increasing food crisis, a growing consumer demand for quality and the market power of food retail, certification schemes have become commonplace in the European agribusiness (Theuvsen et al., 2007; Jahn et al., 2005; Hobbs et al., 2002). The classical view of certification is generally not more than the authentication by a neutral third party that methods, commodities or services conform to a given standard or any specific normative regulation (DIN ISO EN 45011-45013). However, the development from industry independent standards, such as ISO 9001 to industry and product-specific certification has taken effect in 31 different certification systems in the German meat sector that can be characterized by various principles (Theuvsen et al., 2007).
The QS Qualität und Sicherheit GmbH was established in 2001 by a cross-section of six influential organizations of the German meat industry in response to the BSE crisis. The initial objectives were to regain consumer trust by means of a holistic quality assurance system for food supply chains. During the last 7 years since its foundation, QS has seen a remarkable development and become the most important certification approach in the German agribusiness. All in all, 101,249 system partners of the meat and meat product industry are affiliated to QS, including 7,184 foreign members (QS, 2007a).

Table 1. Supply chain coverage by QS

	Feed industry	Livestock farmers	Slaughterhouses	Processors	Meat wholesalers	Food retail
Affiliated (in total)	1,645 (409*)	71,996	330 (116**)	234	118	19,994
% of the whole production	100	90 (pigs) 60 (cattle) 95 (poultry)	85	50	n.a.	90

* thereof feed mix industry; ** thereof combined slaughtering and processing
Sources: Compilation by the authors based on Nienhoff 2007; QS 2007a

Currently, the QS-system almost represents the whole supply chain, ranging from the feed mix industry (100 %) down to the food retail (90 %). A closer look at the turnover of QS-certified products reveals that the majority of the meat and meat products derives from affiliated companies (cf. Table 1). At farm level, QS covers about 90 % of the total pig production which stems from 34,386 farmers (Nienhoff, 2007). The high market penetration is also a matter of downstream acceptance. Germany's top-10 food retailers, which together already combine a market share of 86.2 % (LZ, 2006), have a strong demand for QS goods.
In reference to the framework of this contribution, i.e. to evaluate the ability of QS in terms of supply chain coordination, we chose a case study approach. The different modes of coordination (cf. Chapter 3) are used as the comprehensive framework of our case study. The model finally describes five main areas, namely market harmonization, information sharing, collective learning, incentive alignment and communication (cf. Figure 2).
The characterization of QS is based on an extensive literature analysis, interviews with two department managers of QS and the experiences of the second author as the chairman of the board of trustees of QS. In a retrospective view on the company's latest achievements, we identified seveal activities that – partly in a broader sense – fall within the scope of supply chain coordination.

5 A different perspective of certification: case study of the QS GmbH

The importance of QS for the meat industry is generally underestimated. Up to now, there are no scientific reports on or explicit references to the company's extraordinary role in practice. Thus, the following comments will shed a different light on the QS certification standard. Based on the theoretical framework (cf. Figure 2), the following comments will point out the ability of QS to take on certain tasks within the scope of supply chain coordination.

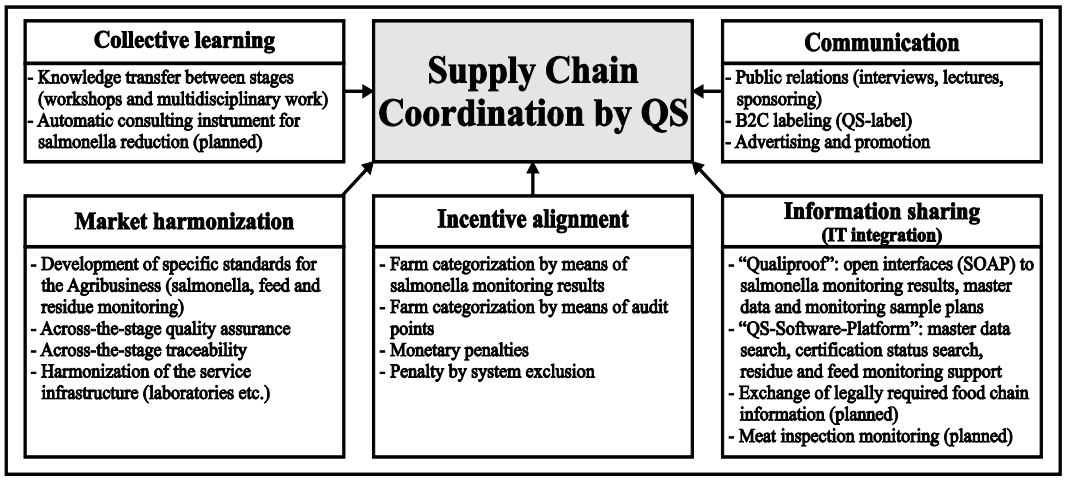

Figure 2. Supply chain coordination by the QS Qualität und Sicherheit GmbH

5.1 Market harmonization

Recent developments in the German meat sector require new forms of inter-organizational cooperation in order to increase food safety and global competitiveness (cf. Chapter Future challenges of supply chain coordination). Since several different business procedures and quality assurance systems have emerged on every stage of the meat supply chain, the comparability of food safety information and the creation of seamless traceability have become a real challenge. General sector standards build a framework for market harmonization and improved networking across stages.

QS addresses how this challenge through the integration of important food safety obligations into its standard in recent years. In contrast to traditional associations, such as the International Organization for Standardization (ISO), there are serious differences. The ISO 9001, for example, lays down general requirements for non-specific quality management systems so that the focus of this standard is product-, process-, and, therefore, industry-neutral. Consequently, no process monitoring or coordination function is subjected to the organization.

The QS standard furthermore provides holistic solutions for certification and traceability across stages which are considered to be special services beyond the classical activities of certification. For instance, the QS salmonella monitoring program was established at an early stage in 2003. In the meantime, the German legislation used the policies and procedures of QS as guidelines for the pig salmonella regulation of March, 13th 2007. The next step will be to extend the QS monitoring program to further zoonosis pathogens, such as campylobacter (Hentschel, 2007). The standardization of the internal microbiological control on carcasses at abattoir level is mentioned by QS as one of its extended business goals for 2007/2008 (Nienhoff, 2007).

5.2 Information sharing (IT integration)

In Section 3 we analyzed the impact of information sharing on the performance of inter-organizational supply chains. The theory indicates that the future competitiveness of the German meat production strongly depends on the level of IT supported coordination.

Unlike vertically aligned systems, there is no supply chain leader in the German red meat sector that pushes the integration of the multiplicity of IT systems. In the present case, special requirements like the establishment of a salmonella monitoring system could hardly be implemented without the support of a coordinating facility. QS approaches this problem by means of its own web based IT-solutions for salmonella, feed and residue monitoring, master data processing and audit report storage (QS, 2007b). The monitoring results are provided to farmers and downstream members by means of web-based interfaces.

The continuous transmission of food chain information between pig farmers, abattoirs and government agencies that is required for risk-based carcass grading, adapted from the EU regulation 854/2004/EC, causes unreasonable efforts within non-contractual relationships. In turn, QS provides web-based EDI solutions to establish information flows between the parties through its IT infrastructure.

Another future purpose concerns the forthcoming integration of livestock transporters and livestock dealers, respectively. QS will arrange for the improvement of information logistics in this sector in the near future (Hentschel, 2007).

5.3 Collective learning

Within the globalized environment of meat production, there are special needs for cost reduc-

tion and improvements in food safety. However, as a consequence of the lack of inter-stage co-operation and information exchange, there is hardly any inter-stage optimization and no holistic inspection of critical workflows (cf. Chapter 1). Practitioners have repeatedly announced the inefficient anonymous coexistence of interrelated institutions, such as veterinaries and farmer consultants (Schepers, 2007) as well as pig breeders and finishers. More intense cooperation, however, calls for the members' awareness of interrelated problems (Vallan, 2007).
QS lobbies for collective learning by means of workshops and its multidisciplinary orientation. They have also announced distributing innovative measures to decrease salmonella prevalence amongst primary producers by means of automatic consulting systems.

5.4 Incentive alignment

Traceability and transparency are the key factors for a sustainable production within the German pork supply chain. Still, several food-scandals – from which even QS-affiliated partners are not excluded – indicate a gap between what actors do and what they are committed to do, e.g., the transmission of completely and accurately filled out forms.
At this stage, QS basically uses incentives that affect the extrinsic motivation of its members, such as the use of sanctions. The same holds true for the three-stage categorization of members by means of salmonella monitoring results. In the future, there will possibly be a strong extrinsic motivation for pig farmers to reduce salmonella prevalence if these categories should turn out to become relevant purchase criteria for food retail or lead to exclusion from the QS system.

5.5 Communication

Amongst the coordination activities of QS, particular attention has to be paid to the system's internal communication and public relations. Compared with other standards, such as GlobalGAP, IFS, BRC Global Standard, IKB or ISO 9001 which are primarily designed for B2B relationships (Theuvsen et al., 2007), the awareness of consumers and especially NGOs with respect to QS is considerably high. As an inherent part of its marketing strategy, QS uses a product label to signalize food safety and consequently to regain consumer trust. Promotional activities of QS, such as the sponsoring of Germany's national handball team, TV-spots, printed advertisements and attendance at important trade fairs underline the increasing B2C orientation. Furthermore, QS regularly takes care of press relations, delivers lectures and arranges congresses.
In the course of several food crises, QS has had to comment on critical TV reports (ARD Panorama, 2007) and high-profile activities of animal right activists (QS, 2007c). Hence, the standard owner increasingly turns to questions of sustainability, animal welfare and social standards as well as strategies in terms of professional crisis management (Nienhoff, 2007).

6 Concluding remarks: opportunities for and effects on the industry

The QS standard has achieved a widespread acceptance in the meat sector and already forms an appropriate framework for safe production and efficient traceability. Our case study of QS in Chapter 5 has exposed the company's scope of supply chain coordination in consideration of 5 different dimensions (Simatupang et al., 2002; Rudberg and Olhager, 2003; Weigand et al., 2003). We have found empirical evidence that the company currently evolves from a classical certification standard owner to a supply chain coordinator.
As central conclusions of our case study we can stress the following perspectives for the red meat sector in general, especially if QS further expands its scope of coordination.

- more efficient and flexible response to market changes (c.f. 5.1)
- integration of heterogeneous IT, process and quality assurance standards (c.f. 5.1)
- assurance of access to export markets and expansion of export opportunities (c.f. 5.1)
- complete and efficient traceability across stages (c.f. 5.2)
- creation of problem awareness and collective problem solving (c.f. 5.3)
- reduction of opportunistic behavior (c.f. 5.4)
- improvement of food quality and safety (c.f. 5.4)
- professional PR and food crisis management (c.f. 5.5)
- sustainable re-establishment of consumer trust (c.f. 5.5)

From our point of view, the – to some extent – imaginary role of QS offers a chance for the German red meat industry to cope with the deficits of supply chain coordination in spot markets.
With the development of specific industry standards, QS stands out from the classical functions of certification. In contrast to traditional associations, such as the International Organization for Standardization (ISO), there are serious differences. The ISO 9001, for example, only lays down general requirements for non-specific quality management systems so that the focus of this standard is product-, process-, and, therefore, industry-neutral. Consequently, no process monitoring or coordination function is subjected to the organization.
The assurance of basic quality and safe production on the commodity market can be achieved through supply chain coordination by QS. Hence, a fundamental re-organization to more intense vertical integration as is often postulated by various researchers (cf. Chapter 2) is not an obligatory precondition to face the new challenges.
Nevertheless, ongoing meat scandals suggest that the QS standard is still in the phase of development. Experience of the recent past shows that the system's weak spots are, e.g., the delay in tracing processes, the missing integration of livestock dealers and the lack of marketing transparency between meat processors and the food retail. In reference to the lack of inter-stage cooperation and problem awareness, QS should generally reconsider its use of incentives. A change towards intrinsic incentives would result in a minor need for control as more members then would act from conviction.
The change to a supply chain coordinator also carries some considerable risks for QS. As a result of the multi-dimensional orientation towards both certification and supply chain coordination, the company walks narrow line between losing its neutrality and trustworthiness on the one hand and the opportunity to gain power and further growth on the other hand. This furthermore means that QS simultaneously has to cope with the conflicting expectations of its different stakeholders, such as NGO's, farmers, processors, and retailers.
From a scientific point of view, the case study approach has a limited scope in terms of generalizability and representativeness. It remains unclear whether the case of QS indicates a general trend – meaning that certification standard owners could generally play an important role in terms of food chain coordination – or simply represents a specific situation in Germany.

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