Available online at www.centmapress.org

INTERNATIONAL JOURNAL ON FOOD SYSTEM DYNAMICS

Int. J. Food System Dynamics 9 (1), 2018, 79-100

DOI:http://dx.doi.org/10.18461/ijfsd.v9i1.916

"Actionable" critical success factors for supply chain information system implementations

Exploratory findings from four German pork supply chains

Janne M. Denolf[1], Jacques H. Trienekens[1], P.M. (Nel) Wognum[1], Verena Schütz[2], Jack G.A.J. van der Vorst[3], and S.W.F. (Onno) Omta[1]

[1]*Wageningen University, Social Sciences Department, Management Studies, Wageningen, The Netherlands*
[2]*Deutscher Raiffeisenverband, Department of Livestock and Meat Industry, Berlin, Germany*
[3]*Wageningen University, Social Sciences Department, Logistics, Decision, and Information Sciences, Wageningen, The Netherlands*

denolfjanne@gmail.com; jacques.trienekens@wur.nl; wognumnel@gmail.com; schuetz@drv.raiffeisen.de; jack.vandervorst@wur.nl; onno.omta@wur.nl

Received August 2017, accepted January 2018, available online January 2018

ABSTRACT

Implementing a supply chain information system (SCIS) incurs organizational and technical complexities. For managing these complexities, information system researchers have identified generic critical success factors. However, CSFs are abstract and, therefore, difficult to use in practice. To maximize the chances of successfully implementing a SCIS in the food industry, we aim to identify "actions" linked to CSFs. We, consequently, investigated four German pork supply chains that implemented a SCIS. Fourteen critical success factors were made "actionable"; most actions were identified for the CSFs "manage change and deliver training" and "select standards, vendor, and software package", indicating their relative importance.

Keywords: supply chain information systems; critical success factors; actionable CSFs (actions); food sector; pork supply chains

1 Introduction

Worldwide, the food sector has been exposed to globalization and longer supply chains, wider product assortments, an increasing number of food scandals and ever increasing consumer demands for quality and safety of food products. Since the 90ties of the last century food companies have to comply with strict public food safety standards (e.g. EU Food Law). Moreover, many food companies have adopted private quality standards, initiated by private parties such as large retailers, food industries and NGOs. These standards not only include safety measurements, but also requirements regarding environmental management and requirements on social aspects, such as labour circumstances and animal welfare. Traceability of products and the processes these undergo is an important element of these standards. For the food supply chain this implies extensive documentation of products and production processes as well as well-organized and controlled gathering, storing, processing, and exchange of product (and process) related data between firms in the food chain. (Trienekens et al., 2012).

The importance of information exchange in food supply chains has been emphasized by, for instance, Hill and Scudder (2002), Schulze, Spiller, and Theuvsen (2006), and Lehmann et al. (2012). More than ever, food supply chains need to implement or re-organize information systems that integrate actors in the

whole supply chain (Wolfert et al., 2010). Such information systems, known as "supply chain information systems" (SCISs) or "inter-organizational information systems" (IOSs), support information exchange in the supply chain by providing relevant information to all chain partners.

Implementing an information system in supply chains is, however, complex. For instance, farmers might not be willing to use a new information system because of the changes needed in business practices and the investments required. For managing such complexities, information system researchers have identified generic "critical success factors" (CSFs) for implementing a SCIS. These have taken a prominent position in the information system (IS) literature. The concept of CSFs was developed by Bullen and Rockart (1986). CSFs were defined as: the key areas where things must go right to ensure successful competitive performance for the organization or supply chain (Ngai et al., 2008). To date, information system researchers have delivered "laundry lists" of CSFs for implementing SCISs. However, according to Boynton and Zmud (1984), Flynn and Arce (1987), and Francoise et al. (2009), these lists are abstract as they have not been made "actionable" and are, therefore, only a partial aid to practitioners. To address this limitation, we aim to make CSFs actionable for implementing SCISs in the food sector.

In the present paper, we use the German pork meat industry as an illustration. In the German pork sector, which is the largest pig producer in the European Union, high pressure on retail margins causes a cascade effect on the upstream supply chain partners. Moreover, in recent decades, the German pork sector has been exposed to many food scandals, such as the dioxin crisis and classical swine flu (Hartmann et al., 2013). To increase profit margins and to cope with food safety, business processes along the pork meat supply chain need to be made more effective and efficient. For example, selection processes for sows and boars can be improved and feed choices can be optimized, leading to better piglets. To do so, several attempts have been made to implement SCISs within the German pork industry (Bahlmann and Spiller, 2009).

To make CSFs actionable, we used a list of CSFs as the starting point. Then, we investigated the implementation of SCISs in four German pork supply chains. Based on these case studies, we defined actions – linked to supply chain responsibilities – that have proved crucial for implementing a SCIS. By defining actions, we bridge the gap between CSFs and practical project management.

2 Critical success factors for implementing supply chain information systems

Implementing a SCIS is complex because it requires integrating multiple supply chain actors, each with their own company culture, power and leadership structure, management methods, and information systems (Lambert and Cooper, 2000). Moreover, different supply chain actors may have other reasons for implementing a SCIS and, therefore, a different implementation objective. A wide range of academicians and practitioners has delivered approaches to cope with such complexities and to increase the chances of successfully implementing a SCIS. One of the approaches is the use of "critical success factors" (CSFs), which are important areas in which intervention is needed and can hence be seen as an information system planning tool (Boynton and Zmud, 1984). Identification of "critical success factors" has given rise to a substantial amount of literature (Ang, Sum, and Yeo, 2002). Despite the popularity of CSFs in information system literature, critical success factors have remained highly abstract and have not been made "actionable".

To make CSFs actionable, we use the CSF framework of Denolf et al. (2015), who undertook a literature review of CSFs for implementing SCISs. They used the socio-technical MIT90s framework of Scott Morton (1986) to classify the CSFs found. The framework, which was developed to help managers understand IT-enabled organizational change, consists of five interacting elements:

- **Project strategy**: the goals of the project and how the supply chain endeavours to fulfil these goals
- **Structure**: the structure of the supply chain and its organizations
- **Information system(s)**: the technology used
- **People**: the roles, knowledge, skills, ambitions, attitudes and social ties of people in the supply chain
- **Management processes**: the management processes that steer the project

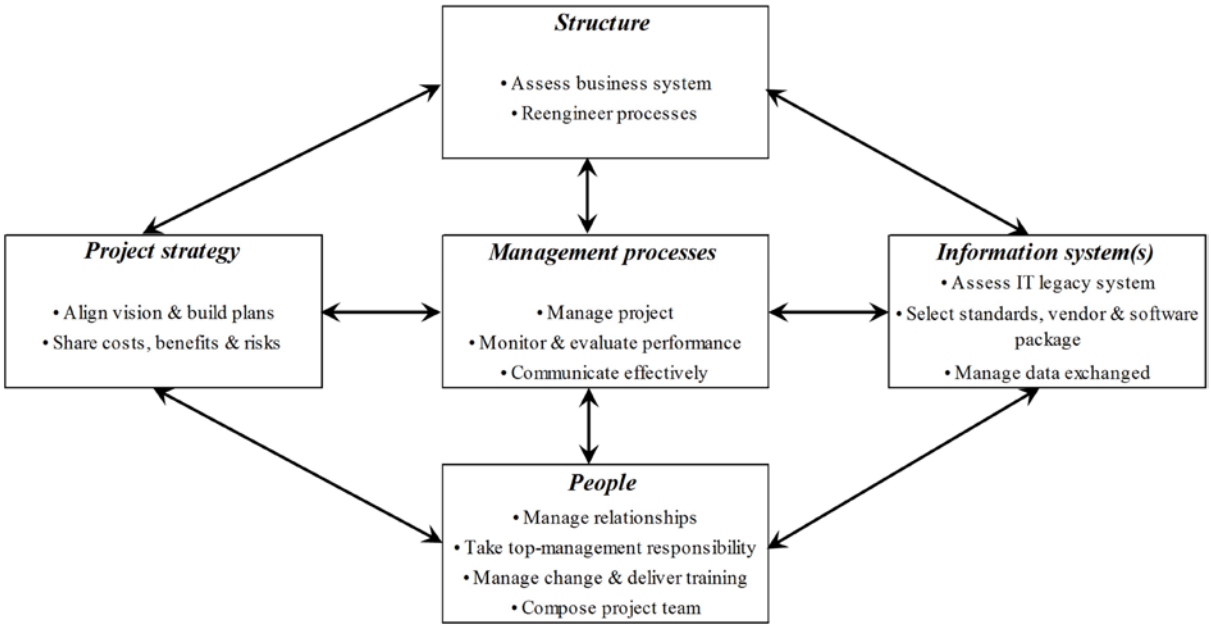

Figure 1: Classification of CSFs for SCIS implementation in the MIT90s framework of Scott Morton (Denolf et al., 2015)

Fourteen critical success factors, which were classified in the MIT90s framework, are described below:

- **Align vision and build plans** – To successfully implement a SCIS, vision alignment and joint business plans across all involved supply chain partners are crucial as it might lead to a consistent implementation direction and, consequently, to enhanced information sharing (Li and Lin, 2006; Lu et al., 2006).
- **Share costs, benefits, and risks** – Supply chain partners have to agree to distribute supply chain benefits, costs, and risks, which is often perceived as extremely challenging (Fawcett et al., 2008; Lee and Whang, 2000). Lu et al. (2006) proposed, therefore, that the supply chain partners gaining the most benefits from the SCIS implementation should financially compensate the partners with fewer benefits.
- **Assess business system** – When implementing a SCIS, business systems need to be assessed since compatibility is an important predictor for success. Regarding the business, compatibility with respect to culture, job stability, reputations, organizational hierarchy, procedures, policies, and strategic horizons across the supply chain organizations should be assessed (Allen et al., 2000; Jharkharia and Shankar, 2005; Mentzer et al., 2000).
- **Reengineer processes** – Implementing a SCIS usually requires adaptation and creation of business and information processes. To do so, current processes should be analysed by means of mapping, for all collaborating supply chain partners (Koh et al., 2011; Ngai and Gunasekaran, 2004). Thereafter, to fully exploit the new SCIS, processes, responsibilities, and alliance guidelines need to be redesigned as well (Allen et al., 2000; Fawcett et al., 2007; Koh et al., 2011).
- **Assess IT legacy system** – Assessment of current IT is required as IT compatibility in the supply chain is indispensable for successfully implementing a SCIS (Fawcett et al., 2007; Jharkharia and Shankar, 2005; Khurana et al., 2011; Ruppel, 2004).
- **Select standards, vendor, and software package** – Before selecting a vendor, agreements on technology standards should be attained when implementing a SCIS (Lu et al., 2006). Most commonly, a SCIS initiator pushes the technology standard decision through, which means that difficulties might arise without an initiator. Then, the supply chain needs to agree on the technical specifications of the SCIS, leading to a vendor and a software package selection (Lee and Whang, 2000).
- **Manage data exchanged** – When implementing a SCIS, exchanged data have to be properly managed since information access privileges and information security are crucial attention points for the participating supply chain partners (Jharkharia and Shankar, 2005; Lee and Whang, 2000; Ngai and Gunasekaran, 2004). Security concerns typically increase when more horizontal partners are involved

because these partners may be suspicious about confidential information being leaked to their competitors (Premkumar, 2000).

- **Manage project** – In a supply chain, strong collaborative motivation and long-term commitment are prerequisites for successfully implementing an information system, since only then can mutual benefits be reaped (Chae et al., 2005; Koh et al., 2011; Lu et al., 2006; Premkumar, 2000). Chae et al. (2005) and Fawcett et al. (2007) stated that committing resources is an indication of strong motivation.
- **Monitor and evaluate performance** – Monitoring and evaluating the performance has been defined as another crucial predictor of a SCIS implementation's success. After vision alignment, performance measures should be designed and agreed on; this is often challenging since these measures are usually different from one firm to another (Koh et al., 2011).
- **Communicate effectively** – Effective communication, which affects all other CSFs, is a prerequisite prior to and during the SCIS implementation trajectory. The large number of employees working for different supply chain actors makes this CSF especially challenging. Communication refers mainly to communicating the work changes to the participating staff members, which is essential to reduce resistance to change (Allen et al., 2000; Koh et al., 2011). In general, during the implementation trajectory of a SCIS, open and frequent communication among the staff involved is critical (Allen et al., 2000; Fawcett et al., 2008; Ruppel, 2004).
- **Manage relationships** – Building trust has been regarded as essential for successfully implementing an information system (Chae et al., 2005; Koh et al., 2011; Lee and Whang, 2000; Ruppel, 2004). To keep distrust to a minimum, effective communication, for instance, is useful (Akintoye et al., 2000).
- **Take top management responsibility** – Top management support has been an often-cited predictor for successful SCIS implementation (Khurana et al., 2011; Sohal et al., 2001). The major responsibility of top management is to provide financial support, which is regularly initiated by their intrinsic motivation and shared implementation interest (Chae et al., 2005; Ngai et al., 2004). Supply chain top management may refer to the top management of a coordinating or governing organization or to a top management committee with representatives from every participating supply chain organization.
- **Manage change and deliver training** – An often-mentioned phenomenon when implementing a SCIS is resistance to change, which, as a result, requires proper change management (Fawcett et al., 2008; Jharkharia and Shankar, 2005; Koh et al., 2011; Ngai and Gunasekaran, 2004). Therefore, users of all collaborating partners should be involved in the design of the information system (Ngai and Gunasekaran, 2004; Ruppel, 2004) and should receive training about the SCIS (Akintoye et al., 2000; Allen et al., 2000).
- **Compose project team** – Quite a few supply chain researchers have emphasized the need for a multidisciplinary project team, composed of staff from every participating supply chain organization (Fawcett et al., 2008; Lu et al., 2006). Lu et al. (2006), suggested that the team should contain four sub-teams: a partner team, a technical team, a business team, and a management team.

The critical success factors above are the subject of further analysis to determine actions that are crucial for implementing a SCIS in the food industry.

3 Research methods

According to Miles and Hubermann (1984), Yin (2003), and Eisenhardt (1989), case study research enables in-depth investigation and is an effective way to study events of a highly complex nature in more depth. In the present research, we investigated the implementation of SCISs in German pork supply chains. A multiple case-study approach was chosen, which permits comparisons that clarify whether a finding is replicated by multiple cases (Eisenhardt, 1991; Yin, 2003).

Special attention was given to the selection process. It was important to select supply chains that completed the implementation of a SCIS because we wanted to learn from the whole project life cycle. Furthermore, to increase the representativeness of the case sample, we incorporated differences between supply chains, such as geography, size, information system, and supply chain organization. Such a case selection strategy is suitable for explorative research and has been named "diverse case method" (Seawright and Gerring, 2008). We selected supply chains that produce and slaughter different amounts of pigs in different regions of Germany, that implemented a SCIS with different purposes, and that were organized differently. Regarding the selection of the interviewees, as advised by Rowley (2002), Yin (2003), and Eisenhardt and Graebner (2007), people with different positions and from different hierarchical levels and organizations were interviewed. As a result, we interviewed on average five

individuals per case, resulting in 19 in total. Specifically, we interviewed top managers, external people (i.e. vendors and/or consultants), project managers, and employees who are/were supposed to work with the system. We selected these people using the snowball sampling method, meaning that we contacted the CEO or main project manager and asked him or her which other people from the supply chain were involved in the project. We then further selected the interviewees based on their position and hierarchical level in the organization. Interviews lasted on average one hour and were tape-recorded.

To conduct the interviews, we applied the "critical incident technique" (CIT), which was developed by Flanagan (1954) within the area of psychology. This technique has been used in other fields as well, such as information seeking behaviour (Bitner et al., 1990) and marketing (Wilkinson, 2001). The critical incident technique is a set of procedures for collecting data from the respondent's perspective in his or her own words. CIT does not force the respondents to talk about certain topics and can deliver top-of-mind answers. In our study, respondents were initially asked to answer background questions regarding their position, the supply chain organization, the implementation objective, and the main functions of the system. Thereafter, we asked the respondents to describe crucial challenges during the project and actions taken to cope with these challenges. A challenge is something important that happened during the implementation and positively or negatively impacted the supply chain. Challenges are assigned to CSFs and form a basis to take actions, which are activities that the participating managers carry out to control and master the various CSFs (Françoise et al., 2009) (see Figure 2). It is crucial to link actions with different actors in the supply chain because the chances of successfully implementing a SCIS are likely to increase when actions are linked to responsibilities (Gottschalk, 2001). Therefore, per challenge, we asked our respondents which actions were taken and by whom.

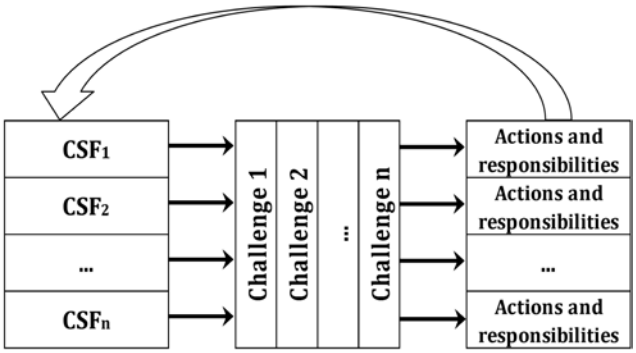

Figure 2. Analytical Framework – based on Francoise et al. (2009)

Through an iterative process, our transcribed interviews were analysed to define challenges and actions connected to CSFs. In a first phase, the challenges were linked to the different critical success factors from the literature. Every challenge could be easily linked to one or more CSFs because of the CSFs' generic character. Thereafter, in a second phase, the actions were identified and also linked to the critical success factors. All actions that were mentioned by our respondents were taken into account. However, any indication of difference in importance among the actions was not considered. In addition, the actions that were mentioned by multiple respondents were not indicated as more crucial or critical.

4 Introduction to the supply chains

In this section, we introduce the four supply chains that have implemented a SCIS. A background to the four supply chains, their supply chain organization, their information system (SCIS), and the challenges that arose during the SCIS implementation are given. The challenges are visualized in a "Gantt-chart", containing a time dimension.

4.1 Supply chain A

Supply chain A is a local supply chain that produces fresh processed pork meat in the north-western area of Germany. This supply chain produces more than 500,000 pigs per year, which is around 1 % of the total German pig production, resulting yearly in 50,000 tons of processed pork meat. The processed meat is distributed through 150 licensed distributors, such as butchers and retailers, emphasizing the quality, the regional aspect, and the transparency of this supply chain's meat.

The local supply chain is a fully integrated supply chain, coordinated and governed by a cooperative of 500 pig farmers, both farrowers and finishers. The cooperative owns a slaughterhouse in which 100 % of the pigs are slaughtered and a meat processing firm in which part of the carcasses are processed. Relationships in the supply chain have a long-term basis and are governed through written contracts with

quality requirements on feeding, animal husbandry, and health management. For instance, the cooperative obliges their farmers to buy feed from a limited number of feed producers.

Supply chain A implemented a supply chain information system to improve the health of the pigs by delivering better management information to their farmers. Management information is communicated to the farmers by farm veterinarians and cooperative consultants, who visit the farms on a regular basis. Before implementing the SCIS, veterinarians and cooperative consultants were not able to digitally register their actions and did not have instant access to slaughter information. The checklists for health status –so-called protocols for veterinarian visits – were filled out manually by veterinarians and were sent to the cooperative. With the SCIS, veterinarians can now enter the data directly in an online checklist on the farm. The checklists (i.e. filled-out protocols) are immediately available to the cooperative consultants and the veterinarians. Slaughter information and protocols are used as a basis for advice to improve farmers' performance and the health status of their pigs.

The interviewees mentioned some challenges that arose during the implementation of the SCIS (see Figure 3). The implementation lasted seven years and was finished in 2010. In addition to selecting the interface standard for exchanging information, it took several years to develop the protocols. Principally, the cooperative had an IT staff member whose work schedule made it challenging for him to support the implementation. After building the protocols, users needed to be convinced and motivated to use them. Motivating the farm veterinarians to use the SCIS took some time since making veterinary practices more transparent is a challenge for them. After 2010, when the implementation was officially finished, protocols were further developed because they were too long, which led to extra administration for the veterinarians. In Figure 3, an overview of the main challenges reported is given.

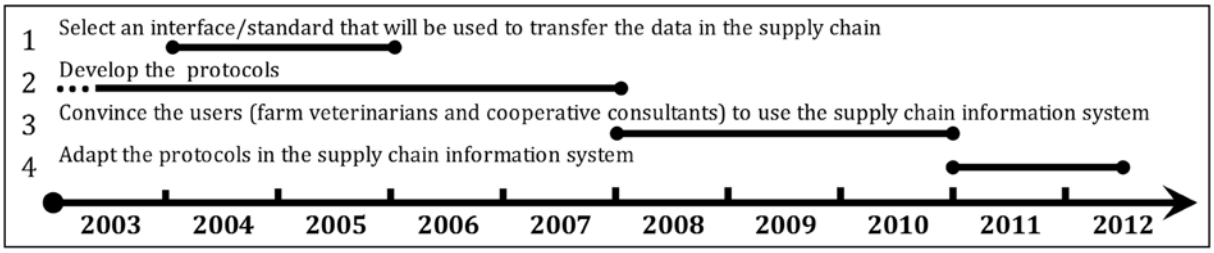

Figure 3. Identified challenges with their duration during the information-system implementation in supply chain A

4.2 Supply chain B

The cooperative, coordinating supply chain B, is one of the three main pork processors of Germany. Like many other pork meat companies, the slaughterhouses and meat-processing companies of this cooperative are located in the north-western area of Germany. The supply chain slaughters more than 7,000,000 pigs per year, which is 12 % of the total German production. Up to 50 % of its processed meat is exported.

The cooperative has 2200 farmers, who own and supply the slaughterhouses, and several meat processing companies. This cooperative has marketing contracts with 80 % of its farmers with whom it has long-term relationships. Marketing contracts are contracts that incorporate buying and selling obligations, meaning that the slaughterhouse has a stable and secure supply of pigs and the farmers have a stable market access. With regards to quality, the cooperative does impose a few restrictions in addition to legal requirements.

In 2002, supply chain B finalized the implementation of their SCIS between the slaughterhouse and farmers. The SCIS is an in-house developed web-based information system to deliver slaughter information to farmers, the main users of the system. Through this system, farmers receive information about their slaughtered pigs, such as carcass grading, meat inspection results, and inter-farm comparisons. Our interviewees identified four implementation challenges, which were directly or indirectly related to the system users (see Figure 4). At the start, to define the farmers' requirements, innovative farmers had to be involved to develop the new SCIS (challenge 5) and, thereafter, all farmers needed to be convinced to use the new information system (6). The large number of farmers in particular made this challenge complex. Crucial during this stage was technical support for the implementation because many farmers had questions on the new system and had different PCs at their farm (7). After 2002, the cooperative took into account the users' feedback to further continuously develop the

information system because, over time, farmers have defined more information system requirements (8).

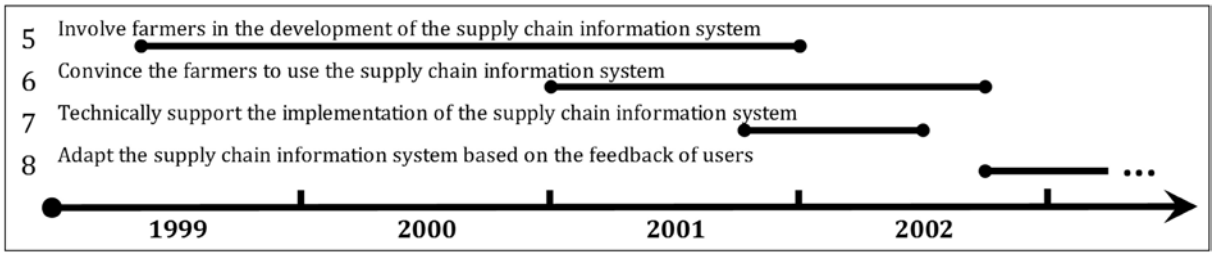

Figure 4. Identified challenges with their duration during the information-system implementation in supply chain B

4.3 Supply chain C

Supply chain C is a local supply chain that produces pork meat in the northern area of Germany, close to the Danish border. It produces about 550,000 pigs per year, which is around 1% of the total amount of slaughtered pigs in Germany. A big part of this pork meat is sold to one supermarket chain under a specific quality label.

The cooperative coordinates and governs part of the local supply chain. In particular, it has its own breeding line, but not its own slaughterhouse or processing company. The cooperative has marketing contracts with its farmers and almost 50% of the raised pigs are delivered to one slaughterhouse, where all pigs intended for the previously mentioned quality label are slaughtered. These pigs therefore need to comply with certain quality label requirements. Thereafter, all pig carcasses are delivered to the processor, with whom the cooperative has a long-term relationship.

Transparency across the entire value chain was the main motive for implementing two parallel SCISs in this supply chain. End-consumers and other actors in the pork meat supply chain want to know the origin and quality of the meat. The first information system is a website that end-consumers of the specific labelled meat can access to check from which farm(s) their meat comes and which feed was delivered to these farms. The second information system enables an efficient electronic data exchange between all project partners – cooperative, slaughterhouse, and processor – and supports the exchange of pig information, such as slaughter data. In case of an emergency, the information system ensures central access to all relevant product and process information. This eBusiness solution was based on open and globally recognized standards and built by two system developers who also developed the intra-organizational systems for the slaughterhouse and the cooperative.

Figure 5 gives an overview of the different implementation challenges of SCIS one and two. Through our respondents, seven challenges were identified for the first information system and five for the second one. During project two, two challenges took almost as long as the complete project duration (challenge 16 and 18). In particular, separating the projects was considered crucial because project team members often confused both projects; the project team composition was almost the same for both projects and objectives were linked. In both projects, defining the required data flows was an important step for implementing a SCIS (13 and 19). At the start of project one, project team composition was considered challenging (9). In the middle of project one, the system developer explained to the project partners that new available data could be bundled to obtain more relevant information (13). Thereafter, organizations that delivered data to the new information system, such as farmers and feed producers (11 and 12), also needed to be convinced. This was challenging because neither party received any information; they were just required to deliver data to the SCIS. Due to the large number of farmers, it took time to convince the farmers. At the end of the project (14 and 15), the information system was further publicised at a press conference, which was crucial since the information system was consumer-oriented. The supply chain wanted to strengthen end-consumer confidence and to increase sales of their quality-labelled meat. Finally, IT was also challenging for the second project (17 and 20). Challenge 20 was a challenge because IT staff of the system developers had to be taught how to program the chosen EDI standards.

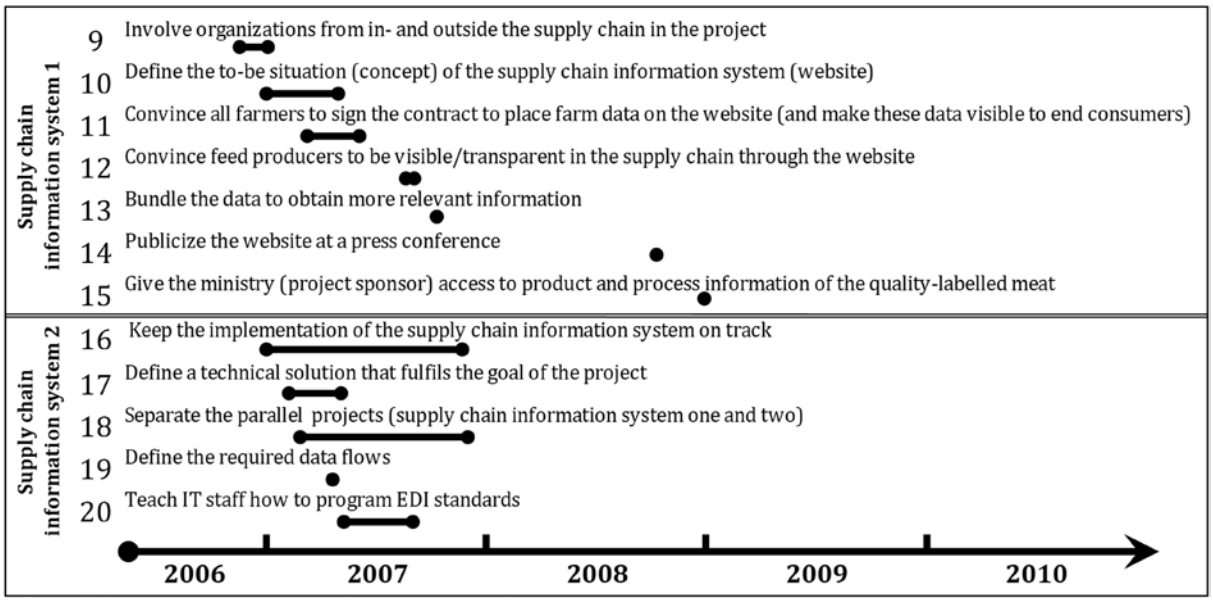

Figure 5. Identified challenges with their duration during implementation of 2 information systems in supply chain C

4.4 Supply chain D

Supply chain D is a local supply chain that produces pork meat in the south of Germany, close to the Austrian border. The supply chain produces approximately 1,100,000 pigs per year, which is around 2 % of the total amount of slaughtered pigs in Germany. After rearing and fattening, pigs are slaughtered in one of the four slaughterhouses owned by one of the largest pig meat producers in Germany.

The coordinating office coordinates and governs part of the supply chain. The cooperative has marketing contracts with its farmers, but does not have its own slaughterhouse or processing company. The cooperative, instead, has long-term relationships with the four slaughterhouses, one of which is 20% owned by the cooperative.

Between 2006 and 2010, the supply chain implemented a SCIS, which was financed by several partners. With this system, farmers, slaughterhouses and other actors in the supply chain have the opportunity to view and retrieve subscriber-related product and production data about the slaughtered pigs. For instance, farmers can view their pig slaughter data and blood test results. In addition, shipping agents, consultants, farm veterinarians, slaughterhouse veterinarians, and other people have access to new data through the SCIS. The data are available to them for documentation, evaluation, and promotion purposes. The centralized storage of all data enables the transparent representation of the origin of all animals slaughtered.

According to the employees, eight challenges arose during the SCIS implementation (see Figure 6). Three of them had to do with convincing the users, such as farmers (challenge 22), shipping agents (26), and veterinarians who inspect the carcasses at the slaughterhouse (28). For example, challenge 26 was considered important because shipping agents were often resistant to new technologies as they are not regarded as being “IT-minded”. Before convincing the users, the functionalities of SCIS had to be defined (21 and 23), planned (24), and developed (25). These challenges took a lot of time because new functionalities were not implemented simultaneously. The project partners believed that implementing a complex SCIS should be done by starting with one functionality; thereafter, functionalities should be implemented one after the other. A last challenge (27) had to do with changing the legacy operating system because the slaughterhouses still used the outdated MS DOS operating system, which was not compatible with the new SCIS.

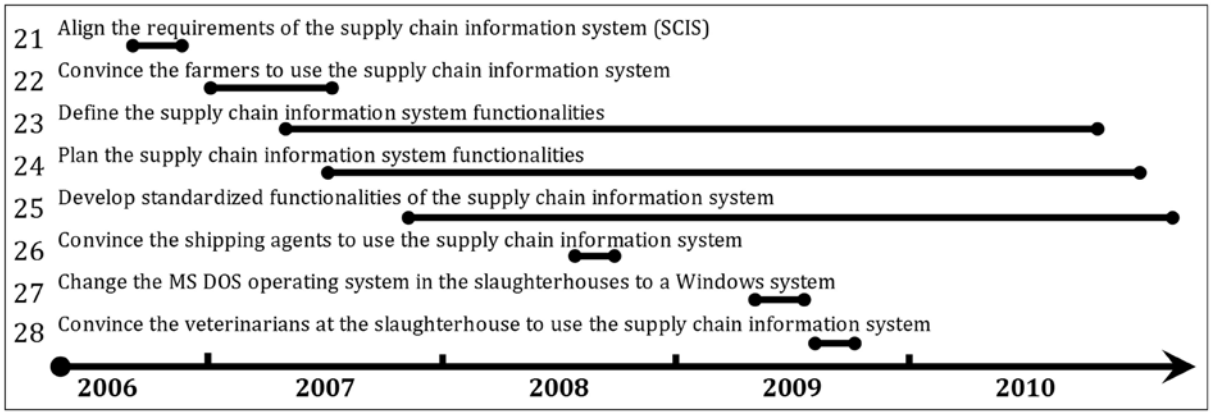

Figure 6. Identified challenges with their duration during the information-system implementation in supply chain D

5 Results – Actionable "critical success factors"

As explained in the previous section, our respondents mentioned multiple challenges that arose when implementing a SCIS. In Table 1, the 28 challenges presented in section 4 are assigned to critical success factors (CSFs), which are in turn connected to an element of Scott-Morton's framework. Challenges form the basis to take "actions" when implementing a SCIS. The challenge numbers in Table 1 (see column 3) refer to the challenge numbers of section four.

Through our four case studies, we identified actions that were taken in the projects when the above-mentioned challenges arose. These actions may be linked to different actors in the SCIS implementation trajectory. Based on Markus and Tanis (2000) and our four case studies, the following six actors were identified (see Table 2): project team (PT), supply chain stage representatives (SSRs), project coordinator (PC), information system developer/vendor (ISD), company executives or top managers (TMs), and operational staff members of the supply chain stages (OSs). The project team contains the supply chain representatives of the involved supply chain stages, the project coordinator, the information system developer, and sometimes top managers of the involved supply chain stages. In a supply chain context, one player needs to take the lead; therefore, a project coordinator was appointed in all cases. Next, the executives of the different supply chain stages play a key role during the implementation trajectory and are sometimes part of the project team. Finally, when decisions are taken, the supply chain stage representatives often pass responsibility to operational staff members, who are not part of the project team.

Table 1.
Identified challenges connected to the Critical success factors (CSFs)

Scott-Morton's element	CSF	Challenge number	Challenges	Case
Project strategy	Align vision and build plans	• 24	• Plan the development of the SCIS	• D
		• 10	• Define an interface to exchange information	• C
		• 18	• Separate parallel projects	• C
		• 16	• Keep the implementation project on track	• C
Structure	Reengineer processes	• 19	• Define the required information flows	• C
Information systems	Assess IT legacy system	• 27	• Change the computer operating system	• D
	Select standards, vendor, software package	• 3/17/21/23	• Define the functional requirements of the SCIS	• A, C, D
		• 2/25	• Build the new supply chain information system	• A, D
		• 1/10	• Define an interface to exchange information	• A, C
		• 7	• Technically support the implementation of the SCIS	• B
		• 4/8	• Adapt the SCIS based on the users' feedback	• A, B
	Manage data exchanged	• 4/19	• Define the required information flows	• A C
		• 13	• Bundle the new obtained data to obtain more information	• C
		• 15	• Give information access to external organizations	• C
People	Compose project team	• 9	• Involve organizations in the project team from in- and outside the supply chain	• C
	Take top management responsibility	• 19	• Define the required information flows	• C
		• 1/10	• Define an interface to exchange information	• A, C
	Manage change and deliver training	• 5	• Involve the future users to develop the new SCIS	• B
		• 11/12	• Convince supply chain organizations that are not using any data to deliver certain data	• C
		• 3/6/22/26/28	• Convince future users to use the new SCIS	• A, B, D
		• 20	• Teach IT staff how to program/build the new SCIS	• C
		• 14	• Make the information system more visible through public communication	• C
Management processes	Manage relationships	• 1/3/5/6/10/11/12/14/19/20/22/26/28	• See section 5.4	• A, B, C, D
	Manage project	• 18	• Separate parallel projects	• C
		• 16	• Keep the project on track	• C
	Communicate effectively	• 1	• See section 5.5	• A, B, C, D
		• 3 to 23		
		• 25 to 28		

5.1 Project strategy

After having analysed the four cases, a list of key actions to implement a SCIS becomes apparent. Below, after briefly describing the challenges, the actions are defined for each critical success factor. Whenever appropriate, examples from the case studies are given to illustrate the actions.

Align vision and build plans – Our respondents named several challenges related to defining the project goal and planning the different functionalities of the new SCIS. With respect to the former, every project partner may have different project goals – and consequently different functional requirements – when implementing a SCIS. Therefore, several actions need to be taken to match the different goals and requirements of the involved supply chain partners (see Table 2). In case D, for instance, some organizations asked the system developer to build functionalities before a definite deadline (i.e. requirements with a high priority), while other organizations asked the system developer to automate a manual data process; in other words, changes that would make the data process more efficient (i.e. requirements with a low priority). Due to the large number of requirements, the system developer in case D took care that functional requirements with a high priority were planned before those with a low priority.

Table 2.
Reported key actions with linked responsibilities to master the CSF "Align vision and build plans"

PC[1]	• Write a project plan • Organize a kick-off meeting with the project team • Explain the overall goal to the project team at the start of the kick-off meeting
PT[2]	• Define the goals and milestones in depth at the kick-off meeting • Agree on the project plan at the kick-off meeting
ISD[3]	• Plan the functional requirements of the SCIS with a high priority before the ones with a low priority; some requirements are a necessity, while others are nice to have

1. Project coordinator; 2. Project team; 3. Information system developer/vendor

5.2 Structure

Reengineer processes – Before reengineering the processes, current processes must be visualised and analysed. To cope with this challenge, respondents named a few actions, which have to be accomplished by the project coordinator (see Table 3). Actions to reengineer the information processes are assigned to the critical success factor "manage data exchanged" (see 5.3).

Table 3.
Reported key actions with linked responsibilities to master the CSF "Reengineer processes"

PC[1]	• Contact every participating supply chain partner to define the current information flows in the supply chain
PT[2]	• Analyse the current information flows to check which processes should be reengineered

1. Project coordinator; 2. Project team

5.3 Information systems

Assess IT legacy system – Respondents of case D named the challenge "change the operating system" because one involved supply chain partners had an outdated operating system, incompatible with the new SCIS. This challenge was classified under the CSF "assess IT legacy system". If not compatible with the new SCIS, outdated operating systems must be replaced, entailing some actions. For instance, in case D, the information system developers explained the management of the involved slaughterhouses that a new operating system (Windows instead of DOS) was required for building the SCIS functionalities. Table 4 gives an overview of the key actions that our respondents considered necessary.

Table 4.
Reported key actions with linked responsibilities to master the CSF "Assess IT legacy system"

ISD[1]	• Map the current IT of the supply chain for its compatibility with the new SCIS • Explain to the management of the supply chain partners that have a legacy system the disadvantages of such a system and the advantages of a new operating system, to convince them to replace their outdated legacy system

1. Information system developer/vendor

Select standards, vendor and software package – The respondents mentioned that defining functional requirements, selecting a standard, building and adapting the SCIS, and technically supporting the implementation were challenges that arose when implementing a SCIS. All these challenges were classified under the CSF "select standards, vendor, and software package". Several actions were identified to cope with these challenges (see Table 5). Regarding the challenge "defining functional requirements" two options, entailing specific actions, can be practised: the project team defines the functional requirements or the project coordinator talks separately with the representatives of the organizations/supply chain stages who required the same functionality. Furthermore, the implementation trajectory of every information system is sprinkled with obstacles, inducing the challenge "technically supporting the implementation". Some respondents of case B indicated that a crucial action to cope with this challenge is releasing an internet platform where farmers could discuss general SCIS issues, weight and slaughter information, technical issues, and further SCIS developments.

Table 5.
Reported key actions with linked responsibilities to master the CSF "select standards, vendor, and software package"

PC[1]	• Organize multiple meetings among the project partners to define the functional requirements or, when no meetings are organized, ask the project partners to express their functional requirements
	• If the project partners are asked separately to express their functional requirements:
	  ➢ Have multiple separate conversations (from general to more specific) with the representatives of the organizations/supply chain stages who require the same functionality (i.e. principal) to register and describe the functional requirements for clarifying the following questions: "What does the principal want?", "What are the goals of the functionalities?", "When does the principal want the functionality to be ready?", "What can the information system developer build for the principal?"
	  ➢ Check the organizational and technical feasibility of the functional requirements
	  ➢ Find a compromise for all functional requirements that are suitable for the supply chain stages who require the same functionality
	  ➢ Send a concept of the new SCIS back to the involved principals and ask for feedback
	• Propose and explain in depth and with a lot of visual aids (i.e. presentations and pictures) different technical standards to cope with the goal of a project during a project meeting by asking the following questions: Which standards exist?, How do they function?, In which processes could these standards be used?, What are the advantages and disadvantages of the different standards?
	• Discuss with the board of the supply chain director what the interface should look like when no agreement could be achieved in the project team
	• Record and bundle all the received users' comments, which were received by phone, email, or face-to-face
	• Discuss regularly with the information system developer the users' wishes and remarks

SSRs[2]	• Present the concept internally to get feedback from employees • Communicate the feedback of internal employees back to the information system developer

PT[3]	• If multiple meetings among the project partners are organized to define functional requirements:
	  ➢ Invite innovative users to several workshops to define the functional requirements
	  ➢ Discuss defining the functional requirements during a project meeting
	• Decide which technical standards to use in the supply chain to reach the project goal by discussing what should be achieved with the interface
	• Select an information system developer that has expertise in the food industry, and with whom the participating project partners have positive experiences

ISD[4]	• Build a SCIS that is user-friendly, does not contain unnecessary colourful pictures, does not contain unnecessary data, has a fast processing speed, and is compatible with the existing ISs in the supply chain • Install a telephone hotline that the users can call when they have technical problems • Release an internet forum where users can discuss the new SCIS • Continue to build the SCIS based on the users' remarks during the SCIS implementation trajectory

1. Project coordinator; 2. Supply chain stage representatives; 3. Project team; 4. Information system developer/vendor

Manage data exchanged – Several actions were mentioned to tackle the challenges "define the required information flows", and "bundle the new obtained data to obtain more information". These two challenges were classified under the CSF "manage data exchanged". Regarding the first challenge, the

supply chain needs to agree on which information should be available to whom because some supply chain partners may be resistant to more transparency. With respect to the second challenge, the cases illustrate that not all data possibilities can be overseen at the start of the project. Throughout the implementation trajectory of the SCIS, opportunities for linking new available data become more and more clear. The information system developer needs to accomplish several actions to bundle and link the available data (see Table 6). In case C, at the start of every project meeting, the system developer presented the work that had been done since the last meeting, which formed the basis for the project meeting discussion. Thereafter, the system developer discovered that the available data, obtained through the new information system, could be bundled to attain more information. To master the CSF "manage data exchanged", our results specify that the project team is a central actor; however, actions also need to be fulfilled by the project coordinator and the information system developer (see Table 6).

Table 6.
Reported key actions with linked responsibilities to master the CSF "Manage data exchanged"

PT[1]	• Ask advice from internal top managers with respect to required information flows – as input for the project meeting • Present at the start of every meeting the stage of development of the SCIS along the project trajectory • Check which data are IT-relevant and bring added value to the supply chain during a meeting • Agree during the project meetings – from general to specific – which information should be available to whom and where, which data are required to make this information available, and what needs to be done by whom • Discuss openly during the project meetings • Be constructive during the meeting.
PC[2]	• Organize meetings with the project partners together or separately to define the functional requirements • Involve top management of the participating supply chain partners in the project meetings to define the required information flows, and consequently easily convert these decisions into practice
ISD[3]	• Explain proactively to the project partners which data could be bundled to provide new information • Discuss with every project partner which extra information they would like to have based on the new available data • Send log-in data for the SCIS per e-mail to (the responsible person of) the users

1. Project team; 2. Project coordinator; 3. Information system developer/vendor

5.4 People

Compose project team – Only one challenge was mentioned that could be linked to the CSF "compose project team". As a result, a limited number of actions were noted (see Table 7). Results indicate that both external and supply chain organizations need to be involved in the project. Moreover, results show that the project team members cannot have all the required knowledge to take decisions during implementation. Consequently, the project coordinator of case C, for instance, brought an IT staff member to the project meeting when different technical standards had to be explained.

Table 7.
Reported key actions with linked responsibilities to master the CSF "Compose project team"

PC[1]	• Involve every supply chain stage in the project • Involve people from your personal network in the project with whom you have had a positive experience and whom you trust • Involve the top management of the supply chain partners in project meetings for strategic and tactical decisions • Involve project people who have implemented similar IT projects before • Involve external, neutral sectorial organizations as project observer
PT[2]	• Bring along a specialist to the meeting when necessary

1. Project coordinator; 2. Project team

Take top management responsibility – Several challenges were linked to the CSF "take top management responsibility". By naming a number of actions, our respondents pointed out that top management involvement is beneficial when implementing a SCIS (see Table 8. Case C illustrates that when top management of all collaborating supply chain partners are involved in the project, then implementation is accomplished faster because decisions taken during project meetings are easily converted into practice. Involvement of top managers in project meetings is, however, not required as their suggestions can be put forward by their project managers, as part of the project team. In conclusion, several actions are listed to master the critical success factor "take top management responsibility" (see Table 8).

Table 8.
Reported key actions with linked responsibilities to master the CSF "Take top management responsibility"

SSRs[1]	• Involve top management of project partners in project meetings to take strategic and tactical decisions, or, • Request input from the top managers of the participating project partners before the project meetings
TMs[2]	• Place high priority on the implementation of the new SCIS • Give suggestions to the project managers concerning strategic and tactical decisions on the SCIS
PT[3]	• Discuss with the board of the project coordinator when no agreement can be reached in the project team concerning tactical or strategic decisions

1. Supply chain stage representatives; 2. Top managers of the involved supply chain stages; 3. Project team

Manage change and deliver training – "Manage change and deliver training" raised a huge amount of interest among our respondents, given the many challenges. "To convince future users to use the new SCIS" was frequently mentioned since some users are scared of more transparency, especially when there is competition among partners at the same supply chain stage. In addition, in such a supply chain context, some supply chain stages may need to be convinced to deliver certain data without retrieving any information from the new SCIS. Next, a SCIS is occasionally developed for end-consumers, who are often large in number. If the latter occurs, then press agencies work as a mediator to convince consumers to use the new system. The work practices of other staff members may also be influenced. There is, for instance, the possibility that the IT staff of the information system developers do not possess sufficient IT knowledge, calling for more actions. In conclusion, to cope with all the challenges, several supply chain actors need to accomplish actions (see Table 9).

In case C, feed producers had to deliver data without actually using any. Therefore, to convince these feed producers, the cooperative and the processor invited the most innovative one for a discussion at the premises of the processor. These organisations explained to the innovative feed producer the idea behind and the need for the SCIS (i.e. a website). That explanation convinced this feed producer to deliver the required data, which created an incentive for the other feed producers since cooperative and processor told them that they could no longer supply feed to the farmers if they did not deliver the required data.

To further convince the feed producers, they were also told to receive an internet platform on which to present themselves (i.e. a link to their company on the website).

Table 9.
Reported key actions with linked responsibilities to master the CSF "Manage change and deliver training"

PC[1]	• Organize workshops with some innovative users or the representative of the supply chain stage(s) who understands and looks after the users' needs to build the information system requirements • During a seminar for "every type of user" use power-points and online demonstrations to outline the reason for the SCIS, the benefits of the new SCIS for their jobs, what the new SCIS looks like and the fact that the output of the SCIS looks just like the system used before, when it is applicable, and how to use it • Give information on the SCIS to the users through information brochures, newsletters, or a website • Present and discuss examples in small user groups showing the benefits of the SCIS • Give users the opportunity to give feedback by appointing a trustful contact person whom the users can call, by creating an email-address, during the seminar, or during personal visits • Record and bundle the wishes of users and answer all users' questions • Impose a deadline, from which point on the users have to use the system • When end-consumers are intended use the system, organize a press conference, considering the proximity of relevant press agencies, the market area of the supply chain, and the required conference facilities, by involving managers with a big network, sending an invitation per post to potentially interesting press contacts, preparing presentations, inviting influenceable people with different backgrounds, providing the participants with the opportunity to ask questions, a discussion session to create trust in the system, and something to eat at the end of the conference
SSR[2] **&** **PC**[1]	• If some supply chain stages need to deliver data without themselves using data, first convince an innovative organization (at the same supply chain stage that needs to deliver data to the SCIS) by explaining the necessity of the new SCIS • After having convinced one organization, present the SCIS during a seminar and give an explanation to the organizations that need to deliver data: the reason for the information system development, the expectations, the benefits of using the new SCIS, the negative consequences of not delivering the data to the new information system, and the opportunities and challenges/risks of the new information system • Create a corporate identity for the supply chain organizations that need to deliver data without using any new info • Give a gift to organizations that have to deliver data (without using any new information) and future users
ISD[3]	• Release an internet platform where users can discuss the SCIS
OS[4]	• If necessary, explain to the IT staff of the system developer how to read certain standards, necessary for the SCIS • Convince future users to use the SCIS during a visit by using positive experiences of other users, by explaining how to get the data out of the SCIS, by explaining the advantages, by creating a "Eureka" effect, and by giving suggestions about what to do with the available data • Convince organizations to deliver data (without using any new information) to the new SCIS during a visit by explaining: the advantages of delivering the data to the new SCIS, which data are going to be visible on the SCIS, the benefits of using the SCIS, the necessity of using the new SCIS, that other similar organizations did not have problems with delivering data to the new SCIS (e.g. by using positive stories)

1. Project coordinator; 2. Supply chain stage representatives; 3. Information system vendor; 4. Operational staff members of the involved supply chain stages

Manage relationships – "Manage relationships" is permanent prior to and during SCIS implementation and is part of every other "people" critical success factor described above: i.e. "compose project team", "take top management responsibility", and "manage change and deliver training". Good and trustful relationships are built and strengthened through, for instance, effective, regular, and open communication among project team members and towards users (See 5.5 – Communicate effectively). Besides communication actions, the other actions identified also contribute to mastering this CSF. For instance, in case D, shipping agents were given a printer as a motivator to use the new SCIS. Such actions can be perceived as strengthening the relationship as well. Next, our results specify that selecting trustful project members is useful for proper relationship management. For instance, in case D, when experiencing a problem with the SCIS, farmers (i.e. users) were given the opportunity to call a contact person whom they had known and had a positive relationship with. In summary, however not stated as such, several challenges and actions may be linked to the CSF "manage relationships".

5.5 Management processes

Manage project – Project management plays an important role in SCIS implementation as our respondents mentioned the challenges "keep the project on track" and "separate parallel projects". The project coordinator is a central actor when tackling these challenges because he has to be aware that parallel projects might be closely linked to each other. For instance, project partners may be the same or project goals may be related. Moreover, in a supply chain, certain project partners may perceive there to be less benefit from the planned project outcome than others. Such critical partners might slow down the implementation and thus require several actions, taken by the project coordinator. To illustrate, before every meeting the project coordinator of Case C called the slaughterhouse representatives to remind them of their tasks since the slaughterhouse did not recognize the benefits of improved information exchange. All in all, project coordinator and project team should fulfil several actions to control the CSF "manage project" (see Table 10).

Table 10.
Reported key actions with linked responsibilities to master the CSF "Manage project"

PC[1]	• Organize regular meetings with all project partners and, when necessary, bring along a specialist • Prepare the following documents for the meetings: goals of the meeting, the content of the meeting, and the agenda • Take care that the project partners stick to the decisions taken by writing emails to explain the expectations • Call the critical project partners with the following purposes: to communicate – again – the goals for the next meeting, to check what the partner has prepared for the next meeting, to check if the partner understands his tasks, and if needed, to explain his tasks again
PT[2]	• Define the tasks for the project partners, the project goals in depth, the milestones, and the project goals that are not taken into account, during the project meeting • Make a summary: Where are we? What are the difficulties? What needs to be done by whom? • Communicate openly, frequently, and with confidence during the project meetings

1. Project coordinator; 2. Project team

Communicate effectively – Communication is permanent prior to and during SCIS implementation and is, principally, part of every critical success factor. "Communication actions" play, therefore, a central role when implementing a SCIS. Based on our interviews, effective communication refers, first of all, to actions related to communication tools such as project meetings, seminars, personal face-to-face conversations, newsletters, internet platforms, phone calls, etc. In addition, some actions refer to the manner of communication. For example, during the project meetings, project partners should discuss openly and constructively. Finally, different project partners communicate with each other: for example, project team member with the other members, project coordinator with the users, project managers with the top executives, project managers with the users, etc. To sum up, according to our four cases, communication actions are essential if all the above critical success factors are to be mastered.

6 Discussion

The results obtained indicated that the elements "information systems", "people" and, to a lesser degree, "management processes" of Scott-Morton's MIT90s framework raised a considerable amount of interest among our respondents, given the fact that many challenges were named for these elements (see Figure 7). The most frequently mentioned challenges were "convince future users to use the new SCIS" and "define the functional requirements of the SCIS" and to a lesser extent "build the new SCIS", "define an interface to exchange information", "adapt the SCIS based on the users' feedback", and "define the required information flows". These six challenges were named in at least two cases; other challenges were mentioned in only one case. A link to "management processes", and more precisely to the CSF "communicate effectively", was present in almost every challenge mentioned. The three Scott-Morton elements that should receive the most attention during SCIS implementation – people, information systems, and management processes – are described below.

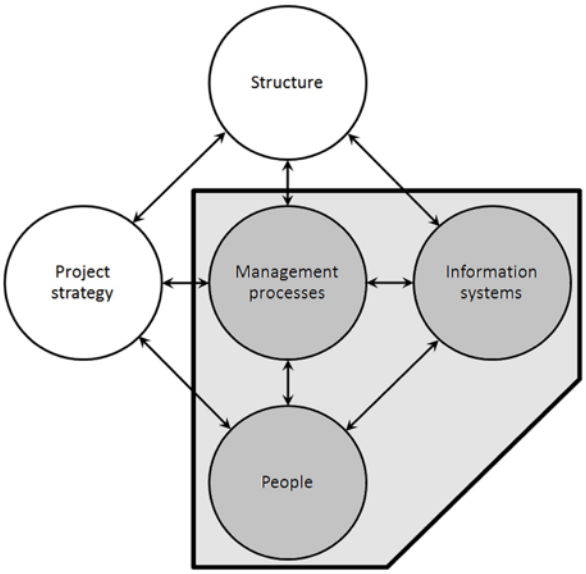

Figure 7. MIT90s elements that should receive the most attention during a SCIS implementation – i.e. grey zone

First, results showed that many key actions were identified for Scott-Morton's element "people". In particular, it became apparent that respondents from all four cases mentioned one or more challenges related to "convince users to use the system" or "convince organizations to deliver data". For instance, when implementing a SCIS, some users may not be willing to use the system because they are reluctant to be more transparent, certainly when there is competition among the horizontal supply chain partners – as in case A. Moreover, in such a supply chain context, it may be that – as in case C – some supply chain stages need to be convinced to deliver certain data without retrieving any information from the new SCIS. For this eventualities, the present paper provides a range of consecutive "convincing actions" that must be taken to implement a SCIS. Other information system researchers stated as well that convincing or motivating the participating individuals – e.g. users, managers – is the most crucial step towards successfully implementing a SCIS. For instance, Russell and Hoag (2004), pointed out that the people involved should receive considerable attention during a SCIS implementation. It is worth noting that, in particular, the CSF "manage change and deliver training" received considerable interest among our respondents.

Second, besides Scott-Morton's element "people", several actions were identified for the element "information systems". In the present paper, the challenge "defining the functional requirements of the SCIS" in particular drew the attention of case A, C, and D respondents. Therefore, supply chains need to find compromises because the participating partners often have different functional requirements. To control "information system" challenges, actions need to be taken, most of them for the CSFs "select standards, vendor, and software package" and "manage data exchanged". Other supply chain researchers concluded as well that supply chains should indeed pay attention to technical critical success factors (Lu et al., 2006; Premkumar, 2000).

Third, and to a lesser degree, when implementing a SCIS, attention needs to be paid to the element "management processes". Our results clarified that actions related to "communicate effectively" were

part of almost every other critical success factor. Other SCIS researchers, such as Ngai et al. (2004) concluded as well that "communicate effectively" is indeed a crucial CSF. Moreover, in a supply chain, certain project partners – as in case C – might perceive that they will get fewer benefits from the planned project outcome than other project partners. Such critical project partners may slow down the implementation. Several actions need to be taken regarding these partners, such as contacting the critical project partners to further explain the goals for the next meeting and to check what the partner has prepared for that meeting. These actions help control and master the CSF "manage project".

With respect to responsibilities, we conclude that the key actors during a SCIS implementation are project coordinator, information system developer, and project team. This paper showed that the project coordinator has to accomplish more actions than any other supply chain actor. In particular, the coordinator, which can be the information system developer, the cooperative – i.e. the chain director –, or another supply chain actor, steers and leads the project. In addition, due to the importance of the CSF "select standards, vendor, and software package", the information system developer is an important actor as well. The present study revealed that the information system developer has to take proactive measures. He or she should make the involved partners aware of which available data could be bundled for obtaining more information. Due to the importance of negotiating, discussing, and compromising among the supply chain organizations, the project team also needs to fulfil several actions. It is important to note that top management, supply chain stage representatives, and operational staff members should fulfil a limited number of actions.

Additionally, from a CSF perspective, the results obtained show that challenges – and connected actions – were identified for almost all 14 critical success factors. Not surprisingly, none of the challenges identified could be linked to the CSFs "share costs, benefits, and risks", "monitor and evaluate performance", and "assess business system". All supply chains received external financial support for implementing a SCIS; therefore, financial issues were not apparent. Furthermore, neither "monitor and evaluate performance" nor "assess business system" have received substantial interest from other supply chain researchers. For instance, Lu et al. (2006) and Ngai et al (2004), who identified critical success factors for implementing SCIS, have not discussed these two particular CSFs.

Finally, our methodological choices do show some shortcomings. First, actions were identified in four German pork case studies; no other food sectors were considered. Nevertheless, our results give a good indication of actions that should be taken when implementing a SCIS in the food sector because we selected pork supply chains that are different in nature. Moreover, the pork industry has been exposed to similar challenges to other food industries. Other food industries also need to cope with low profit margins and face an increasing demand for healthy, safe, and high-quality food. In addition, meat supply chains have structural similarities with the other food supply chains. For example, in other food supply chains, farmers – often united in a cooperative – take care of the primary production as well. The second shortcoming is that all actions mentioned by our respondents were taken into account. This methodological choice implies that some actions were named in one case only, while others in multiple.

7 Conclusions

Due to the involvement of different organizations, implementing a SCIS is complex. From a technical point of view, every supply chain organization has different IT operating systems, and wants to apply different standards to exchange data. Moreover, such organizations often have incompatible organizational structures and cultures. The concept of critical success factors (CSFs) has formed a promising approach to deal with these complexities and, as a result, to successfully implement SCISs. However, information system researchers so far have delivered abstract CSFs for implementing a SCIS that have not been made "actionable" for management practice.

To maximize the chances of successfully implementing a SCIS in the food industry, we aimed to identify key actions linked to CSFs. Therefore, we investigated four German pork supply chains that have implemented a SCIS. To identify the actions, we applied the critical incident technique and first asked our respondents to describe the challenges that arose when implementing their SCIS. Thereafter, key actions – with connected supply chain responsibilities – were identified for every challenge.

To summarize, the present paper sheds light on the complex implementation of SCISs and extends the abstract concept of critical success factors. To do so, a list of challenges that might arise when implementing a SCIS was pinpointed. Specifically, our results suggest that "convince future users to use the new SCIS" – part of the CSF "manage change and deliver training" – and "define the functional requirements of the SCIS" – part of the CSF "select standards, vendor, and software package" – are crucial challenges. Thereafter, possible critical actions – with connected supply chain responsibilities – were

identified for implementing a SCIS. By doing so, we link the concepts CSFs, challenges, actions, and responsibilities and bridge the gap between CSFs and operational project management for the implementation of a SCIS. Due to the latter, our results should be of interest to managers responsible for implementing a SCIS in the food sector.

The emerging field of CSFs for implementing SCISs offers several potential areas for further research. First, due to the explorative character of the present study, further studies should verify the robustness of our findings as some actions may only be applicable in a specific context. For instance, certain actions might be relevant in one type of supply chain with a particular "supply chain organization", but not in another. Second, more effort should be made to further explore the interrelationships of CSFs and related actions for implementing SCISs because these have been presented as "laundry lists". Such a presentation gives the impression that CSFs and their connected actions are stand-alone elements. Bringing together the CSF concept and the MIT90s framework has been a first step towards increasing the understanding of the interrelationships among CSFs to implement SCISs. Third, it would be beneficial to investigate the relative importance of CSFs and related "actions" for implementing a SCIS. Such research needs to be conducted since, in the present study, any indication of difference in importance among actions was not considered and the actions that were mentioned by multiple respondents were not indicated as more crucial.

Acknowledgements

The authors wish to acknowledge the European Fund for Regional Development (EFRO) and the Industry-Academia Partnerships and Pathways (IAPP) for having funded this research via the TIPO and Quarisma projects. Furthermore, we would like to thank the interviewees who agreed to be involved, and Deutscher Raiffeisenverband, which brought us in contact with these interviewees.

References

Akintoye, A., McIntosh, G., and Fitzgerald, E. (2000). A survey of supply chain collaboration and management in the UK construction industry. *European Journal of Purchasing & Supply Management*, **6** (3): 159-168.

Allen, D.K., Colligan, D., Finnie, A.; and Kern, T. (2000). Trust, power and interorganizational information systems: the case of the electronic trading community TransLease. *Information Systems Journal*, **10** (1): 21-40.

Ang, J.S.K., Sum, C.-C., and Yeo, L.-N. A (2002). Multiple-case design methodology for studying MRP success and CSFs. *Information & Management*, **39** (4): 271-281.

Bahlmann, J., Spiller, A. (2009). Inter-organizational information systems in meat chains: the linkage between supply chain organization and system requirements. *Journal on Chain and Network Science*, **9** (1): 59-69.

Bitner, M.J., Booms, B.H., and Tetreault, M.S. (1990). The service encounter: Diagnosing favorable and unfavorable incidents. *Journal of Marketing*, **54** (1): 71-84.

Boynton, A.C., Zmud, R.W. (1984). An assessment of critical success factors. *Sloan Management Review*, **25** (4): 17-27.

Bullen, C.V., Rockart, J.F. (1986). A Primer on critical success factors. In Bullen, C.V., Rockart, J.F. (Eds.), The Rise of Managerial Computing: The Best of the Center for Information System Research. Homewood, Illinois, Dow Jones-Irwin: 383-423.

Chae, B., Yen, H.R., and Sheu, C. (2005). Information technology and supply chain collaboration: moderating effects of existing relationships between partners. *Engineering Management, IEEE Transactions*, **52** (4): 440-448.

Denolf, J.M., Trienekens, J.H., Wognum, P.M., van der Vorst, J.G.A.J., and Omta, S.W.F. (2015). A framework of critical success factors for implementing supply chain information systems. *Computers in industry*, **68** (2015): 16-26.

Eisenhardt, K.M. (1989). Building theories from case study research. *Academy of management review*, **14** (4): 532-550.

Eisenhardt, K.M. (1991). Better stories and better constructs: the case for rigor and comparative logic. *Academy of Management review*, **16** (3): 620-627.

Eisenhardt, K.M., Graebner, M.E. (2007). Theory building from cases: opportunities and challenges. *Academy of management journal*, **50** (1): 25-32.

Fawcett, S.E., Osterhaus, P., Magnan, G.M., Brau, J.C., and McCarter, M.W. (2007). Information sharing and supply chain performance: the role of connectivity and willingness. *Supply Chain Management: An International Journal*, **12** (5): 358-368.

Fawcett, S.E., Magnan, G.M., and McCarter, M.W. (2008). Benefits, barriers, and bridges to effective supply chain management. *Supply Chain Management: An International Journal,* **13** (1):35-48.

Flanagan, J.C. (1954). The critical incident technique. *Psychological bulletin,* **51** (4): 327-358.

Flynn, D.J., Arce, E.A. (1997). A CASE tool to support critical success factors analysis in IT planning and requirements determination. *Information and software technology,* **39** (5): 311-321.

Françoise, O., Bourgault, M., and Pellerin, R. (2009). ERP implementation through critical success factors' management. *Business Process Management Journal,* **15** (3): 371-394.

Gottschalk, P. (2001). Descriptions of responsibility for implementation: a content analysis of strategic information systems/technology planning documents. T*echnological Forecasting and Social Change,* **68** (2): 207-221.

Hartmann, M., Heinen, S., Melis, S., and Simons, J. (2013). Consumers' awareness of CSR in the German pork industry. *British Food Journal,* **115** (1): 124-141.

Hill, C.A., Scudder, G.D. (2002). The use of electronic data interchange for supply chain coordination in the food industry. *Journal of Operations Management,* **20** (4): 375-387.

Jharkharia, S., Shankar, R. (2005). IT-enablement of supply chains: understanding the barriers. *Journal of Enterprise Information Management,* **18** (1): 11-27.

Khurana, M., Mishra, P., and Singh, A. (2011). Barriers to information sharing in supply chain of manufacturing industries. *International Journal of Manufacturing Systems,* **1** (1): 9-29.

Koh, S.C.L., Gunasekaran, A., and Goodman, T. (2011). Drivers, barriers and critical success factors for ERPII implementation in supply chains: A critical analysis. *The Journal of Strategic Information Systems,* **20** (4): 385-402.

Lambert, D.M., Cooper, M.C. (2000). Issues in supply chain management. *Industrial marketing management,* **29** (1): 65-83.

Lee, H.L., Whang, S. (2000). Information sharing in a supply chain. *International Journal of Manufacturing Technology and Management,* **1** (1): 79-93.

Lehmann, R.J., Reiche, R., and Schiefer, G. (2012). Future internet and the agri-food sector: State-of-the-art in literature and research. *Computers and Electronics in Agriculture,* **89**: 158-174.

Li, S., Lin, B. (2006). Accessing information sharing and information quality in supply chain management. *Decision support systems,* **42** (3): 1641-1656.

Lu, X.-H., Huang, L.-H., Heng, M.S. (2006). Critical success factors of inter-organizational information systems—A case study of Cisco and Xiao Tong in China. *Information & Management,* **43** (3): 395-408.

Markus, M.L., Tanis, C. (2000). The enterprise systems experience–from adoption to success. In Zmud R.W. (Ed.), Framing the domains of IT research: Glimpsing the future through the past. Cincinnatti, OH, Pinnaflex Educational Resources, Inc: 207-173.

Mentzer, J.T., Min, S., and Zacharia, Z.G. (2000). The nature of interfirm partnering in supply chain management. *Journal of Retailing,* **76** (4): 549-568.

Miles, M.B., Huberman, A.M. (1994). Qualitative data analysis: an expanded sourcebook. London, SAGE.

Ngai, E., Cheng, T., and Ho, S. (2004). Critical success factors of web-based supply chain management systems: an exploratory study. *Production Planning & Control,* **15** (6): 622-630.

Ngai, E.W., Gunasekaran, A. (2004). Implementation of EDI in Hong Kong: an empirical analysis. *Industrial Management & Data Systems,* **104** (1): 88-100.

Ngai, E.W., Law, C.C., and Wat, F.K. (2008). Examining the critical success factors in the adoption of enterprise resource planning. *Computers in industry,* **59** (6): 548-564.

Premkumar, G.P. (2000). Interorganization systems and supply chain management. *Information Systems Management,* **17** (3): 56-69.

Rowley, J. (2002). Using case studies in research. *Management research news,* **25** (1): 16-27.

Ruppel, C. (2004). An information systems perspective of supply chain tool compatibility: the roles of technology fit and relationships. *Business Process Management Journal,* **10** (3): 311-324.

Russell, D.M., Hoag, A.M. (2004). People and information technology in the supply chain: Social and organizational influences on adoption. *International Journal of Physical Distribution & Logistics Management*, **34** (2): 102-122

Schulze, B., Spiller, A., and Theuvsen, L. (2006). Is more vertical integration the future of food supply chains? Empirical evidence and theoretical considerations from German pork production. In Bijman, J., Omta, O., Trienekens, J., Wijnands, J., Wubben, E. (Eds.), International agri-food chains and networks: management and organization. Wageningen, Wageningen Academic Publishers: 49-63.

Scott Morton, M.S. (1991). The corporation of the 1990s: Information technology and organizational transformation. New York, Oxford University Press.

Seawright, J., Gerring, J. (2008). Case Selection Techniques in Case Study Research A Menu of Qualitative and Quantitative *Options. Political Research Quarterly*, **61** (2): 294-308.

Sohal, A.S., Moss, S., and Monash, L.N. (2001). Comparing IT success in manufacturing and service industries. *International Journal of Operations and Production Management*, **21** (1-2): 30-45.

Trienekens J.H., Wognum, P.M., Beulens, A.J.M.,. van der Vorst, J.G.A.J (2012). Transparency in complex dynamic food supply chains. A*dvanced Engineering Informatics*, **26**: 55–65

Wilkinson, M.A. (2001). Information sources used by lawyers in problem solving: An empirical exploration. Library & Information. *Science Research*, **23** (3): 257-276.

Wolfert, J., Verdouw, C., Verloop, C., and Beulens, A. (2010). Organizing information integration in agri-food—A method based on a service-oriented architecture and living lab approach. *Computers and electronics in agriculture*, **70** (2): 389-405.

Yin, R. (2003). Case study research: Design and methods. Beverly Hills, CA, Sage Publications,.