A roadmap for selecting an inter-organizational information system for a food supply chain

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Preface

This thesis is one of the last parts of my MSc Food technology with specialisation Food Innovation and Management, which I conducted at Wageningen University. During the search for a nice topic for my thesis, I talked to prof. Dr. S.W.F. Omta. During the conversations we had, I became very interested in the topic of supply chain management and the information systems that becoming more and more important in supply chains. After I knew I wanted to do my thesis on a supply chain management topic a meeting was arranged with my supervisors dr. J.H. Trienekens, dr. PM Wognum and J.M. Denolf to get started on supply chain management and information system issues.

During my research I received a lot of help, constructive critics and feedback. Thanks to this I was able to finish my MSc thesis. I would like to thank Dr. J.H. Trienekens, Dr. PM Wognum and J.M. Denolf for their time, help and feedback during my research. I have learned a lot during my research, not only about the topic, but also about doing scientific research and possible pitfalls during the research.

I would like to thank all the persons and companies to take the time to help me with participating in an interview as well as bring me into contact with other companies and people. Without these people and companies I would miss expertise and practical insights of selecting and implementing an inter-organisational information system for a food supply chain.

Last but not least I would like to thank my girlfriend F. Arts for her support during my research and writing of my report.

Gert van den Brink

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Abstract

Due to economic changes, stricter rules and regulations, and globalisation of the last few decades supply chain management (SCM) is increasingly important. Actors in food supply chains (FSCs) are collaborating more and more to gain a competitive advantage. In this way an increase in profitability and sustainability of their SC is accomplished. To increase efficiency, competitiveness, quality and safety of their business and products even more, FSCs are increasingly implementing inter-organisational information systems (IOS). An IOS connects or replaces information systems (IS) of actors in the FSC. By connecting these ISs actors in FSCs can communicate and share information faster, more and better. But selecting an IOS is a big and complex task. Multiple factors need to be taken into account, for selecting an IOS for a FSC. These factors are, amongst others: contract coordination mechanisms (CCM), available resources, costs, benefits, risks and organisational/FSC changes. But also general factors in SCM, such as trust, commitment, mutuality, etc., need to be taken into account. Due to this big and complex task FSCs are struggling to select an IOS. This thesis provides a roadmap for selecting an IOS for a FSC. The roadmap supports a FSC in what to do and where to look for, when selecting an IOS. This roadmap is constructed by describing first the factors, secondly the relation between these factors, than the importance of these factors and finally the necessary steps to select an IOS.

Management Summary

Actors in food supply chains (FSCs) are collaborating more extensively the last few years, in order to increase market share and/or profits. To increase this collaboration inter-organisational information systems (IOSs) are gaining popularity in supply chain management (SCM). IOSs are connecting information systems (ISs) (e.g. ERP) from each actor in the FSC, to increase collaboration, efficiency, quality and safety and reduce costs. Although selecting an IOS involves numerous factors, which causes complexity in the selecting process. To reduce the complexity and support FSCs in selecting an IOS the following objective is created.
The objective of this report is to reduce complexity and to provide a roadmap for selecting an IOS for a FSC. To accomplish the objective the following questions are answered.

Main question: What factors, relation between these factors, importance of these factors, and steps need to be taken into account to provide a roadmap for selecting an IOS for a FSC?

Sub questions:
1. What are the factors, and the properties of these factors, that are important for selecting an IOS for a FSC?
2. What is the relation between the factors important for selecting an IOS?
3. What is the difference in importance between the factors that are important for selecting an IOS?
4. What are the necessary steps, and in which order, to be able to provide a roadmap for selecting an IOS for a FSC?

To accomplish the objective and answer the research questions a design-oriented research is used. This is done by identifying the problem, setting requirements, diagnose the problem, develop a prototype of a design, asses the prototype roadmap and finally a recommended roadmap is provided.
To understand the problem and fulfil the requirements a literature study is performed. Based on this literature study a roadmap is provided which is assessed by conducting interviews with experts. Four different types of experts are interviewed to provide different views on selecting an IOS for a FSC. Based on the results of these interviews a recommended roadmap is provided.

In the theoretical frame work the factors, relation between these factors and importance of these factors are described, as well as the necessary steps for selecting an IOS for a FSC.
The factors for selecting an IOS can be divided in SCM issues and selecting issues. The factors of the general SCM issues are environment, culture, governance, strategy and finance between actors in the FSC. To come to a general and mutual point of view for the IOS and FSC, the actors in the FSC have to agree on the SCM issues.
By agreeing on the general view of the FSC a degree of collaboration is imbedded. This collaboration is called a contract coordination mechanism (CCM). This CCM in combination with the available resources of the FSC determines the FSCM team who will analyse the possible options for the IOSs.
Next to the SCM issues are the selecting issues for the IOS. The selecting issues contain the following factors like: benefits & costs, risks, technical factors of IOS, vendor and

organizational changes, which are analysed by the FSCM team. These factors consist of multiple sub-factors, who are described in the theoretical framework.
Each factor mentioned can relate and/or affect other factors in the selecting process. It starts with the CCM of the FSC which affect the available resources as well as the FSCM team. The management team will divide the resources for the tasks necessary to select the IOS. These tasks are analysing the costs& benefits, risks, the technical aspects of the IOS, organisational changes and vendor. The type of vendor will have an effect on the final IOS as it depends on the quality and capabilities of the vendor. Furthermore the vendor will communicate with the FSCM team to agree on the potential IOS, the vendor will affect the costs/benefits and risks as well. Next to the companies/persons that are involved the product (IOS) will have an effect on the organizational changes, costs& benefits and risks as it would be implemented. The relations between these factors are depicted in figure 1.

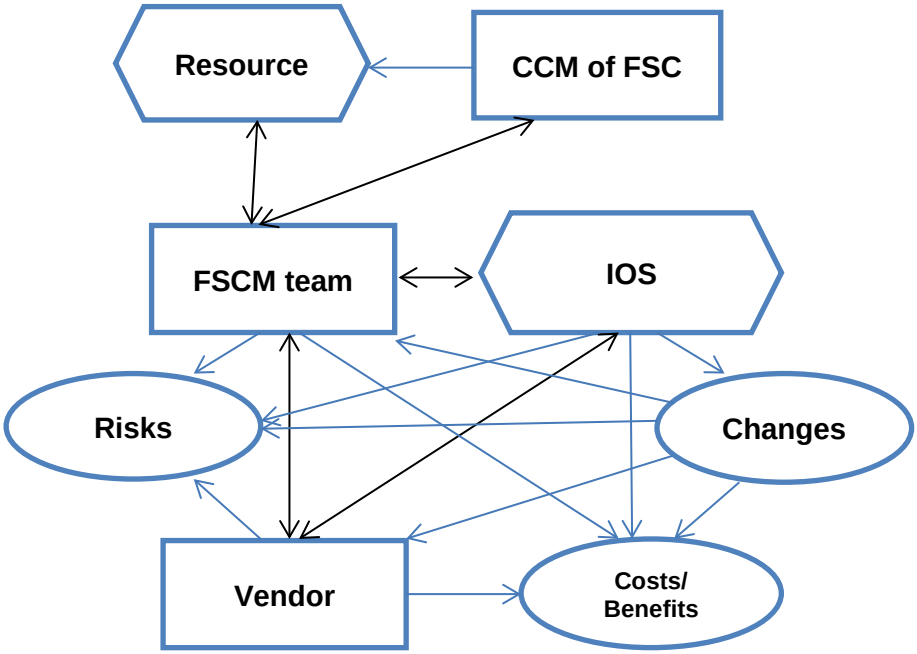

Figure 1: Relations between factors for selecting an IOS for a FSC.

All the mentioned factors and relation between these factors need to be taken into account for selecting an IOS.
Furthermore the importance of these factors is not equal. Although ranking these factors quantitatively on importance is rather difficult due to differences between SCs, actors, direct effects, indirect effects and intangible factors. Therefore a qualitative rank on importance is made. First general SCM issues are important, such as trust, mutuality, commitment and information sharing; secondly the selecting issues are important. The reason is that the SCM issues can already block the selecting process of an IOS if there is not a mutual agreement.

Based on the factors, relation and importance of the factors the following steps for selecting an IOS are depicted in figure 2. To create this figure the roadmap is assessed with interviews. Based on the assessment adjustments are made and a final roadmap is provided. This roadmap is depicted in figure 2.

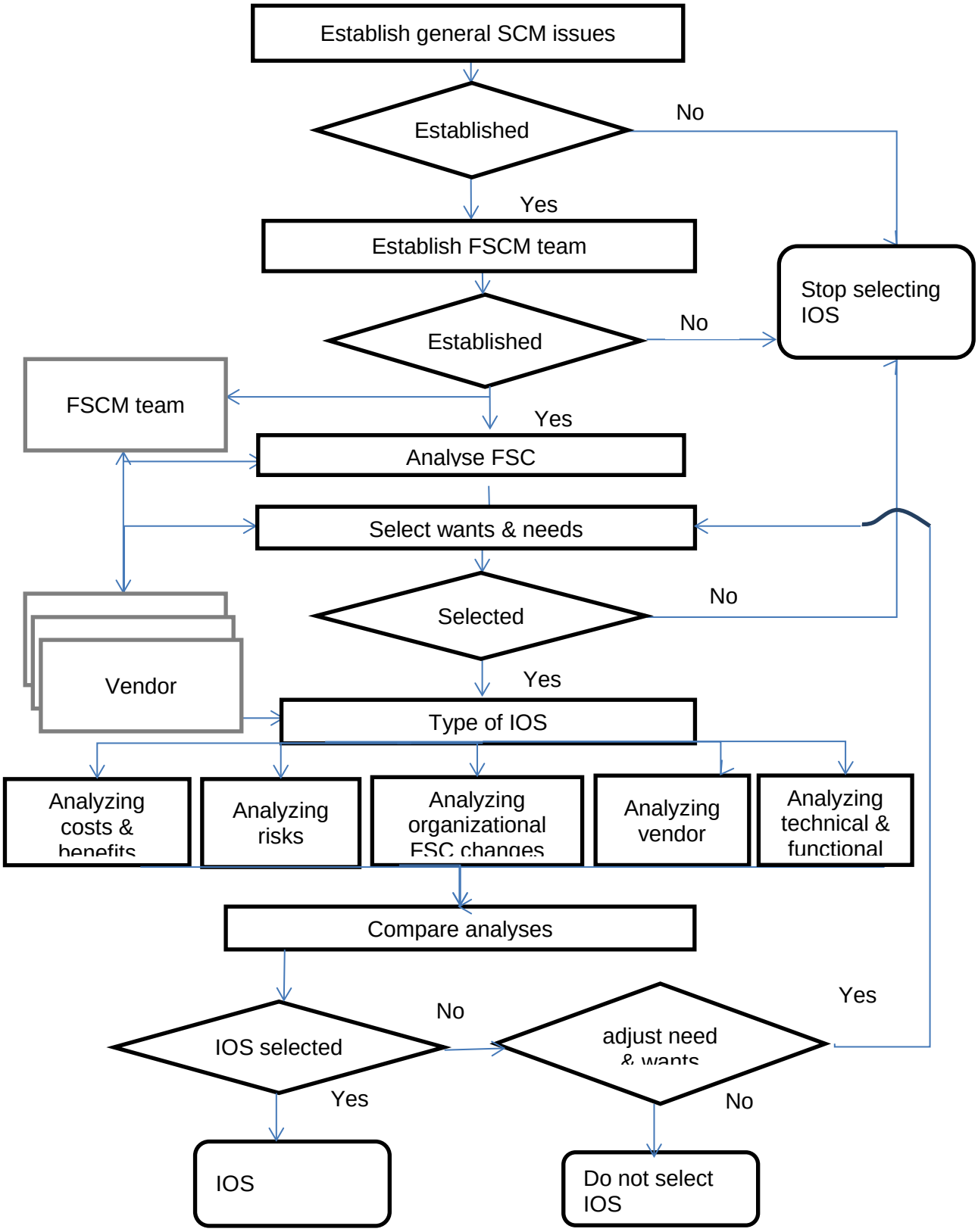

Figure 2: Roadmap for selecting an IOS for a FSC.

Although this report provides multiple topics that are important for selecting an IOS, there are topics that can be further investigated, for example validating the roadmap even more with a case study. Beside that other topics like the direct and indirect effects of cost & benefits and risks of an IOS, are area's that can be investigated further.

Contents

Figures & tables

1. Introduction

Where in previous decades the focus was on intra-organisational process and alignment; the last decades there is increase in importance of supply chain (SC) collaboration. This is due to the changed consumer consumption attitude, entrance of global retailers and more strict regulations and laws, especially in the food industry (Matopoulos et al. 2007). Harold Sirkin from the Boston Consulting Group said this about the changing environment:

'As the economy changes, as competition becomes more global, it's no longer company versus company but supply chain versus supply chain'

In general a SC is defined as a system of suppliers, manufacturers, distributors, retailers and customers connected in both directions by material, financial and information flows (Fiala, 2005). For example in the organic pork SC the actors are suppliers of organic boar sperm, feed producers, farmers, slaughterhouses, distributors, food retailers and consumers.

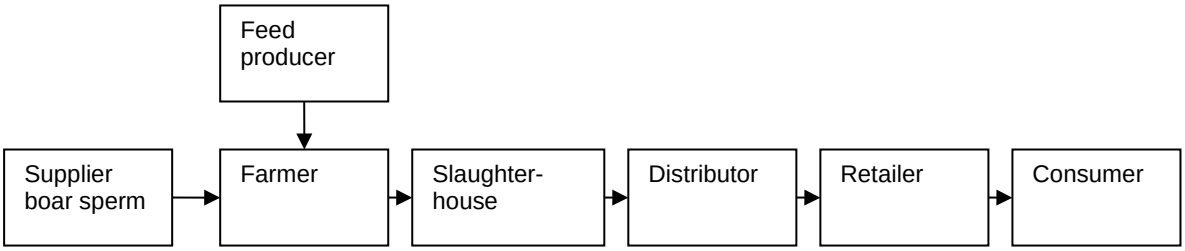

Figure 3: Actors in the organic pork supply chain.

The objective of a SC is to provide value for the end consumer in terms of product and service, and for each actor in the SC to generated profit in doing so (Sahin and Robinson, 2002). For food supply chains (FSC) this is not different.
But there are some differences between FSCs and other SCs. In FSCs the products are perishable, vary in quality and quantity. This is due to biologic variation, seasonality, weather, diseases and different successive lead times (Zigger and Trienekens, 1999). Due to the deterioration, the amount and the variation of the food it is difficult for farmers and producers to produce continuously the same quality and quantity of food. Beside the differences in products there are also differences in consumer demands as regards FSCs and other SCs. Driven by food scandals such as BSE, dioxin and *E.coli* outbreaks, safety is one of the most important factors for consumers and therefore also for the food manufacturers. Because of the importance of safe food, regulations and laws are implemented to assure safer food. One of the most important factors for safe/quality food is traceability (Opara, 2003). With traceability a food product can be traced to who did what and where it came from.

The reason why actors in FSCs, but also in other SCs, are collaborating more and more is because the FSC can be more competitive when collaborating. Collaboration between actors in a FSC can result in a more efficient, sustainable, safe and transparent FSC. But also enhanced decision making and cycle time reduction are advantages of SC collaboration (Beulens et al., 2005; Davenport, 2000; Handfield et al., 2003; Matopoulos et al., 2007). An example of increased efficiency, in SC coordination/collaboration, is the reduced bullwhip effect. The bullwhip effect is described by Fawcett et al. (2007) as 'the exaggerations of fluctuating demand through the SC as suppliers overcompensate to avoid stock outages and

then under anticipate future demand'. Figure 4 shows what happens with the demand in the SC, when no communication/collaboration takes place.

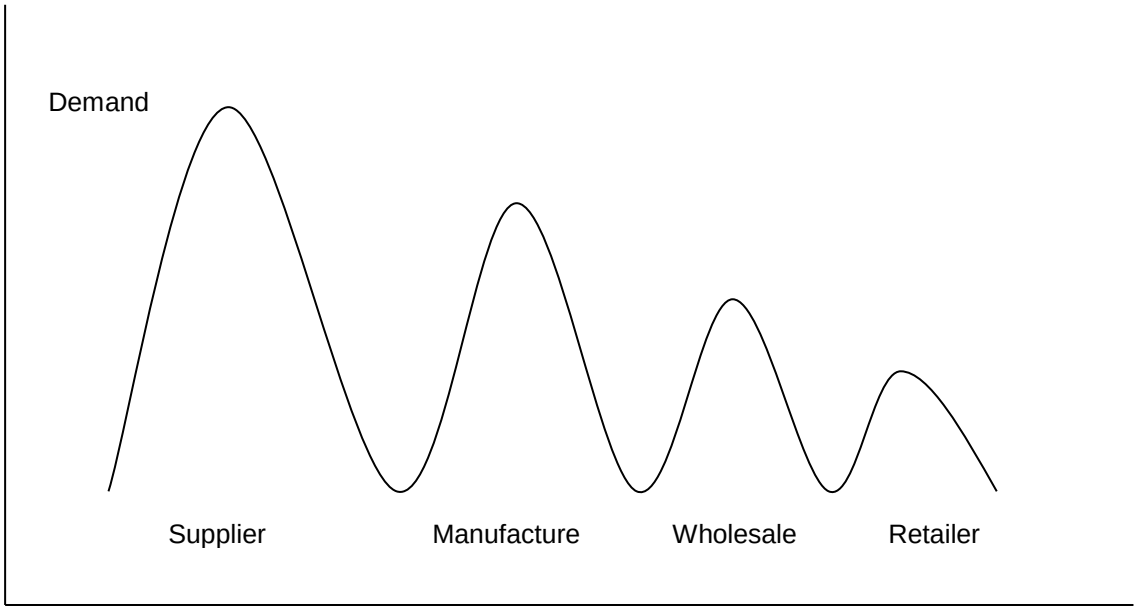

Figure 4: The bullwhip effect (Fawcett et al., 2007).

So collaboration between actors in the FSC is getting increasingly important to create more value for the consumer, like safer and cheaper food for example. By increasing the value of the food for the consumer, the market share of the food product can increase and/or profit can be generated.

Before SCM became an issue companies were mainly focussing on optimising the intra-organisational information systems (IIS). This was done by installing all kinds of computer systems and software, to optimise the production process, to decrease costs of staff and to provide management with more accurate data, for example. These intra-organizational information systems (IIS) are, for example, enterprise resource planning system (ERP), point of sales data and data warehousing. With these systems companies are able to streamline their operations, leverage and integrate data processes (Karsak and Özogul, 2009).

To collaborate even more and share information with actors in a SC the IISs of each actor should be able to share information with the actors in the FSC. This is quite a difficult task as each actor in the FSC has their own type of IIS and software of these IISs. But with the upcoming of new IT possibilities in SCM it is easier and faster to share information. These new IT possibilities are systems that connect actors digitally; inter-organisational information systems (IOSs). An IOS can communicate and share information between actors in a SC automatically. This information system (IS) can replace all the different IISs or connect all kind of different IISs from each actor in the SC. So it is actually a collection of different IISs which consist of IT resources, including communication networks, hardware IT applications, standards for data transmission and human skills and experiences from different actors in the SC (Williamson et al., 2004). In figure 5 an overview is provided on how an IOS in a SC could look like.

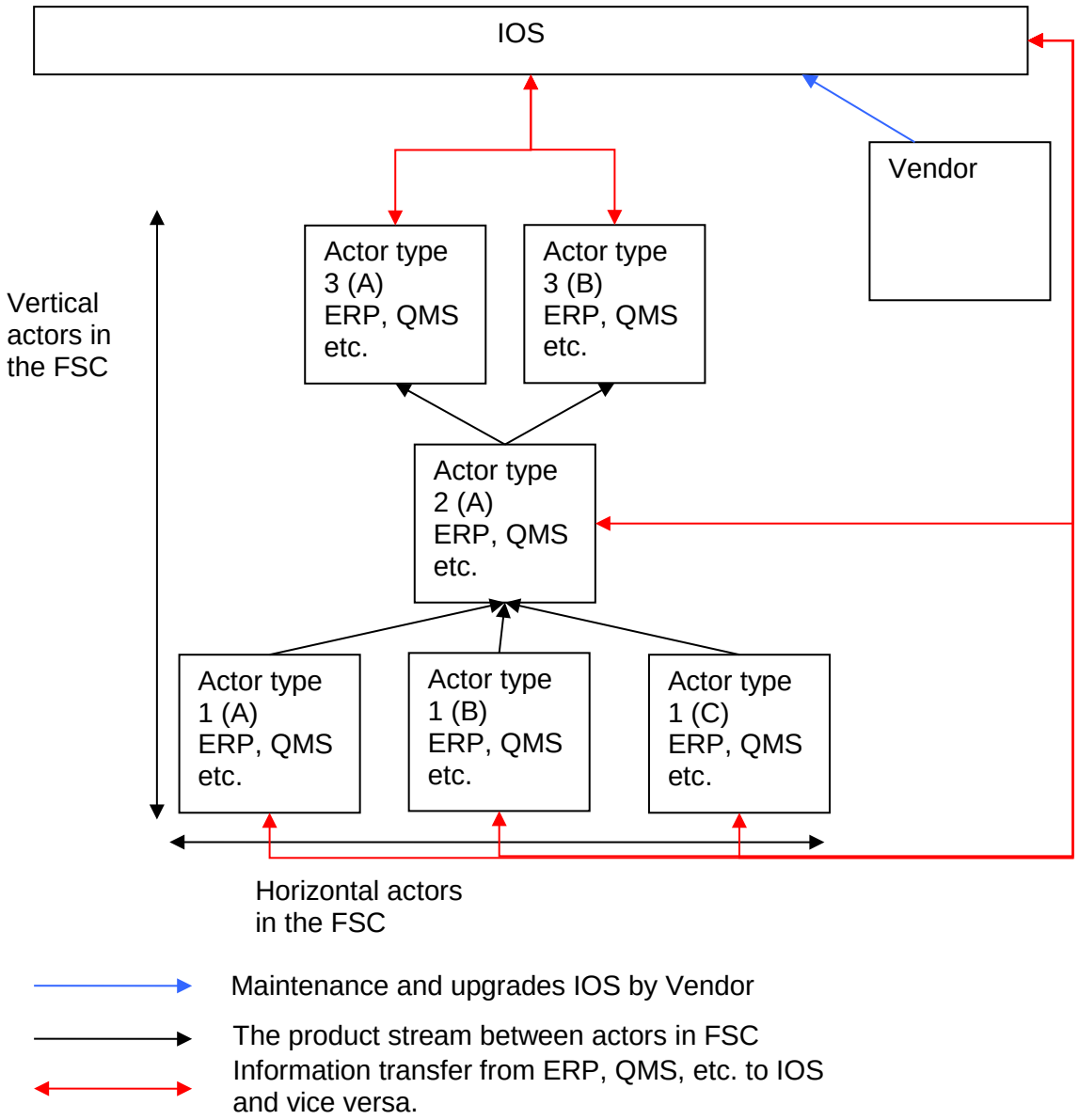

Figure 5: Overview of an IOS in a SC.

Vertical actors in a SC are different types of actors in a SC such as supplier, distributor and retailer. Horizontal actors in a SC are same type of actors in a SC such as farmer A, farmer B and farmer C who produce the same type of product.

So to benefit even more from SC collaboration an IOS can be very useful. With the help of IOSs much more data can be compared and the SC can be more efficient, sustainable and traceable, and reduce costs; as well as to increase information extraction, product quality, communication, efficiency, customer relation, decision making and savings (Chae et al., 2005; Davenport, 2000; Handfield et al., 2002).

In order to make the IOS work actors in the SC need to deliver information which other actors in the SC can use. This information transaction can be done in several ways such as: direct company-to-company linkages (hard wired), web-based, cloud-based, email with more

options and combinations of these possibilities are options for information sharing (Sarkis et al., 2004; Williamson et al., 2004).

So by implementing an IOS in a FSC more value for the consumer can be created and thereby market share and/or profit can increase.

An example of a FSC that is searching for options to implement an IOS is an organic pork SC in the Netherlands. The organic pork SC is the major player in the Dutch organic pork sector, owned by one of the biggest Dutch slaughterhouse. The important pillars of this SC are 'Tasty, honest and natural meat', which was formed into the slogan 'Meat from a Healthy Source'. Why the meat is called tasty, honest and natural is due to organic farming of the pigs. This means that these pigs are bred according to European Regulation (EC) no. 2092/91. Some of these rules are that organic pigs are from an organic boar, eat organic food, and get maximum two doses of antibiotics in their lives. Due to these measures the price per kilo organic pork meat is higher than conventional pork meat (Trienekens et al., 2009).
At this moment the slaughterhouses and farmers communicate through an electronic system called 'FarmingNet'. With this system data is gathered and exchanged for conventional and organic pigs. Due to this system analyses of data can be carried out, which gives for both actors data that can be used in the production process. Examples of the data are meat/fat ratios of the pigs, the weight of the pig and deviations in carcass quality. With the help of that data the quality of the pig meat and communication between the two actors can increase. But there is a certain scope to this system. To be able to make a chain wide system, all the data from chain actors needs to be gathered and be available for all actors in the supply chain. This means combining FarmingNet, medication registration, origin of the pig (parents of the pig), individual data for each pig and more. To gather all the data from all the different IISs to make an IOS will be a complex task, not only this makes it difficult to establish an IOS but also other factors play a role for selecting and establishing an IOS.

2. Problem analysis

Besides all the advantages of an IOS, there are some struggles and challenges for selecting an IOS. Selecting an IOS involves multiple actors which each have a different view and opinion on an IOS. Furthermore there are multiple factors that play a role in selecting an IOS. These factors are general SC issues like differences in culture, governance, strategy and finance between actors in the FSC (Bernroider et al., 2009; Cheng et al., 2001; Fawcett et al., 2008). But also specific selecting issues such as: benefits, costs, risks, technical factors of the IOS, organizational changes and vendor (Baki et al., 2005; Beulens et al., 2005; Sahay and Gupta, 2003).
Another challenge that occurs when selecting an IOS for a FSC is quantifying the benefits of an IOS. These benefits are difficult to quantify due to 'soft' as well as 'hard' benefits. For example increased efficiency due to an IOS can be quantified, whereas increased product quality and thereby increasing the value for the costumer is difficult to quantify (Vickery et al., 2003).
Also the differences between FSCs cause challenges for selecting an IOS. Due to the differences between FSCs there is not one solution for selecting an IOS. So for each FSC a different specific IOS fits best (Lin and Chen, 2003).
Due to these challenges that play a role and not fully understood selecting an IOS is a difficult and complex decision to make (Eckartzs et al., 2009 (b); Matopoulos et al., 2007).

Multiple articles describe the successful implementation of IIS like ERP systems, for example, but what makes it so difficult to implement an IOS? Besides the mentioned complexity and lack of understanding the reason why the implementation of an IOS is so difficult is multiple times described, for example, by Shapiro, 2009. In his book they mention multiple factors that play a role in why it is difficult to implement an IOS. One of these factors is the difficulty of establishing intercompany coordination. They describe it with the example of a manufacturer of consumer goods who is not willing to share sensitive cost data with a major original equipment manufacturer and distributor of these products, who is also selling to other distributors and to its own franchise stores. In this research the main reasons for difficulties for selecting and implementing an IOS are organizational issues between the companies within the supply chain, mainly driven by money and competitiveness as described in the example and also identified by Stefanou, 1999.

In literature an overview of the factors important for selecting an IOS is lacking as well as a roadmap for selecting an IOS. This report will try to provide the factors that play a role in selecting an IOS and to help selecting an IOS for a FSC. This is done by accomplishing the following objectives.

General research objective
Provide a roadmap for selecting an IOS for a FSC.
By accomplishing this objective a FSC should be able to use the roadmap for selecting an IOS for a FSC. This provides the factors, relation between these factors, importance of these factors and the steps that need to be taken into account to come to the right conclusion.
In order to accomplish the general research objective smaller and more specific objectives are formulated, described below.

Specific research objectives

Find the factors that are important for selecting an IOS for a FSC.

By accomplishing this factor and overview of the factors that play a role in the selecting process is provided. This is the first step in accomplishing the general objective.

Describe the factors and mention the most important properties of these factors, which are important for selecting an IOS for a FSC.

By describing the properties of these factors an increase understanding of these factors is provided, but which also can help to identify relations between factors and importance of factors

Describe the relation between the factors important for selecting an IOS for a FSC.

By accomplishing this objective the relations between the factors are identified. By identifying this effect the impact of a factor on the amount of other factors can be described, this can help to increase the understanding of the complexity and relation of these factors.

Describe the difference in importance between the factors.

If the differences in importance of the factors are identified better decisions can be made on the type of IOS.

Describe the steps that need to be taken into account to make a roadmap.

By identifying the steps that need to be taken into account to make a roadmap the core of the roadmap is identified.

By combining the specific research objectives the general research objective is accomplished. The method how to accomplish these objectives is described in the next chapter: research design

Keywords: inter-organisational information system, food supply chain, supply chain management and project management.

3. Research design

With the aim of accomplishing the research objectives and to solve the problem of selecting an IOS for a FSC the following questions are formulated:

Main question:
What factors, relation between these factors, importance of these factors, and steps need to be taken into account to provide a roadmap for selecting an IOS for a FSC?

Sub questions:

1. What are the factors, and the properties of these factors, that are important for selecting an IOS for a FSC?
2. What is the relation between the factors important for selecting an IOS?
3. What is the difference in importance between the factors that are important for selecting an IOS?
4. What are the necessary steps, and in which order, to be able to provide a roadmap for selecting an IOS for a FSC?

3.1 Design-oriented research

To accomplish the objectives and answer the research questions a design-oriented research is used. This method is a useful tool for developing a roadmap as it is designing a plan for selecting an IOS for a FSC. Furthermore the problem is diagnosed and defined beforehand, which is a requirement for this type of research. This problem is already described in the previous chapter problem analysis. Design-oriented research can be described with the design cycle as depicted in the figure below (Verschuren and Doorewaard, 2010).

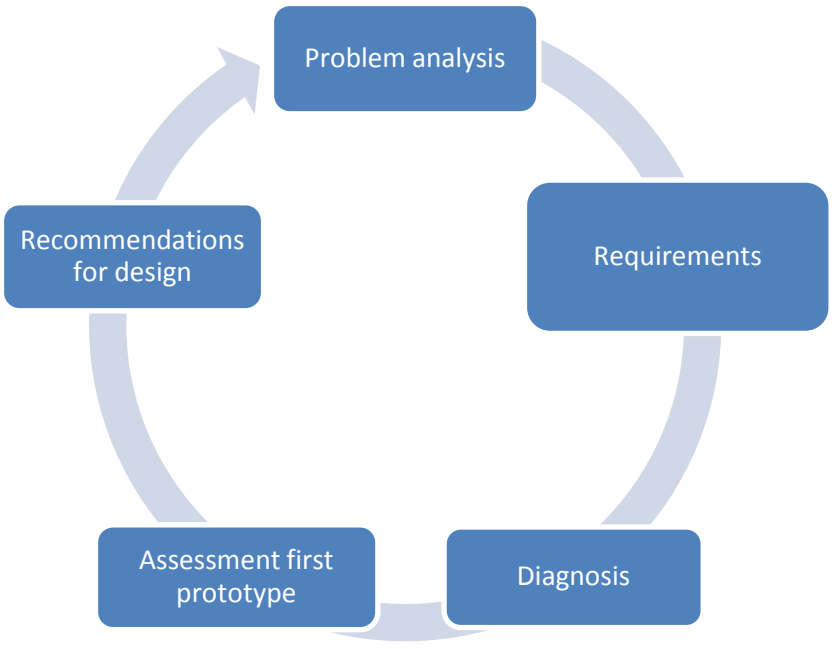

Figure 6: Design cycle of design oriented research.

As depicted in the figure the design cycle consists of a problem analysis, requirements of the roadmap, diagnosis, assessment of first prototype of the design and recommendations for a design. In this case the design is a roadmap for selecting an IOS for a FSC.
The steps described above are further explained and made more specific.

3.2 Problem analysis

First a problem is identified based on that problem analysis objectives are described, as already described in chapter 2 the problem analysis.

3.3

Based on the objectives requirements for the roadmap are set (Verschuren and Doorewaard, 2010). To accomplish the objective, the roadmap should comply to the following requirements:

- This roadmap should be a tool for selecting an IOS.
- Any FSC should be able to use this roadmap.
- Include the steps necessary to make a well-considered decision.
- Include the factors the relation between the factors and the importance of the factors that affect the decision of an IOS.

These requirements are in line with the already described objectives of this research.

3.3 Diagnosis

After the problem is identified and the requirements are set the background and the causes of the problem can be examined. If the reason for the problem is understood then the first prototype of a design/roadmap can be determined. By answering the sub-questions and thereby accomplishing the objectives the problem is step by step solved. In the diagnosis step this problem is examined by a literature study. The following research objects are studied: literature about FSCs, SCM, IOSs and CCMs. These subjects are studied as they play all a role in the decision making process of selecting an IOS for a FSC. So FSCs need to be studied to increase the understanding about FSCs. SCM is studied as it consists of the management, organizational structure, cultural differences and strategies in a SC. IOSs are studied as it is the system that need to be selected. Subjects as costs, benefits, user friendly and safety are subjects that need to be understood for selecting such a system. CCMs are studied as it determines the collaboration between the companies in the SC. This collaboration and the extend of this collaboration plays a role in the FSC.
Based on the findings of this diagnosis/literature study a first prototype of a roadmap is developed.

3.4 Assessment of first prototype of the design

The prototype developed is assessed by interviews with experts. In these interviews four experts, are asked multiple questions concerning the prototype of the roadmap and the factors that play a role in the roadmap. By conducting these interviews a practical insight in selecting an IOS is gained and the roadmap is assessed. The interviews are performed with a general interview guide approach. This type of interviewing is chosen because in this way the same general areas of information are collected from each interviewee. Besides that, this approach still allows a degree of freedom and adaptability in getting the information from the interviewee. The interviewee does not get the list of subjects in advance, which will be discussed during the interview. In this way no pre-formulated answers are given, a better insight in the thinking process of the interviewee can be provided and a more interactive interview can be conducted. In appendix 1 the topics discussed during the interviews are described; these topics are based on the theoretical framework. So the factors, relation between the factors and the importance of the factors, as well as the steps for selecting an IOS are discussed. Next to the topics there is a part in the interview where the experts can provide their own point of view and information. This is done to add potentially missed factors, relations and/or steps in the theoretical framework.

Four interviews are conducted thereby four different views on selecting an IOSs for a FSC are provided. These different views are gained by four different experts. These persons are the following a project leader for implementing an IOS, a PhD working on information systems for farmers, a vendor of IOSs and an actor/user of an IOS. Each person is shortly described below.

The project leader is working in the TIVO project group. In this project group she is working with multiple actors of an organic pork supply chain to select and install an IOS. The organic pork supply chain wants to establish an IOS in order to increase efficiency and collaboration between the different actors in the SC.
The PhD is working on information systems for farmers, at the WUR. His research is focused on providing insights in information systems for farmers. As well as providing a framework for companies that develops tools for farmers to simplify data exchange and to provide possible information facilities for farmers to gain more insight in the business process.
The person representing a vendor is an expert and business developer of IOSs for FSCs. This company is making and implementing IOSs for FSCs. They want to increase cooperation between actors in the FSC horizontally as well as vertically.
The actor/user of an IOS in a FSC, participated in the team of selecting an IOS for a feed company. Beside that he and his team are controlling and managing the IOS for the feed company. The representative of the actor works already for more than 6 years with an IOS. The feed company selects, controls, audits and provides information from sellers of animal feed for purchasers of animal feed that is used for all kind of animals in the food industry. In this way the feed company guarantees quality of animal feed from numerous sellers.

Due to constraints such as time, quantity and quality of the experts able to participate in this interview, only four interviews are conducted. Although the number of participants is low, each expert provides a different view on selecting an IOS. This makes it a useful tool for the first assessment of roadmap and the factors that play a role in the roadmap. Furthermore the persons selected have allot of expertise and knowledge on IOSs.

3.5 Recommendations for a design

Based on the assessment of the roadmap, the roadmap is adjusted to provide a recommendation for a roadmap. Furthermore the roadmap is checked if it solves the problem described in the problem analysis and meets the requirements set, if this is the case the design process ends. If the roadmap does not solve the problem and meets the set requirements the design cycle need to be performed again.

3.6 Overview research

In figure 6 the steps for this design-oriented research are shown. Based on these steps a problem analysis is determined. After that theory about SCM, FSCs, factors for IOSs and CCMs are studied. Second a prototype roadmap is created based on the literature study. After that, the interviews with vendors of IOSs and actors in FCSs are performed. These interviews are used to validate and adjust the roadmap and the factors that play a role in the roadmap. With these results a final redesigned recommended roadmap is provided that can be used by FSCs for selecting an IOS.

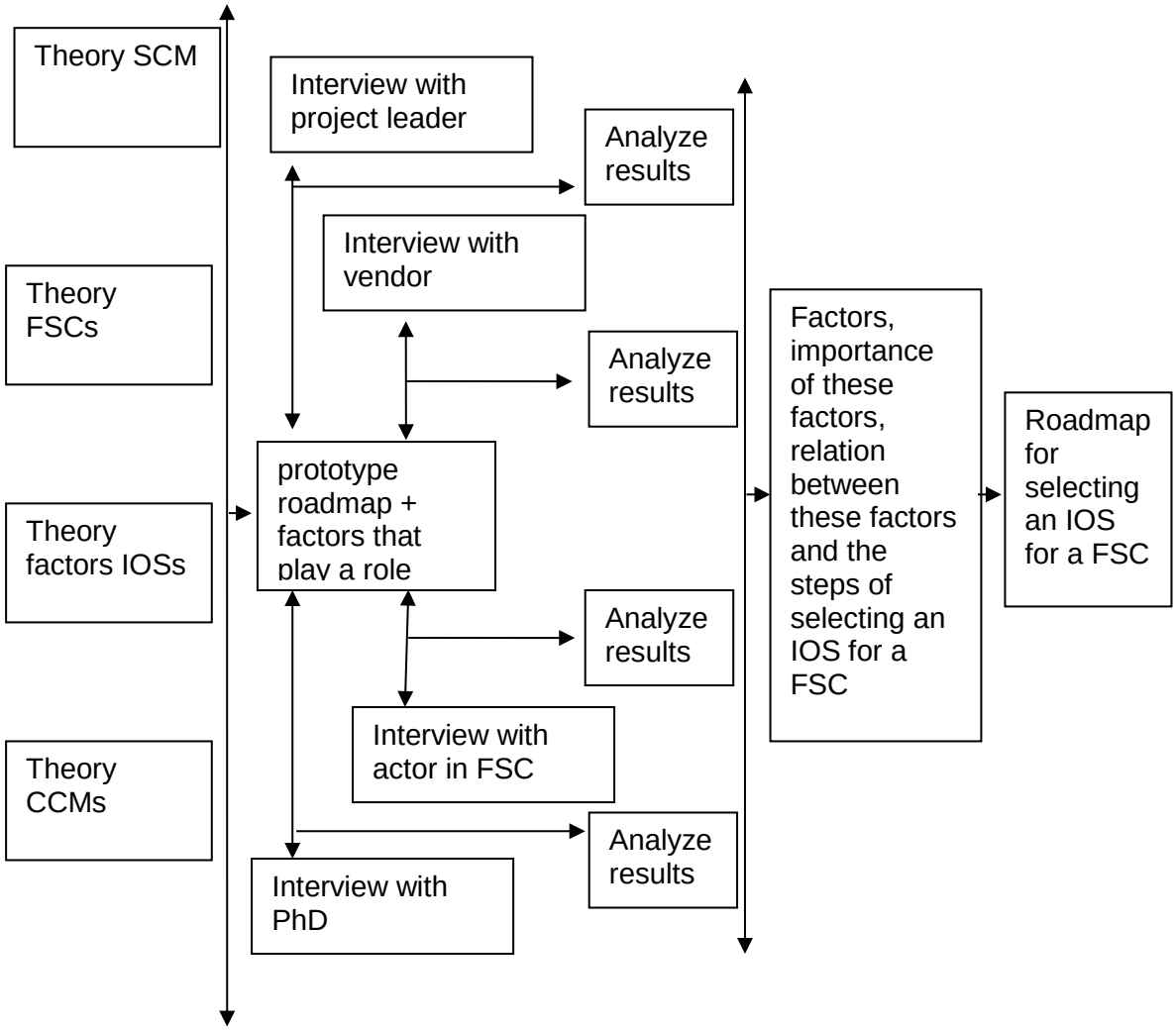

Figure 7: Research model for a roadmap for selecting an IOS for a FSC.

Figure 7 provides an overview of the theories and method used to full fill the goal of supporting the FSC by selecting an IOS by using a roadmap.

This research will focus on the factors that need to be taken into account to select an IOS for a FSC in general, rather than explaining all the factors for the different types of FSCs, because every FSC is different. Furthermore this research is to support the FSC in the steps and decisions for selecting an IOS; and not an extensive description on how to make these decisions.

So this research has as main goal to provide a roadmap for selecting an IOS for a FSC. This is done by gaining inside in the factors, the relation between these factors, the importance of these factors and the steps for selecting an IOS for a FSC. This research could help FSCs for selecting an IOS, for example the organic pork supply chain. Besides FSCs, researches that want to do more research on: CCMs, FSCs or other SCs, IOS and/or relations between several factors, important for selecting an IOS, can use this research.

4. Theoretical framework

In general companies and FSCs want to be sustainable and profitable. This is done by creating value for consumers. If more value is created consumers are more likely to buy the product. This can result in increased profits and/or market share for the company/FSC (Fawcett et al., 2007; Horvath, 2001; Lehmann and Winer, 2008; Sahay, 2003). To increase value for the consumer an IS for a FSC can be used. Increasing value with the help of an IS is done by increasing efficiency and thereby reducing the price of the product for example. Although multiple studies show that most organisations are not comfortable in evaluating and selecting such information system (IS) investment (Eckartz et al., 2009 (b); Verville and Halingten, 2002). Many methodologies and techniques are available to evaluate and select these ISs, ranging from qualitative to quantitative analyses. When dealing with evaluating an IS in a FSC not only a cost and benefit analysis of the IS need to be performed but also the FSC need to be evaluated. The FSC need to analyse the FSC to know the current status of the FSC and to find possibilities for increasing value for the consumer by improving supply chain collaboration. Multiple factors have to be taken into account for assessing a FSC: ranging from culture differences between actors to financial possibilities. Another factor that need to be taken into account is the governance structure of the FSC. The governance of a FSC is determined by the rules and contracts set in the FSC (Gunasekaran and Ngai, 2004).
Evaluating an IT project involves multiple steps, such as preliminary analysis, analysis of operations, evaluation of the ISs, and risk analysis. These steps need to be performed in order to make thorough analysis of the IT project. Furthermore these steps need to be managed in a certain time frame. These steps are important as they provide the guidelines for analysing the IOS. Although the factors involved in selecting an IOS are of equal importance as they determine what needs to be analysed (Eckartz et al., 2009, (b)). But before an IOS can be selected an increase understanding of the difference between a company and a FSC need to be described. These differences will influence the selection process of an IOS as well as the type of IOS that will be selected.

4.1 Differences between actors in the FSC and the FSC

Multiple differences can be found between actors in the FSC and the FSC as a whole. These differences can be found in multiple areas like decision making, objectives, culture, language, financial situation, etc. These differences can cause problems in selecting an IOS for a FSC as every actor in the FSC has its own opinion about how an IOS should look like (Eckartz, 2009 (b)). By identifying what factors play an important role between actors and in the FSC, an increased understanding of these factors is gained. By understanding these factors and discuss and agree on them a mutual benefit for the FSC can be created, like increased efficiency, cost savings, etc. (Chae et al., 2005; Davenpoort, 2000).
The struggles in SCM due to the differences between actors and the FSC as a whole can be found in the area of culture (Matopoulos et al., 2007), governance (Beulens et al., 2005), strategy (Soliman et al., 2004), finance (Huang et al., 2003) and environment (Fawcett et al., 2007), CGSFE.
Cultural differences between actors in the FSC can cause difficulties in the collaboration between these actors. For example in having the different norms, language and terms. Another cultural factor is trust that plays a role in differences between the actors in the FSC. (Chae et al., 2005 and Matopoulos et al., 2007). Governance is another factor that plays a role in SCM, where decision power and information accessibility play a role. Whereas in most companies a board can make the decisions in a SC there is often not a board. So decision

making is often done in differently, which will be discussed later. Also the information accessibility between the different actors can affect the FSC as a whole. Information need to be shared in order improve the collaboration in the FSC, to what extend depends on the level of the collaboration and trust (Beulens et al., 200; Kumar and Dissel, 1996). Another factor that is linked to governance is the strategy. The strategy of each actor is different as they have different goals and have to deal with a different environment and financial situation for example. These differences between the actors in the FSC can make it difficult to set a goal for the FSC a whole. Although one of the main reasons for collaborating is increasing profitability in the FSC. Dividing increased profits mutually is another point of attention, which is linked to governance (Barrat, 2004; Soliman et al., 2004).

Financial capabilities of each actor play also an important role in the FSC each actor is able to invest in the collaboration to a certain extend. This will influence the power of the actor as well as the division of profit for example (Huang et al., 2003).

The factors mentioned before are all affected on the environment the actor and the FSC is in. For example pressure of the government to make a traceable FSC could be a driver for setting certain goals. Another example is that increasing the tax on certain products could mean that the FSC is less profitable, which affects the finance of the FSC and of the actors (Fawcett et al., 2007).

The CGSFE play a role in the FSC as well as for the individual actors. Although as mentioned they will probably differ. These differences can make it very difficult for the FSC to collaborate well and thereby creating more value for the consumer. To decrease the difficulties, clear rules and an agreement on the degree of collaboration can be set in a contract coordination mechanism (CCM). This CCM will determine the degree of collaboration based on the CGSFE agreed on by the FSC actors. By agreeing on a CCM all actors in the FSC know the degree of collaboration as well as their tasks and responsibilities. Based on the CCM of the FSC resources will be available for projects and collaboration (Stadtler and Kilger, 2005; Raynaud et al., 2005; Thomas and Griffin, 1996). Figure 8 depicts the FSC and the actors in the FSC, which is created by combining the literature discussed previously.

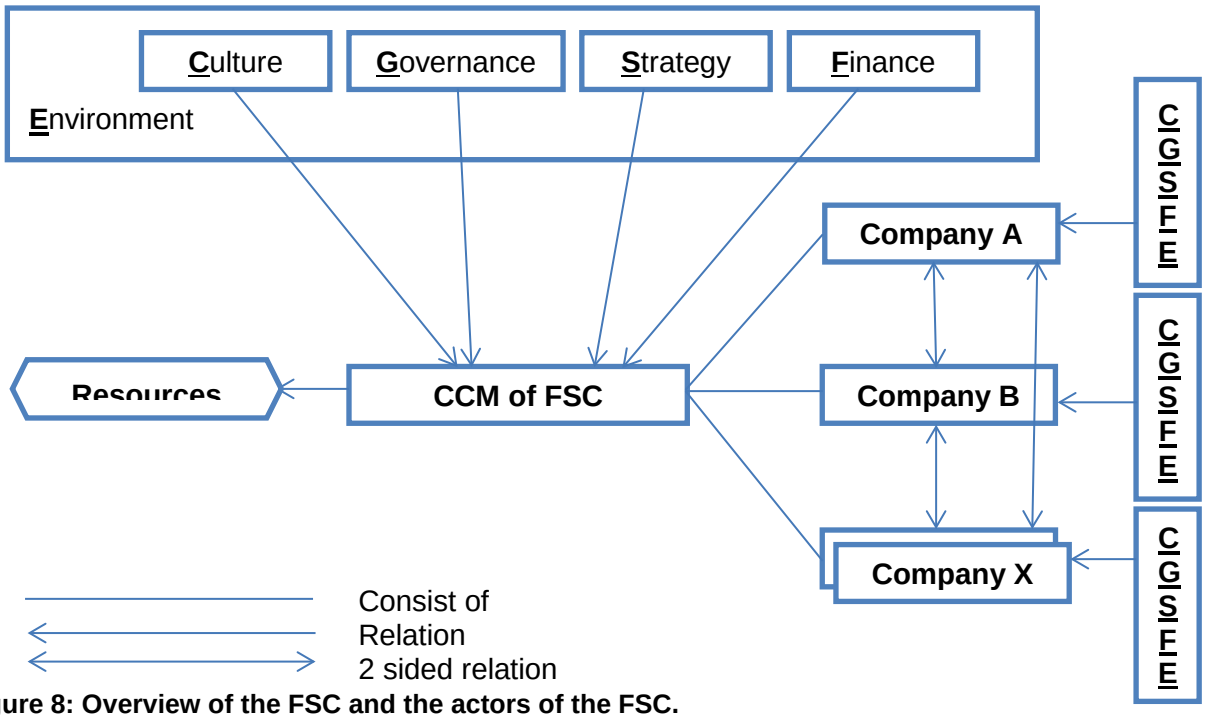

Figure 8: Overview of the FSC and the actors of the FSC.

Each actor is part of the FSC and will act according to their CGSFE and that of the FSC as agreed on in CCM. Based on the CCM the FSC will act and use resources accordingly.

To gain a greater understanding of the SCM issues that play a role in the FSC the factors mentioned in figure 8 are further investigated. A more extensive description of these factors is described in the next chapter. .

4.2 SCM issues

The SCM issues play in every SC a role. These SCM issues contain multiple factors like: environment, culture, governance, strategy, finance, CCM and resources. Although the factors are for all SCs the same the content of these factors can differ allot. The factors of the SCM issues are described in the following part. By describing these factors an increased understanding about these factors is gained as well as the importance of these factors for SCM.

4.2.1 Environment

The environment is the surroundings where companies/SCs have to deal with and anticipate on, by doing so they can be a sustainable and profitable company/SC. Although there are differences between the environment of a companies and SCs. Examples of these differences in the environment are the market, pressure on the supply chain, government pressure and traceability. The environment plays a role in culture, governance, strategy and finance as depicted in figure 8. The environment of the SC can be analysed with the help of PESTEL and Porters five forces model, this will not be further discussed as it is not part of this research (Johnson et al., 2012).
One big advantage of SC collaboration is that all actors together can anticipate, define and respond to changes in the competitive environment. In this way a better understanding of the environment can be realised, this can result in a more profitable SC (Fawcett et al., 2007).

4.2.2 Governance

Several factors are important when studying the governance of a FSC. The three most important governance factors concerning FSC collaboration, and play a role in CCMs are described in the following part. These factors are decision power, mutuality and competition and information sharing (Beulens et al., 2005 and Eckartz et al., 2010).

Structure/decision power
The structure of an inter-organisational relationship is described by Kumar and van Dissel (1996) as followed: ‘the level of specification of roles, obligations, rights, procedures, information flows, data and analysis and computational methods used in the inter-organisational relationship’. This definition mentions that the structure of a FSC influences the decision power between actors in the FSC. This could mean that the decision power rests on one actor or on multiple. So the division of power can be divided in different ways; this can be symmetric, where all actors have the same power, or asymmetric, where there are differences in power between actors. A FSC governance council can help mitigate internal resistance to FSC activities and mediate in decision making. Beside that a council can bridge emotional and strategic distances between actors in the SC (Fawcett et al., 2006). But often large retailers set the standards and have a lot of power in the FSC, called dependency (Barrat, 2004; Wever et al., 2010). Compared to companies this division in power is more difficult to establish as the FSC has in general not one board as in the

individual actors but is divided by multiple representatives of the different companies, as depicted in figure 8. This makes it for companies often easier and faster to make decisions and structure their business (Wu et al., 2006).
Making decisions in a FSC is most likely more difficult, although by defining clearly the inter-organisational relationship between these actors can reduce the difficulties and thereby help the decision making process. The organisational relationship between the actors plays a role and need to be defined in the CCM, as figure 7 the relation between governance and CCM is depicted. The decision making process is of importance for selecting an IOS as multiple decisions have to be made. Another factor that plays an important role in the decision making process, but also affects the general governance of the FSC is mutuality/interdependency (Barrat, 2004).

Mutuality/interdependency
Interdependence means that not one actor controls the whole SC operations, but multiple actors play a role. Therefore there must be mutual dependence or mutuality between the actors in the FSC; which means mutuality between benefits and risks. With mutuality between actors in the FSC a long-term relation can be established. By lacking mutuality in the SC the relation between the actors will probably not last very long (Beulens et al., 2005).
Due to the complexity of a FSC there are three dependencies described by Kumar and van Dissel. The first is pooled dependency where actors share and use a common resource, like a database for example. Second sequential dependency, where actors work in series, the output from one actor is the input from another actor. The third is reciprocal dependency, here actors feedback their work to other actors in the FSC (Kumar and Dissel, 1996). Clear rules and contracts have to be made to structure the continuous changes in feedback and in- and outputs for example. Due to this dynamics in the FSC structuring and defining these rules and contracts can be very complex (Eckartz et al. 2010 and Wu et al., 2006). In these rules and contracts mutuality of responsibility, benefits of importance. If this is not the case individual actor may not be committed to the FSC (Chae et al., 2005).
Another factor that plays a role in governance for a FSC is competition and information accessibility.

Competition and information accessibility
Within FSC and between actors in the FSC, there is competition. The competitiveness between the actors is often between horizontal FSC actors who are not willing to reveal sensitive information to other actors; although information sharing is one of the most important aspects to collaborate. The underlying issue is often a lack of trust between actors in the FSC, but clear arrangements can be made about information accessibility of horizontal actors in the FSC, for example different accessibility of personnel and/or actors. The accessibility of information depends on the rules, contracts and level of collaboration of the FSC (Barrat, 2004; Davenport, 2000).
Beside horizontal there are vertical actors in the FSC. Successful vertical relationships are associated with high levels of information sharing and trust begins with the culture of the company. Although, as well as in the horizontal actors, not all vertical actors are willing to share their information with other actors in the FSC. For example suppliers of a product do not want to tell the cost price of the production to the customer as it can influence the price negotiation of the product (Davenport, 2000; Wu et al., 2006).

Structure/decision power, mutuality/interdependency and competition & information sharing are the three factors that influence the governance in a SC the most.

4.2.3 Strategy

Beside governance strategy is very important for all companies and FSC. The strategy of a company or FSC sets the direction of that company and FSC. The two most important factors in the selection procedure of an IOS are described below (Sahin and Robinson, 2002; Soliman, 2004).

Goal/objective

Goals in a FSC often differ from goals of the individual actors. To come to general goals and objectives, and thereby aligning the FSC, clear contracts and rules can be set and complied to. In this way a strategic fit can be created. A 'good' strategic fit between the actors is an important factor that can lead to a successful collaboration.

An important goal of a FSC is to deliver safe and quality food to the end consumer. Next to that an important goal of a FSC could be which is often general for all SCs, to create a transparent, efficient, profitable and a sustainable supply chain. The goal of the FSC will also affect the CCM of the FSC, as also depicted in figure 8 (Sahin and Robinson, 2002; Ziggers and Trienekens, 1999). Agreeing on a mutual goal with multiple actors can cause some difficulties. To accomplish the formulation of these goals/objectives commitment is of importance.

Commitment/ long-term orientation

Commitment or long-term orientation is a predictor for successful long-term relationships between actors. Commitment refers to the willingness of an actor to put effort in developing a long term relationship. So commitment is necessary and important to implement an IOS for a FSC. Especially commitment and long-term orientation from top-management is of importance, because they have to provide the necessary resource to select and implement an IOS. Especially in the beginning resources such as time, money, etc. are necessary to develop the IOS and develop long-term relationships. (Barrat, 2004; Soliman et al., 2004).

Goal and commitment of the FSC is of importance for the strategy as it determines the direction of the FSC.

4.2.4 Culture

Next to strategy other SCM issues are of importance such as, culture. Culture is imbedded in the company/FSC and is difficult to change, although culture is really important in collaborating between actors. The two most important factors concerning culture in FSC collaboration are trust and semantics (Beulens et al., 2007; Matopoulos et al., 2007).

Trust

Defining trust is a difficult task and is often described as actors doing what they supposed to do, at the right time, always. Therefore trust is one of the most important things for good collaboration (Fawcett et al., 2007). If there is a lack of trust between actors in the FSC, there will be less collaboration, which results in fewer benefits for the FSC as a whole. Thereby trust is also affecting the CCM of the FSC, as also depicted in figure 8. Furthermore trust can contributed to a long-term stability of an organisation and effective co-ordination of the SC,

this can result in an efficient, profitable and sustainable FSC (Barrat, 2004; Fawcett et al., 2007)
Trust is closely linked to power, when power is abused by SC actors the trust of the actor decreases. Trust is not only important for the relation between the actors in the FSC, but also plays a role by the employees of an actor. These employees are paid by the actor and in return for their payment they expect people to work according to their standards (Eckartz et al., 2010; Matopoulos et al., 2007). By not performing well or abusing trust the actor will sanction the employee accordingly. Sanctions could mean demoting, warning etc. This can also be used for the governance structure and power of the FSC, for example when actors are not doing what they supposed to do a fine could be an appropriate sanction.

Semantics
Semantics is the use of the same language and sharing the same mental models. This means that everybody in the company/SC knows the language, rules, concepts and agreements. By defining these, often in a CCM, each actor in the FSC can act accordingly In a FSC, differences in semantics could occur for example due to differences in language. This could increase the difficulties between the different actors, who already have a difficult task to collaborate with a common goal (Beulens et al., 2005; Chae et al., 2005)

4.2.5 Finance
Finance is very important for all companies and SCs. To implement an IOS, several costs are involved, but to have a sustainable and healthy financing of an IOS, the costs should finally be paid by the consumer. The upfront costs, on the other hand, need to be paid by the FSC. These costs are an investment for developing and implementing the IOS. The division of the costs depends on the different factors like: financial capabilities of the actors and differences in benefits and risks between the actors. Sharing these costs is often a sensitive point in the commercial world. The financial capabilities of a company often affect the CCM, as depicted in figure 8. A big company who is financially strong and invests allot of money in the FSC will often have more power as a smaller company (Huang et al., 2003).

The FSC acts according to their culture, governance, strategy, finance and environment of the FSC. For each FSC the CGSFE are different and therefore most likely to have different rules and contracts that are agreed upon. These different types of rules and contracts are discussed in the next part as it determines to what degree the FSC is collaborating.

4.2.6 Type of contract coordination mechanisms
As mentioned all the factors like: environment, governance, strategy, culture and finance have an effect on the FSC and CCM, as depicted in figure 8. The FSC is regulated according to these factors. The type of regulation is called a contract coordination mechanism (CCM). There are different types of CCMs, the following division between CCMs is often used for agri-food research and shown in figure 9.

Spot market contract	Formal contract	Relational contract	Equity based contract	Vertical integration

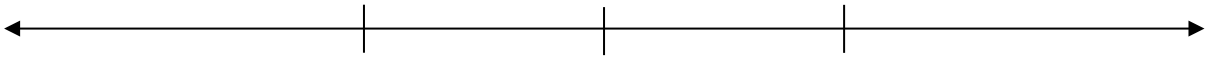

Figure 9: CCMs often used for agri-food research (combined from Peterson et al., 2001 and Raynaud et al., 2005).

Figure 9 shows the different type of CCMs. From left to right: from low information sharing/collaboration to high information sharing/collaboration (Fawcett et al., 2007; Harland, 2003; Raynaud et al., 2005). The division from spot market contract to vertical integration need some explanation. In spot market contracts, farmers, producers and/or retailers negotiate only on short term contracts. In this way they can change their selling and/or buying behaviour very quickly. The transactions are governed by classic contract law (Omta et al., 2006). In a formal contract as many aspects as possible, about the relation between the actors are covered. This means that the specification on deliveries, production of the food, the duration of the contract, etc. are all written down (Skjoett-Larsen, 1999). In a relational contract two or more actors in a supply chain share risks and benefits emanating from mutual defined goals and objectives (Peterson et al., 2001). With an equity-based contract a new business is created by two or more actors, while not interfering with their own business (Peterson et al., 2001). In this way both parties are partly owner of the business and get paid on the amount of profit made and the percentage of the business they own. The forms of new businesses could be joint ventures and partial ownership relationship for example (Peterson et al., 2001). Vertical integration is the alignment of the direction and control across the actors of the SC (Fawcett et al., 2007 and Peterson et al., 2001). So with vertical integration all actors in the supply chain work together to increase the efficiency, profitability, sustainability and value of the product produced.
The following figure, which is slightly adjusted from Peterson et al., 2001, perfectly shows the differences in the several CCMs, ranging from spot market to vertical integration.

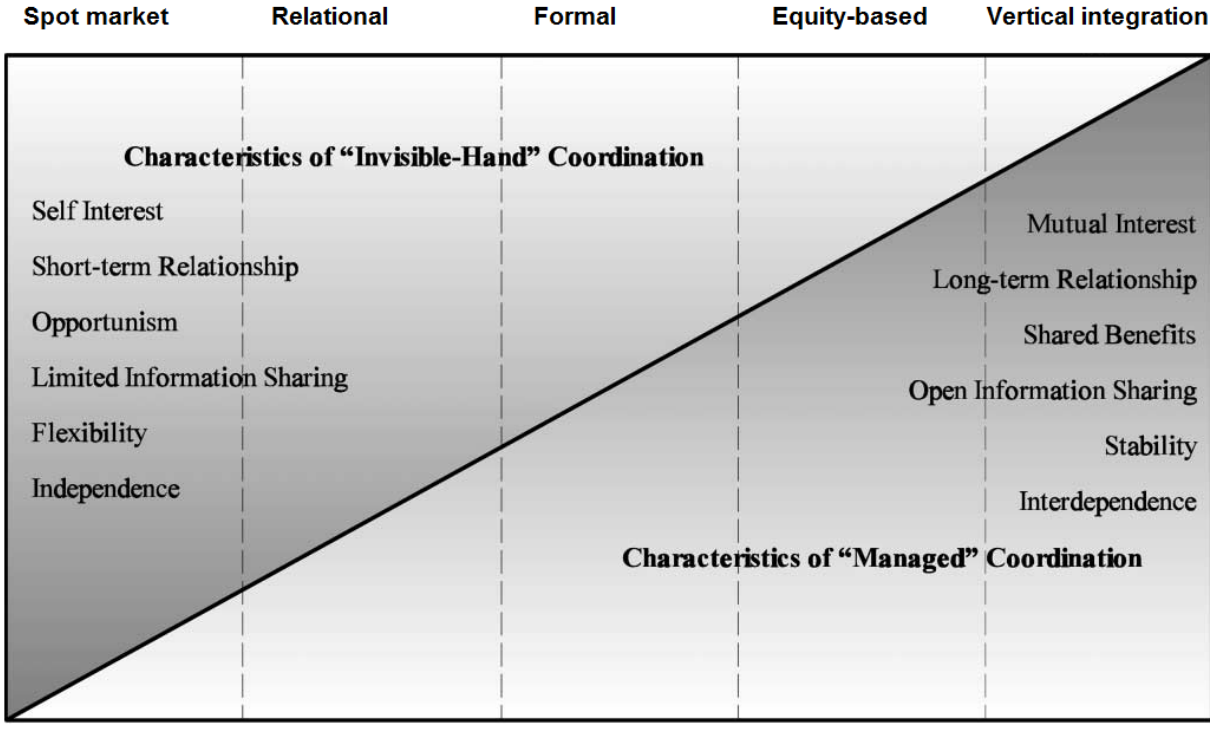

Figure 10: The types of contract coordination mechanisms. (Adjusted from Peterson et al., 2001 with Raynaud et al., 2005)

The five CCMs mentioned in this figure are not the only forms of CCMs, there are also intermediate forms. These types of contract forms can be related to the kind of relation the actors in the FSC have (Fawcett et al. 2007; Raynaud et al., 2005).
The type of CCM shows how aligned the SC is and to what degree actors in the SC collaborate. Based on the CCM of the FSC and the rules and agreements, the FSC will use resources to increase efficiency for example by selecting an IOS for the FSC.

4.2.7 Resources

Resources are a factor that plays a role in selecting a FSCM team and the kind of IOS that can be selected. Therefore the kind of resources that are available or necessary for implementing an IOS need to be discussed. These resources are people, money, materials, time and technology (Fawcett et al., 2007; Lin and Chen, 2003).

People

The quality and productivity of the work that is performed is determined by the people who are working. Education and training are important to increase knowledge and capabilities of the employees this can expand the successful human resources. By combining people of different expertise and knowledge the human resources of that FSC can increase. For example people from a FSC actor who are really specialized in ICT and have knowledge on what is useful for the FSC could develop an IOS for the FSC. In this way the FSC reduces costs and is not dependent on a vendor (Fawcett et al., 2007; Lin and Chen, 2003).

Money

With money is meant the amount of money a SC has, which can be used for production, investments, etc. In this case an investment for an IOS is needed. Who is paying what in these investments, need to be discussed and divided equally according to their size, advantages, costs, risks etc. (Fawcett et al., 2007; Lin and Chen, 2003).

Materials

With materials is meant any good that can be used and is available for the FSC, or in this case the IOS. Examples of these materials are databases and computers. Often these materials for an IOS have to be purchased (Fawcett et al., 2007; Lin and Chen, 2003).

Technology

Technology includes the software and equipment to make an IOS for example. Often this is provided by the vendor. Although if there is an actor in the SC with a strong IT department ‘in-house’ development of an IOS is a possibility (Fawcett et al., 2007; Lin and Chen, 2003).

Time

Time can also be seen as a resource. The time need to be divided between the available tasks. Time is limited, for example the time available to obtain information to select an IOS and the time to implement an IOS is limited (Fawcett et al., 2007; Lin and Chen, 2003).

As already mentioned collaboration between actors in the FSC can create value, and thereby making the FSC more sustainable and profitable. L. Horvath (2001) and B.S. Sahay (2003) describe that collaboration is the key to value creation in SCM. The common goal of this collaboration is: to create a transparent, visible demand pattern that paces the entire SC (Holweg et al., 2005). However getting all the actors in same direction is often quite difficult. This is mainly caused by the lack of one board, but by clearly describing and mutually agreeing on a CCM where culture, governance, strategy, finance and environment; trust, mutuality, information sharing and commitment play a role the FSC as a whole will be more collaborative. This can lead to a more coherent and collaborative FSC with as mutual goal creating more value for the consumer and thereby increasing market share and/or profit for the FSC. If the FSC lacks in accomplishing this the FSC will not be able to select an IOS as these SCM issues are key, before selecting an IOS.

If all the actors are willing to work for the mutual goal and increase collaboration an IOS can be selected.

4.3 IOS

Where in previous years the focus was on IIS, the last few years there is an increased focus on IOSs. An IIS is a system that can improve business operations, for example enterprise resource planning system (ERP), point of sales data and data warehousing. Most companies and actors in the FSC will have their own ISSs. To increase efficiency within the FSC with the help of an IOS, these IISs need to be coupled to the IOS in order to be able to share information. Sharing information is much easier with the help of an IOS, although it is not a requisite for SC collaboration. The basis for SC collaboration is a relationship between actors where trust, commitment and mutuality are very important as described in the previous chapter (Chae et al., 2005). The factors mentioned in the previous chapter will affect the selection of the IOS. The IOS will be affected by the SCM issues as these SCM issues will determine to what extend the FSC will collaborate as described in the CCM. This CCM is determined based on the CGFSE as described in picture 7 (Fawcett et al., 2007; Peterson et al., 2001). So the extent and the functions of the IOS are based on these factors. For example the goal and objective of the FSC will affect the selection process on the type of IOS as well as the available resources. Also the CCM of the FSC will affect the type of IOS that is needed. For example the degree of collaboration determines the extend of the IOS. But beside the SCM issues also other factors need to be taken into account for selecting an IOS.

Like in every project/investment multiple factors need to be analysed in order to make underpinned and well weighted decisions. In order to perform the analyses and make a final decision for selecting an IOS a food supply chain management (FSCM) team need to be established. The FSCM team will start analysing the current FSC in order to know what possible difficulties are; and the factors that are important for selecting an IOS. These factors are costs & benefits, technical properties of IOS, risks, organisational changes and the vendor, which are described in chapter 4.4. These factors are all of importance as they need to be analysed by the FSCM team in order to make a underpinned and well balanced decision on selecting an IOS for a FSC (Bernroider et al., 2009; Opera, 2003; Sahay, 2003). The vendor is a specialist in making IOSs mostly for specific industries. Beside the specific industry where the vendor is working in, other properties of the vendor are important such as strength, vision and experience (Baki et al., 2005; Bernroider et al., 2009).

A better understanding of the selecting issues will provide more insight and the relations between the selecting issues.

4.4 Selecting issues

The factors for selecting an IOS are in this part more in-depth discussed. This will create a greater understanding of the factors that are involved. As well as describing the role of each factor in the selecting procedure.

4.4.1 Food supply chain management team

A food supply chain management (FSCM) team can help to build collaboration between FSC actors. In this FSCM team a diverse set of talents and expertise can be brought together to make decisions or solve problems, for example for selecting an IOS. The FSCM team need to take into account the other factors for selecting an IOS, such as the CCM of the FSC, the resources, the IOS itself, risks, benefits and costs, vendor and organisational changes, as

depicted in the figure below (Chae et al., 2005; Fawcett et al., 2007; Gunasekaran and Ngai, 2004).

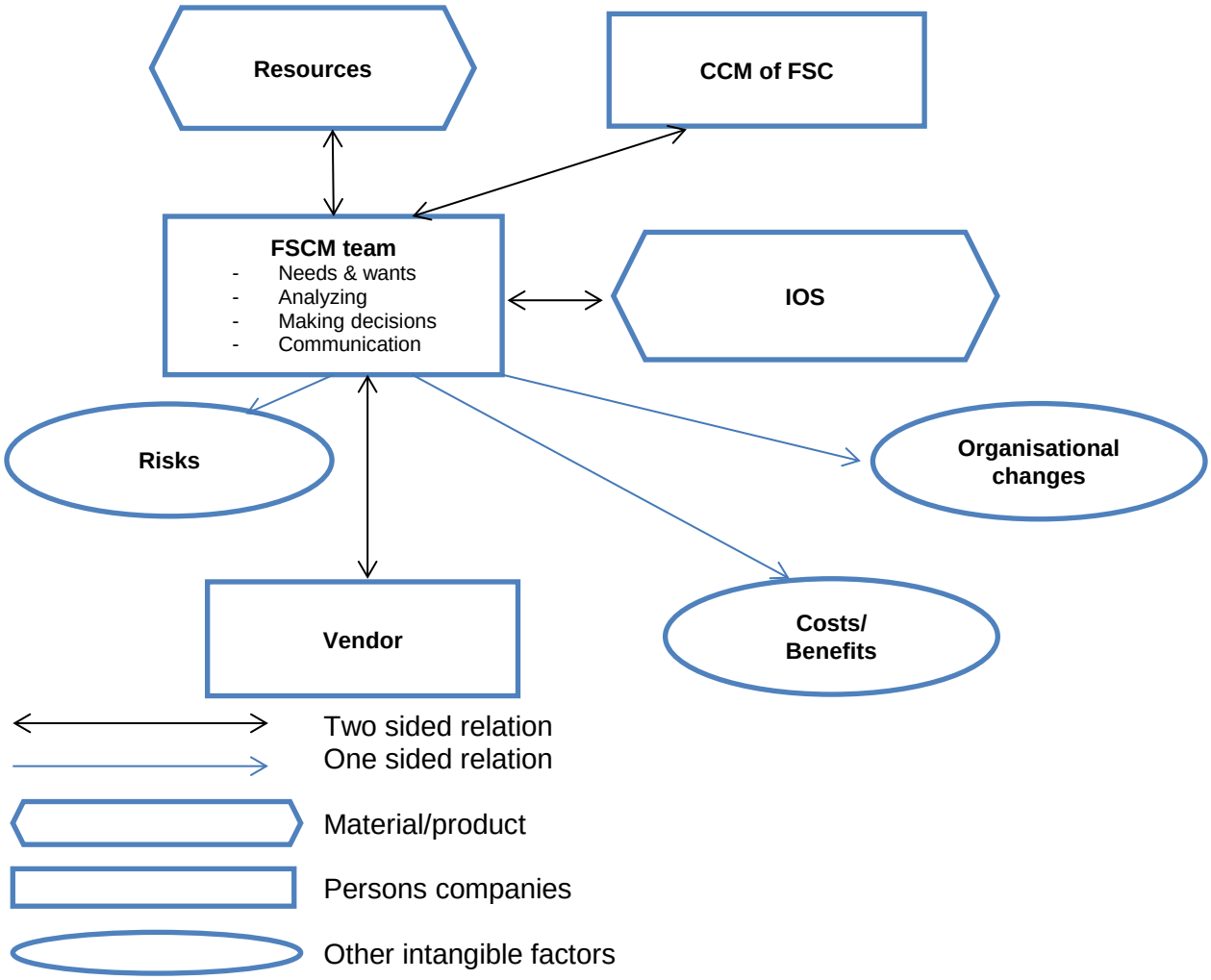

Figure 11: overview of the relation between the FSCM team and other factors.

This figure will be further explained during the description of the FSCM team. Fawcett et al. (2007) describes several factors that impact team dynamics and success, these factors are depicted in table 1. This table provides grip on the factors that can be taken into account for selecting FSCM team. The better the FSCM fits to the task the more likely it is that selecting an IOS will be a success.

Table 1: Factors that have an impact on team dynamics and success.

Availability of resources	Measures used for team and team members
Clarity of team objective	Commitment of members
Team autonomy	Complexity of team task
Team cohesiveness	Executive management support
Team leadership	Functional/technical skills of team members
Team longevity	Open and honest team communication
Team member personalities	Experience with teams
Team process skills of team members	Overall FSC support for team success
Team reward structure	Performance feedback and information support
Team size	

To transform a group into a team the following requirements are important:

- Common goal
- Leadership
- Open communication
- Cooperation even if this means making compromises
- Team members have specific roles and responsibilities
- Performance measurement
- Individual responsibility
- Adequate resources
- Time (working together)

In general a team will consist of multiple people with different qualities and expertise. Although to make a team, the CCM and the available resources need to be taken into account, as depicted in figure 11. The available resource need to be taken into account as it determines the people, money, materials and time for the FSCM team to select and IOS. Also the CCM plays a role in establishing a FSCM team, as the power division, goal of the FSC, etc. affect the kind of people needed for the team (Fawcett et al., 2007). Besides that the FSCM need to analyse the other factors like the IOS itself, costs & benefits, risks, organisational changes and vendor, as indicated in figure 11 with arrows going from the FSCM to the other factors (Fawcett et al., 2007; Gunasekaran and Ngai, 2004). Furthermore the FSCM team is communicating with the vendor about the wants and needs of the FSC, these wants and needs are based on the goals and objectives identified in the CCM of the FSC. Also the resources need to be taken into account as it sets limitations to the selection of an IOS (Fawcett et al., 2007; Gunasekaran and Ngai, 2004; Wei et al., 2005).

Establishing a FSCM team and provide the necessary resources is an important task to perform well in making a decision, about an IOS. As the FSCM team is one of the key factors that need to combine all the other factors to make a well underpinned and well-considered decision (Fawcett et al., 2007).

4.4.2 Inter-organisational information system (IOS)

When selecting an IOS there are needs and wants of the FSC team. The needs and wants can be translated by the vendor in features, technology and support & service for the IOSs. Therefore the features, technology and support & service that play a role in an IOS are discussed. Furthermore this information system developed by the vendor will involve organisational changes, risks and costs and benefits, these relations are depicted in figure 12 and further described in this chapter (Bernroider et al., 2009 ; Olson et al., 2011 ; Sarkis and Talluri, 2004).

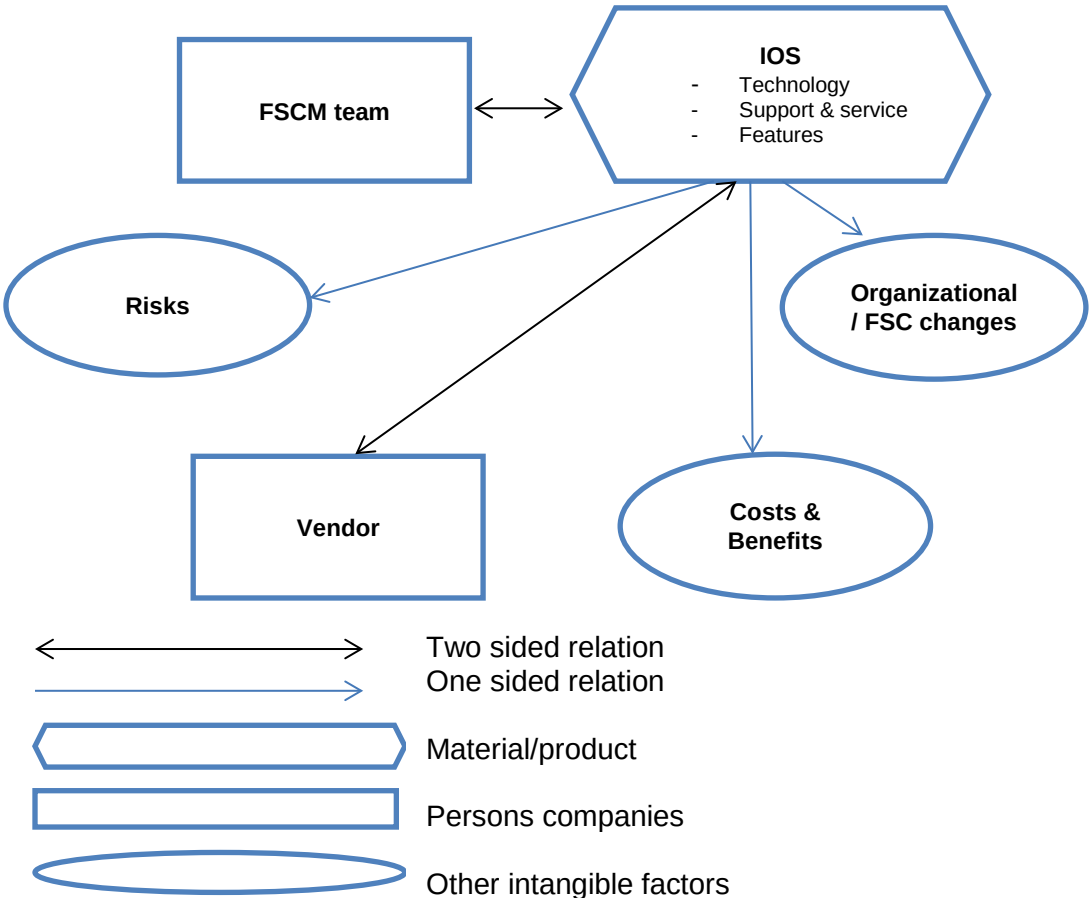

Figure 12: overview of the relation between IOS and the other factors.

This figure shows how this IOS is relating to the other factors in selecting an IOS.

Features

The features of the IOS consist mainly of the security and the user factors of an IOS (Bernroider et al., 2009; Sarkis and Talluri, 2004).

Security is about protecting the IOS from outside threats; this can be done by using firewalls for example. Also the authorisation of people that have access to the IOS is an important issue for security. Examples of authorisations are: the people who have excess to the IOS, the excess to certain amounts of information and the availability of tasks that can be performed in the IOS. This are important issues that need to be discussed by the FSCM team, the relation is also depicted in figure 12. Based on the structure and decision power of actors as described in the previous part authorisation of people and actors will be provided. Also trust of the actors plays an important role as actors have access to the IOS and thereby to sensitive information (Bernroider et al.,2009; Wei et al.,2005).

Another factor that is important and linked to the tasks that can and need to be performed with an IOS are the user factors. With user factors are meant the friendly/easy to use of the system for all actors and personnel that need to use the IOS. So people who are not an expert in IT, need to be able to work with a complex programme like an IOS. This is not specific to analyses for a FSC but is generally important for selecting any information system that need to be used by non-experts. Beside that system performance is important such as responsiveness. Responsiveness is the time the system needs to perform a certain task (Bernroider et al.,2009).

Technology

The technology of an IOS can be described by the reliability and the flexibility of the IOS (Sarkis and Talluri, 2004). Reliability is how reliable the IOS is, how often is there a problem occurring with the system. As these problems are costing money for the FSC and the FSC is not able to use the IOS, the importance of reliability is high. Flexibility is the adaptability of the IOS when external changes occur. With this is meant if the system is able to quickly adjust when more actors are added, new products are implemented and/or other applications are installed. This flexibility is even more important as actors in the FSC have multiple and different IIS that need to be coupled to the IOS. If this flexibility is lacking the IOS is not working as it should, and can be considered as a risk of that specific IOS (Olson et al., 2011; Sarkis and Talluri, 2004).

Support & service

The support and service of an IOS play a role in selecting an IOS. The factors important in support and service are: the implementation time, pre-sales support, maintenance support and documentation& training of the IOS (Bernroider et al., 2009; Sarkis and Talluri, 2004). These factors play a role in selecting an IOS as it helps the FSC to make decision and get started with the IOS quickly, if good service and support is delivered by the vendor (Baki et al., 2005; Wu et al., 2006).

The Implementation time is the time to implement the IOS in the FSC; this depends on the amount of IISs to combine, the degree of customisation, needs and wants, etc. The faster the IOS can be implemented the more likely fewer resources need to be used over time, which is a benefit for the FSC. Although fast implementation of the IOS can also come with more costs as expertise can be necessary to deal with these fast changes.

Pre-sales support is the communication and advice before buying and developing and IOS for the FSC. This support should be about what to think of before implementing an IOS. This support is mainly performed by the vendor of the IOS. Beside support before selecting an IOS support during the use of an IOS is also of importance for example maintenance support. Maintenance support is advice and help from the vendor for maintenance of the IOS. Maintenance of the IOS is of importance the IOS needs to be up to date to minimize problems. Often the maintenance of an IOS is performed by the vendor of the IOS, because they know everything about the installed IOS. Figure 12 shows the two side relation of the IOS and the vendor (Bernroider et al., 2009; Olson et al., 2011).

Documentation & training is another factor of support & service. Trainings consist of training the personnel how to use the system, but also training the IT personnel to implement changes and to solve potential problems. Beside that documentation of information is important to be able to use that information. These trainings and documentation are of importance as it makes the people of the FSC work efficiently with the IOS. (Baki et al., 2005 ; Bernroider et al.,2009)

The IOS, produced by the vendor, contains the features, technology and support & service based on the needs and wants of the FSC. The type of IOS developed by the vendor will be analyzed by the FSCM team to check if it functions well and meets their wants and needs. The type of IOS will affect the costs & benefits, risks and organizational changes as depicted in figure 12 and described above. The more features, technology and support& service the IOS contains, the more benefits the FSC can gain. Although increasing the amount of features, technology and support & service of the IOS will involve higher costs. Furthermore

by increasing the features and possibilities of the IOS makes more likely that organizational changes will be more radical. By increasing the IOS the bigger the financial risks the FSC have to deal with (Matopoulos et al., 2007; Whittaker, 1999).

4.4.3 Costs & Benefits

To know if the IOS is sustainable and profitable for the FSC, costs & benefits need to be calculated and analysed. This section describes what these costs and benefits are for an IOS as well as what the effect and relation of these costs and benefits on the other factors and the selection process. In figure 13 the costs and benefits are depicted as well as the relation.

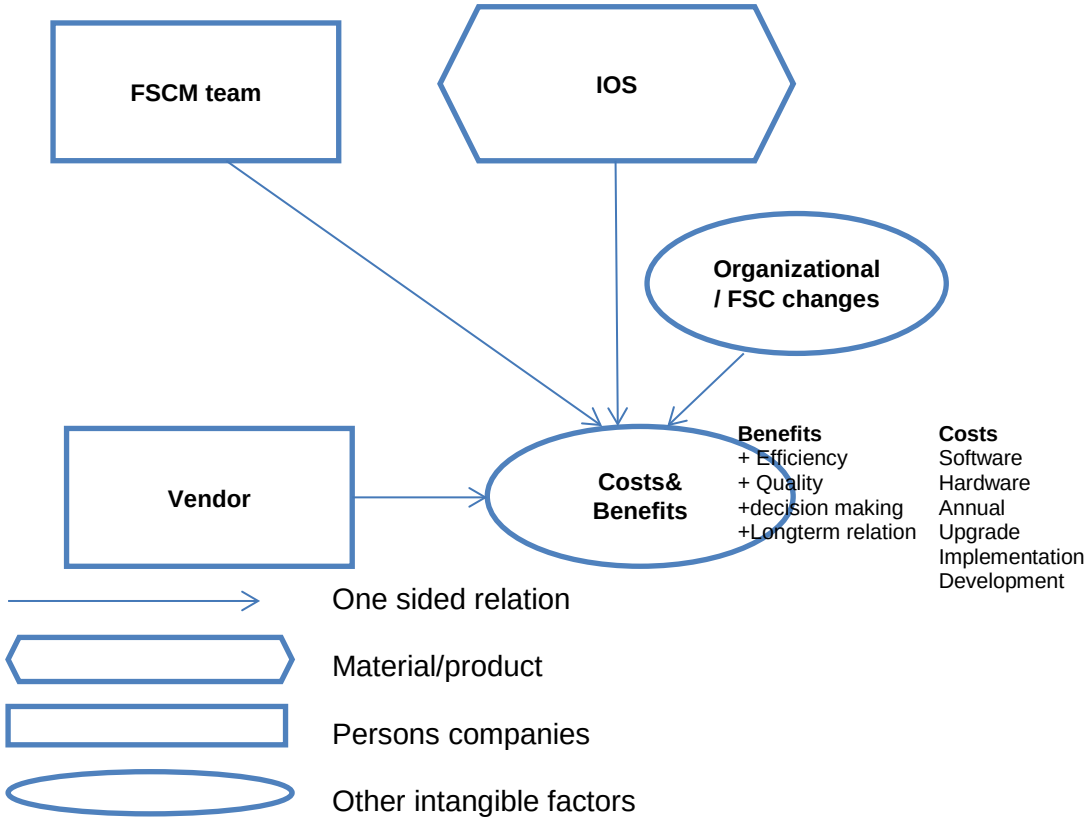

Figure 13: Overview of the relation between the selecting factors and the costs & benefits.

Figure 13 the costs & benefits and the relation to the other factors will be further explained in this chapter.

Costs

Several costs need to be taken into account when selecting an IOS. These costs start from the development of the system to the annual maintenance costs (Bernroider et al., 2009; Sahay and Gupta, 2003).

Development costs are costs for developing the IOS for the FSC. These costs increase when more customization and specific wants are needed, because the vendor needs more resources to make the IOS; this relation is depicted in figure 13. Besides that costs can increase if more actors are present in the FSC and have different IISs.

To be able to work with the IOS, software is needed. This software needs to be installed for all actors in the FSC to be able to use the IOS. So the more actors are part of the FSC the higher the software costs; although the software cannot be used without the suitable hardware. The hardware contains servers, computers, etc., which need to be installed. To

implement and install all the hard and software implementation costs are involved. Implementation costs are costs for planning and implementation. This means costs and installing of the software and hardware, but also personnel costs, management costs and training costs (Baki et al., 2005; Bernroider et al., 2009)
To keep the IOS up and running the IOS needs to be maintained regularly. But also costs for electricity and small replacement costs are annual costs. Furthermore to improve and keep the IOS up to date, upgrades need to be installed when necessary. Upgrading the IOS involves costs. These upgrade costs contain costs for upgrading the IOS with renewed and better applications, for example better software and/or hardware. These costs also depend on the vendor who will perform the maintenance, for example. This relation is also depicted in figure 13 (Bernroider et al., 2009; Olson et al., 2011).
All these costs can vary depending on the degree of customization and amount of actors in the FSC (Bernroider et al., 2009. The types of costs are not specific for the FSC as all these costs play a role in selecting an IS. An actor/FSC is willing to pay these costs if it provides them more costs than benefits. All though there is no difference in the type of costs dividing these costs between the actors in the FSC will be different for each supply chain, as every FSC is different. Besides the costs benefits play a role in selecting an IOS for a FSC.

Benefits

The benefits of information sharing in an IOS are described by multiple authors. This section describes these benefits. One of these benefits is increased efficiency. Due to faster data transaction, better forecasts and sales data, and minimised SC disruption efficiency can be realised. Besides that, efficiency is realised by knowledge sharing and thereby increasing innovation capacity and faster product development. Also transactional costs and the bullwhip effect can be reduced due to the implementation of an IOS (Chae et al., 2005; Davenport, 2000). By reducing the bullwhip effect, fewer inventories are necessary and thereby the cycle time of the product can be reduced. In FSCs the cycle times are meanly based on seasonality and growth times of the food. Although if products are faster on the shelves by faster communication and direct communication based on sales for example, the expiration date can be longer (Fawcett et al., 2008). This means that products can be kept longer on the shelves and thereby increasing the time a product can be sold. Finally this results in less spoilage and increased efficiency. Due to increase in efficiency, increased revenues and decreased costs can be realised. This benefit is gained by the changes that are made in the FSC by using an IOS (Handfield et al., 2003; Horvath, 2001; Matopoulos et al., 2007). The benefit of increased efficiency is often mentioned for selecting an IS. An IOS can also increase the efficiency throughout the supply chain and thereby accomplishing the goal of the FSC in increasing value for the consumer as described in the SCM issues (Davenpoort, 2000). This relation between IOS and benefits is also depicted in figure 13.
A second benefit is increased product quality and safety. This can be realised by increasing the available data from other actors in the FSC. With the help of the IOS the quality of the food can be monitored at each step in the FSC. Due to the data from the IOS the FSC knows what in the chain can be improved and/or optimised; this results in an increase of the quality. Safety can be more guaranteed due to better traceability of the food and a clear overview of the FSC. All actors in the FSC know were the food comes from and what kind of processes are performed. Increase in quality is adding value to the product, thereby increasing the total value of the product, which can result in increased profits (Bernroider et al., 2009; Matopoulos et al., 2007; Ziggers and Trienekens 1999). This benefit is gained by

collaboration in the FSC and less likely to occur when no collaboration in the FSC takes place.

Furthermore due to the increase of data and the quality of the data that can be extracted from the IOS, enhanced decisions can be made, which is another benefit of an IOS. By providing better and more data better management decision can be made for the FSC as well as for the individual actors. If the management is able to make better decisions, the FSC and individual actors can perform better. This results in a more profitable and sustainable FSC and actors (Beulens et al., 2005; Horvath, 2001).
Furthermore due to faster and better data, enhanced customer service can be performed. This is done by better information sharing and traceability of the food. Beside that due to the IOS, easy and faster communication to the consumer can be established, for example by reducing stock outage by automated ordering systems. So customer service can also be seen as adding value and thereby contributing to the value adding process (Davenport, 2000; Sahin and Robinson, 2002).
Another benefit is establishing a long-term relationship between all the actors in the FSC. The IOS can strengthen this relationship as an increased collaboration takes place. Due to the strengthening of these relationships, a more sustainable and long term relationship between actors can be established. Furthermore this benefit can help the entire FSC as it increases trust, commitment and information sharing between the actors. As described in the SCM issues trust, commitment and information sharing are key in collaboration in the FSC. Increasing these factors further can lead to even more benefits for the FSC (Davenport, 2000; Fawcett et al., 2008; Matopoulos et al., 2007).
Al these benefits can contribute to the value creating process of the food for the consumer. By increasing the value by providing, cheaper and/or higher quality products more market share and/or profit can be realised by the FSC.

As depicted in figure 13, the factors relate positively to each other. The higher the customization and integration of the IOS the higher the costs and benefits can be, for example. The costs & benefits of the IOS are important as it is one of the main drivers for decision making in project management. This means that costs and benefits can influence the type of IOS that will be selected and thereby influencing the risks of the IOS for example. For that reason it is important that the FSCM team identifies and analyses these costs & benefits, this relation is depicted in figure 13 (Beulens et al., 2005; Davenport, 2000).

Although these costs & benefits are dependent on the IOS, FSCM team, organisational changes and vendor. These costs and benefits are crucial in analysing the IOS for the FSC as it will determine to a large extend the decision on the IOS.

4.4.4 Risks

Selecting and finally implementing a type of IOS affects not only the costs & benefits, but also risks. Risks are often not really investigated and underestimated, although they are really important and can involve serious costs. By analysing the potential risks of an IOS these risks can be minimised by planning and management the process well. In figure 14 the risks of an IOS are described as well as the relation of the risks to the other factors, which are further described in this chapter (Eckartz et al., 2009 (b); Whittaker, 1999).

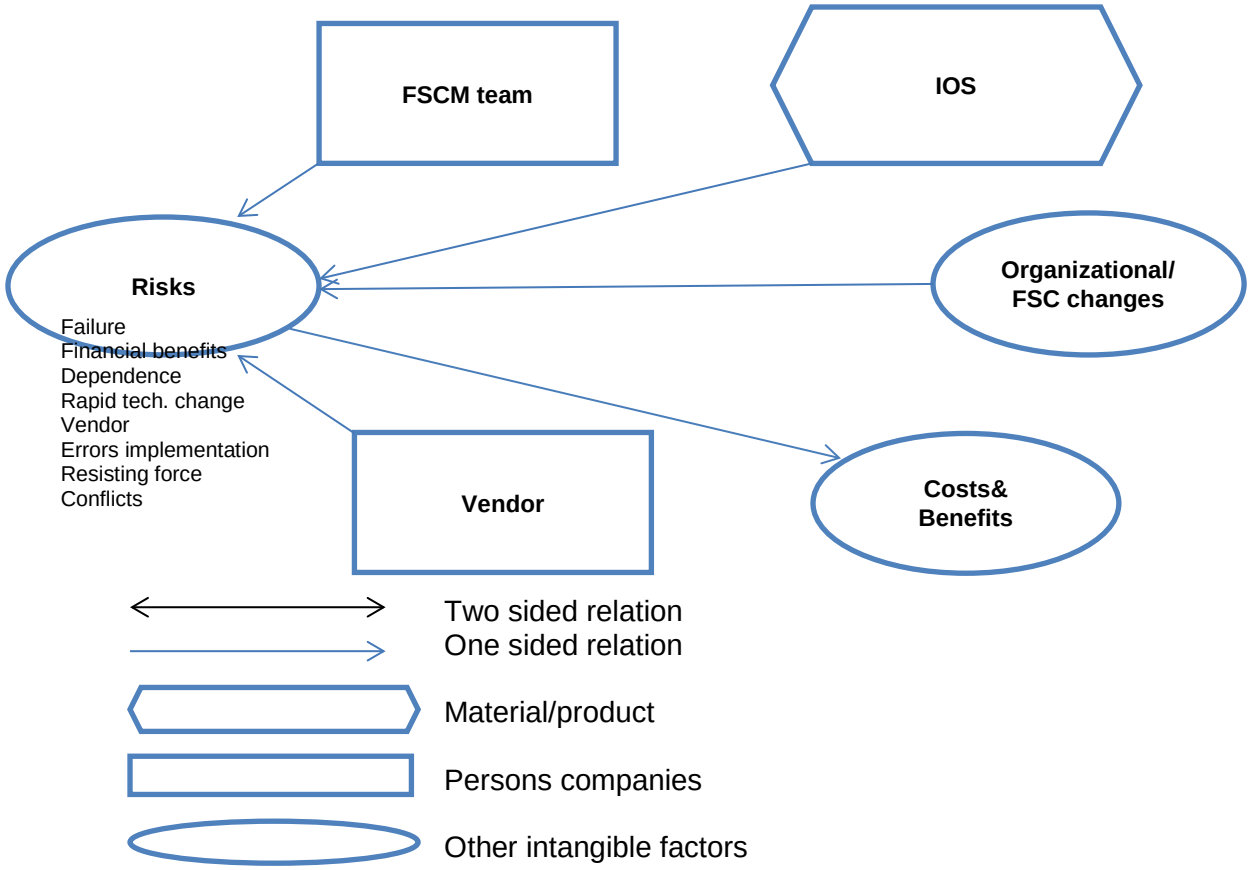

Figure 14: Overview of the relation between the selecting factors and the risks.

One of the risks that need to be taken into account is the risk of failure (Hayes, 2010). The risk of failure to implement an IOS system can be caused by a lack of trust, commitment, etc. Due to already established relations between the actors in the FSC and FSCM team, trust is not the main reason for failure, if already a FSCM team is formed. According to Whittaker (1999), who conducted a survey of 1450 Canadian private and public institutions, the three main reasons for failure are poor project planning, a weak business case and a lack of top-management involvement and support. Poor project planning is caused by inadequate risk management, which is especially getting important in bigger companies/FSCs. A weak business case is caused when the IOS is not relating to the company/FSC needs. A lack of top-management involvement and support, results in no decision making and no available resources. This top-management can be the boards of the actors, the board of the FSC, if there is one, or the FSCM team. Especially for FSCs, commitment of all actors in the FSC is important as all actors contribute to the collaboration of the FSC. This relation of the FSCM team and risk is depicted in figure 14.

So these factors need to be taken into account. If not, the implementation of an IOS will result in a failure from the start. The risk of failure includes loss of money, time and delay or abandonment of IOS (Gunasekaran et al., 2001; Whittaker, 1999).

Besides the potential risk of failure the risk of errors during implementation is also a risk that needs to be taken into account. Sometimes only errors are found when the IOS is implemented. Money loss due to errors in the system can be reduced when the system is utilized in pilot projects and/or run next to already existing systems, as well as expertise of the vendor (Kumar and van Dissel, 1996; Matopoulos et al., 2007; Whittaker, 1999).

Another risk is the risk of uncertainty about financial benefits and costs. The main uncertainty is caused by the potential profits and savings of implementing an IOS. Some profits and

savings are difficult to estimate, but a cost/benefit analysis is a critical part for the actors in the FSC for making a decision (Vickery et al., 2003). To make an estimation of the costs and benefits a business case for the specific FSC for implementing an IOS can be used, this is described by Eckartz et al. (2009 (b)). After the implementation the performance of the SC can be estimated. A study performed by Gunasekaran et al. (2001) made a framework, based on literature, to measure the performance in a SC. Also Fiala (2005) describes a model that can predict the effect of real SC information sharing. This can help predicting the benefits, although some indirect benefits and intangible benefits are difficult to score.
Also costs are not that easy to estimate, due to customization of existing software for example. As described by Whittaker (1999), more than half of the IT projects will costs 189 per cent of the estimated costs. One of the causes is delay in schedules of finishing the IOS. This relation between risk and benefits and costs is also depicted in figure 14.
Furthermore, the risk of dependence is the risk that one actor in the FSC relies more on other actors in the FSC. This risk is mostly high for small companies cooperating with large companies due to the differences in power. This can result in abuse of the power the large company has and thereby decreasing trust between the companies (Beulens et al., 2005 and Kumar and Dissel, 1996). Another risk that affects the relation of the actors in the FSC is the risk of conflicts. Risk of conflicts can be conflicts between the actors in the FSC or with the vendor. For example conflicts due to not clear structured relationships in the FSC or due to a lack of the level of specification on the roles, obligations and agreements between FSC actors. Besides that there are allot of other reasons that can results in a conflict between FSC actors, such as: stealing, fouling of data, etc. although this can be solved by auditing the actors of the FSC. Besides that, the chance of conflicts will reduce if the actors in the FSC trust each other. Again trust is an important issue in collaboration between FSC actors (Fawcett et al., 2007; Hayes, 2010; Kumar and Dissel, 1996; Matopoulos et al., 2007).
Although an IOS is most likely to reduce complexity between the actors, it can cause an actual increase of operational complexity. The risk of increased operational complexity can be caused by a company who takes part in more than one SC. Due to this a company needs more IOSs and/or have to collect data from different systems to be able to use that information and to make ‘good’ decisions (Gunasekaran et al, 2001; Vickery et al., 2003).
Next to the possible conflicts between the actors in the FSC, the resisting force of employees of these actors can also be a risk, as depicted in figure 14 (Hayes, 2010). The risk of resisting force to change is the risk of the willingness to cooperate and change of people that need to work with the IOS. There are several reasons for resistance to change: parochial self-interest, misunderstanding and lack of trust, different assessments, and lower tolerance for change. Parochial self-interest can be described as people/actors resist change because they think they will lose something of value. Misunderstanding and a lack of trust in this case can resist people/actors to change, because they do not understand the implications it may have for them. Due to the misunderstanding actors may perceive that the change will cost them more than they will gain. This misunderstanding is arises often from a lack of trust. With different assessments is meant that people/actors are assessing the change (IOS) differently, in this way they see for example more costs than benefits, than other people/actors. Low tolerance of change is when people/actors are concerned they are not able to develop the new skills and behaviours. Also the rivalry between actors, especially horizontal actors, can be a barrier/risk for implementing an IOS (Hayes, 2010).
This rivalry between actors can even develop into a bigger risk, risk of inaccurate/wrong information sharing. This risk can be caused by a FSC actor, that provides wrong, incomplete and/or too much (unnecessary) information. This can be reduced by training personnel and

actors in the FSC, beside that trust is an important issue here (Cheng et al., 2001; Gunasekaran et al., 2001).
A risk that comes more from outside the FSC is the risk of the vendor. The risk of the vendor is about the vendor vision and strength which is discussed in the next part. This risk can be large when the vendor's financial strength is low, which can result in bankruptcy and loss of money and an up-to-date IOS (Bernroider et al., 2009; Verville and Halingten, 2002).
A risk that is unavoidable is the risk of rapid technology change. Due to rapid technology changes, the IOS that will be implemented can already be old and would need upgrades. This is an on-going process, but by selecting an up-to-date vendor which continuously upgrades the IOS, the risk of rapid technology change can be reduced (Fawcett et al, 2006).
The FSCM team needs to control and manage these risks in order to minimize them and thereby decreasing unnecessary costs.

4.4.5 Organizational/FSC changes

If finally the IOS will be implemented organizational changes are most likely to occur. Therefor these organizational/FSC changes need to be taken into account, when selecting a potential IOS. These organizational changes are divided in people (Fawcett et al., 2006), business processes (Eckartz et al., 2009 (a)) and partnership relation (Eckartz et al., 2010), as depicted in figure 15. What these changes mean and how they affect the other factors the changes is described in this chapter.

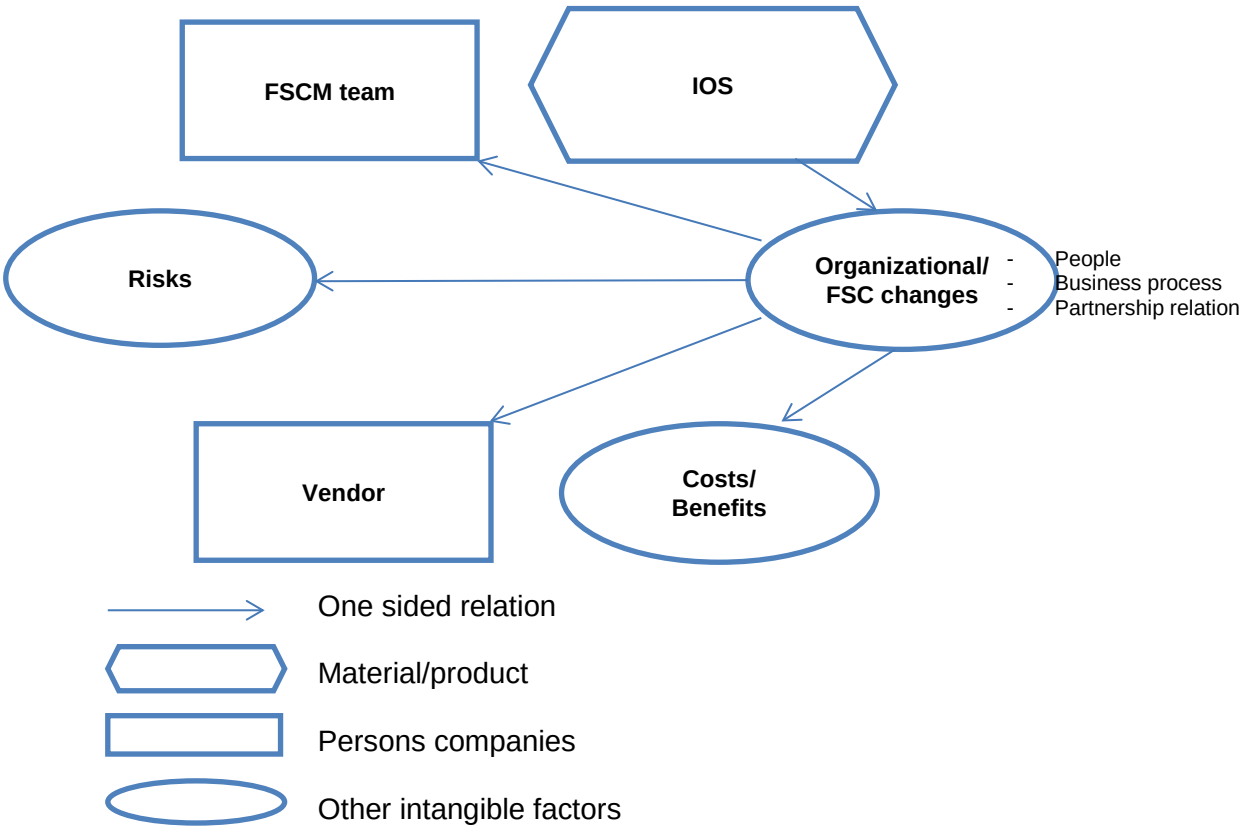

Figure 15: Overview of the relation between the selecting factors and the organizational changes.

People

One of the people issues actors and the FSC have to deal with are the changing tasks. As depicted in figure 15 the IOS will affect the tasks in the FSC. Some of these tasks will disappear/change, for example placing orders, keeping inventory data, gathering and

calculating data, the way of communicating and information sharing. These changes in tasks have an impact on the employees that are confronted with these changes. The changes can be perceived as painful and hard to understand, therefore management needs to clearly communicate upfront with their employees what is happening to a certain level, why these changes are made and listen to employees for potential misunderstanding and unrecognized obstacles. This can be described as the 'underscore and explore' communication strategy, which is very effective as described by Hayes (2010). In this way the risk of resistance to change can be reduced and thereby it is easier to implement these changes (Fawcett et al. 2007; Hayes 2010).

Business processes

Linked to the tasks of the employees are the business processes. These business processes will most likely change as well, due to the various new ways of working. Examples of changed business processes are: automated order placement to actors instead of sending it by hand, changed inventory keeping due to better information accessibility and/or changed production process due to more information about product quality (Eckartz et al. 2009a; Eckartz et al 2009 b).

Partnership relation

When implementing an IOS relations between actors in the FSC will change. Due to increased information sharing, perceived commitment of actors and mutuality in the implementing process; trust between the actors will most likely increase. Thereby a more effective FSC can be built as described by Fawcett et al. (2006) and Matopoulos et al. (2007).

Although the FSC cooperates in a certain CCM, the coordination structure between the actors in the FSC will probably change to a more vertically integrated CCM. This is caused due to the increased collaboration, trust and mutuality between the actors in the SC (Eckartz et al. 2009 b; Lambert and Cooper, 2000).

The power division between actors will be more mutually divided in the FSC, due to the implementation processes of the IOS. This is caused by the increased trust and mutuality in benefits and risks (Eckartz et al. 2009 b, and Kwon and Suh, 2005). The increased mutuality and trust between the actors is caused by shared benefits and risks. This will most likely result in increased partnership. This contributes to the long-term relation between the actors in the FSC (Eckartz et al., 2010; Kwon and Suh, 2005).

The organizational/FSC changes that will be caused by the implementation of the IOS, will involve some benefits, costs and risks. For example, due to increased efficiency, in communicating and information sharing between actors in the FSC, less people are necessary to do the same work (Davenport, 2000). This can result in a reduction of the people that are needed; and save money for the company and FSC. Beside benefits, costs are involved in these organisational/FSC changes. For example people are not familiar with the IOS, therefore these people need to be trained to be able to work with the IOS. Also risks are involved in organizational/FSC changes, for example people who are not willing to use the new system because people think that they lose something of value, like a face-to-face conversation instead of automatically purchase system. So the relation between organisational/FSC changes and costs & benefits and risks are one-sided (Chae et al., 2005; Fawcett et al. 2007; Kwon and Suh, 2005; Matopoulos et al., 2007).

Furthermore the FSCM need to know these changes as these changes will play a role in the selecting process of the IOS. Not only the FSCM team has to know these changes but also

the vendor need to know these in order to probably implement the IOS and how is the IOS affecting the FSC and its business processes (Eckartz et al. 2009a; Hayes 2010). These relations between the organizational changes and FSCM team and vendor are depicted in figure 15.
The last factors that plays a role in selecting an IOS is a vendor. The vendor is the company that develops and provides IOSs. The following part will describe the factors that need to be taken into account when assessing a vendor.

4.4.6 Vendor

The final factor that needs to be taken into account for selecting an IOS is the vendor. In this part the factors important for selecting a vendor are discussed, which are mainly the vendor vision and vendor strength (Baki et al., 2005; Bernroider et al., 2009). Furthermore the relation between the vendor and the other factors are further discussed, which are depicted in figure 16.

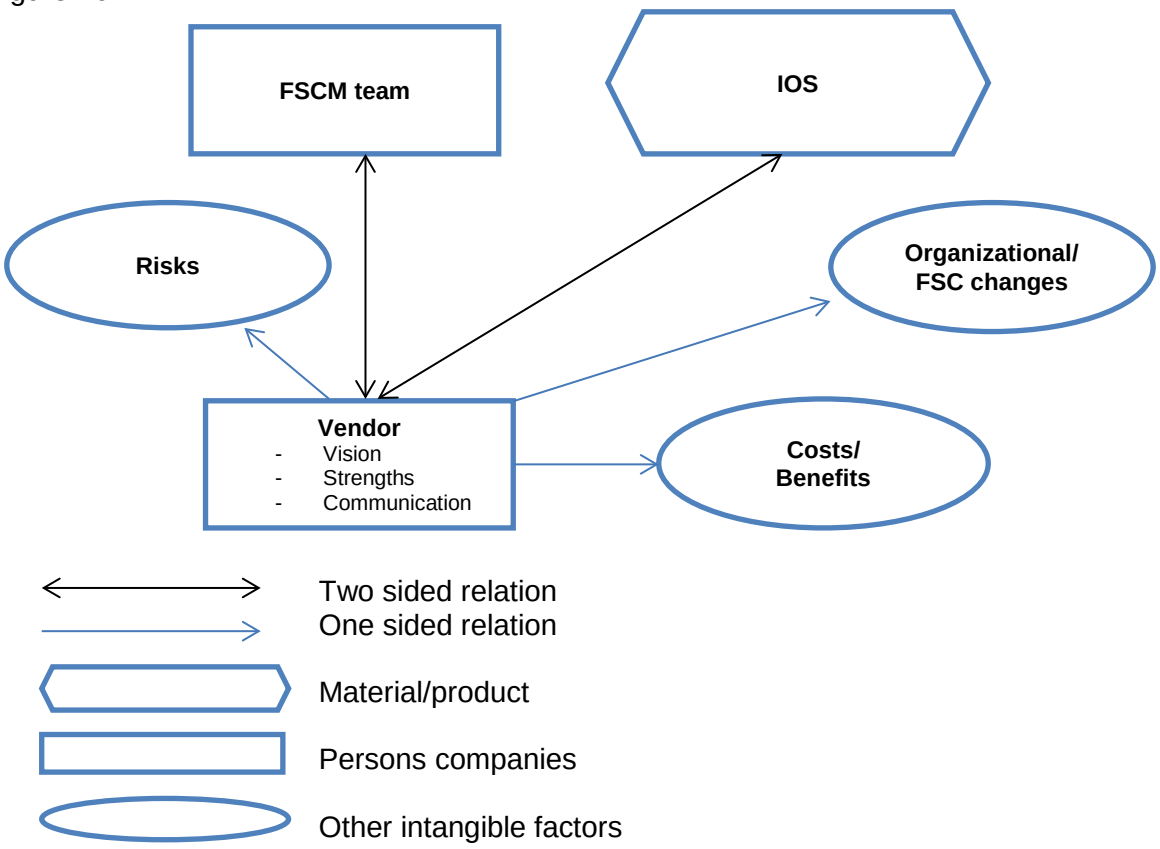

Figure 16: Overview of the relation between the selecting factors and the vendor.

Vendor vision

The vendors' vision can be divided in three properties: policy, strategy and innovation.
The policy of the vendor is about the rules and contracts of the vendor. This consists for example about values, but also about who should be the owner of the IOS system, the FSC or the vendor. Furthermore the strategy of the vendor is of importance. The strategy is about the goal and objectives, and partnerships of the vendor. So if the goal or objective of the vendor is targeting another market as the FSC is in, it could be that the FSC chooses for a different vendor, for example. Another important factor for the vision about the vendor is innovation. Innovation is about development and innovation of the IOS by the vendor. Innovation can contribute to improving the IOSs. So if the innovation of the vendor is high, more and new capabilities for the IOS will be developed. This can result in an even more

efficient FSC, for example. So policy, strategy and innovation have a great effect on the opinion of the FSC about the vendor (Baki et al., 2005; Bernroider et al., 2009; Olson et al., 2011; Verville and Halingten, 2002).

Vendor strength

Vendor strength includes multiple different strengths such as: Financial strength, personnel strength and experience (Baki et al., 2005; Benroider et al., 2009).
Financial strength is about the financial situation of the vendor. A FSC does not want to take the risk to invest in an IOS, if the financial situation of the vendor is bad and/or near bankruptcy. Bankruptcy of the vendor leads for the FSC to no maintenance, support and updates and loss in money.
Another factor that plays a role is strength of the vendor. Personnel strength is about the technical, communicating and managing skills of the personnel of the vendor. These are important for developing, implementing and maintaining the IOS for the FSC.
Personnel strength is closely linked to the experience of the vendor. Experience is about the experiences of the vendor and the success of these experiences. Experiences in the same industry are a plus, because the vendor has know-how of the sector the FSC is in (Baki et al., 2005; Verville and Halingten, 2002).
The relation between all the actors to the vendor can be described as followed. The vendor, which communicates with the FSCM team on the possibilities and negotiates with the FSCM team, provides the IOS. The type of IOS the vendor provides consists of technology, features, supports & services, this shows the relation between the IOS and vendor as also depicted in figure 16 (Baki et al., 2005 ; Bernroider et al., 2009 ; Wu et al., 2006).
Also the vendor need to be analysed by the FSCM team benefits, costs and risks are involved during this analyses. The kind of benefits depends on the kind of vendor. A benefit could be a fast implementation time due to the experience of the vendor. Experience of the vendor can come with higher costs due to the expertise in their branch. Risk of a vendor could be the financial strength, if the vendor has financial troubles and goes bankrupt, the investment in an IOS can fail. These relations are depicted in figure 16 (Baki et al., 2005; Bernroider et al., 2009; Olson et al., 2011; Verville and Halingten, 2002).
This means that the relation, as depicted in figure 16, between the vendor and the IOS is two-sided, as the vendor needs to make the IOS and the IOS need to be updated and maintained by the vendor. Furthermore the FSC and vendor have to communicate to provide possible options for the FSC in selecting an IOS. As mentioned the kind of vendor has an effect on the risks and costs & benefits, as mentioned above.

4.4.7 Overview factors and relations

A list with an overview of the factors involved for selecting an IOS for a FSC are described below, in order to summarize the factors that are involved.

General SC issues

- Contract coordination mechanism
  - *Environment*
  - *Governance*
    - Structure/Decision power
    - Mutuality/Interdependency
    - Competition/Information accessibility
  - *Strategy*
    - Goal/Objective

- Commitment/Long term orientation
- *Culture*
  - Trust
  - Semantics
- *Finance*

Resources
- *People*
- *Money*
- *Materials*
- *Technology*
- *Time*

Selecting issues

FSCM team

Type of IOS
- *Technology*
  - Reliability
  - Flexibility
- *Features*
  - Security
  - User factors
- *Service & Support*
  - Implementation time
  - Pre-sales support
  - Maintenance support
  - Documentation & training

Benefits & Costs
- *Benefits*
  - Increased efficiency
  - Increased product quality and safety
  - Enhanced decision making
  - Enhanced customer service
  - Reducing risks
  - Long term relationship between actors
- *Costs*
  - Development costs
  - Software costs
  - Hardware costs
  - Implementation costs
  - Annual costs
  - Upgrade costs

Risks
- Risk of failure
- Risk of uncertainty about financial benefits
- Risk of dependence
- Risk of conflicts
- Risk of increased operational complexity
- Risk of resisting force
- Risk of errors during implementation

- Risk of rapid technology change
- Risk of vendor

Organizational/FSC changes

- *People*
- *Business processes*
- *Relation*
  - Trust
  - Coordination
  - Decision power
  - Interdependency

Vendor

- *Vendor vision*
  - Policy
  - Strategy
  - Innovation
- *Vendor strength*
  - Financial strength
  - Personnel strength
  - Experience

Beside the overview the relation and the effects of the factors is one of the reasons for complexity. An overview of these relations is depicted below.

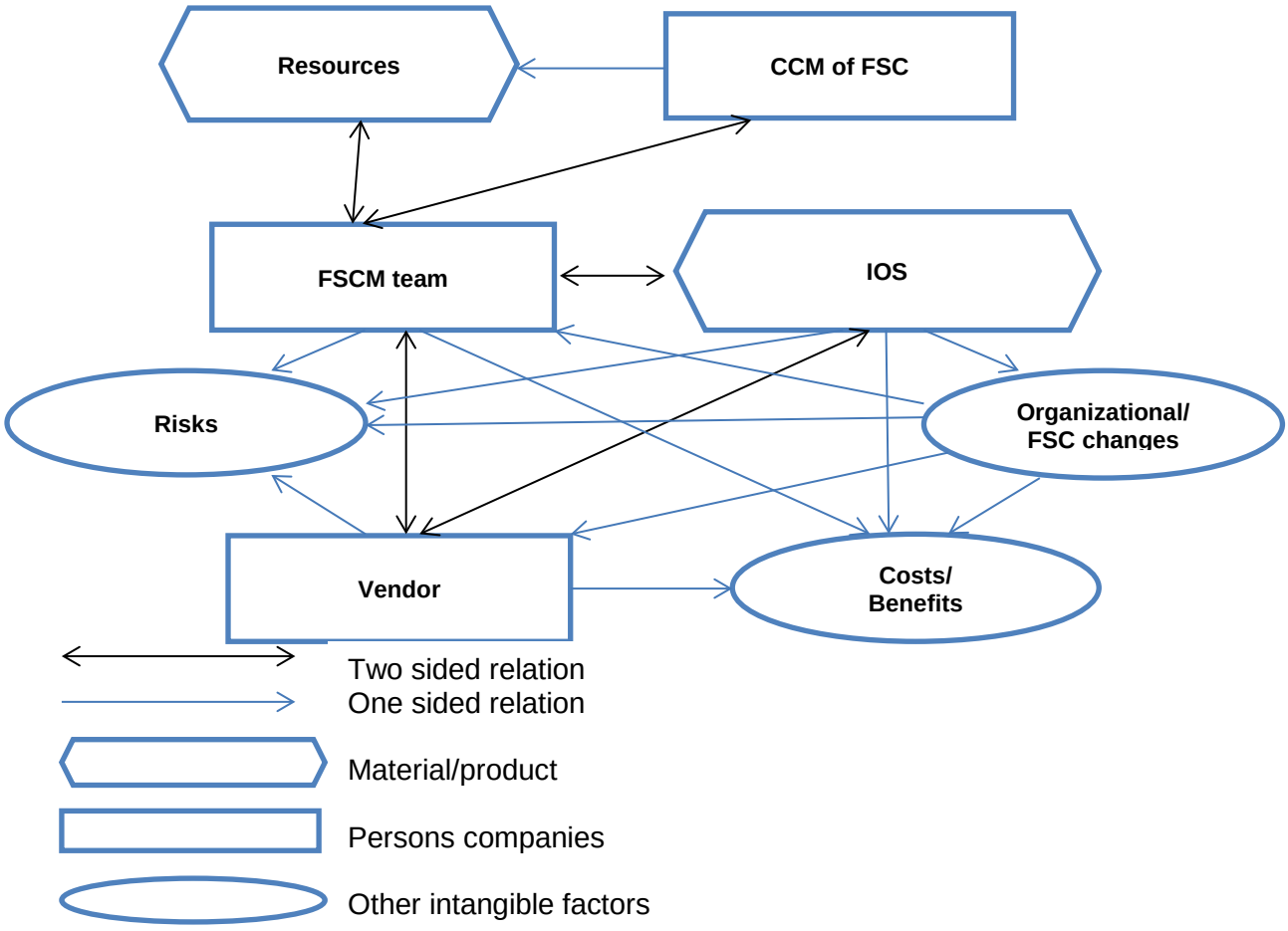

Figure 17: Overview of the relations between the factors for selecting an IOS for a FSC.

A description of each relation is already provided above. Next to the factors the relation between these factors the importance of these factors plays also a role, this is described in the next chapter.

4.5 Importance of factors

As state it in the previous chapters the factors involved for selecting an IOS for a FSC can be divided in two large groups the general FSC factors and the selecting factors of the IOS. All the factors in these large groups are not equally important therefore the importance of these factors is discussed below.

4.5.1 General FSC issues

The general FSC factors are more important than the selecting factors of the IOS itself (Stefanou, 1999). If the actors do not mutual agree, are not committed to the SC and project, do not trust actors and do not share information the analyses of the IOS can stop even before a team is selected. The general FSC factors that are really important are trust, mutuality, commitment and information sharing (Eckartz et al. 2010; Kwon and Suh, 2005; Matopoulos et al. 2007). These factors all play a role in the CCM of the FSC who need to be agreed on before starting with the selection procedure of an IOS.

4.5.2 Difficult to rank factors on importance

Although the factors mentioned above are important, it is very difficult to rank these factors, quantitative on importance. This is caused due to differences between FSCs (CCM, resources, type of IOS), actors (size, decisions, etc.), direct and indirect effects and intangible factors (Vickery et al., 2003). For every actors/FSC these factors are different in importance. For example increased efficiency of the FSC can be caused by different factors such as, reduced lead times, better communication, reduced bullwhip effect, etc. But is increased efficiency more important as increased product quality, which results in a higher value of the product sold? This is really difficult to measure although several tried to make a system that can measure these different benefits for a specific business case (see for example Ward et al., 2008). With the methods they provide a better estimation of the gained benefits of an IT investment can be accomplished. For each individual case it is possible to estimate the gained benefits, but a general ranking for all FSCs is not possible. This is due to the causes described above.

So although it is difficult to rank specific factors quantitative on importance, due to differences between SCs, actors, direct effects, indirect effects and intangible factors, a qualitative rank on importance is made. First general SCM issues are important, such as trust, mutuality, commitment and information sharing. Secondly the selecting issues are important.

Numerous factors are described, so when a FSC want to adopt an IOS all these factors need to be taken into account. Due to uncertainties, large amounts of data, the importance of the factors and the relation between the factors that play a role in implementing an IOS; a well-balanced decision on what kind of IOS to choose is a very complex task. To reduce this complex task the steps that need to be taken in order to analyse and select a potential IOS are described in the next chapter.

5. Design roadmap

As mentioned in the theoretical framework multiple factors play a role in selecting an IOS. Making a decision based on multiple factors and the size of these factors is called multiple criteria decision making (Tan et al., 2012). To help making a decision a multi-criteria decision making process is important. A roadmap can be a very useful tool for this type of decision making, as it provides the goals, factors as well as the steps for selecting an IOS.

5.1 Goal of a roadmap

The goal of the roadmap is to support the FSC by providing the steps to make the best possible decision for an IOS. To accomplish this goal the roadmap should be able to be used as a guide for FSCs in how to select an IOS and should meet the requirements set in chapter 3.2. This is done by providing the steps for selecting an IOS as well as providing methods for accomplishing these steps. Furthermore the factors, relation between these factors and importance of these factors that play a role in these steps need to be taken into account, as these factors affect the outcome of these steps.

5.2 Roadmap steps

To be able to select an IOS the steps that have to be taken need to be identified. As most projects it starts with selecting a project team and ends with an output. In this case the output is a decision. This process starts from forming and ends with adjourning as is described by Fawcett et al. (2007).

Forming is deciding who belongs in the team. Storming establishes common ground and identifying individual roles and responsibilities. The next step is norming, at this step team rules and procedures are established. After norming comes performing this involves identifying problems and opportunities, establishing a plan and implementing the plan. Finally adjourning this involves the upfront definitions of milestones, an ending point (output) and a target completion date (Fawcett et al., 2007).

5.2.1 Establish FSCM team

A project starts with putting a team together that have the right skill set to fulfil the objective as described in the theoretical framework. This team will also be established based on the governance and the CCM of the FSC. Decision power, dividing of tasks, rules and contracts described in the CCM will play all a role in establishing a team (Eckartz et al., 2010 and Raynaud et al., 2005). Fawcett et al. (2007) describes the advantages of a team that needs to solve problems or make a decision. The biggest advantage in forming a team is that it gives the opportunity to bring a diverse set of talents and expertise together. Besides forming a team, a common ground, individual roles and responsibilities need to established, the storming step. After that the norming step need to be made, where the rules and procedures of the team are established. The factors that play a role in selecting a FSCM team are described in the theoretical framework (Karsak and Özogul, 2009; Verville and Halingten, 2002). The way to select such a multifunctional team can be done by using a fuzzy approach in combination with the grey decision making approach as described by Tseng et al. (2004). This method provides the FSC some tools in how to select a team.

5.2.2 Analyzing FSC

After a FSCM team is established an analysis of the FSC need to be done, to know what the current state of the FSC is and what the strategy and objectives of the FSC in general are.

Next to that the problems and opportunities are identified. This is done by analysing the environment, strategy, governance, culture and finance of the FSC. The factors where to focus on analysing the current situation of the FSC are described in the theoretical framework. By analysing and identifying the current situations, problems are identified and possible solutions can be formed. The analysis of the FSC is part of the performing step (Eckartz et al. 2009 (a); Fawcett et al., 2007). The analyses can be performed by evaluating models that can analyses the current performance of the supply chain, as described by Estampe et al., 2013. They provide a framework for evaluating the supply chain performance.

5.2.3 Wants and needs

After analysing the FSC, the needs and wants based on the FSC analyses have to be made. These needs and wants originated mainly from the level of integration, goal and objectives, the available resources of the FSC and problems in the FSC. These needs and wants can be translated in to features, technology and support & service. These specific features, technology and support & service wanted and needed by the FSC, are then tried to be fulfilled by the vendor or, if possible, by own ICT people in the FSC. Establishing these needs and wants are also part of the performing step of the decision making process (Eckartz et al. 2009 a; Fawcett et al., 2007; Verville and Halingten, 2002). To establish the wants and needs the FSCM can discuss and clarify the general want and needs of the FSC for selecting an IOS.

5.2.4 Type of IOSs available by vendors

The vendor will try to fulfil all the wants and needs of the FSC. But according to the available resources and the amount of features, technology and support & service needed, the vendor tries to find an optimum for the situation. Due to the multiple criteria that are set for selecting an IOS there will never be a perfect IOS. So the best possible offer for an IOS that is created by a vendor need to be selected (Eckartz, 2012, Stewart, 1992 and Wei et al., 2005). The different type of IOSs provided by the vendors can be collected in order to analyze them.

5.2.5 Analyzing IOS

After the vendor provided a proposition of a possible IOS, the IOS need to be analysed. These analyses are described below and are part of the performing step.

Technology and functionality analysis

The technology and functionality analysis need to be performed on the IOS that will be provided. To analyse the technology and functionality of the IOS, the factors described in the theoretical framework need to be taken into account. This can easily be tested by test runs with the IOS as well as previous experience of other customers. These tests need to be verified with the wants and needs of the FSC (Baresi and Pezzè, 2006; Karsak and Özogul, 2009).

Cost & benefit analysis

Cost & benefits analyses need to be performed in order to know what these are and if they can effort the IOS. The kind of costs and benefits that need to take into account are described the theoretical framework. This is an important analysis because it contributes to a large part if to select and implement an IOS (Bernroider et al., 2009; Eckartz, 2012). This

analyses can be carried out in multiple ways, one of these ways is the business case as described by Eckartz et al., 2009 (b). A business case can provide more insights in the potential costs and benefits for the food supply chain.

Risk analysis

A risk analysis need to be performed in order to know the kind and size of the risks involved. The kinds of risk are described in the theoretical framework. Although some of these risks may be not applicable for all FSC. The size of these risks will differ for each FSC (Benaroch, 2002; Matopoulos et al., 2007; Willcocks and Griffiths, 1994). In order to assess these risks the timed Petri nets framework can be used, as described by Tuncel and Alpan (2010). With this computer the supply chain is simulated as well as the effects of the various risks.

Vendor analysis

The vendor will be analysed based on the factors described in of the theoretical framework. This analysis is important for the long-term of the FSC and IOS. The innovation, capabilities and strength of the vendor determines the quality and the development of IOS. If the vendor stops innovating the IOS, the IOS is within a view years out-dated and old (Verville and Halingten, 2002). The vendor can be analysed by a fuzzy programming approach, which a multi criteria decision making method, as described by Kumar et al. (2006). With this method multiple criteria are taken into account for selecting a vendor.

Changes in organizations/FSC analyses

As described in the theoretical framework a gap analysis can be made. In this way the current and desired state are described, and the changes needed to reach the desired state can be identified. The kind of changes that are involved can be found in the theoretical framework. Furthermore the changes that can occur can be analysed by taken into account the IOS and the departments that will be affected by the implementation of the IOS (Fawcett et al., 2007; Hayes, 2010).

Based on this analysis's a risk & reward comparison can be made, the functionality and technology is assessed, changes by implementing an IOS are identified and the vendor of the IOS is assessed.

5.2.6 Decision

Finally all the pros and cons are evaluated in the analyses phase and the best possible IOS can be selected. This final step is the adjourning step; in this step the specific ending point is reached, which is the decision (Fawcett et al., 2007; Karsak and Özogul, 2009; Wei et al., 2005). After the analyses the team will discuss if an IOS will be selected. There are three options. The first option is there will be an IOS selected, the second options is there will be no IOS selected and the last option is that the wants & needs need to be adjusted to continue the selection process of an IOS. After a decision is made the team can be disband and the resources can be used in other projects or work. Although often after selecting an IOS the project is not finished and the team stays together after implementation of an IOS.

5.3 Designed roadmap

The steps described in the chapter 5.2 are summarized below based on these steps a roadmap is developed.

- Select a FSCM team
- Analysing FSC
- Wants and needs
- Type of IOSs available by vendors
- Analysing IOS
- Technology & functionality
- Costs & benefits
- Risk
- Vendor
- Organizational/FSC changes
- Decision

In figure 17 a roadmap is provided, which consists of all the steps mentioned in this chapter. Starting with selecting a FSCM and ending with a final decision.

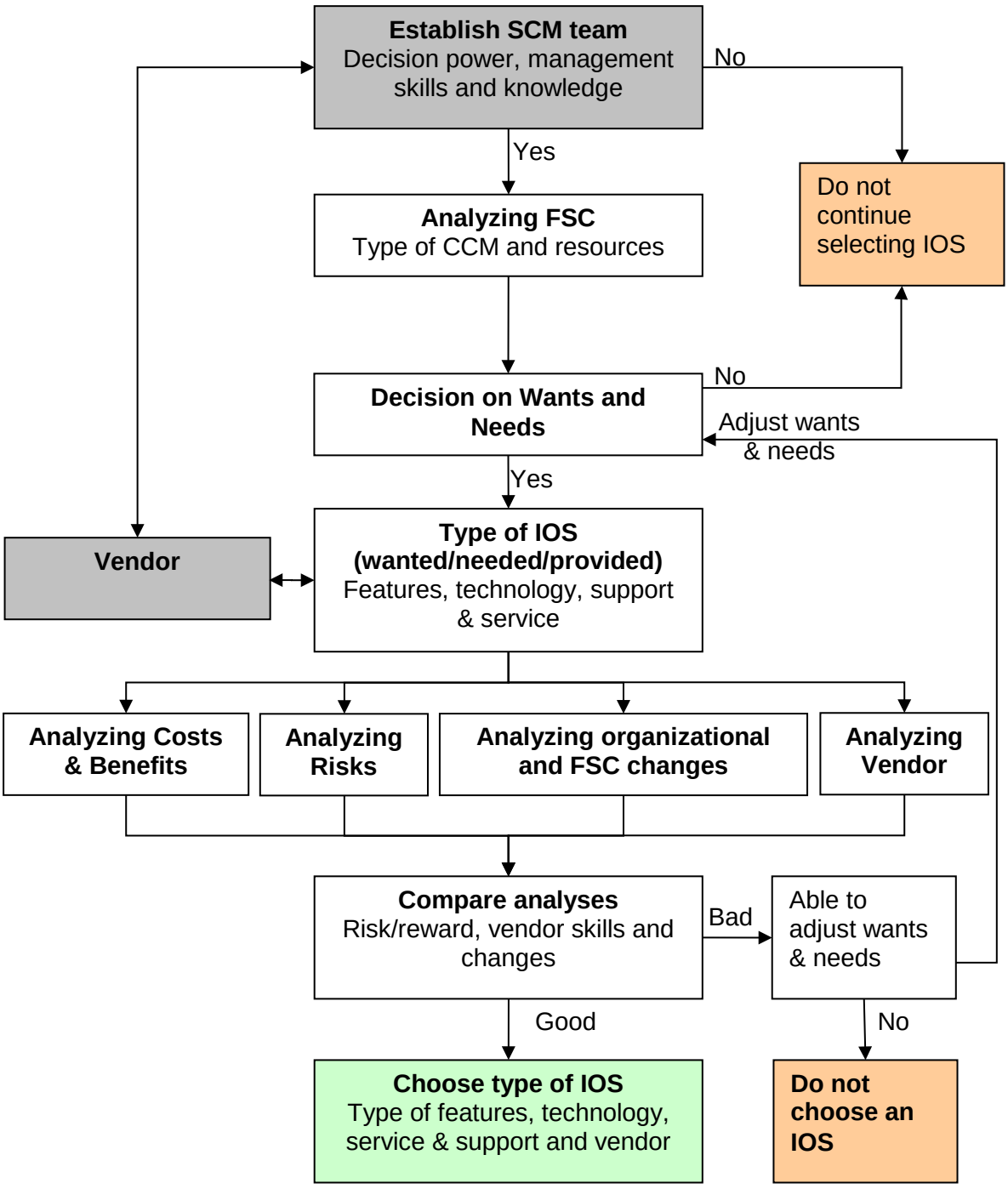

Figure 17: Roadmap designed based on theoretical framework.

The roadmap depicted in figure 19, as described in the previous chapter, contains the steps that need to be taken into account for selecting an IOS for a FSC. The roadmap will be validated in the order to check the practical use of it. The validation of theoretical framework and roadmap are described in the next to two chapters.

6. Results

The roadmap and the factors that play a role in the roadmap are assessed by interviewing several experts, in semi-structured interviews. In appendix 1 the topics discussed in these interviews are described. Based on the interviews a table is created below. Table 2 contains the factors that play a role in the roadmap that have been discussed, the general comment of the experts and if the experts agree with these factors yes or no. Keep in mind that this are interpret opinions of four different experts.

Table 2: Results of assessing the factors by the interviewees.

Issue	Factor	General comment	Interv. 1	Interv. 2	Interv. 3	Interv. 4
General SC issues		Definitely important even without implementing IOS.	Yes	Yes	Yes	Yes
	Contract coordination mechanism	-	Yes	Yes	No	Yes
	Environment	Plays a role as it determines the boundaries for the FSC.	Yes	Yes	Yes	Yes
	Governance Structure/ Decision power	Important as it divides the power between the actors.	Yes	Yes	Yes	Yes
	Governance Mutuality/ Interdependency	Less important although mutuality improves collaboration.	Yes	Yes	Yes	Yes
	Governance Competition/ Information accessibility	Without information sharing no IOS.	Yes	Yes	Yes	Yes
	Strategy Goal/Objective	Needs to be clear from the start.	Yes	Yes	Yes	Yes
	Strategy Commitment/ Long term orientation	Without commitment of top management, many problems can occur during selecting process	Yes	Yes	Yes	Yes
	Culture Trust	Trust is most important between actors otherwise they won't start with an IOS. Although to control this audits are often performed.	Yes	Yes	Yes	Yes
	Culture Semantics	For everybody it should be clear what the agreements and rules are.	Yes	Yes	Yes	Yes
	Finance	Determines the financial	Yes	Yes	Yes	Yes

		capabilities of the FSC.				
	Resources	Important as it determines to a large extend the size of the project and the capabilities.	Yes	Yes	Yes	Yes
	People	Determines quality and capabilities in terms of usage and project management.	Yes	Yes	Yes	Yes
	Money	Based on the willingness and amount of benefits.	Yes	Yes	Yes	Yes
	Materials	-	Yes	Yes	Yes	Yes
	Technology	Changes continuously.	Yes	Yes	Yes	Yes
	Time	Very important as it plays a big role in controlling costs.	Yes	Yes	Yes	Yes
Selecting issues			Yes	Yes	Yes	Yes
	FSCM team	Important as it determines for a large part the success of the project.	No	Yes	Yes	Yes
	Type of IOS		Yes	Yes	Yes	Yes
	Technology Reliability	If IOS is not reliable, large costs can be involved.	Yes	Yes	Yes	Yes
	Technology Flexibility	Important if new applications are added.	Yes	Yes	Yes	Yes
	Features Security	Is key for the SC and therefor for the vendor.	Yes	Yes	Yes	Yes
	Features User factors	Everybody should be able to use it.	Yes	Yes	Yes	Yes
	Service & Support Implementation time	The faster an IOS can be implemented, fewer costs are involved.	Yes	Yes	Yes	Yes
	Service & Support Pre-sales support	Important for the FSC, because it can help the FSC. Beside that it can help in determining readiness of the FSC.	Yes	Yes	Yes	Yes
	Service & Support Maintenance support	Keeping IOS up-to-date is important to keep it running and improving.	No	Yes	Yes	Yes
	Service & Support Documentation & training	Training can help to increase the efficiency of the IOS.	Yes	Yes	Yes	Yes
	Benefits & Costs	Main factor for FSC to select an IOS.	Yes	Yes	Yes	Yes

	Benefit Increased efficiency	Especially due to increased information sharing, monitoring and dividing resources.	Yes	Yes	Yes	Yes
	Benefit Increased product quality and safety	Mainly due to traceability and monitoring.	Yes	Yes	Yes	Yes
	Benefit Enhanced decision making	More and accurate information will be available to base decisions on.	Yes	Yes	Yes	Yes
	Benefit Enhanced customer service	More information can be provided as well as keeping track of stock and automatic ordering.	Yes	Yes	Yes	Yes
	Benefit Reducing risks **(added by interviewee 1)**	Increased controlling and audits throughout the chain furthermore better control of purchasing.	Yes	Yes	Yes	Yes
	Benefit Long term relationship between actors	An IOS can help to increase relationship between actors in the FSC.	Yes	Yes	Yes	Yes
	Costs Development costs	Depends mainly on customization of the IOS.	Yes	Yes	Yes	Yes
	Costs Software costs	-	Yes	Yes	Yes	Yes
	Costs Hardware costs	-	Yes	Yes	Yes	Yes
	Costs Implementation costs	Depends mainly on the size of the IOS.	Yes	Yes	Yes	Yes
	Costs Annual costs	Depending on the amount of maintenance and the amount of service hours.	Yes	Yes	Yes	Yes
	Costs Upgrade costs	Depends mainly on the developments of the vendor and new technologies.	Yes	Yes	Yes	Yes
	Risks	Often not well analysed by FSCs.	Yes	Yes	Yes	Yes
	Risk of failure	Is always possible for all kind of reasons.	Yes	Yes	Yes	Yes
	Risk of uncertainty	Difficult to calculate due to intangible benefits.	Yes	Yes	Yes	Yes

	about financial benefits					
	Risk of dependence	Risk of dependence is there, but not biggest risk.	Yes	Yes	Yes	Yes
	Risk of conflicts	Can always occur.	Yes	Yes	Yes	Yes
	Risk of increased operational complexity	Is possible, although there are already new possibilities to reduce this.	Yes	Yes	Yes	Yes
	Risk of resisting force	Is connected to the commitment of the management and employees.	Yes	Yes	Yes	Yes
	Risk of errors during implementation	Can be caused mainly due to bad management.	Yes	Yes	Yes	Yes
	Risk of rapid technology change	Technology will change rapidly, the vendor need to be quickly adapt to keep up-to-date.	Yes	Yes	Yes	Yes
	Risk of vendor	If vendor goes bankrupt during the implementation, big costs can be involved.	Yes	No	Yes	Yes
	Organizational/ FSC changes	An IOS will have an effect on the FSC and thereby changing it.	Yes	Yes	Yes	Yes
	People	The tasks of some people can and most likely will disappear.	Yes	Yes	Yes	Yes
	Business processes	Business process can change depending on the kind of IOS.	Yes	Yes	Yes	Yes
	Relation Trust	Trust between the actors is most likely to increase.	Yes	Yes	Yes	Yes
	Relation Coordination	Will go to more vertical integration	Yes	Yes	Yes	Yes
	Relation Decision power	Decision power will be more mutual divided.	Yes	Yes	Yes	Yes
	Relation Interdependency	Mutuality between actors will probably increase.	Yes	No	Yes	Yes
	Vendor		Yes	Yes	Yes	Yes
	Vendor vision Policy	-	Yes	Yes	Yes	Yes
	Vendor vision Strategy	Strategy of vendor is of importance for the FSC as it determines the future of the vendor and thereby partly the	Yes	Yes	Yes	Yes

		direction of the updates on IOSs.				
	Vendor vision Innovation	Important for FSC as it determines continuous improvement of the IOS.	Yes	Yes	Yes	Yes
	Vendor strength Financial strength	Important because of the continuity of the IOS updates as well as securing the investment in a healthy vendor.	Yes	Yes	Yes	Yes
	Vendor strength Personnel strength	Strength of the vendor mainly depending on the strength of the staff working there, as it sets the policy, innovation, strategy as well as the technical capabilities.	Yes	Yes	Yes	Yes
	Vendor strength Experience	Experience of the vendor can help the FSC as the vendor knows what important is.	Yes	Yes	Yes	Yes

So in general almost all factors play a role in the roadmap during the selecting of an IOS as identified by the interviewees. Some didn't agree on a view points, although there is not one factor were less than three interviewees did not agree on. Furthermore the first interviewee added a benefit, risk reduction, which was recognized by the other 3 interviewees as important benefit.
Some general comments were made which can add some additional information to these factors, such as:

- One interviewee mentioned that user friendly plays an important role in selecting a system as *'everybody should be able to use it without doing multiple trainings. The system should be comparable with outlook, easy and simple to use.'*
- Two interviewees mentioned that if new information systems are implemented. A second server is used to run the new information system in order to minimize errors and problems. If this new system passes the trials it will be implemented.
- One interviewee mentioned that the factor of increased operational complexity can be reduced due to the new developments of a new system that is able to combine the different IOSs.
- Trust is of great importance according to one interviewee. The interviewee even stated that *'being condemned to your actors in order to survive can increase trust as well as commitment.'*
- Two interviewees stated that the experience of the vendor is of great importance for the FSC. Especially, the vendor needs to have a critic view towards readiness of the FSC. With readiness is meant: trust, commitment and mutuality between the actors.
- All interviewees said that '*trust, mutuality and commitment is key'* and is one of the most important factors in succeeding in selecting/implementing an IOS.
- According to 2 interviewees the FSC is often analysed together with the vendor if this is wanted by the FSCM team. Due to the experience of a vendor, they can increase the speed and solve struggles faster, as well as establishing the needs and wants

> can be performed together with the vendor. In this way the vendor also can immediately say what they can and cannot make and think about the best possible solution that fits in the future needs.

These lose sentences are described here as it can add value to redesign of the roadmap for selecting an IOS for a FSC.

The relations between the factors and the role in the roadmap is explained and discussed with all the interviewees. Two of the four interviewees found it difficult to say anything about it; the other two provided comments and agreed on the provided explanatio. These two interviewees stated that it is most likely that an IOS will result in a more vertical integration of the SC, as it intensifies the relation between the actors in the SC. Although one interviewee mentioned that changes in the FSC relation are not caused by the IOS but mainly by changes in the strategies of the actors in the FSC, in the core business for example.

All four interviewees said it is very difficult to rank the factors on importance as it depends on the type of FSC, as well as on intangible benefits and risks. Although three of the four interviewees stated that trust, commitment, mutuality and information sharing are the most important before starting selecting an IOS

All the interviewees found the roadmap a useful tool for selecting an IOS for a FSC. Although two interviewees stated that a thorough analysis of the organizational/FSC changes is lacking sometimes. This is often caused by the necessity of an IOS and/or performed after selecting an IOS. Two of the four interviewees stated that a decision step after each action should be stated as it provides an action to do.

7. Analyses

In this chapter the roadmap and the factors that play a role in the roadmap are analysed. This is done by validating the prototype roadmap with the results of the interviews. Based on the assessment of the prototype roadmap adjustments are made. These are described in the redesign of the roadmap.

7.1 Redesign roadmap

After the comments of the interviewees, the roadmap is redesigned. The changes that have affected the redesign of the roadmap are: adding decision steps. Secondly SCM issues before establishing the FSCM team is added as the SCM issues need first be clear before a FSCM team will be established. Last the functional and technical analyses is added as it is an important part of the IOS. Figure 19 provides the redesigned of the roadmap.

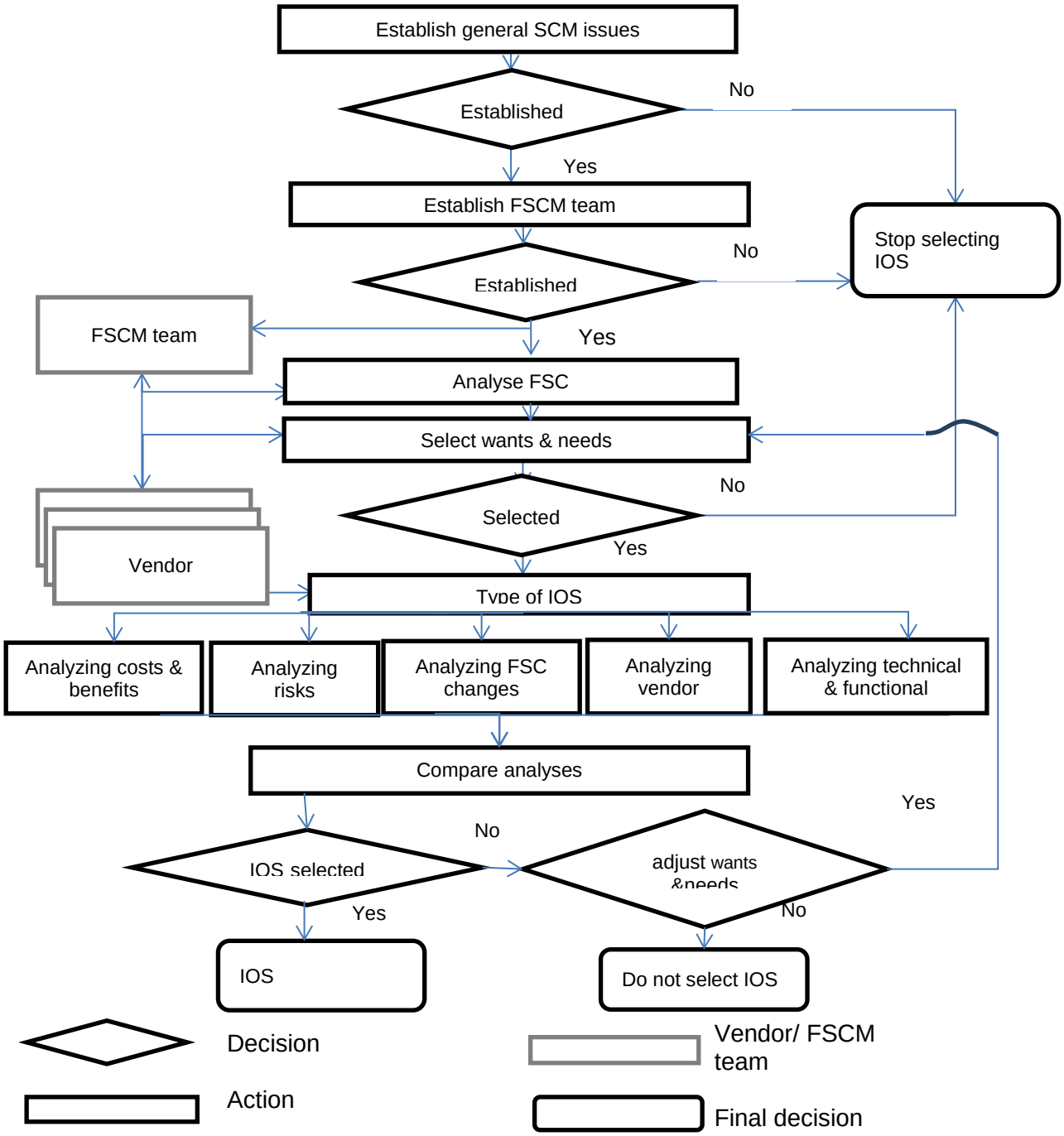

Figure 188: Roadmap for selecting an IOS for a FSC.

The roadmap consists of multiple boxes and arrows. The boxes have different colours, the grey colour means a team or vendor, the black colour means actions that need to be taken and the black diamonds are decisions.

The starting point of the roadmap is to establish the general SCM issues. The FSC need to establish these before a FSCM team can be selected. If already problems are occurring in the establishing these, which cannot be solved an IOS will not be selected. The FSCM team need to be selected by the actors that are involved in the process of selecting an IOS for the FSC. These actors need to trust each other, be committed to the project and have to share information together. Beside that the CCM/level of integration between the actors and the available resources are important. These issues are very important in order to establish a team that has the knowledge, decision power, management skills and the resources to make a project plan for selecting an IOS. If actors in the FSC fail to establish this team, an IOS cannot be selected. The FSCM team will contact possible vendors that can provide IOSs.
After the FSCM team is established they should analyse the current situation of the FSC. This involves goal/objective, mutuality in risk & reward, environment issues (laws & regulations for example), decision power, degree of information sharing, semantics, long-term orientation and finance. The analyses of the FSC can be done together with the vendor, who has most likely more experience with the necessary issues that are involved selecting an IOS.
After analysing the FSC the needs and wants of the FSC must be clear. The needs and wants can be established together with the vendor, although if the FSCM team do not agree on the needs and wants, the selection procedure will stop. If they do agree on the need and wants; the technology, features, support and service of the IOS that are involved need to be discussed with the vendor.
The technology, features, support and service needed to fulfil the wants and needs of the FSCM team, have to be made by the vendor. Beside that the vendor has to say if it is possible to make the IOS, the FSCM team wants. Finally the vendor comes with a proposition of a potential IOS that meet these wants and needs as much as possible.
This potential IOS need to be analysed. Analysing an IOS is important, because it determines if the FSCM team will buy the IOS. The analysis's that are involved are a technology & functionality analysis, costs and benefit analysis, risk analysis, organizational/FSC change analysis and vendor analysis. The kind and size of benefits, costs, risks, changes and vendor will differ for all FSCs.
If the analyses are performed, they need to be compared. This involves risk and reward, organizational/FSC changes, technology and functionality of the IOS and the strength of the vendor. Beside that the profitability and sustainability of the FSC is of importance.
If these analyses together are positive, the decision will be made to choose the analysed IOS and thereby the implementation of the IOS can be started.
If the analyses together are negative, the decision will be made to reject the analysed IOS or to change the wants and needs of the FSC. If these wants and needs can be changed the process will start again from the wants and needs. However if these needs and wants cannot be changed the selection process of an IOS will stop.

7.2 Factors, relations and importance of the factors that play a role in the roadmap.

An overview of the factors, relations and the importance of the factors that play a role in the roadmap are provided below.

General SC issues

- Contract coordination mechanism
  - *Environment*
  - *Governance*
    - Structure/Decision power
    - Mutuality/Interdependency
    - Competition/Information accessibility
  - *Strategy*
    - Goal/Objective
    - Commitment/Long term orientation
  - *Culture*
    - Trust
    - Semantics
  - *Finance*

- Resources
  - *People*
  - *Money*
  - *Materials*
  - *Technology*
  - *Time*

Selecting issues

- FSCM team

- Type of IOS
  - *Technology*
    - Reliability
    - Flexibility
  - *Features*
    - Security
    - User factors
  - *Service & Support*
    - Implementation time
    - Pre-sales support
    - Maintenance support
    - Documentation & training

- Benefits & Costs
  - *Benefits*
    - Increased efficiency
    - Increased product quality and safety
    - Enhanced decision making

- Enhanced customer service
- Reducing risks
- Long term relationship between actors

Costs

- Development costs
- Software costs
- Hardware costs
- Implementation costs
- Annual costs
- Upgrade costs

Risks

- Risk of failure
- Risk of uncertainty about financial benefits
- Risk of dependence
- Risk of conflicts
- Risk of increased operational complexity
- Risk of resisting force
- Risk of errors during implementation
- Risk of rapid technology change
- Risk of vendor

Organizational/FSC changes

People

Business processes

Relation

- Trust
- Coordination
- Decision power
- Interdependency

Vendor

Vendor vision

- Policy
- Strategy
- Innovation

Vendor strength

- Financial strength
- Personnel strength
- Experience

By combining the SC issues and selecting factors an overview of all the relations between factors that are important for selecting an IOS for a FSC is created. The figure below shows the relations between the factors that play a role in the roadmap. This can help the FSC by the understanding the factors and the impact of these factors during the use of the roadmap for selecting an IOS.

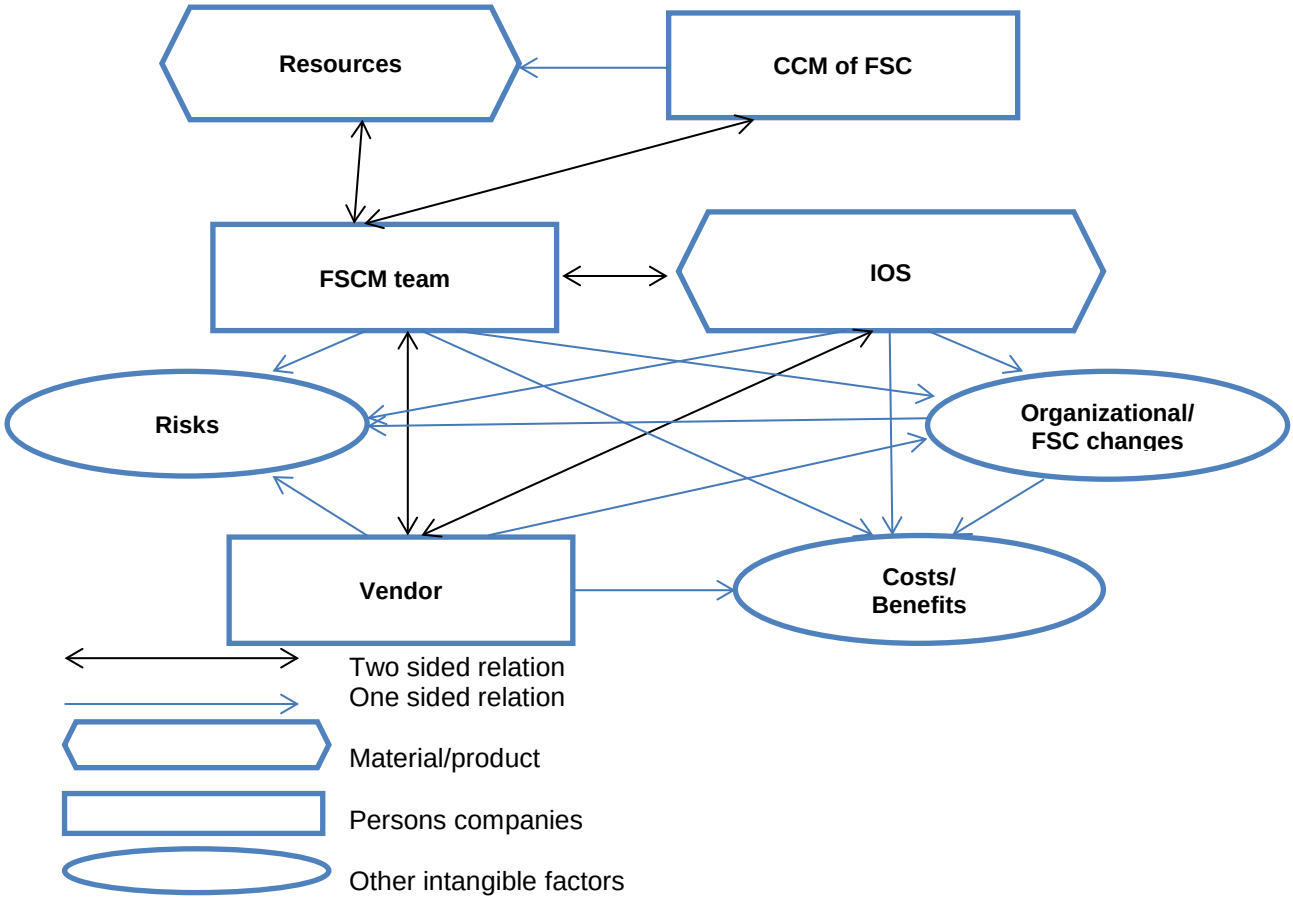

Figure 199: Factors and the relation between factors important for selecting an IOS for a FSC. (Barrat, 2004; Baki and Çakar, 2005; Bernroider et al., 2009; Beulens et al., 2005; Chae et al., 2005; Cheng et al., 2001; Davenport, 2000; Eckartz et al. 2009 a; Eckartz et al., 2009 (b); Eckartz et al., 2012; Fawcett et al., 2006; Gunasekaran et al., 2001; Handfield et al., 2003; Holweg et al., 2005; Huang et al., 2003; Matopoulos et al., 2007; Olson et al., 2011; Opera, 2003; Peterson et al., 2001; Raynaud et al., 2005; Sahay and Gupta, 2003; Sahin and Robinson, 2002; Sarkis and Talluri, 2004; Soliman et al., 2004; Vickery et al., 2003; Verville and Halingten, 2002; Wei et al., 2005; Wever, 2012; Wever et al., 2010; Williamson et al., 2004; Whittaker 1999; Ziggers and Trienekens, 1999).

Figure 18 starts with the CCM, which is based on the environment, governance, culture, strategy and finance of the FSC. The type of CCM influences the amount and type of resources available for the FSCM team. The management team will divide the resources necessary to select the IOS. The tasks that are involved for selecting an IOS are: analysing the costs& benefits, risks, the technical aspects of the IOS, organisational changes and vendor; as well as managing these factors. The type of vendor will have an effect on the final IOS as it depends on the quality and capabilities of the vendor. Furthermore the vendor will communicate with the FSCM team to agree on the potential IOS. Next to the companies/persons that are involved, the product, IOS, will have an effect on the organizational changes, costs& benefits and risks as it would be implemented. Furthermore the risks and organizational changes also affects other factors as they bring costs for example. All the factors mentioned contribute to in the selecting process of an IOS. Although it is difficult to rank specific factors quantitative on importance, but a qualitative rank on importance is provided. First general SCM issues are important, such as trust, mutuality, commitment and information sharing; secondly the selecting issues are important.

The role of these factors in the roadmap is explained in the next chapter.

7.3 The role of the factors in the roadmap

The factors, relation of these factors and the importance of these factors can support the FSC in each step of the roadmap. This can simplify and provide the factors and relations that need to be taken into account at each step of the decision making process. Furthermore it can reduce the potential time for selecting an IOS as it already provides the factors and relations that need to be taken into account.

Based on the importance of the factors first the SCM issues are of importance after that the selecting issues start playing a role in the roadmap as depicted in figure 19. At the first step the SCM issues need to be established factors that play a role in during this step are the CCM and resources of the FSC. In the CCM the environment, governance, strategy, culture and finance need to be taken into account. The FSC need to agree on the goal and objective and decision power for example. But also the factors like trust, commitment, information sharing and mutuality need to be taken into account, as described in the list above, in establishing and agreeing on these factors.
In the next step a FSCM team need to be selected based on the available resources and SCM issues this team will be created, as this relation is showed in figure 18. The FSCM team should be
In the step of analysing the FSC the performance of the FSC is determined, based on this analysis, available resources and CCM the needs and wants for the IOS are selected. These needs and wants need to be translated by the vendor to create a possible IOS. The factors that play a role and need to be analysed by the FSC are costs & benefits, risks, FSC changes, technology & functionality and vendor, this is also described in figure 18. These factors are also mentioned in the overview of the factors that play a role in the roadmap for selecting an IOS for a FSC and have to be taken into account during the analysis of the IOS. What the influence is of these factors on the selecting process will be different for each FSC.
In the last step before the decision is made the type of IOS are compared based on the results of the analysis and if it meets the need and wants of the FSC.

The roadmap that is provided in figure 19 meets the requirements as described in the research design. Because it is an roadmap for selecting an IOS for a FSC, it contains the steps to make a well-considered decision and the factors that play a role in this roadmap are described and provided.

8. Discussion

An analysis of the results is important to provide an unbiased view.
In the first part of the theoretical framework the factors important for selecting an IOS for a FSC have been identified. Although multiple sources of literature were used, it does not mean that all factors and relations have been identified. For example in the interviews with the vendor and actors, other factors have been identified.
Furthermore the factors have been ranked on importance. This ranking was done qualitative due to situational differences, but in this way the weight of the factors has not been identified.
In the last part of the theoretical framework the steps that need to be made for selecting an IOS have been identified. Although another approach for selecting an IOS can also be used, it does not mean that the way of making a decision in this report is the best way or the only way to select an IOS.
A general remark on the theoretical framework is that every FSC is different. This could mean that the factors, the relation between the factors and the importance of the factors can differ as well.

The interviews with a vendor, researcher, project leader and an actor, involve only four people. This can result in a limitation concerning variety and thereby missing certain factors, relations and importance of factors. Besides that, the sample size of the interviews is small, this could give a lack in the representation of the actual factors, relations and importance of these factors, although four different angles of selecting an IOS are provided. Another point of discussion which continues the previous point is that, due to the small sample size, no statistical analyses can be performed. The small sample size is caused by the lack of a database with FSCs who have implemented an IOS; another cause is the lack of time.
Due to the design of the interviews the roadmap based on the factors that are found in the literature was discussed, this can result on focussing on only on the steps and factors that play a role as described in the roadmap, instead of finding new steps and/or factors. Although a basis for an interview must be created and the interviewee was asked to add missing factors, relations and steps in the decision making process. Beside that the general interview approach is used to provide a degree of freedom to extract information from the interviewee.

This qualitative report provides factors, the relation between these factors, the importance of the grouped factors and the steps for selecting an IOS for FSC. An extensive literature research is done to make this report as complete as possible, given the time limits and other limitations of the research.

9. Further research

After this research there are enough research area's that can be worked on to increase the knowledge on selecting an IOS for FSC. The following topics are recommendations for further research:

- Investigate the importance of the factors quantitative, for example by a quantitative regression analysis, in this way the weight of the importance can be measured. To do this more FSCs and people needs to be interviewed and with a different kind of interview method and questionnaire.
- Probably this research and roadmap is not only for FSC but SC in general. To validate this further, research can be done in other SCs.
- Check the provided roadmap with multiple case studies, in this way the roadmap can be checked and finally be used in real cases.
- Further investigate the kind of analyses that can be used for the analyses of the FSC, risks, costs & benefits, organizational changes, functional & technical of the IOS and vendor.
- After selecting an IOS, the IOS need to be implemented. In this report some of the factors of implementation are mentioned, because these factors play an important role in the selection process of an IOS. Although these factors can be more elaborated and there can be other factors added. So what are the important issues/factors during the implementation of an IOS?
- Due to difficulties in measuring increased performance after implementation of an IOS. Research can be done on the performance before implementing an IOS and after implementing an IOS. In this way a better understanding of the performance of a FSC and an IOS can be found.
- Investigate the direct and indirect effects of cost & benefits and risks of an IOS. In this way an increased understanding of the costs & benefits and risks is made. This can result in a better decision on if and/or what kind of IOS to select.
- Investigate the degree of integration between actors in the FSC, the amount of actors that should participate in an IOS and the type of actors that should participate (vertical and horizontal actors); without exploding into a very complex network/chain of all kind of actors and relations between actors.
- Investigate companies/FSCs that did not implement a system yet, but want to. What kind of problems/struggles do they deal with and how to solve these. What is their view on IOS and what has formed this view to IOS? Is this view negative or positive? How should they manage these different views and problems? And why didn't they implement an IOS yet?

10. Conclusion

The general research objective of this research is to provide a roadmap for selecting an IOS for a FSC. To accomplish this objective research questions are answered in the theoretical framework and interviews.

Main question:
What factors, relation between these factors, importance of these factors, and steps need to be taken into account to provide a roadmap for selecting an IOS for a FSC?
The main question is answered by answering the sub-questions of this research.

Sub questions:

1. *What are the factors, and the properties of these factors, that are important for selecting an IOS for a FSC?*

The factors for selecting an IOS can be divided by the SCM issues, consisting of the environment, governance, culture, strategy, finance and resources of the FSC, and selecting issues. The selecting issues are divided in the FSCM team, type of IOS, vendor, risks, costs & benefits and organizational changes.

2. *What is the relation between the factors important for selecting an IOS?*

The SCM issues affect the final IOS that will be selected as the FSC has to deal with the level of integration and resources of the actors in the FSC. The FSCM team has to deal with these factors as it had to divide the available resources over the project. During this project the relation of the selecting issues affect each other as it depends on the wants and needs of the FSC, capabilities of the vendor and the involved risks, costs & benefits and organisational changes. All these relations and resources need to be management by the FSCM team. A more detailed description is described in chapter 4.

3. What is the difference in importance between the factors that are important for selecting an IOS?

As the SCM issues determine to a large degree the level of integration between the actors and the available resources for the IOS, it is more important than the selecting issues. Furthermore if there is no mutuality, trust, information sharing in the FSC there will be no IOS at all. This supports furthermore that SCM issues are more important as the selecting issues. Although distinguishing the factors further on importance is extremely difficult due to differences between SCs, actors, direct effects, indirect effects and intangible factors.

4. What are the necessary steps, and in which order, to be able to provide a roadmap for selecting an IOS for a FSC?
    a. Establish general SCM issues
    b. Establish FSCM team
    c. Analyse FSC
    d. Select want & needs
    e. Type of IOS
    f. Analyse risks, costs & benefits, organizational changes, technical and functional, and vendor simultaneously
    g. Compare analyses

h. Decision on IOS

By combining the answers to these sub-questions the main question is answered. Furthermore the answer to these questions are used for accomplishing the goal of this research. The goal of this research is to: provide a roadmap for selecting an IOS for a FSC.
In figure 20 the roadmap for selecting an IOS for a FSC is depicted. This roadmap can support FSCs with selecting an IOS. Furthermore, in combination with the theoretical framework, it can provided the FSC the factors and the relation between these factors that need to be taken into account at each steps of the decision making process.

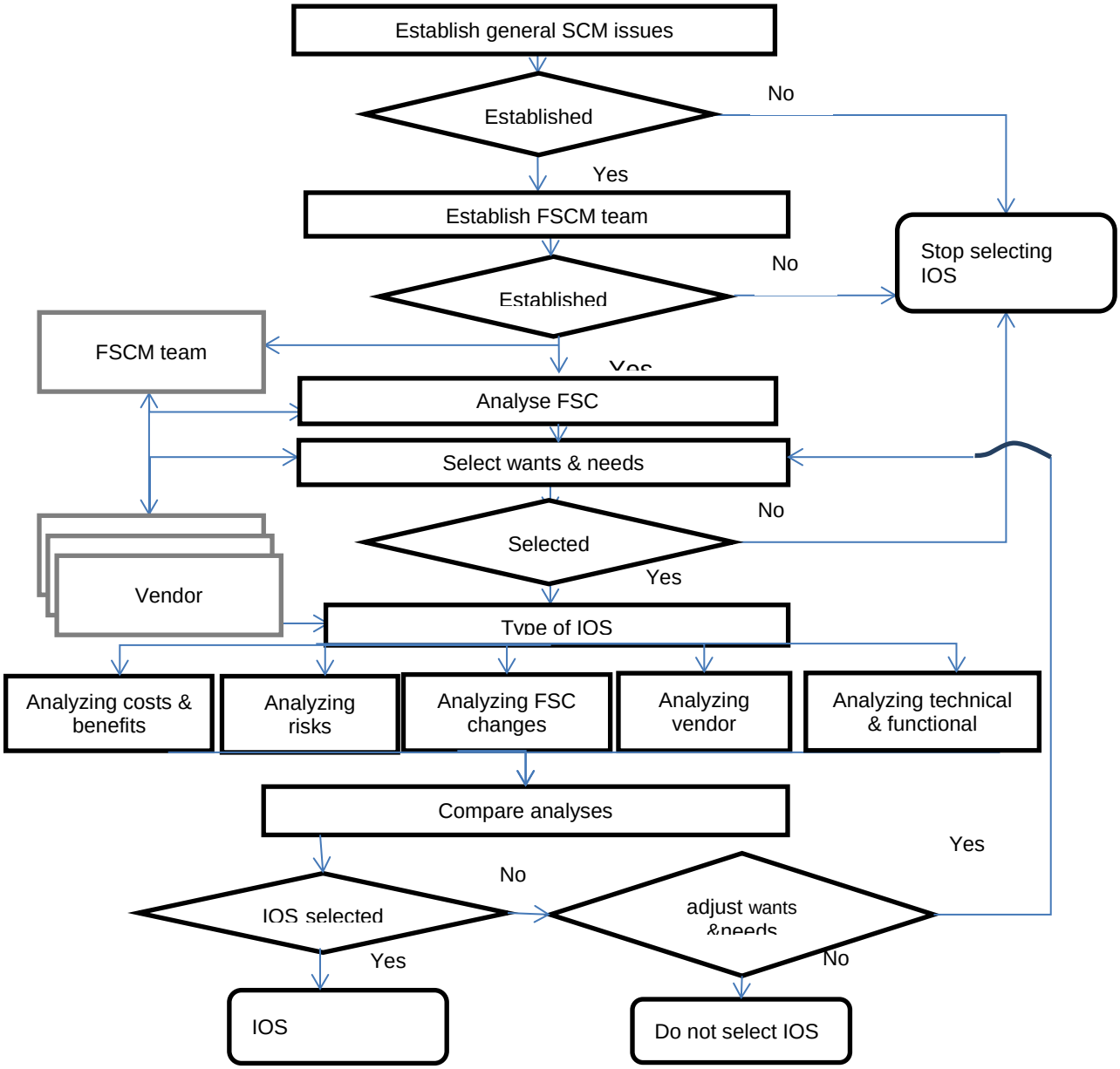

Figure 20: A roadmap for selecting an IOS for a FSC.

This roadmap provides the steps recommended to take into account for selecting an IOS for a FSC. Furthermore this roadmap meets the requirements set in the research design. By taking into account these steps the FSC should be able to make a thorough analyses and thereby select the best possible IOS for that specific FSC.

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12. Appendix

12.1 Appendix 1: Topics questionnaires

Introduce myself and what I do

General

Name of interviewee
Company interviewee is working for
Function interviewee
Function interviewee during selecting and implementation of IOS
Years of experience in SCM

Specifics supply chain. (this part not for the vendor)

Describe the FSC

- Environment
  - Competitors
  - Consumers
  - Product
  - Economics
- Governance
  - Structure/decision power
  - Mutuality/interdependency
  - Competition/information accessibility
- Strategy
  - Goal/objective
  - Commitment/Long term orientation
- Culture
  - Trust
  - Semantics (communication language & rules)
- Finance

- The relation between SC actors
- CCM (level of integration)
- Resources of the FSC (people, money, time, technology, materials)

- Interviewee something to add

Selection/Implementation of IOS for the FSC

- Start-up of selecting an IOS (making team or already SCM team)
  - Goal and objective of IOS
  - Needs & wants
- Function IOS (technology, features, service & support)
- Costs & Benefits (kind of benefits and costs and analysed/calculated)
  - Correct calculation costs & benefits (profitable)
  - Division of costs and benefits

- Risks (kind of risks and analysed/calculated)
    - Risk/reward analyses
- Vendor selection (kind of vendor analysed)
- Expected changes occur in organization and FSC (kind of changes; tasks, trust relation between actors, level of integration, decision power and commitment)
- struggles selecting/implementing IOS (factors that almost stopped selecting an IOS)
- three most important factors for selecting an IOS

- Interviewee something to add

Factors from literature

- Show list with my factors for selecting IOS (at bottom of questionnaire)
- Response of interviewee on list (add/change factors)

Relation between factors

- Show the figure of the relation between the factors that are important for selecting an IOS.
    - describe the relations
    - ask if the interviewee did find these relations in the implementation of an IOS
    - are there relations not described that the interviewee did noticed during the implementation of the IOS.
    - Interviewee something to add on this topic

Selecting method IOS (already a part)

- How? (roadmap/ step decision plan or other)
- selecting procedure
    - team/board?
    - Kind of members in team
    - Specialties in the team (ICT, management, decision power, trust, etc.)
    - factors taken into account
    - analyses of (benefits, risk, costs and changes in FSC and organizational)
    - steps (for selecting an IOS)
    - order
    - if you have to do it again (Same/Different)
- Show roadmap I produced, explain and interviewee provides comments (adding, changing etc.)
- thoughts on: providing roadmap in general for selecting an IOS for FSCs

- Interviewee something to add on this topic
- something in general to add

- questions for me

thank you for participating in this interview and my research!

list of factors for selecting IOS

Contract coordination mechanism

- *Environment*
  - PESTEL
  - Porter's five forces
- *Governance*
  - Structure/Decision power
  - Mutuality/Interdependency
  - Competition/Information accessibility
- *Strategy*
  - Goal/Objective
  - Commitment/Long term orientation
- *Culture*
  - Trust
  - Semantics
- *Finance*

Resources

- *People*
- *Money*
- *Materials*
- *Technology*
- *Time*

FSCM team

Type of IOS

- *Technology*
  - Reliability
  - Flexibility
- *Features*
  - Security
  - User factors
- *Service & Support*
  - Implementation time
  - Pre-sales support
  - Maintenance support
  - Documentation & training

Organizational/FSC changes

- *People*

- *Relation*
  - Trust
  - Coordination
  - Decision power
  - Commitment
  - Interdependency

Business processes

Benefits & Costs

Benefits

- Increased efficiency
- Increased product quality and safety
- Enhanced decision making
- Enhanced customer service
- Long term relationship between actors

Costs

- Development costs
- Software costs
- Hardware costs
- Implementation costs
- Annual costs
- Upgrade costs

Risks

- Risk of failure
- Risk of uncertainty about financial benefits
- Risk of dependence
- Risk of conflicts
- Risk of increased operational complexity
- Risk of resisting force
- Risk of errors during implementation
- Risk of rapid technology change
- Risk of vendor

Vendor

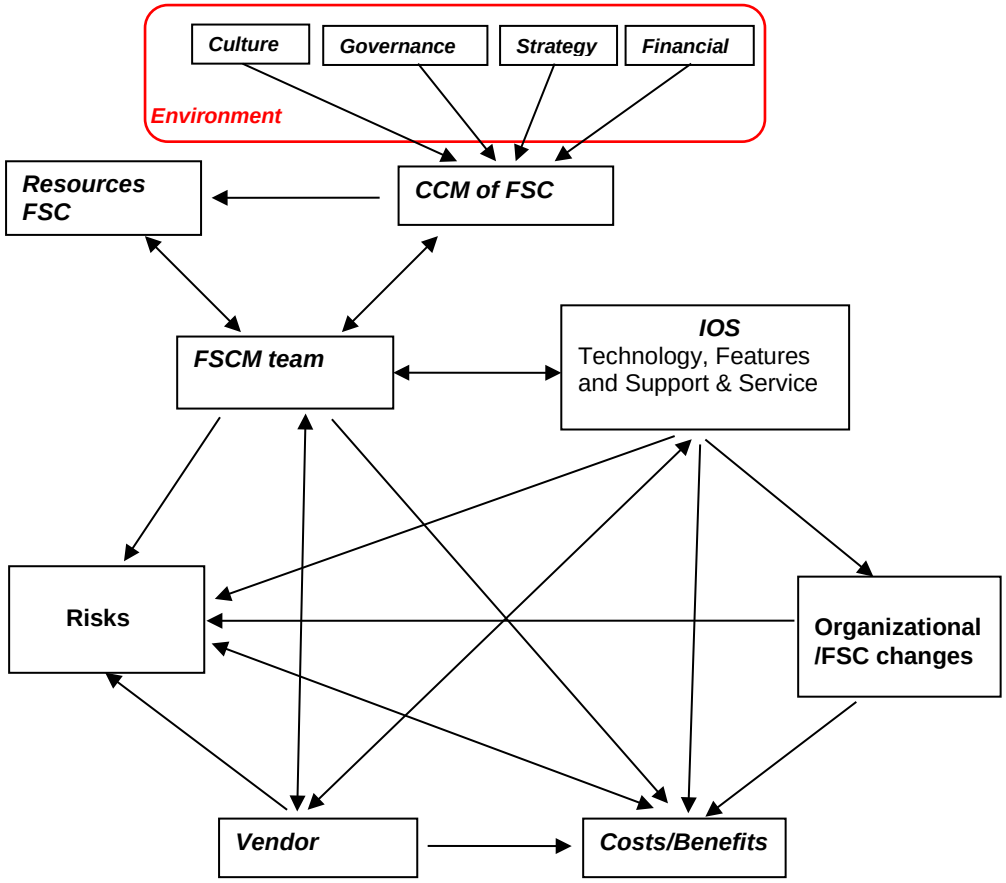
Vendor vision

- Policy
- Strategy
- Innovation

Vendor strength

- Financial strength
- Personnel strength
- Experience

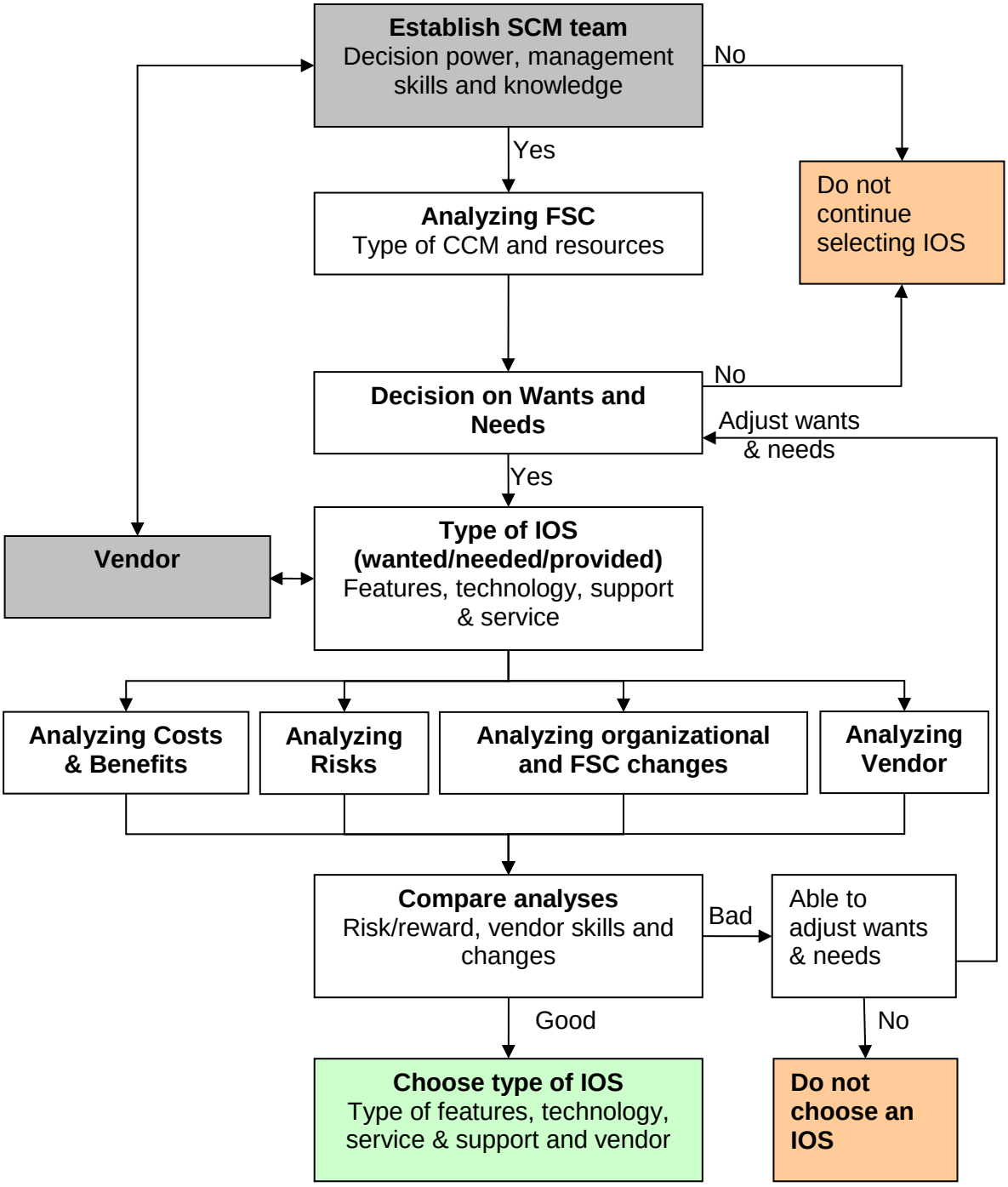
Relation between factors important for selecting an IOS



One sided relation between the factors

Two sided relation between the factors

Roadmap


Establish SCM team
Decision power, management skills and knowledge
No
Yes
Do not continue selecting IOS
Analyzing FSC
Type of CCM and resources
Decision on Wants and Needs
No
Adjust wants & needs
Yes
Vendor
Type of IOS (wanted/needed/provided)
Features, technology, support & service
Analyzing Costs & Benefits
Analyzing Risks
Analyzing organizational and FSC changes
Analyzing Vendor
Compare analyses
Risk/reward, vendor skills and changes
Bad
Able to adjust wants & needs
Good
No
Choose type of IOS
Type of features, technology, service & support and vendor
Do not choose an IOS