Interaction between Manufacturing Operations Strategy and Supply Chain Strategy

A conceptual framework and interaction models building

Author

Tingting Wang

Dec 2017

Supervisor LTH

Jan Olhager

LUNDS UNIVERSITET

Department of Industrial Management and Logistics - Engineering Logistics

Faculty of Engineering

Lund University

Abstract

Problem – Research in Operations strategies (OSs) has achieved a fundamental consensus on what constitutes it concerning process and content. However, it is still underdeveloped and without a consensus on what a Supply chain strategy (SCS) is and what constitute it; it is also unclear regarding how the OSs and SCSs can be tailored and how are they related to each other in an organization. Therefore, both the theory and the industry call for a relevant research in filling this gap.

Purpose – The purpose is to review the literature on manufacturing OSs as well as on SCSs, with a strong focus on conceptualizing SCSs mainly in aspects of its decision framework; also the thesis work includes developing models that can describe how these two types of strategies are related in the strategic fit process.

Accordingly, two research questions are formulated to achieve this research purpose:

Research question 1: What is a supply chain strategy and what detailed strategic decisions and elements constitute it?

Research question 2: How can supply chain strategy and manufacturing operations strategy interact and be related to each other to realize the company's strategic objectives?

Method – The work is mostly theoretical, it conducts literature studies and upon which builds a conceptual framework and interaction models, but a case study is conducted to compare and verify the built conceptual framework and interaction models.

Results – The definition of SCSs is extended and a detailed decision framework for SCSs is constructed and tested at the case company Alfa Laval, which gives empirical support for the reliability and validity of its contents. 'Inside-out' and 'Outside-in' models are built to describe the interactions between OSs and SCSs, the 'Inside-out' model is verified according to the Case study while the 'Outside-in' model hasn't received empirical evidence and calls for further research on it. The paper also figures out two contingency factors that influence the adaptation and choices of the conceptual framework and models: The degree and complexity of operations; and the organizational structure.

Keywords – Operations strategies (OSs), Supply chain strategies (SCSs), Conceptual framework, Conceptual models, Interaction, Strategic fit, etc.

Preface

This thesis concludes the author's Masters of Science at Lund University Faculty of Engineering (LTH), specializing in Logistics and Supply Chain Management. The thesis is mainly built on Literature studies and conceptual works, with additionally a case study performed at Alfa Laval, Sweden to verify the conceptual works.

I would like to take this opportunity to thank my supervisor Jan Olhager, who spends time and patience, shares rich experience and knowledge, and guides me at the clear direction of this study throughout the entire working period. Without your supervision, this thesis project would not go smoothly this way.

My gratefulness also goes to Alfa Laval, especially the two managers that I interviewed: I would like to thank Alexandra Kristensson and Jens Richter for your time and interest in this study. I appreciate very much your kind reception and responses during and after the interviews which helped me to collect and process the data properly and correctly.

At last but not least, I want to thank my dear family and friends who give me constant encouragement and support all the time.

Dec 2017

Table of content

List of Figures

List of Tables

Glossary

ATO: Assembly to order

BUs: Business units

CODP: Customer order decoupling point

ETO: Engineer to order

GS: Global sourcing organization

IDS: Inventory days of supply

MTF: Make-to forecast

MTO: Make to order

MTS: Make to stock

OD: Operations development

OSs: Operations strategies

PDL: Parts, distribution logistics organization

PGs: Product groups

PHE: Plate heat exchangers

ROCE: return on capital employed

SC: Supply chain

SCM: Supply chain management

SCSs: Supply chain strategies

SCS: Supply chain strategy

SLRs: Systematic literature reviews

1 Introduction

This chapter presents the motivations of this research with the background, research goals and questions, focus and delimitations, as well as why this is important to research, contributes to companies and individuals. The structure of this paper is illustrated in the end.

1.1 Research background

Research on manufacturing operations strategy (OSs) has been around for some time since Skinner (1969) proposed his seminal work regarding management of operations from a strategic point of view. The research in this area has achieved a fundamental consensus on what constitutes an operations strategy regarding process and content (Olhager and Rudberg, 2003; Hayes et al. 2005).

In the area of supply chain strategy (SCSs) research, it started and progressed differently, on the one hand, researchers agreed upon that the strategic idea of 'one size fits all' won't work since the seminal framework was proposed by Fisher (1997) called for the principle of 'Fit-and match'. On the other hand, this concept, however, is still not as well developed as operations strategy: there is still a variety of perceptions as to what a supply chain strategy is (Rose et al 2012; Birhanu et al., Lanka, and Rao 2014; Birhanu et al. 2014).

Furthermore, in many studies, interactions between operations strategy and supply chain strategy are often neglected, and the research is underdeveloped. Qi et al. (2017) point out, one of the major weaknesses in the field of operations strategy is that the OSs theory fails to make contextual considerations concerning supply chain and so does the research in supply chain strategy.

1.2 Problem description

In today's 'New world economy,' business became much more difficult than it had been before. Operational excellence plays a vital role in achieving an organization's success (Hayes et al. 2005), while supply chain strategy was recognized significant for a company to balance the conflicts among different functions and handle various issues along the supply chain, inter-departmental conflicts and the challenge of goal restructuring (Stevens 1989; Perez-Franco et. al. 2016). More importantly, both operations and supply chain strategies capabilities are dynamic capabilities (Hayes et al. 2005, p61, p91; Qi et al. 2017). With excellent strategic alignment, OSs and SCSs can be used as a useful weapon in accomplishing an organization's competitiveness. However, as described in the research background, there is not a consensus on what a SCS is, and it is still unclear regarding how these two strategies can be tailored and related to each other to better exploit and develop the dynamic capabilities. Thus, both the theory and the industry strongly call for a relevant research in filling this gap.

1.3 Research purpose and questions

The purpose of the thesis is to review the literature on manufacturing operations strategy as well as on supply chain strategy, with a strong focus on conceptualizing supply chain strategy mainly in aspects of its decision framework. The thesis work includes developing models that can describe how these two types of strategies are related to each other in the strategic fit process. The thesis work will be mostly theoretical, but the framework and models would be compared with industry practice in a larger corporation to test the similarity or difference, the contingencies, as well as validity.

Accordingly, two research questions are designed to achieve this research purpose:

Research question 1: What is a supply chain strategy and what detailed strategic decisions and elements constitute it?

Research question 2: How can supply chain strategy and manufacturing operations strategy interact and be related to each other to realize the company's strategic objectives?

To answer the research question 1, this thesis shall choose a relevant definition of SCSs or redefine it properly, meanwhile develop a conceptual framework for stating choices and decisions included by SCSs; to answer the research question 2, this thesis works to develop conceptual models to describe such interactions and relations between SCss and Oss within a company. Based on these, a further case study will be conducted to compare and finalize the built framework and models.

1.4 Focus area and delimitations

This thesis focuses on a theoretical basis of work regarding supply chain strategy and manufacturing operations strategy as well as their relations and interactions. The service operations strategy is delimitated in this study to have a focus and achieve a qualified result within the limited time frame; besides, different researchers may vary slightly regarding what OSs typically are about, yet there is a consensus on what constitutes an operations strategy in terms of process and content. This consensus area becomes the focus of literature studies in OSs, while a few other aspects beyond this consensus area are not covered; the relations or interactions with other functional strategies such as financial, marketing strategies won't be particularly discussed in order to have a moderate degree of complexity for a thesis; the case study in the end would enrich the research results in a way, yet it might not be sufficient to reach a generalization of the study without further tests.

1.5 Contributions

1.5.1 Contributions to research

The research aim and questions of this study are formulated to fill the weak part of SCSs study, and bridge the gap of interactions between SCSs and OSs. Thus, the results with developed framework and models shall give valuable input to the research of these fields meanwhile facilitate and lead to relevant further researches.

1.5.2 Contributions to companies, and/or society

Every manufacturing firm needs both OSs for the internal operations and SCSs for linking up with suppliers and customers. This thesis covers rich literature in these two areas and builds a conceptual framework and interaction models accordingly, which will help manufacturing companies to clearly define their SCSs and gain an insight of proper strategic alignment and interactions to realize the company's strategic objectives. Thus, it has a potential to benefit the companies in the society.

1.5.3 Contributions to individuals

The research provides profound knowledge and increases the academic ability for the author and students. It also benefits for students' future development in the field of logistics and supply chain management.

1.6 Target group

The study is directed to the department of Industrial Management and Logistics, in Faculty of Engineering at Lund University. It finalizes the authors' master study in Logistics and supply chain management; the target group is both researchers from relevant fields or especially interested in supply chain strategy and manufacturing operations strategy, etc. and companies in the industry who need to develop their supply chain strategies and manufacturing operations strategies.

1.7 Structure of this thesis

This thesis is structured in 6 parts, and each part is briefly described as followings.

Chapter 1: Introduction. This chapter presents the motivations of this research with the background, research goals and questions, focus and delimitations, as well as why this is important to research and of contributions to companies and individuals.

Chapter 2: Methodology. This chapter presents the motivations of chosen methodology which guides both the theoretical and the empirical parts of the study and evaluates the trustworthiness of the results mainly in terms of validity, credibility and objectivity.

Chapter 3: Theoretical framework. This chapter presents the theory and frame of reference about OSs and SCSs in aspects of contents, alignments process, as well as their interactions, etc. The structure of theory follows a logical order, rather than chronological order.

Chapter 4: Analysis and conceptual works. This section performs a thorough analysis of the theories constructed in the previous chapter to develop a conceptual framework related to research question 1 and conceptual models related to research question 2. The framework and models are properly elaborated and clarified.

Chapter 5: Case study and analysis. A case study is conducted to compare with the framework and models developed in the last chapter and address essential findings.

Chapter 6: Conclusions and discussions. This chapter raises some discussions and tries to conclude according to the previous analysis and results, limits and further research are proposed.

The positioning of these parts in this paper can be illustrated according to Figure 1.1 as below.

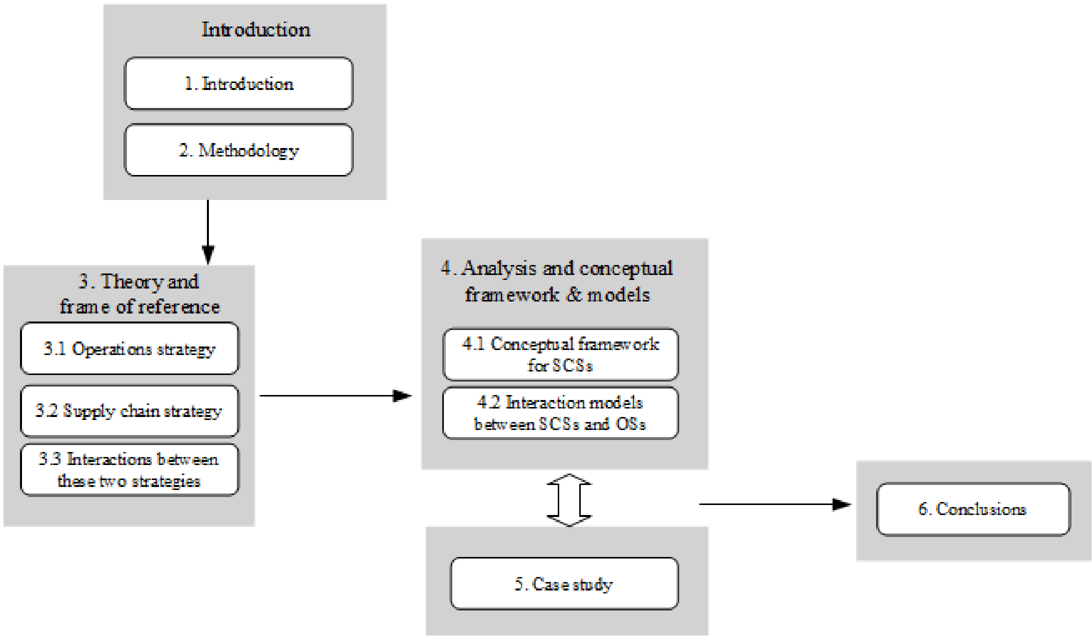


Figure 1.1: The illustration of the structure of the paper (Source: Adopted from Björklund and Paulsson (2014, p48)

2 Methodology

This chapter presents the motivations of the chosen methodology which guides both the theoretical and the empirical parts of the study. It mainly covers the scientific perspective or research philosophy, research approach, research strategy, research method, and the core data collection and analysis methods. The trustworthiness and credibility of the results mainly in terms of validity, reliability, and objectivity are evaluated in the end.

2.1 The outline of the methodology

While specific research approach, strategy, and methods, etc. are selected, the methodology chapter can still be presented through different possible structures. In this thesis, the onion model proposed by Saunders et al. (2009) is adopted as an overall outline to structure and present the motivations of different methods in this paper. The onion is shown in Figure 2.1.

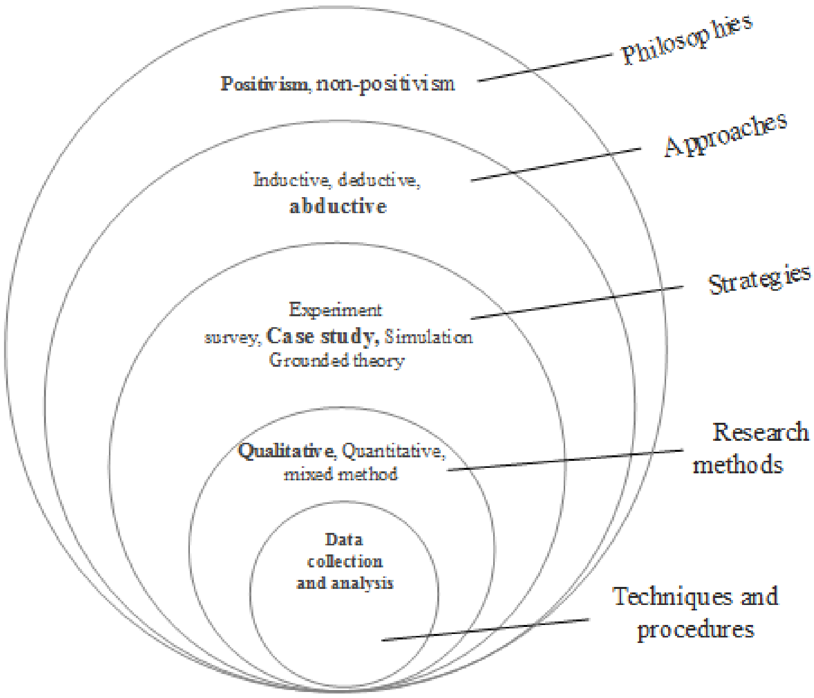


Figure 2.1: Methodology outline (Source: adopted from Saunders et al., 2009)

As shown in Figure 2.1, each layer of the onion include several options that are more common in engineering and management study, hence will be briefly introduced, while the options marked in bold font became the selected solution for this paper with proper motivations being elaborated. Accordingly, the introducing order of the methodology aspects goes from the outer layer to the inner layer across the 'onion.'

2.2 Research philosophy

Positivism and non-positivism are considered as two epistemological extremes which represent a person's approach to knowledge and stands in close connection with his/her conception of the world. A positivist investigator views knowledge growth as a cumulative process in which new knowledge is added to old one often through verifying or falsifying hypotheses and theories, and the results lead to objective and true knowledge. The investigator is an external observer who doesn't affect the object that is investigated. The same result shall be achieved independently of who the observer is (Björklund and Paulsson 2014, p. 71).

Non-positivist sees knowledge can be acquired via the creation of understanding. The investigator is not to be distinguished from the observed phenomenon and does not have as firmly controlled methods for collection and analysis of data as positivists do. Non-positivists also strive for objectivity, yet this is more in the form of an 'ideal' (Björklund and Paulsson 2014, p. 71).

This paper derived from existing knowledge through literature review to develop conceptual models as added knowledge to previous knowledge, with all methods profiled and controlled, the results were tested in a case company to go beyond the author's limits and reduce the risk of subjectivity in knowledge building. Thus, the objectivity has been put in a vital place and strived hard during the whole process of work, yet the research philosophy was not likely to be defined as a strict positivism because of the home-made analysis models for conceptual works and lack of quantitative or statistic methods that often used in positivism.

2.3 Research approach

An inductive research approach can carry out empirical studies without prior studies on existing theories, while a deductive approach starts with the theories and make predictions about the empirical material, which is further verified with the help of collected facts (Björklund and Paulsson 2014, p. 71). Creswell (2002) suggests if a topic is rich of literature to define a theoretical framework or hypothesis, it leans towards deduction; while a research topic that is new and with much debate and little existing literature. It may be more appropriate to work inductively. It is possible to apply both a deductive and abductive approach within the same research (Saunders et al. 2009), or combined two approaches at the level of progression taking place forwards and backward between the various levels of abstraction. This approach is named abduction (Björklund and Paulsson 2014, p. 71).

In this paper, the abductive approach is considered more relevant and appropriate. It starts with an extensive literature review to build knowledge base and narrow down to conceptual buildings. The conceptual models are further tested in a case company. During this progress, some knowledge and important findings are addressed, which sometimes required an additional search or more detailed clarification of the relevant literature to enrich the pre-structured framework, until the theoretical framework and the results reach the best match.

2.4 Research strategy

Research strategies can be used for exploratory, descriptive and explanatory research.The purpose of this paper is considered as both descriptive and explanatory relevance. Table 2.1 gives a comparison regarding some common research strategies for consideration.

Table 2.1: An overview of common research strategies in engineering and management (Source: from different researchers and summarized by the author)

Research strategy	Descriptions/Applications	Main purpose/comments
Experiment (Björklund and Paulsson 2014, p75; Denscombe, 2009: 75-77)	Scientific test based on the use of artificial 'mini-reality' to find the appropriate version of design; identify causes or observe the influential factors.	Quantitative relevant, mainly for exploratory purpose.
Survey (Björklund and Paulsson 2014, p77; Saunders et al. 2009:144)	Studies the sampling of individual units from a population.	Quantitative and descriptive relevant. The risk of misinterpretation is often greater than interviews.
Case study (Saunders et al. 2009:146; Höst et al., 2006)	An empirical inquiry in investigating a contemporary phenomenon within its real life context.	Qualitative relevant, often in explanatory and exploratory research.
Grounded theory (Saunders et al. 2009: 149)	Helps to predicts and explains behavior and emphasizes on theory developing and building.	'Theory building' through a combination of induction and deduction.
Archival Research (Saunders et al. 2009:149, 150)	Administrative records and documents etc. as the principal data source.	For the research questions that focus on the past and changes over time.

According to the applications, the experiments and archival research are not relevant strategies to achieve the purpose or answer the research questions set in this paper. Survey has a greater risk than case study about misinterpretations, especially for a qualitative study that requires large extent of exploratory and explanatory. Thus, survey is not the preferred strategy to the case study in this paper. Conceptual framework and models, though not mentioned in this 'onion' by Saunders et al. (2009), was considered as the first phase of research strategy in this thesis. Then, case study was chosen as the formal research strategy to evaluate or compare the built framework and models from the empirical aspect. This two-steps design of research strategy helped to increase the credibility of the study. The research strategy is directed to data collection and analysis methods which would be introduced in coming sessions in 2.6 and 2.7.

2.5 Research method

There are two methods can be chosen for data collection and analysis: Quantitative and qualitative. 'Quantitative is predominantly used as a synonym for data collection technique or data analysis procedure that generates or uses numerical data, while qualitative method is used predominantly for the data collection technique or data analysis procedure that generates or uses words rather than numbers and often describes and explains problems and situations (Saunders et al. 2009, p 151).

As refers to Table 2.1 above, case study is more likely to be concerned with qualitative study and the conceptual works are mainly based on qualitative learning and processing of the theories as well. Thus, this paper is primarily about the qualitative study, though it doesn't necessarily mean that any numerical information was avoided during the data collection and analysis procedure.

2.6 Data collection methods

2.6.1 Literature studies

Why literature studies

Undertaking a literature review for providing evidence-informed policy and practice in any discipline is a key research objective for academic and practitioner communities (Tranfield et al. 2003). Literature studies are also critical for a thesis. Well implemented literature studies support the aim to build further on existing knowledge and reduce the risk to overlook existing theories as well. Through the presenting of relevant literature sources, it makes it easier to understand the starting point and also enable other users such as other researchers or organizations to use and develop further the results. Literature studies could sometime constitute the entire thesis work though more common in other subjects than engineering (Höst et al. 2011, p59).

Accordingly, this thesis's primary aim is to conceptualize the SCSs especially in aspects of its decision framework or areas and describe how the OSs and SCSs are related in the strategic fit process based on a good understanding of both strategies. The work is mainly theoretical oriented and it requires a comprehensive understanding and analysis of existing knowledge in the fields of SCSs, OSs, and strategic alignment process and logic, etc. Therefore, sufficient and relevant literature studies become the essential method and primary approach to carry out this thesis work. Besides, there is a key strength of literature studies to have access to a lot of information within a constrained time frame and with scarce economic resources (Björklund and Paulsson 2014, p76). This was an evaluable strength considering the thesis time constraint.

How the work was conducted

Literature studies as a data collection method, the information gained from literature studies are viewed as secondary data. Thus, it is particularly important to notice that, secondary data have often been produced for an aim other than the one of the current study, and the information might be biased or not fully comprehensive depending on the databased and search words for instance. Therefore, it is important to always question the information and the specific use of the thesis (Björklund and Paulsson 2014, p73, 76).

In SCM, the using of systematic literature reviews (SLRs) as a scientific methodology had fallen behind some other disciplines but is receiving more and more attention from the researchers (Durach et al. 2017). Accordingly, Durach et al. (2017) develop a paradigm for conducting systematic literature reviews in SCM deriving from general SLR steps and developed from previous SLR research specific for SCM. This paradigm contributes to the methodology skills, transparency and replication of studies and is presented in Table 2.2:

Table 2.2: Guidelines for conducting SLRs in SCM (Source: Durach et al. 2017)

Common SLR steps	Description of steps in an SCM review
Step 1: Define research question	Develop an initial theoretical framework regarding the phenomenon under study with the aim of refining it in light of the SLR literature: Framework must specify limitations regarding units of analysis, study contexts and construct definitions.
Step 2: Determine required characteristics of primary studies	Develop criteria for determining if a publication can provide information regarding the theoretical framework: Assess contribution including units of analysis, study contexts, definitions, and operationalization of constructs.
Step 3: Retrieve sample of potentially relevant literature ('baseline sample')	Identify literature through structured and rigorous searches: Multiple searches may be required to identify literature on all aspects of the theoretical framework; Think of the breadth of definitions and terminologies in SCM.
Step 4: Select pertinent literature ('synthesis sample')	Conduct theoretically driven selection of literature to identify studies per inclusion/exclusion criteria; Conduct a detailed relevance test that goes beyond what is stated in titles and abstracts.
Step 5: Synthesize literature	Develop data extraction structures through code units of analysis, sources of data, study contexts, definitions, construct measures, research methods and relate them to study outcomes; Integrate data to refine theoretical framework; Develop narrative propositions.
Step 6: Report the results	Explain refined theoretical framework and compare with initial theoretical assumptions.

The literature studies in this paper were comparable with these guidelines with a similar awareness in mind during the entire procedure. It will be presented in the followings:

Step 1: Define research questions.

The research gap, aim, and research questions as well as the delimitations were well identified based on prior knowledge and scoping studies.

Step 2: Determine required characteristics of primary studies:

The literature studies in this thesis should include three parts: Literature about contents of OSs and the way the OSs were aligned at the company; Literature about the dynamic views and theories about SCSs and the way the SCSs were aligned at the company; Literature about the interactions between OSs and SCSs. Besides, different parts of knowledge served for different purpose in connecting to the research aim and question, defined as following:

The use of different parts of literature

The contents of OSs were considered as a prerequisite of knowledge for further conceptual works. There had been a consensus among previous researchers regarding what OSs are about and what decision aspects and areas were included, thus the literature studies of this part could go quite straightforward and the purpose is to gain the consensus knowledge about OSs. In the analysis and conceptual works, the detailed content of OSs might not be used directly, but without intensive studies on what OSs are about and having that knowledge in mind, the conceptual works regarding SCSs decision framework and interaction between OSs and SCSs won't go the right way.

The fragmented and various theories about SCSs were used as a foundation of knowledge to build the conceptual SCSs decision framework. Due to that, there was still not a consensus regarding what SCSs are and what contents it covers, and the theories about them were still much dynamic and even fragmented. This part of literature studies required a lot of attention and energy during the search and reading to obtain as much information and different theories as possible. It also required much more work to process the literature in a structured way, and critical thinking on the theories was important. This part of knowledge become the theoretical input for building the SCSs decision framework in research question one. The literature studies of this part make sure that the conceptual decision framework of SCSs is more reliable and have objective standings.

The strategic alignments about OSs and SCSs, as well as their interactions were used not only to build the logic way of thinking about strategic alignment, but also give knowledge base and evidence for developing the interaction models. Hence, the studies also tried to figure out different views and theories in this area. The literature studies of this part make sure that the conceptual interaction models are reliable and have objective standings.

Step 3: Retrieve sample of potentially relevant literature

The baseline samples of literature for this research mainly included the seminal articles by Fisher (1997) regarding ‘What Is the Right Supply Chain for Your Product’, and by Skinner (1969) regarding ‘Manufacturing-missing link in corporate strategy’, as well as the textbook by Hayes et al. (2005) named ‘Operations, Strategy, and Technology - Pursuing the Competitive Edge’. They are good baseline samples considering the significant influence and reputation in the relevant field. Intensive studies on these samples were conducted which led to further search and selection.

Step 4: Select pertinent literature

The pertinent literature search was mainly conducted through the University library ‘LUB Search’ including both online resources and printing books; and Google Scholar, as well as the additional material which was recommended by the supervisor. Different keywords were used such as Operations strategies, supply chain strategies, strategic supply chain, supply chain strategic alignment, supply chain differentiation, supply chain strategic interaction and so on. Apparently, only the literature that related to the thesis shall be used and included (Björklund and Paulsson 2014, p76), this refers to the inclusion and exclusion criteria defined in step 2. Normally, the found literature was compared from the journals, the number of citations and the abstracts to select the most interesting, reliable and relevant ones related to this thesis. Attention was also paid to latest articles in recent years as they also had a literature review in previous research. Additionally, when reading an article or a book, there were sometimes new interesting references used which gave another way for digging further and finding relevant literature. At last, a reading list was made every week during the phase of literature studies and discussed with supervisor to select right articles, point out what knowledge had been gained and what else is expected for the next.

Step 5: Synthesize literature

This step includes coding schemes to extract pertinent information from the literature, synthesizing studies by summarizing, integrating or cumulating the findings across the primary studies. For OSs, the coding mainly followed the consensus decision areas summarized by Olhager and Rudberg (2003) and Hayes et al. (2005, p41), while the SCSs were broken to more coding themes considering the fragmentation and non-consensus of knowledge. It included the definitions, typology/classification, strategic alignment and decision categories, etc. literature in interactions between OSs and SCSs was under-developed in previous research, and there was less work to do with synthesizing.

Step 6: Report the results

The chapter of the literature review was finally completed in a written form based on these steps and evaluated during the process through ‘back and forward’ of abductive approach to improve and supplement the determined framework. The conceptual framework and interaction models were built based on this body of theory and will be further elaborated in session 2.7.1.

2.6.2 Semi-structured interviews

Why semi-structured interview

Since case study could achieve more accurate and objective interpretation than a survey, it was decided as the primary research strategy as mentioned. According to the design of this thesis, one or two larger corporations would be selected to compare the conceptual works developed from literature studies. Thus a semi-structured interview was believed the most appropriate primary data collection method because on the one hand, interviews have access to information that is highly relevant for the study and allow an in-depth level of understanding (Björklund and Paulsson 2014, p77). On the other hand, semi-structured interviews have a stronger focus on explanatory meanwhile are appropriate for exploratory queries (Saunders et al. 2009, p.320-323), these two features suited for the research aim. Besides, having the interview questions semi-structured and sent to the interviewees in advance would also help the interviewees to understand the purpose and focus. Thus it increased the quality and validity of the interview. The interview guide is available in Appendix A.

How the work was conducted

After some efforts were tried, Alfa Laval, a large multinational corporation who has a lot of operations and supply chain activities was targeted as the case company, and two managers from the company agreed to offer the interviews at Alfa Laval Lund AB, located in Lund. One manager is Richter, who is the Operations Development (OD) manager at the organization named Plate Heat Exchangers (PHE), a product group (PG) that linked to a related business unit within Alfa Laval; the other manager is Kristensson who is the manager of supply chain program in the central Operations Development (OD). The company information and their organization structure etc. would be further introduced in the empirical findings of the case study in chapter 5.

Since there are a lot of interactions between SCSs and OSs at Alfa Laval, it was determined to have the interview with both managers at the same time. However, the interview guide was structured in three parts and for each part, the key interviewee switched from one to another according to their main responsible area, but the two managers often helped to complement for each other, which is considered as an advantage for interviewing them together. Around two weeks ahead of the meeting, a semi-structured interview guide was sent to the managers to introduce the aim and interview areas as clear as possible. This interview guide is in Appendix A. The interview was launched at 14:30 Oct.17, 2017 at the office of Alfa Laval Lund AB in Lund. The schedule followed the interview guide yet in a flexible way, and it lasted for complete two hours. The interview was fully recorded and transcribed into full texts afterward for further analysis and for traceability. When the findings were presented in a written thesis format, it was sent to the managers for reviewing and confirmation. During this process of review, the managers have added some additional data as new input.

2.6.3 Secondary data about the case company

Besides the primary data collected through interviews at Alfa Laval, there were also some secondary data mainly collected from the official homepage of the company to briefly introduce the company and the business scope, organization structure and so on which is in session 5.1-General about Alfa Laval.

2.7 Data analysis methods

The literature studies and interview transcriptions need to be further processed and analyzed. The data analysis methods for these two types of data are also different. Conceptual works and case study data processing will be introduced in this session.

2.7.1 Conceptual works

In the Logistics and supply chain management, there was few written data analysis method found regarding how to build a conceptual framework or a model according to the author's best knowledge. According to the literature studies, many researchers develop their theoretical models based on their rich empirical experience in the industry, for example, Fisher (1997) and Hayes et al. (2005). This degree of freedom was not suitable for this thesis considering the author’s limits of practical experience. Thus it highly relied on sufficient literature studies and data processing to build reliable conceptual models.

In this thesis, some quantitative approach or engineering skills such as statistical processing or simulation (Björklund and Paulsson 2014, p78) did not seem relevant for analyzing the literature data either. Instead, analysis models were used to process the literature findings and build conceptual works accordingly. There are both home-made analysis models and already existing models for analysis models (Björklund and Paulsson 2014, p78). For example, ‘5 whys’ was an existing model. This thesis used home-made analysis models because there are a lot of details need to be processed: The data was gathered, understood, compared and classified, then presented in a structured way, and the conceptual works were built based on deep understanding of these processed data. In more details:

For SCSs decision framework, in the chapter of literature review, the knowledge has been sorted out into different themes, such as the SC definitions, SCSs classifications, decision categories, strategic alignments, and interactions with OSs, etc. The next, the SC definition to be used in this research was identified and improved; based on this definition, the detailed decision categories and attributes related to SCSs were discussed and determined when comparing different literature references that were studied; then within each category, the detailed policies and choices to be put in place to support the objectives within such category were figured out also based on comparisons among different literature references that were studied. As a result, the SCSs decision framework was built. It was constructed by clear structure, detailed decision contents, and attributes that differentiate a supply chain strategy. The analysis pattern and interpretation of the framework could be further read in the analysis chapter.

For the interaction models, according to the question regarding which of OSs and SCSs shall come first and how the other should be tailored to them, some literature gave their views and arguments. It was, therefore, natural to define two possible ways: ‘Inside-out’ referring to that OSs come first, or ‘outside-in’ that SCSs come first. Meanwhile, the contingency factor that influences or determines these two different models were figured out based on the author’s understanding of the knowledge within OSs and SCSs. Then, the detailed steps regarding how to align the first-come strategies and how the other should be related to them were discussed and proposed, based on the logic and inspiration from relevant literature studies regarding the strategic alignments and interactions.

The central principle of these home-made analysis models is the objectivity, for each step and analysis was built based on literature studies and knowledge obtained during this learning process, having clear arguments or scientific reference was kept in mind when proposing something.

2.7.2 Interview data analysis

The analysis of interview data is critical because it tells whether the empirical evidence supports or makes changes to the conceptual proposals so to answer the research questions, yet the analysis should have an objective standpoint: both the conformance and nonconformance to the conceptual proposals need to be noticed and reported. Yin (2003) proposed four data analysis methods that are related to the case study: Pattern Matching, Explanation Building, Logic Models and Cross-case Synthesis, presented in Table 2.2 below:

Table 2.3: Data Analysis Techniques (Source: Yin 2003, p116-136, summarized by author).

Data Analysis methods	**Descriptions**	**Notes**
Pattern Matching	Compares an empirically-based pattern with a predicted one or with several predictions.	For case study
Explanation Building	Explanation about the case in order for further studies.	A more complicated form of pattern matching
Logic Models	Transforming complexity of events into an evaluation	Also being seen as another type of pattern matching.
Cross-case Synthesis	For multiple case studies	

In the interviews with Alfa Laval, the aim is very explicit: to compare their practice with the conceptual framework and models that built from literature studies. Accordingly, the 'Pattern matching' is the best suitable analysis method for the collected interview data, namely, the collected data would be compared with the previously conceptualized SCSs decision framework and interaction model between OSs and SCSs.

The interview was fully recorded as explained before, so it was fully transcribed soon after the interview, and transcriptions were studied, analyzed and restructured through the method of pattern matching to be corresponding to the conceptual framework and conceptual model. The results were presented in chapter 5 and delivered to the managers for double check and confirmation. The managers read them through and gave detailed comments and feedback on it, accordingly, a modified version was made for a second review through email condensation, this was repeating until it was finalized and confirmed by the managers and meanwhile interviewees Kristensson and Richter at the case company Alfa Laval. This review process helped to ensure accuracy and correct interpretation and analysis of the data. Hence, it increased the trustworthiness of the results. Session 5.4 was about the rethinking of the built conceptual works based on the empirical findings and pattern matching in 5.2 and 5.3.

2.7.3 Investigation design

By here, the data collection and analysis methods were presented, an investigation design shown in Figure 2.2 helps to summarize the chosen methods and their relations. Investigation design refers to the choice of a certain design that enables the progress from aim to results (Björklund and Paulsson 2014, p84).

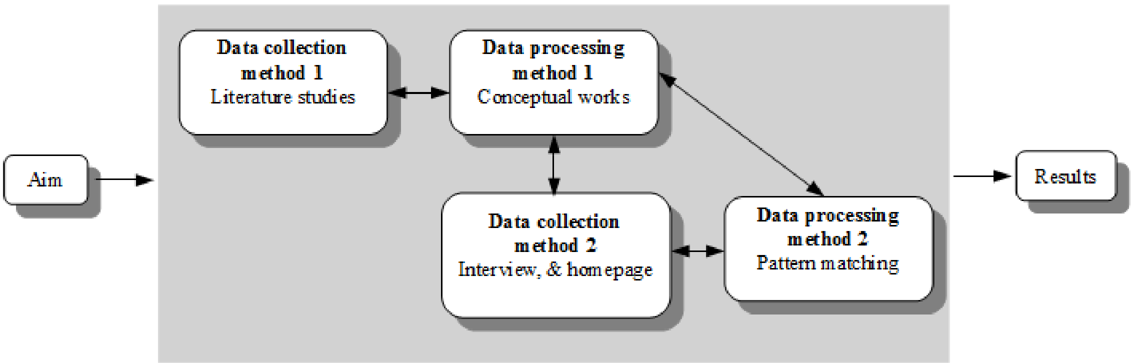


Figure 2.2: Investigation design in this thesis (Source: Adopted from Björklund and Paulsson 2014, p84)

2.8 Trustworthiness and credibility

Validity, reliability, and objectivity are key criteria of credibility in research (Lindroth 2001). A study is valid if it measures what it was originally intended to measure, a study is reliable if another investigation can reproduce the results using the same methods and in a similar setting. Objectivity is contrary to subjectivity. It requires the researchers to obey the data without affecting the analysis or results by subjective opinions and prejudice.

2.8.1 Validity

The validity in this thesis is first of all about how to select literature data that is highly relevant to the research aim and research questions. The details could refer to ‘How the work was conducted’ under the session of Data collection method in 2.6. The literature selection was very purposeful and conformed with guideline of systematic literature reviews to have the selected articles fully evaluated all the time to ensure the validity through sufficient and qualified literature data. The chapter of the literature review was fully assessed several times before it was ready to proceed to the conceptual works. The analysis of literature and conceptual works were also directly and explicitly linked to the research questions. Validity also required the data collection and processing for case study to be highly relevant to the research questions, to achieve this. The interview guide has been appropriately designed before sent to the case company. The interview process was well leaded to explore data needed to test and compare the conceptual works while the analysis of the transcriptions followed a pattern matching method and was directly tailored to the conceptual framework and interaction models. Therefore, the validity of this research was performed through the entire work process, and was highly achieved as a result.

2.8.2 Reliability

According to Saunders et al. (2009), three measures are considered crucial for a study to achieve the requirements of reliability. First, the study is reproducible on another occasion with the same result. Second, another observer should obtain the same observations as the researcher. Third, a sense of how conclusions were formulated from the conducted data should be presented. These three dimensions were kept in mind when conducting the study. First, using literature, interview transcriptions and each feedback from tutoring were documented and traceable. It would be reproducible at another occasion or by another researcher; second, following the same data and methods, the essential results will be same to the current one, except that the wording could be different, for instance; third, before the conclusions were drawn, there was formal analysis method of pattern matching, and less formal analysis of home-made analysis model but objectivity-oriented, as well as discussions presenting the sense in how these conclusions were formulated.

2.8.3 Objectivity

The objectivity, as mentioned earlier, was put at a crucial place to follow from the data collection to data analysis. For each decision category, and the policies and choices within it, as well as the cross-functional aspects, literature references were used to present how and why they were chosen to constitute the SCSs. In the interaction models, each step has motivated adequately with scientific references as well regarding how and why it should be aligned this way. The contingency factor for the interaction models did not have a direct reference from previous research, yet it came from the knowledge gained after the intensive literature studies. This contingency factor was considered as an additional contribution by the author.

3. Literature Review

This chapter presents the fundamental literature studies and frame of reference about OSs and SCSs in aspects of contents, alignments process, as well as their interactions, etc. The structure of theory follows a logical order, rather than chronological order. Some necessary discussion and analysis may be included at the end of each theory body.

3.1 Operations strategy

Since Skinner's (1969) seminal work, which provides insights into the management of operations from a strategic point of view, many studies have investigated operations strategies (OSs), and the literature developed as a whole (Anderson et al. 1989).

There are three different levels of management-related strategies (Hayes et al. 2005, p35):

At the highest level, corporate strategy encompasses decisions about the industries and markets it participates in, and how it structures itself to attack those targets markets, as well as how it acquires and allocates key corporate resources to various activities and groups.

At the second level, the corporation’s strategic business units (SBUs) often have their business strategy, which’s purpose and basis in the underlying attitudes and preferences helps a company to shape the way it manages itself, and how that strategy is translated into the functional strategies required to implement it. The business strategy specifies 1) the scope of the business and its relationship to the corporation, and 2) how it proposes to position itself within its particular industry to achieve and maintain competitive advantages.

The third level of strategy is composed of several functional strategies within the SBU and often consists of a marketing/sales strategy, an operations strategy, a financial control strategy, and a research/development strategy (Hayes et al 2005, p34-35). Supply chain strategy is, according to numerous scholars, viewed as a functional strategy (Sillanpää and sillanpää 2014). However, there is still no consensus in the research whether to view SCS as a functional strategy below a BU or more than this. The way how SCS is viewed in this paper will be addressed in the analysis chapter.

According to Hayes et al (2005, p33), an operations strategy is ‘*a set of goals, policies, and self-imposed restrictions that together describe how the organization proposes to direct and develop all the resources invested in operations so as to best fulfill (and possibly redefine) its mission’*. An operations strategy helps to weld together the massive resources invested in the operations function into a cohesive and purposeful whole, operations can become a powerful source in creating a firm's competitive advantage. The different levels of strategies in a firm can be seen in Figure 3.1.

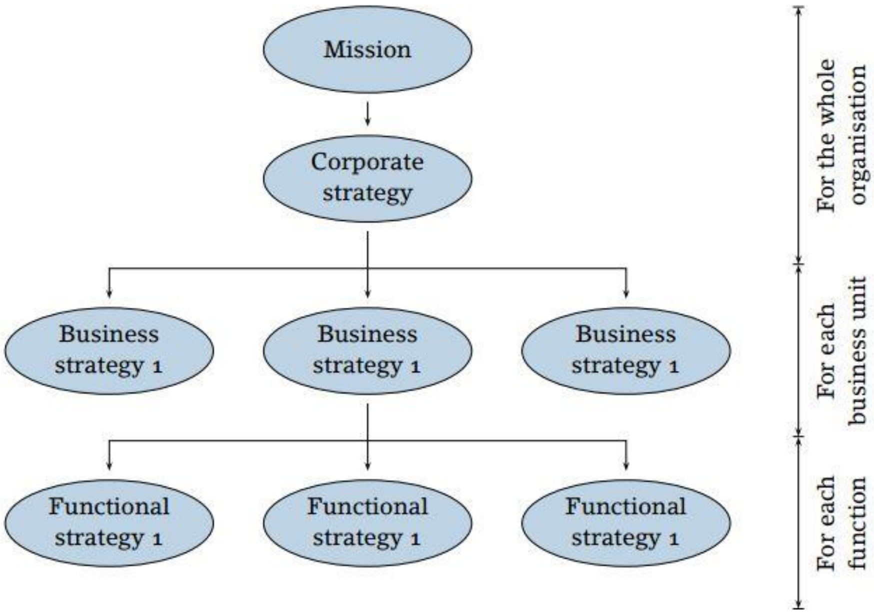


Figure 3.1: Different levels of strategies for a firm (Source: Waters 2009).

This session will systematically introduce operations strategy and its key involving decisions, with focus on its Contingency Theory; Framework for Implementation; Operating Capability; and the Structural Decisions as well as Infrastructural Policies and Systems.

3.1.1Contingency theory and the decision framework

- *Fit and focus*

After the idea of using 'one best way' to manage operations had been disputed by a number of critics over the years, Skinner (Skinner 1969, and Skinner 1974) proposed the most effective challenges for it. Skinner's research results through the years show that higher management tends to empower the managers in the operational organization/departments for a wide range of decision making, which partly results in a mismatch between the operational decisions and cooperate strategy. Based on Skinner's three key arguments, Hayes et al. (2005) give them some further exploration and elaborations. This is the contingency theory of operations strategy regarding 'Fit and Focus':

1) Different firms/business units have different situations regarding strengths and weaknesses. Thus they may choose different ways to compete in the market, and this requires them to adopt different 'yardsticks of successes.'

Hayes et al. (2005, p39-40) further elaborate that, the most vital element of an SBU's competitive strategy to be implicated for its operations strategy is about how it chooses to differentiate its products and service from those major competitors of it. As different customers are attracted by different attributes, this differentiation could be achieved through, for example, offering the lowest price; or offering higher quality etc.; the next dimension for firms to seek this differentiation is dependability, in the means of, for instance, doing works specified and minimize failures, respond quickly and et cetera. Other important sources include flexibility, speed/responsiveness to achieve competitive differentiation.

2) The different configuration, equipping and managing an operations function will result in different operations characteristics. A company may therefore either achieve a given form of differentiation or face difficulties to be differentiated.

Thus, different operating systems have different performance characteristics: an operations organization's inherent strengths and weaknesses usually reflect the influence of the decisions made by its managers, and the organization is able to do certain things easily and well, and other things difficultly.

3) Therefore, 'one best way' doesn't work for all, the task for an operations function is to seek congruence ('fitness') between the SBU competitive approach and the way the operations' function is designed, organized and managed.

Accordingly, an operations organization's priorities should reflect its SBU's competitive strategy. Management must make sure that its operations organization is configured and managed to be able to provide that form of competitive differentiation. In one word, a firm must make choices that reflect its context, goals, resources, and personnel. When a business strategy is transformed into an appropriate collection of buildings, equipment, people and procedures, time and perseverance are required to ensure that hundreds of decisions, regardless of their importance, will collectively support and hone the desired operations edge. (Hayes et al. 2005, p41).

- *Key decisions framework*

Basically, there is a consensus on operations strategy decision framework, although different authors might slightly include or exclude certain aspects within it. A comparison is available in Table 3.1, conducted by Olhager and Rudberg (2003) and the years of referred literature editions are updated at the time of this thesis.

Table 3.1: Different perspectives on decision categories within an operations strategy (Source: Olhager and Rudberg 2003, updated by the author)

	Hayes et al. (2005)	Fine and Hax (1985)	Samson (1991)	Miltenburg (1995)	Skinner (1996)	Hill (2009)
Structural categories						
Capacity	√	√	√	√	√	√
Vertical integration	√	√	√	√	√	√
Facilities	√	√	√	√	√	√
Process technology	√	√	√	√	√	√
Infrastructural categories						
Human resources	√	√	√	√	√	√
Organization	√		√	√		√
Quality	√	√	√			√
Production planning and control	√		√	√	√	√
New product development	√	√	√			
Performance measurement system	√			√	√	

From the table above, there were still no more than half of the choosing researchers agreed on the last two categories: The new product development and the performance measurement system. Thus, these two categories are not considered to be included in the consensus contents. The collective impact of these decisions is having limits on an operations organization's strategic capabilities (Hayes et al. 2005, p41). Further review will go through the consensus perspectives that majority of researchers agreed upon according to Table 3.1 above. These perspectives as well as their decision areas to be reviewed in this thesis are summarized in Table 3.2 as below:

Table 3.2: OSs Decision Categories reviewed in this thesis (Source: Adopted from Hayes et al. 2005, P41)

Structural decisions, and decision area

- **Capacity**-amount, type, timing
- **Sourcing and vertical integration**-direction, extent, balance
- **Facilities**-size, location, specialization
- **Process technology**- drivers of process development, approaches of process technology

Infrastructural policies & systems, and decision area

- **Human resource systems-**employee selection, skills, payment & reward system, etc.
- **Organization-**challenges, centralized vs. decentralized, etc.
- **Quality systems-**tasks & responsibilities, quality management approach, quality assurance & control, quality improvement & culture, etc.
- **Planning and control systems-**production schedule, material planning, shop floor activity control, inventory, etc.

3.1.2 Structural decisions

The four structural decisions, namely the capacity, sourcing and vertical integration, facility and process technology, are typically viewed as structural in nature as they are mainly about the organization's physical bricks-and-mortar attributes that typically require substantial capital investments and once in place, it will be difficult to alter or reverse them (Hayes et al. 2005, p42).

Capacity

Capacity refers to an organization's potential to produce goods or deliver service over a specified time interval. Capacity planning usually involves long-term and short-term considerations where long-term considerations relate to the overall level of capacity, and short-term considerations relate to variations in capacity requirements due to seasonal, random, and irregular fluctuations in demand, etc. (Operations management 2017, chapter 5). More briefly, it could also be understood as the rate at which a transformation system can create outputs.

A firm's capacity strategy must reflect the firm's values, resources, the overall approach to competition, as well as willingness to face various kinds of risks. Moreover, it should mesh with and reinforce the firm's other strategies and objectives. A firm's capacity strategy should be integrated with its business strategy. At last, the capacity strategy should also embody a mental model regarding 'how the world works'' in terms of predicted growth and variability of the demand; Costs of facilities; Technology evolution; Competitors' behavior; as well as anticipated availability, capabilities, and costs of external suppliers.

- *Influential factors*

An operation's capacity can be affected by following eight factors Hayes et al. (2005, p79):

-Technology, capacity rely on the used process technology

- The interaction of multiple resource constraints, the bottleneck is determinant.

- Mix dependent on various resources

- Capacity can sometimes be stored, in terms of excess equipment for example

- Management policies affect capacity directly

- Capacity is dynamic, as experience gained by a facility, its total capacity can expand even no new investment is made.

- Capacity is also location specific, depends on how effective of such local unit and whether the resources allocated is appropriate.

- Finally, capacity is also affected by the degree of variability of demand and processing, depending on the rate jobs arrive, some idle time is lost and can never be used again.

- *The type and timing of capacity increments-capacity cushion*

One of the central questions in operations strategy is about how the amount and timing of capacity changes should relate to long-term changes in demand. Capacity cushion here refers to the amount of capacity over expected demand. Typically, three options show the possibilities of capacity cushion available when demand is expected to grow steadily. They are shown in Figure 3.2 below.

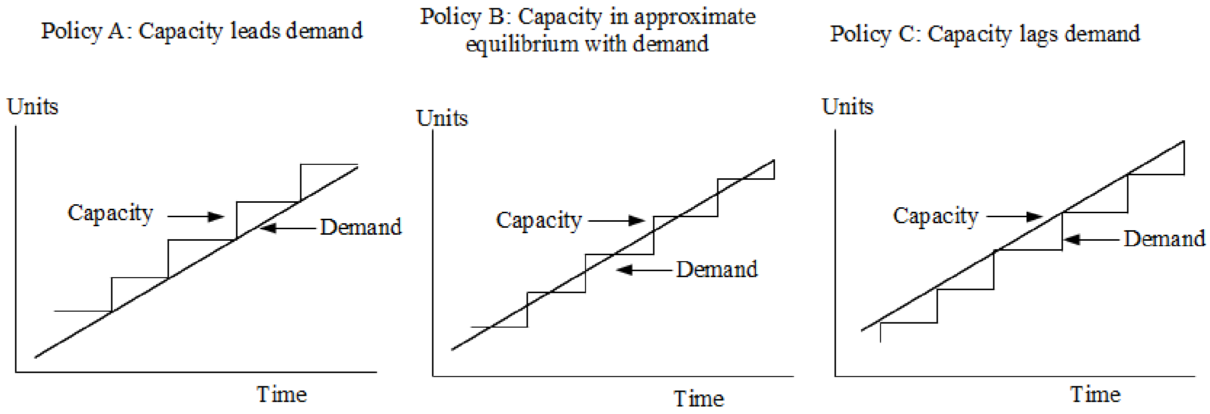


Figure 3.2: Alternative capacity expansion strategies (Source: Hayes et al. 2005, P85)

Here, policy A is to lead demand with capacity, which aims to build and maintain extra capacity (analogous to an inventory safety stock). In this way, the likelihood of running short is less than having too much. Then policy B is a policy about building capacity to the forecast: over time the capacity is increased in approximate equilibrium with demand, as nearly as possible. As a result, due to the forecast, time for construction, etc. the capacity is sometimes outstripped by demand, and at other times slightly larger than demand. Both situations seem to have same likelihood. Overall on average, it would prefer to have 'about the right amount' of capacity. Policy C is contrary to policy A in the capacity strategy, which adds capacity only after demand exceeds it (Hayes et al. 2005, p79).

The capacity expansion strategy should base on the market growing situation/trend. In practice, managers tend to adopt one of the following philosophies (Hayes et al. 2005, p105):

1) Don't add capacity until the need for it develops (policy A)
2) Try to outguess the market by following a countercyclical strategy.
3) Build for the long haul (often policy B or C)
4) Follow the leader(s) in the industry, so that you also benefit when it is a right forecast, and won't fail alone either when it turns to be wrong.

Further, when thinking the approach for expanding capacity without increase investment, one can assign multiple workstations to serve a single long queue which can result in less WIP and shorter throughput times than aligning one station for one line.

- *The sizing of capacity increments-scale considerations*

Economies of scale refer to the effect when a *'facility's total capital and operating costs generally increase at a slower rate than its capacity or output volume'. However, size is not equal to 'scale' which refers to that 'multiple units of the same type are being processed'* (Hayes et al 2005, p92, 96). Except for economies, there are also phenomena of diseconomies of scale due to, for instance, longer distance of distribution, bureaucratization, and confusions due to a large scale of the facility. An optimal economic size can be pursued after according to the distribution of total delivered cost and average delivered costs/unit, presented in Figure 3.3.

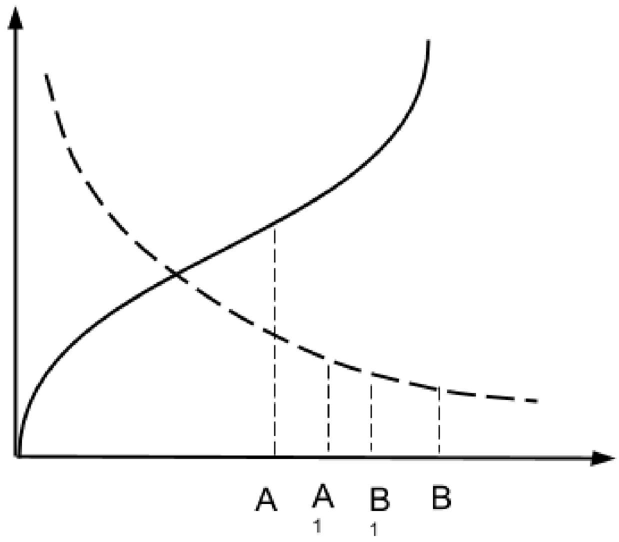


Figure 3.3: Conceptual presentation of total delivered cost and average cost/unit (Source: Hayes et al 2005, p102).

According to the curve of the costs, facility sizes range from size A and B are likely to have economic of scale. They are minimum respectively optimal economic size. In practice, sometimes only size A_1 or B_1 is feasible due to technological or organizational reasons, in this way, size A_1 or B_1 represent the minimum respectively optimal feasible economic size.

Sourcing and vertical integration

Sourcing and vertical integration is one of the most fundamental strategic decisions any organization has and these decisions have a profound impact on the organization's competitive performance (Hayes et al 2005, P116). Vertical integration is the merging of two businesses that are at different stages of the production process and often operated by two different firms, such as when a manufacturer owns its supplier and/or distributor. Merging in the way with something further on in the process (and thus closer to the final consumer) is known as forward integration, while merging with something further back in the supply chain is known as backward integration (The economist 2009). In the earlier history, for instance, the mid-1980, there was an emphasis on a high degree of vertical integration to reduce intermediaries and cost, in contrary, having no manufacturing capabilities was perceived sympathy. Yet in the past 20 years, a clear trend indicates the superiority of extensive outsourcing enabling the focus on a narrow set of 'core competencies'. Thus, there is not a general answer to tell whether outsourcing or vertical integration is a better strategy as merits change over time. Rather, it is more valuable to analyze in which conditions will outsource be a better strategy and under what situation is vertical integration more appropriate (Hayes et al 2005, P116-119).

Hayes et al (2005) figure out that the most appropriate attributes of analysis for vertical integration and outsourcing decisions are resources and capabilities. Accordingly, a framework is laid out for vertical integration which focuses on the choices between the assets and capabilities that a company should own and others that can be accessed through relationships with partners, customers, and suppliers. The framework is shown in Figure 3.4 below:

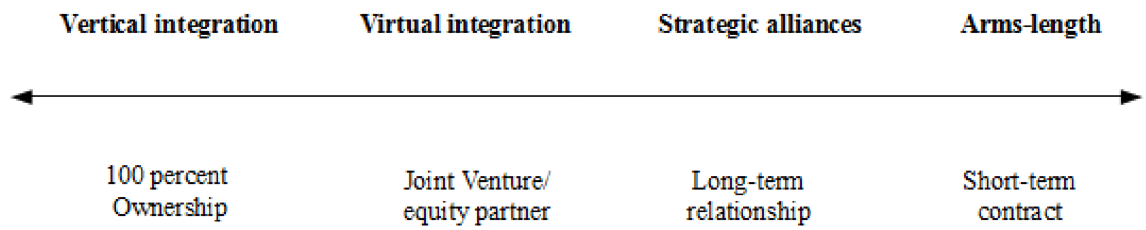


Figure 3.4: Continuum of governance structures (Source: Hayes et al 2005, P120)

In the above figure, the term 'Virtual integration' can be used to connote a relationship which involves a very high degree of coordination and cooperation between two independent firms. At first glance, virtual integration appears to encompass the best of both worlds through a higher degree of coordination and information exchange than arm-length contractual relationships, meanwhile avoiding parts of the organizational costs such as bureaucracy, overhead costs, and loss of incentives. However, when it could obtain the 'best of both worlds', there may be equal chance to be vulnerable for the worst of both as well. While the

‘Strategic alliances’ allows a greater degree of close coordination than the ‘Arms-length’ relationships where two parties do not have collective ownership contract with one another to buy or sell a product or service at an agreed upon price and time. Not any type of vertical ownership of assets is involved either (Hayes et al. 2005, P121). In practice, organizations need to choose the appropriate level of focus through this continuum.

One way to analyze the choices is to see the differences between two parties in governing decisions, information flows, and activities. In more details, three factors influence the choices of decisions in the continuum: 1) Capabilities and resources; 2) Coordination requirements; and 3) Strategic control and risks (Hayes et al. 2005, P123-136).

Operating capabilities and resource constraints are the first issues for an organization to assess, for the desired vertical integration should be feasible. Besides, the time required to acquire certain set of capabilities imposes a hard constraint on a company’s vertical integration as well. Generally, when the company simply lacks of financial resources to acquire the required assets, or there is prohibitive time to build or acquire certain capabilities, other craft alternative arrangements such as virtual integration may need to be considered. Yet this consideration will need to be jointly made together with other two sets of factors: coordination, and strategic control and risks.

Different degree of integration alone the continuum of governance structures in Figure 3.4 can all achieve various degrees of coordination. Thus, when designing the strategy, the object is to choose one that best addresses the specific types of coordination that need to be provided. Information exchange is a typical required coordination. While in many retail supply chains as an example, the new technologies have improved the coordination efficiency through, for instance, reducing the costs of stock-outs and excess inventories which facilitate the outsourcing. Thus, if part designs and specifications can be codified precisely and conveyed in standard ways, coordination between R&D and manufacturing may not require vertical integration. Yet there are also situations that the information required for close coordination is not easy to capture in codified format or be adequately interpreted. For instance, if the critical information about design requirements or production tend to be tacit and idiosyncratic, companies tend to lean more toward the vertically integrated end of the spectrum due to the costs of information and intensive face-to-face communication is often required.

Strategic control and risks of outsourcing is the third facet to be concerned for vertical integration strategy. The principle here is that supply chains need to be designed not just to create value, but also to capture that value. There are two types of risks regarding outsourcing: The risk of 'lock-in' which associates with a high cost of switching partners; and the risks related to the leakage of intellectual property. For lock-in risks, if switching costs for the partners are inherently low, outsourcing enables a company to take full advantage of the benefits of the market-based arrangements, and vice versa.

Regarding the intellectual property, if it can be readily identified and protected contractually, collaborative arrangements and outsourcing bring no particular risks of leakage; while if intellectual property could not be well protected by legal mechanisms and is inherently easy to imitate, vertical integration may be a useful way to inhibit such leakage. Additionally, trade-secret laws protect leakage as well, but it is not as strong as patent protection. Figure 3.5 provides a framework for organizational boundaries concerns the three factors.

	Vertical integration	Arms-length relationships
Coordination	'Messy' interfaces; adjacent tasks involve a high degree of mutual adaptation, exchange of 'tacit' knowledge, and learning by doing. Requisite information is highly idiosyncratic.	Standardized interfaces between adjacent tasks; requisite information is highly codified and standardized (prices, quantities, delivery etc)
Strategic control	Very high: significant investments in highly durable relationship-specific assets needed for optimal execution of tasks. Investments cannot be recovered if relationship terminates; • Co-location of specialized facilities •Investments in brand equity •Large proprietary learning curves • Long-term investments in idiosyncratic R&D programs	Very low: assets applicable to businesses with a large number of other potential customers or suppliers
Coordination property	Unclear or weak intellectual property protection. Easy-to-imitate technology. 'Messy' interfaces between different technological components	Strong intellectual property protection. Difficult-to-imitate technology. 'Clean' boundaries between different Technological components.

Figure 3.5: A Framework for organizational boundaries (Source: Hayes et al 2005, P137).

Facilities

There are three key structural decisions for creating an operations network when an operations organization is about to divide up its activities and assign different sets of activities to separate operating units: These are 'how many and how big different facilities should be utilized,' 'where should they be located', and 'how should each be specialized'? Thus, they refer to the size, location, and specialization of facilities (Hayes et al. 2005, P142).

When taking size into considerations, as Hayes et al. state (2005, P143), a network consists of a few large facilities may be easier to coordinate and better able to exploit economies of scale than one composed of a larger number of smaller facilities. Yet small and focused facilities have their important advantages as well. First, they are easier to manage and staff with effective managers. Second, they are more flexible and responsive to changing market demands and quicker to adapt to new technologies and approaches. Meanwhile, the overhead structures are more simple and lean, while communication becomes easier and learnings occur more rapidly since the reduced number of tasks repetitively can often lead to better quality and lower overall costs.

In regarding facility locations, there are concerns about, for instance, whether to locate near the markets or customers, near sources of raw materials, close to low-cost labor or pools of special skills. Each approach has its advantages in different situations and disadvantages in others. Thus trade-offs should be carefully assessed when making decisions.

When considering the specialization of facilities network, horizontal structure and vertical structure are two of the most common forms. Horizontal structure refers to that each facility is assigned to produce a restricted set of similar products and thus different facilities are capable of supplying customers directly and do not require large amounts of inputs from their 'sister' facilities in order to perform their tasks. In contrary, vertical structure is specialized by process stage which creates a process-focused or vertical network where a chain of operations includes a sequence of formal or informal buyer-supplier relationships. It means that each facility within the network is dependent on one another for key inputs and its 'customers' are often sister facilities.

Generally, managing a horizontal network typically requires decisions regarding the degree of autonomy that individual facilities should have, and which practices should be standardized across the network, while the key challenges in managing a vertical network revolve around how to coordinate the flows of goods and materials along the chain so as to meet delivery promises and minimize the costs of either understocking or overstocking, as well as to facilitate the development and introduction of new products (Hayes et al. 2005, P143-152).

Process technology

Process development can be a competitive tool for enhancing an organization's overall innovative capabilities. It is a hidden source in many industries which is still ignored by many companies. New process technologies can underpin the launch of successful new products in a variety of industries. The process development is, however, rooted in specific organizational capabilities and choices. Thus, there are three key drivers for process development performance according to Hayes et al. (2005, p196-217):

The first driver is the integration of product and process development. The matrix in Figure 3.6 depicts the roles of operations and process development alone with different phases of product lifecycle in different industries.

Rate of Process innovation	Low ← Rate of product innovation → High	
High	**Process focused** •Commodity chemicals •Steel •Shipbuilding Process development focuses on cost reduction	**Process enabling** •Pharmaceuticals/biotechnology •Specialty chemicals •Semiconductors •Advanced materials •High precision, miniature electronic goods •Services Process development focuses on solving complex technical issues, rapid to market, and fast ramp-up.
Low	**Mature** •Apparel •Agriculture •Cement •Paper Process development focuses on cost reduction.	**Product focused** •Software •Entertainment •Assembled products Either little process development or a focus on design for manufacturability.
	Low	High

Figure 3.6: The relationship between product and process innovation (Source: Hayes et al 2005, P198).

According to Figure 3.6, the two left-hand quadrants represent two aspects of the mature phase of the product lifecycle, where product innovation decreases. Process innovation continues actively in the upper left-hand quadrant containing industries that are given, while in the lower-left quadrant, both process and product innovation are slowed down.

The lower right-hand quadrant depicts the industries where product innovation is rampant, and process technologies are relatively stable; while in the upper right-hand quadrant, both product and process technologies evolve rapidly, they must be carefully synchronized and have a tight connection. This quadrant is vital where capability for fast, efficient and high-quality process development has a direct effect on the commercial success of new product introductions, and product and process capabilities are mutually dependent.

The second driver for process development refers to the timing of technology transfer from development to operations. The real power of process development and operational capabilities often lies in the following perspectives:

1) How they help companies to achieve faster time to market through, for instance, reducing product development lead times, obtain more flexible process development capability and process development skills.
2) How they help companies to achieve smoother and rapid production ramp-up, through effective and thorough process development before commercial launch for instance. Naturally, the faster and more effectively a firm can ramp-up production, the faster it can penetrate the market and further reduce the production costs.
3) How to enhanced customer acceptance of new products. Through a strong process development capability an organization sometimes can fundamentally alter its basic product concept which enhances customer acceptance of it.
4) And alternatively how they help companies to make a stronger proprietary position. Innovative process technologies can help to provide a way for organizations to extend the proprietary position of a product, hence, set a barrier to imitation.

The third driver for process development relies on the degree of autonomy granted to operating units to develop, change, and improve process technologies. This is to be discussed in terms of centralized versus decentralized process development and technology choices.

Under an extreme case of centralized approach, process technologies are selected and developed through a central process technology group while the operating units responsible for a given product or service are mandated to adopt a uniform standard process technology. The benefits of centralized process includes achieving a critical mass of technical talent to stay on the cutting edge of process technology changes; extracting the cumulative experiences of multiple operating units more efficiently; eliminating redundant development efforts and facilitate communication and coordination internally and externally; enabling the best practices to be shared across dispersed operating units, and the standardized process technologies are implemented across multiple units.

To the contrary, under a decentralized approach, individual operating units are given a high degree of latitude in developing, choosing and modifying technologies. At an extreme case, each unit can have its own process development group to be completely responsible for the technologies used there. Advantages of decentralized approach include that, the 'local' process development and engineering are likely to be more responsive to the needs of its customers and environment; expanding the number of process experiments who can be conducted within the network; possibly accelerating the transfer of technology from R&D to operations etc.

When to make a choice between these two approaches, the trade-offs come down to the organization's specific strategy and competitive priorities, mainly including the following aspects to be considered:

1) How important are the differences of 'local' for the markets or operating conditions?
2) How fully can the optimized process transfer to operations? For example, if learning-by-doing is particularly required for process optimal, then decentralization is more promising.
3) How do the major improvements in performance occur? If occur through multiple improvements within the process after transferred, as an example, then it would be too costly to adapt centralized approach.

3.1.3 Infrastructural policies and systems

Infrastructural aspects of operations strategy are the systems, policies, and practices that determine how the structural decisions of an organization are to be managed. It is as critical to the success of the company. Further, structural and infrastructural decisions are often made at different points of time by different groups of people who may be physically separated and have less interaction in the normal course of business. Hence, clear and full communication to all these groups, and consistently monitor the structural and infrastructural decisions are vital to a company's success (Hayes et al. 2005, p44).

Infrastructural developments involve high investments as well and are difficult to change or set performance parameters, yet in any year it probably will make at least one major decision falls into one of them (Hayes et al. 2005, p44). Cross-functional improvement team is recommended by Hill et al. (2009, 302-303).

Organization/Human Resource systems

Conventionally, organizations often split supporting activities into specialist areas and create functional silos which result in little strategic debates between functions. This leads to unconnected, uncoordinated, functionally biased and reactive developments of an organization. Organizations operated in this structure have created a situation where the delivery systems are supported from a distance, line roles and responsibilities are reduced, pay and reward systems are inappropriate and too many management layers been created. To cope with these shortages and realign infrastructure to markets, organizations must redefine functional objectives based on a cross-functional market review which is supported with data; existing management structures must be challenged with better-defined roles and responsibilities Hill et al. (2009, 328).

Human resource managers must design policies to motivate employees to work as a team to achieve the organization's goals (Fine and Hax 1985); Accordingly, payment and reward systems for employees need to be based on their skill and performance while overheads and flatten management structures should be reduced. Step changes should be avoided for they are costly, disruptive, difficult to get right and difficult to change again once made. Thus, changes must be made based on cross-functional teams who monitor the market needs and identify improvement areas, compare investment alternatives and develop the organizational infrastructure Hill et al (2009, 328).

Further, organizational structure can influence decision-making process as their degrees of empowerments are different. This often refers to the centralization and decentralization of organizational structure. From the definition, centralization means the concentration of authority at the top level of the administrative system, while decentralization, on the other hand, means dispersal of authority among the lower levels of the administrative system. Thus, the centralization versus decentralization revolves around the location of the decision making power in the administrative system (Jubenkanda and Marume, 2016). According to Kim et al. (2014), decentralized organizational structure encourages bottom-up action plans to a greater extent than a centralized organizational structure does. Table 3.3 shows the main differences between centralization and decentralization.

Table 3.3: Centralization vs. Decentralization (Source: Zdravkovic et al. 2014)

Organizational structure	Centralized	Decentralized
Geographical dispersion	Single location	Geographically distributed
Coordination: authority, decision rights and regulations	Vertical coordination: decision rights are strictly defined and governed by upper management; rigid accountability and responsibilities; standardized methods and procedures; homogeneous goals set by high-level authorities.	Lateral coordination: authority and decision making rights are pushed down to the business units, groups, or even individuals; individual entities in the organization are collaboratively working towards some goals.
Communication patterns	Communication patterns follow the hierarchy, direct interactions and communications are not practiced.	Informal communication lines, flexible, constantly changing communication lines; fluid, project-oriented teams.

Interests for a further discussion of the integration among managerial processes, organizational structure and corporate culture can see Hax and Majluf (1984b, Chapter 5).

Quality systems

Quality includes the design quality and conformance quality. Operational managers should be somewhat involved in design quality, yet their most crucial roles are with quality conformance (Fine and Hax 1985). Quality conformance is a vital factor which probably affects the market share more than any other factor, thus it is either an order-winner or an order-qualifier (Hill et al. 2009, p316). Following four important aspects are addressed.

- *Tasks and responsibilities*

Quality conformance concerns the tasks of measuring levels and responsibilities for meeting targets. In projector jobbing processes, these tasks and responsibilities of quality conformance rests with the persons who deliver the product or service; in continuous processing, quality checks are built into the process itself; and in batch and line, the execution and evaluation of tasks and responsibilities are often separate and conformance levels tend to consider how they recombine the doing and evaluating activities (Hill et al. 2009, p316).

- *Approach to manage quality*

Once the tasks and responsibilities are established, the organization must determine an approach to manage quality. The approaches can be either reactive or proactive approach. The former one means products and services are checked during the delivery to see of target conformance levels are met. Otherwise, changes to the process are made. This approach tends to occur in batch or line processes where the doing and evaluating tasks are usually separate, yet this separation can be overcome through challenging management structures, redefining roles and responsibilities and aligning improvement teams. While the latter one means the processes are continually monitored and redesigned to ensure that poor quality products or services would not be delivered. This approach ensures the minimal cost of rectification, scrap, returned products and non-repeat business (Hill et al. 2009, p317).

- *Quality assurance and control*

Quality assurance is about developing quality management structures, determining roles and responsibilities as well as establishing the procedures to ensure that quality target levels are met; whereas quality control is ensuring that the specifications are met. Organizations must combine quality assurance and quality control to overcome some weak link or the separation of roles in doing and evaluating tasks (Hill et al. 2009, p317). For different product and process positions, the quality assurance and control have different essential meanings and need to emphasize on different aspects. Figure 3.7 presents these different focuses of quality control for different process type in related to different product mix type.

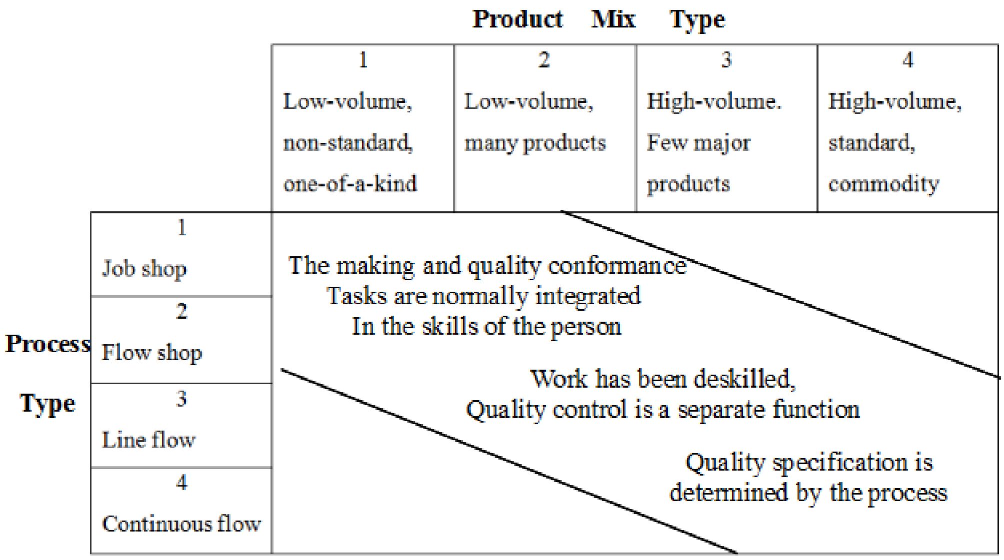


Figure 3.7: Quality control for different product/process positions (Source: (Hill et al. 2009)

- *Quality improvement culture*

It was found that many companies with high-profile reputations for quality have been told to do more empowerment to their employees. The embedded culture of quality improvement will help to improve the situation of doing, and evaluation tasks separately and better avoid the significant costs for reallocations of the task and responsibility or changing approach for quality management (Hill et al. 2009, p317). In other words, letting everybody is committed and delegated with responsibility and authority is significant for quality and helps an organization to improve from a vicious circle to a good circle (Bergman & Klefsjö 2010), as illustrated in Figure 3.8:

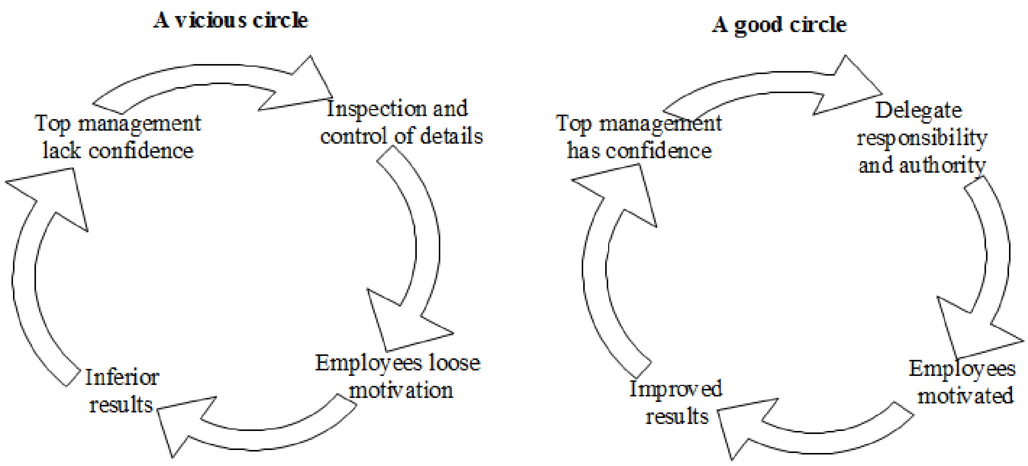


Figure 3.8: A vicious circle and a good circle, linked to the effect of delegating responsibility and authority (Source: Bergman & Klefsjö 2010, p47)

Planning and control systems

Organizations use systems to schedule, plan and control their operations mainly in the following ways (Hill et al 2009 p318-326; Hayes et al 2005 p41):

- *Schedule production*

Schedule production is mainly about the determinations on products to be made in certain period of time based on either known or forecasted customer orders. Some critical decisions include the make-to-order, assemble-to-order or make-to-stock decisions.

A company should choose one or a combination of these approaches to support its markets. The links of the master scheduling approach with operations and market needs are shown in Table 3.4: make-to-order approach fits for markets with low-volume, wide-ranging and special products. Operations can use a jobbing or low-volume batch process, manages changes in sales volume and product mix with order backlog and reschedules orders to satisfy the requirements on delivery speed; by contract, make-to-stock approach suits high-volume, standard products with a narrow range. In this way, operations can use a high-volume batch or line process, meanwhile holds finished goods inventory and eliminate process lead time to meet demand changes and delivery requirements; the assemble-to-order approach is used when market characteristics fall between these two approaches.

Table 3.4: Linking the master scheduling approach to operations and market needs (Source: Hill et al 2009, p326)

Strategic variables			Master scheduling approach		
			MTO	ATO	MTS
Market	Product	Type	Special	→	Standard
		Range	Wide	→	Narrow
	Individual product volume/period		Low	→	High
	Delivery	Speed	Difficult	→	Easy
		Reliability	Difficult	→	Easy
	Process choice	Jobbing or low-volume batch		→	High-volume batch or line
Operations	Managing volume and mix changes	Order backlog		Work-in-progress inventory	Finished goods inventory
	Meeting delivery speed requirements	Reschedule orders		Reduce process LT	Eliminate process LT

- *Plan materials*

This refers to the use of BOM (Bill of materials) for each product in which material requirements are calculated from the master production schedule. Normally, the planning regarding how many materials to produce and when to produce relies on whether the business uses a time-phased or rate-based approach. The differences between time-phased or rate-based approaches are depicted in Table 3.5 as below:

Table 3.5: Linking materials planning approach to operations and market needs (Source: Hill et al 2009, p327)

Strategic variables			Material planning approach	
			Time phased	Rate based
Market	Product	Type	Special	Standard
		Range	Wide	Narrow
	Individual product volume/period		Low	High
	Ability to cope with product mix changes		High	Limited
	Delivery	Speed	Difficult	Easy
		Schedule changes	Difficult	Easy
Operations	Process choice		Jobbing or low-volume batch	High-volume batch or line
	Cost reduction sources	Overheads	No	Yes
		Inventory	No	Yes

Here, as could be exemplified, the time-phased planning suits low-volume and special products with a wide range adapting jobbing or low-volume batch process. Zero inventory and operations overheads are low as skilled operators plan and schedule activities themselves. The process is able to cope with product mix changes yet the long lead time results in difficulties to meet the delivery speed and schedule changes. Rate-based approach is then much to the contrary.

- *Control shop-floor activities*

Shop-floor activities must be controlled to ensure that orders can be delivered with customer requirements met. Push or pull order systems are basically the operations that an organization can choose between.

The links between shop-floor control systems, operations and market needs are exhibited in Table 3.6: When the markets have high-volume demand and standard products, for instance, orders can be pulled through the shop floor using Kanban systems or likewise to control material flows and finished goods to meet the delivery requirements; By contrary, low-volume specials are manufactured by skillful operators to control the flow of orders by pushing through the shop floor. This could turn out to have high changeover costs between jobs, but demand increases are more incremental and easier to be met.

Table 3.6: Linking shop-floor control systems to operations and market needs (Source: Hill et al 2009, p327)

Strategic variables			Shop floor control approach	
			Push	Pull
Market	Product	Type	Special	Standard
		Range	Wide	Narrow
	Individual product volume/period		Low	High
	Demand Variability	Volume	Easy increment	Difficult stepped
		Product mix	High	Low
	Delivery	Speed	Schedule change	Finished goods inventory
		Schedule changes	More difficult	Less difficult
Operations	Process choice		Jobbing or low-volume batch	High-volume batch or line
	Cost reduction sources	Overheads	No	Yes
		Inventory	No	Yes
	Changeover cost		High	Low
	Control	Key feature	Order status	Flow of material
		Basis	Person or system	System
		Ease of task	Complex	Easy

- *Inventory*

Inventory is a mechanism be used to cushion stable delivery systems for the unstable markets. Hill et al (2009) suggest that there are three inventory types or categories: Corporate inventory in terms of safety stock to safeguard against supply uncertainties; Sales and marketing inventory to meet demand uncertainties and customer agreement to hold stock or launch a new product; Purchasing for bulk buying to benefit from quantity discounts; as well as operations.

To manage the inventory successfully, a company must change a number of aspects: For the first, should use inventory to support markets. For the second, establish inventory targets and functional responsibilities according to the market needs, meanwhile continually review such systems as markets are always changing. For the third, analyze and manage inventory by cause, once the targets and responsibilities are established, the inventory levels can be monitored and managed by causes.

3.1.4 Approaches for strategy alignment

The alignment or formulation of operations strategy has often been conceptualized as a top-down process of "formulation and implementation" within the guidelines of overall corporate strategy since Skinner (1969) has postulated it for the first time. Top-down approach has been widely accepted and dominated empirical studies on the process of operations strategy (Marucheck et al., 1990; Menda and Dilts, 1997; Schroeder et al., 1986; Ward et al., 1996; Ward and Duray, 2000). Hill et al. (2009) and Hayes et al. (2005) mainly support this approach as well.

In top-down approach for this strategic formulation, top management specifies the organization's long-term goals, intentions, and means prior to actions in the form of a plan which is elaborated in as many details as possible to translate it into collective actions with a minimum of discretion left. According to the outcomes, the plans are either reinforced or modified to be appropriate (Burgelman and Grove, 2007; Kim et al. 2014).

To the contrary, the bottom-up formulation may emerge as an unplanned pattern of actions and may realize outcomes not initially intended by top management (Burgelman and Grove 2007; Kim et al. 2014). The strategy is initiated by lower managers' actions which represent their interpretations of the company's directions, which may partially differ from top management's prior intentions.

Kim et al. (2014) suggest that a combination of top-down and bottom-up processes would enable a complementary effect of both top management's strategic intentions and the lower-level manager's expertise. According to their empirical case study at several German manufacturers, the authors found empirical evidence of such combined process regarding the strategic formulation. Within the case companies, top management determines action plans based on specific objectives derived from its desired outcomes, and stipulates these plans in detail to lower-level managers, while bottom-up action plans usually begin as autonomous initiatives of lower-level managers and are scaled up from small by earning top management's support. For an initiative to earn the status of a high-priority action plan, lower-level managers must demonstrate its value-generating potential through early successes. As a result, usually only a few are able to demonstrate value-generating potential and so become one of top management's action plans. According to these empirical supports or findings, the authors proposed this integrated process formulation demonstrated in Figure 3.9.

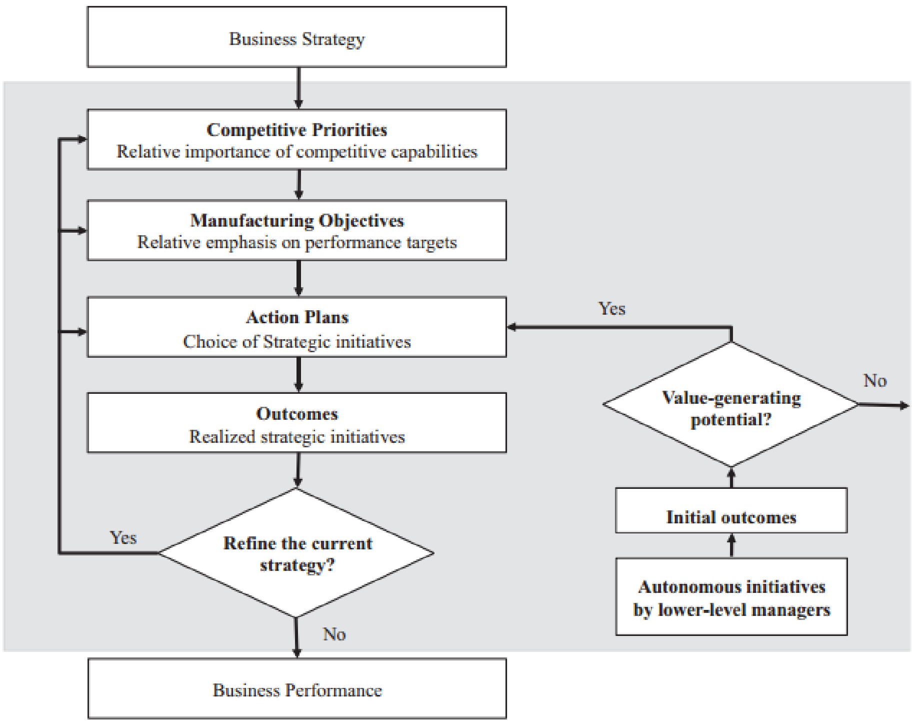


Figure 3.9: An integrated model of the operations strategy formulation process (Source: Kim et al 2014).

From the empirical data analysis, the authors further figured out that, top-down action plans mainly focus on new products and technology (35% of total top-down action plans are about new product and technology), and somewhat less so on organization and coordination (28% of total top-down action plans are in this area), while bottom-up action plans address much more manufacturing and supply chain processes (69% of total top-down actions are in this area) than they do new products or technologies (17% of total top-down actions are in this area). This supports the authors' arguments that this integrated process with both approaches acts as a contemporary of each other in operations strategic formulation (Kim et al. 2014).

Further, the authors identified the centralized or decentralized organizational structure is a contingency factor that affects the balance of top-down planning and bottom-up learning: Their empirical results show that decentralized organizations adopt relatively more bottom-up actions than centralized organizations do.

3.2 Supply chain strategy

Since the early days of supply chain management studies, supply chain strategy (SCss) was recognized as an important role in helping companies balance the conflicts among different functions and handle issues such as high supply chain costs, high inventory levels, poor customer service, inter-departmental conflicts and the challenge of goal restructuring (Stevens 1989; Perez-Franco et al. 2016). In 1997, Fisher presented a seminal framework of supply chain strategy applying the principle of 'Fit-and match' with products types defined by either functional products or innovative products. Fisher's model receives lots of concerns and attention from both the industrial managers and academic researchers. The model becomes one of the most influential and essential one for the further development of the supply chain strategic study. Since then, determining and classifying variety types of supply chain strategy has become one dominant paradigm of supply chain strategy studies on one hand (Christopher, 2000; Mason-Jones et. al 2000; Frohlich and Westbrook 2001; Lee, 2002; Chopra, and Meindl, 2007; Simchi-Livi, et al 2013, and more). Meanwhile, the alignment of supply chain strategy in terms of top-down approach (Chopra and Meindl, 2007; Perez-Franco et al., 2016; Basheer Ahmad and Gazanfar Adnan 2017), and/or aligned with implied supply chain uncertainties (Lee, 2002), or driven by outcomes Melnyk et al. 2010) etc. started to draw much attention of different researchers and became a major focus and one of the central research questions in their studies. On the other hand, the research in supply chain strategy appears to let a hundred schools of thought strive. Yet there is no consensus in fundamental ideas regarding how a supply chain strategy is to be properly defined, what decision categories does it consist of, how to make the 'type-and-match' solutions applicable in detailed steps in practice and how to differentiate a company's supply chain strategy and so on, are considered relevantly insufficient in supply chain strategy research (Hilletofth, 2008; Perez-Franco et al., 2016). In the following sessions, the development and theory of supply chain strategy will be reviewed in more details, in the aspects of its definition, classifications, alignments and decision categories.

3.2.1 Definitions

As been figured out by Rose, et al (2012), and further confirmed by Birhanu et al, Lanka, and Rao, (2014), the definition of supply chain strategy has not been jointly agreed upon or explicitly defined.

In Andrews's 'The Concept of Corporate Strategy' (1987), he opens its first section by stating that *'strategy is the pattern of decisions in a company' that 'reveals'* its goals. Cigolini *et al.* (2004) - after conducting an extensive meta-analysis of over a hundred case studies in supply chain management - conclude that *'what companies actually did, rather than what they claimed their strategic intent to be, is the best clue to reveal their very supply chain management strategies.' (*Cigolini *et al. 2004. p.12).*

Chopra and Meindl (2007, p23-24), viewed supply chain strategy for determining *'the nature of procurement of raw materials, transportation of materials to and from the company, manufacture of the product or operation to provide the service, and distribution of the product to the customer, along with any follow-up service and a specification of whether these processes will be performed in-house or outsourced'*. Namely, supply chain strategy includes not only the broad structure of the supply chain and the traditionally called 'supplier strategy,' 'operations strategy,' and 'logistics strategy', but also the design decisions regarding inventory, transportation, operating facilities, and information flows as well Chopra and Meindl (2007, p24).

Schnetzler, el al (2007) define supply chain strategy *as 'a set of prioritized supply chain management objectives, e.g. strategic priorities and a way to operationalize them, i. e., to determine appropriate measures, in order to build up and capitalize on so-called logistics success potentials that can potentially result in successful business performance*' and a few years later, Rose, et al (2012) added that supply chain strategy can also be emergent beyond deliberate and defined the concept as a *'deliberate and/or emergent conceptual framework by which a company involves its supply chain and supply chain members in its efforts to reach its own corporate strategic objective'.*

Perez-Franco, et al (2016) define the supply chain strategy of a BU as *'the collection of general and specific objectives set for the supply chain of the BU, and the policies and choices put in place to support them, with the purpose of supporting the business strategy, given the BU's context and the environment'.* This definition, claimed by the authors, is in line with the tacit definition of SCS given in Stevens (1989) and the explicit definition given in Narasimhan et al. (2008).

Possibly due to the lack of a jointly agreed definition or the very general and abstract meaning, different understandings of supply chain strategy might grow in the research field and an ambiguous way towards understanding its connotation and extension might exist among managers. This calls for a well-structured definition of supply chain strategy in terms of detailed decision categories. In this thesis, the latest definition offered by Perez-Franco, et al (2016) mentioned above will be used but adjusted, while '*the policies and choices put in place to support* the *general and specific objectives'* will be further addressed in the analysis chapter as well to make the definition more concrete and also to answer the research question one regarding the decision categories of supply chain strategy.

3.2.2 Classifications and discussion

According to the literature review, supply chain strategy classifications, in other words, supply chain strategy based on ***'type-and-match'*** solutions is the most popular study within this field. Therefore, this session is about to summarize these different types of supply chain strategy, as well as the logic that form them.

Cost-efficient versus responsive supply chain

Cost-efficient and responsiveness are two classical types of supply chain strategy, which was originally from Fisher (1997) and are still being one of the most applied and followed ideal supply chain strategy. Supply chain efficiency is the inverse of the cost of making and delivering a product to the customer, while responsiveness includes supply chain ability in doing the followings (Chopra and Meindl, 2007):

- Respond to wide ranges of quantities demanded
- Meet short lead times
- Handle a large variety of products
- Build highly innovative products
- Meet a high service level
- Handle supply uncertainty

According to product nature or design, it is a start point to define whether the product is to be functional or innovative based on a set of aspects of demand. Relevantly, functional products are usually predictable with demand pattern, while innovative products have unpredictable demand pattern due to market uncertainty. See the details in Table 3.7 below.

Table 3.7: Differences in demand of functional versus innovative products (Source: Fisher 1997)

Aspects of demand	Functional (predictable demand)	Innovative (unpredictable demand)
Product life cycle	More than 2 years	3 months to 1 year
Contribution margin	5%-20%	20%-60%
Product variety	low	high
Average margin of error in the forecast at the time production is committed	10%	40%-100%
Average stock out rate	1%-2%	10%-40%
Average forced end-of-season markdown as percentage of full price	0%	10%-25%
Lead time required for made-to-order products	6 months to one year	1 days to 2 weeks

Based on these market demand aspects, the designed products are potentially to be classified into either functional or innovative types. A matrix is then developed to define the type-and-match of the supply chain strategy according to the product types. See Figure 3.10.

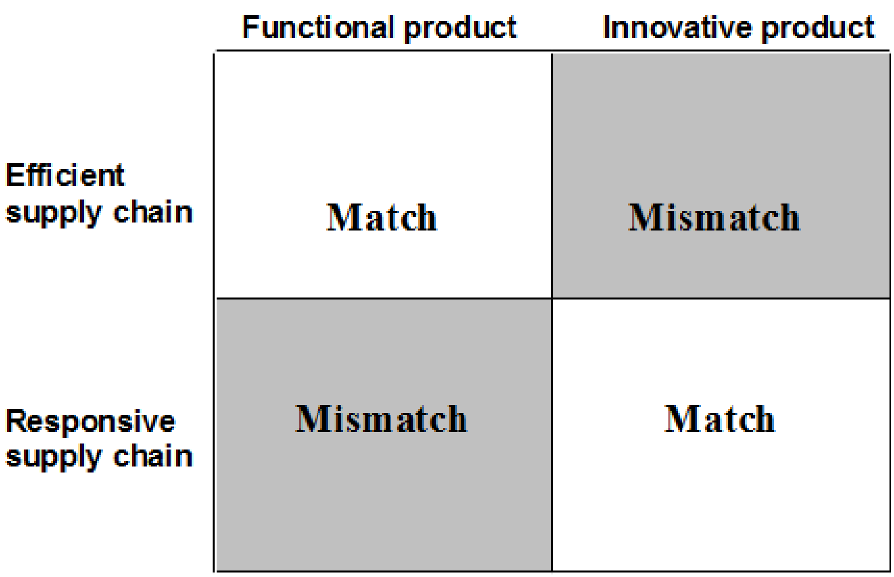


Figure 3.10: Matching supply chain strategy with product (Source: Fisher 1997)

In this matrix, the ideal supply chain strategy is formulated according to product type: An efficient process is for functional products and a responsive process is for innovative products. Companies who fall into the mismatch matrixes (the lower left-hand or the upper right-hand cells) tend to be the ones with the problem (Fisher 1997).

In practice, there are companies situated in the mismatched cells or somewhere between, for example, some computer companies who target customization and innovative designs for the market, yet operate a physical efficient supply chain. These companies are encouraged to getting out of the mismatched cell (Fisher 1997).

In 2007, an empirical study in Sweden by Olhager and Selldin was conducted to test again the model. Generally, it confirms that different product types call for different supply chain strategies, although the data shows that there isn't an overall clear match between product type and supply chain design, companies are having the tendency to fit the appropriate supply chain to the product. When the products are still functional type, a lag for shifting the focus from responsive to efficient supply chain, however, exist within quite several companies according to this empirical study, namely, situated in the lower left-hand cell, which is, claimed rarely according to Fisher's conclusions in 1997. The results of this empirical study prove that companies with a match between product type and supply chain strategy outperform those with mismatches with respects to Cost, delivery speed, and delivery dependability. It also supports that no matter it is an efficient or responsive supply chain, the company can achieve good a cost performance as long as it matches between product and supply chain type. Yet good quality can be obtained for any type of supply chain and any type of product.

There are many other authors followed Fisher's matrix in supply chain strategy study, like Ramdas and Spekman (2000); Hopp (2003); Chopra and Meindl (2007); Minnich (2007); and Lyons (2014) to name a few. Yet some questions or empirical evidence against this model also exists at the same time: Lo and Power (2010) found empirical evidence against Fisher's dividing products and supply chains into dichotomous types; Qi et al. (2009) found that Fisher's preferred matches were outperformed by other combinations beyond his framework (Perez-Franco et al. 2016); Godsell et al. (2011) strongly argue to consider end-customer needs in determining SCSs which is customer responsive SCSs. It is proposed by the authors that the focus on "product" needs to be replaced by a focus on "end-customer"—more specifically, by the market segment's needs for certain product; The mentioned study by

Olhager and Selldin (2007) introduces a supply chain frontier which indicates that a supply chain strategy can be formulated based on a combination of different degree of efficiency and responsiveness positioned along the frontier. This brings the idea that future supply chains are likely to have attributes that support both a strong physical function in delivering the goods and a strong responsive function for conveying information from the market. The frontier is shown in Figure 3.11 below.

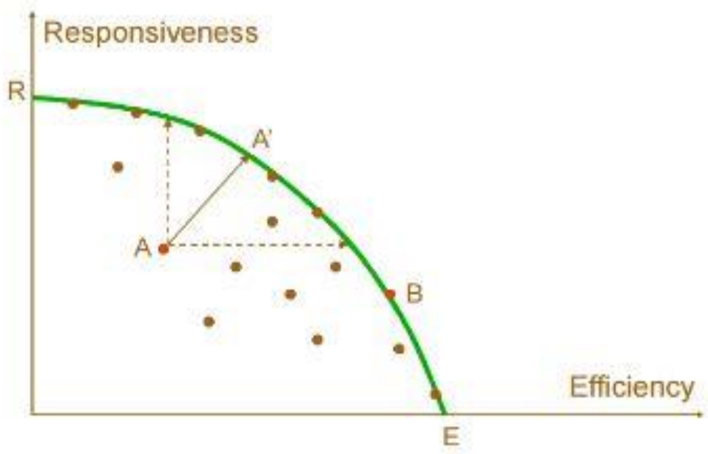


Figure 3.11: Efficient-Responsiveness frontier (Source: Norrman (2017), adopted from Olhager and Selldin 2007)

Efficient, Responsive, Risk-hedging, and Agile

Based on Fisher’s idea that takes into account the market uncertainty applied to the product when determining the right supply chain type, Lee (2002) suggests that both the demand and the supply uncertainty will be used as a framework to devise the right supply chain. Therefore, the supply chain strategy grows into four types based on different combination of the demand and supply uncertainty.

Lee (2002) states three critical factors for a company to be successful with its SCS:

1) The strategy needs to be tailored according to the specific customer need.
2) Both supply uncertainty and demand uncertainty should be studied and aligned with right supply chain strategy.
3) Using internet as a powerful tool.

Whereas low supply chain uncertainty refers to the ‘stable process’ having mature manufacturing process and underlying technology, meanwhile a well-established supply base is out there. High supply chain uncertainty refers to the ‘evolving supply process’ that at its early development stage of the manufacturing process and underlying technology which are rapidly changing. Meanwhile, the supply base is limited in both size and experience. Table 3.8 shows main characteristics between the two types of supply chain uncertainty.

Table 3.8: Stable process versus evolving process (Source: Lee 2002)

Stable process (Low supply uncertainty)	Evolving process (High supply uncertainty)
Less breakdowns	Vulnerable to breakdowns
Stable and higher yields	Variable and lower yields
Less quality problem	Potential quality problems
More supply sources	Limited supply sources
Reliable suppliers	Unreliable suppliers
Less process changes	More process changes
Less capacity constraint	Potential capacity constrained
Easier to changeover	Difficult to changeover
Flexible	Inflexible
Dependable lead time	Variable lead time

Joint this supply uncertainty with demand uncertainty that applied by Fisher’s, supply chain strategy increase from the dichotomous type of either efficient or responsive supply chain into a four type matrix in the information age, presented in Figure 3.12 as following: which additionally include the risk-hedging supply chain and the agile supply chain.

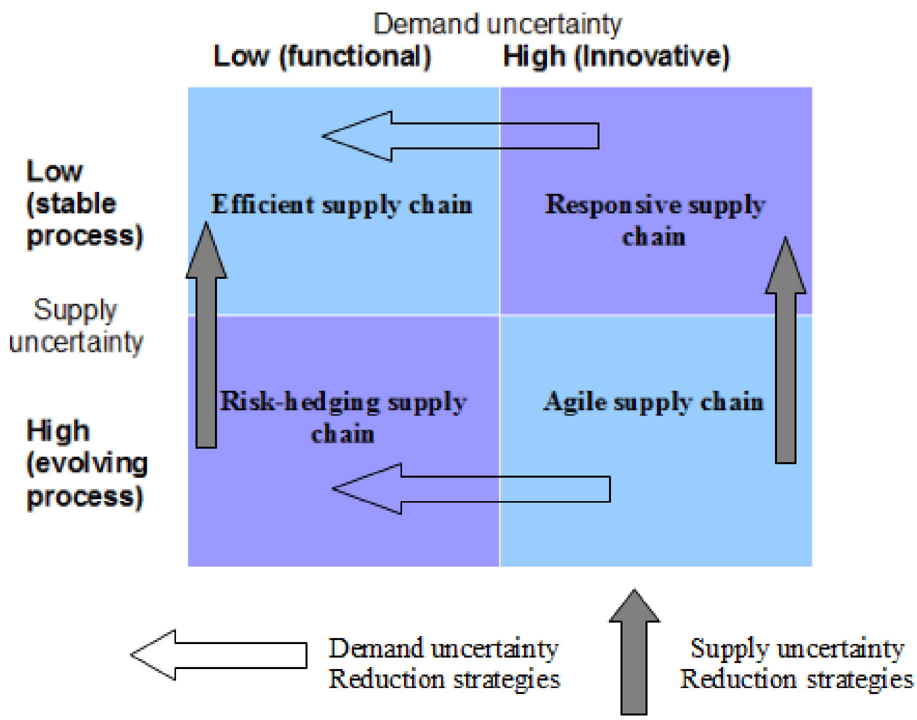


Figure 3.12: Matched strategies according to demand and supply uncertainty (Source: Lee 2002)

This matrix tells that the efficient supply chain and responsive supply chain are ideal in the case of low supply chain uncertainty, namely they are matched with the stable process. When a higher supply uncertainty is implied under the evolving process, functional products need to embrace a risk-hedging supply chain and innovative products need an agile supply chain. Here the risk-hedging supply chains are *'supply chains that utilize strategies aimed at pooling and sharing resources in a supply chain so that the risks in supply disruption can also be shared'*. While agile supply chain refers to *the 'supply chains that utilize strategies aimed at being responsive and flexible to customer needs, while the risks of supply shortages or disruptions are hedged by pooling inventory or other capacity resources'* Lee (2002).

Further, the author suggests several manners to reduce the implied uncertainty across the supply. As a result, the suitable supply chain strategy may also change under different implied uncertainty.

For supply uncertainty reduction, the recommended ways include free exchange of information and exchange from the early stage of product development; early design collaboration; as well as supplier hubs to reduce the supply risks of their manufacturing lines.

For demand uncertainty, information sharing and tight coordination are strongly suggested in order to reduce the system induced uncertainty bullwhip effect Lee (2002).

The followers of Lee's classification of supply chain strategy include Jacoby (2010), Özkir and Demirel (2011), etc., in their studies.

Lean, agile and leagile

Another well-known supply chain strategy classification falls into the type of Lean, agile, and leagile (Naylor et al. 1999; Mason-Jones, et al 2000; Christopher 2000). To some extent, lean and agile can be viewed as an interchangeable name for Fisher's essential type of physical efficient and respectively responsive supply chain. Some authors such as Lyons, (2014) still treat them equally as the same thing, yet as described in Lee's matrix (2002) mentioned above, responsive and agile are two different supply chain types. Mason-Jones et al., (2000) understand them this way:

Agility means *'using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile marketplace'*, while Leanness refers to *'developing a value stream to eliminate all waste, including time, and to ensure a level schedule'*.

The synonymous difference between agile and responsiveness can be observed: agile supply chain emphasizes on the ability to respond both quickly and cost-efficiently to any sudden changes in the marketplace (Mason-Jones, et al 2000), compared with the responsive supply chain that deals with product demand uncertainty. A synonymous difference between Lean and Efficient supply chain is given by Chibba (2007), yet in most of the case, they are assumed to have the same meaning in the metrics part as their major objective is towards efficiency (Birhanu et al. 2014).

Mason-Jones et al. (2000) suggest adapting Lean for commodities and Agile for fashion products. These are having same standpoints derived from product type as Fisher (1997). But the authors apply the order qualifier and order winners to this supply chain strategic design. Further, the introduction of Leagile strategy is a different thinking, which might be traced back to the research by Naylor et al. (1999). Leagile allows a combination of both lean and agile through different stage of the supply chain. The customer order decoupling point is a suggested penetration position from where the downstream of the supply chain is adaptable with an Agile strategy for responding to a volatile market demand and upstream is to be Lean for providing level scheduling (Naylor et al. 1999).

The solutions of Lean, Agile and Leagile can be illustrated according to the block diagrams in Figure 3.13. Other authors that study or adapt this classification of supply chain strategy include M. Bruce et al. (2004), Christopher et al. (2006) and Qi et al. (2017).

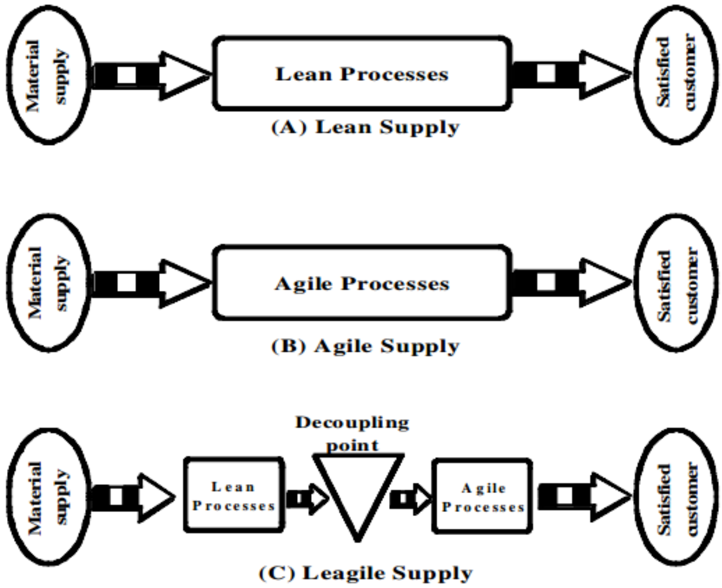


Figure 3.13: Block diagrams representing Lean, Agile and Leagile supply chain. (Source: Mason-Jones et al 2000).

Corresponding to CODP

Some studies are taking the customer order decoupling points (CODP) to name and differentiate supply chain strategy type. Martinez-Olvera and Shunk (2006) consider that there are five "business models" that manufacturing firms may follow: engineer-to-order (ETO), make-to-order (MTO), and assemble-to-order (ATO), make-to-stock (MTS), and make-to forecast (MTF). The authors argue that each business model is associated with a series of specific values for the "supply chain structural elements," which in turn define that there are five ideal supply chain strategies, one for each business model. Another study focuses on DELL's supply chain solutions and finds that there are four different supply chain strategies adapted by DELL: Build to order, build to plan, build to stock, and build to specification. Each strategy targets a different customer segment (Simchi-Livi, et al. 2013).

Arcs of integration

Frohlich and Westbrook (2001) define supply chain strategy according to the degree of supply chain integration. Deriving from the strategic importance of integrating suppliers, manufacturers, and customers, the authors investigate supplier and customer integration strategies in a global sample of 322 manufacturers and argue that different supply chain strategies can be empirically classified into at least five valid types defined by the direction and degree of integration towards suppliers and/or customers. According to the literature, there are two interrelated supply chain integration (SCI) forms that manufacturers often employ. The first is the *forward* physical flow of deliveries between suppliers, manufacturers, and customers. Different degree of coordination and integrations are involved in terms of just-in-time, product postponement and mass customization, or third party logistics and so on. The other prevalent type of integration refers to *backward* coordination of information technologies and the flow of data from customers to suppliers (Frohlich and Westbrook, 2001). Figure 3.14 illustrates these two integration forms. There are also authors that define internal and external integration as two major dimensions of SCI. Internal integration refers to the degree to which a manufacturer structures its own organizational strategies, practices, and processes into collaborative, synchronized processes to fulfill its customers' requirements and efficiently interact with its suppliers. Whereas external integration refers to the degree to which a manufacturer and its external partners structure inter-organizational strategies, practices, and processes into collaborative, synchronized processes (Flynn et al., 2010).

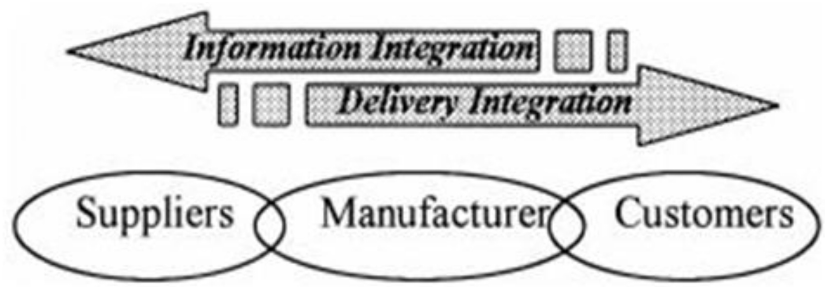
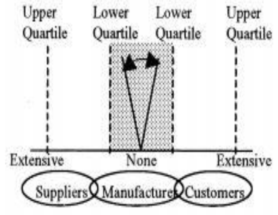
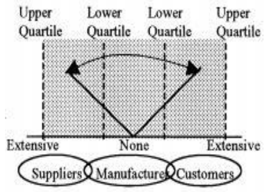
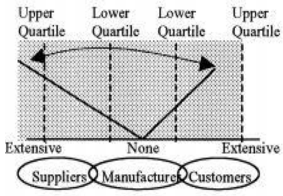
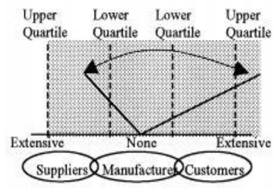
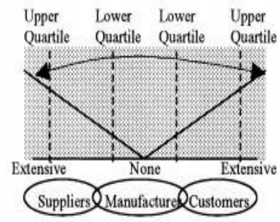


Figure 3.14: Two ways of supply chain integration (Source: Frohlich and Westbrook, 2001)

According to Frohlich and Westbrook (2001), five type of supply chain strategy with different degree and direction of integrations are defined and presented here in Table 3.9. The findings provide evidence that supply chains establishing integrations with both suppliers and customers are having higher performance than those established lower degree or lend to one side of integrations. Hence, it implies that company should set the goal of broader supply chain integrations in order to keep competitive (Frohlich and Westbrook, 2001). Further emphasis on the importance of supply chain integration includes studies by Cousins and Menguc (2006), Storey et al. (2006), and Birhanu, et al. (2014) etc.

Table 3.9: Supply chain strategies corresponding to the arcs of integration (Source: Frohlich and Westbrook 2001)

Supply chain type	Characteristics	Illustration	SC performance
Inward-facing	In lower quartile for both suppliers and customers		Recorded as having the lowest performance
Periphery-facing	Above lower quartile for suppliers or customers but below upper quartile for both		The greater the degree of the arc, the higher the performance is likely to be.
Supplier-facing	In a upper quartile for suppliers and below upper quartile for customers		Having few apparent advantages over the inward-facing strategy.
Customer-facing	In upper quartile for customers and below upper quartile for suppliers		Having few apparent advantages over the inward-facing strategy.
Outward-facing	In upper quartile for both the suppliers and customers.		Strongly associated with highest level of performance improvements.

Pull and Push

Another classification of SCSs supported by different authors is based on pull and push strategy (Harrison et al 2003; Simchi-Levi et al 2003; Minnich, H. Maier 2007; Kim et al 2012). In push-based systems, production decisions are based on the long-term forecasts and execution is initiated in response to a customer order, while in pull-based systems, production is driven by market demand and execution is initiated in anticipation of customer orders. According to Harrison et al. (2003), a supply chain is almost always a combination of both push and pull, where the interface between the push-based and the pull-based stages is called the push-pull. In particular, this hybrid strategy is composed of a push element for the component procurement and a pull element for production, plus additional push/pull elements based on network equilibrium and other cooperative mechanisms (Olhager, 2003). The organizational competencies could be strengthened by using the combined effect of strategies to fetch off the advantages of both strategies in serving the customer better at relatively lower cost.

Others

There are for sure more classifications of supply chain strategy available in this research field. For instance, Melnyk, et al. (2010) stand for the outcome-driven supply chain and argue that costs, responsiveness, security, sustainability, resilience, and innovation are six major outcomes to drive what a supply chain to be designed based on trade-offs and having at least one standout outcome to be achievable. Beyond Efficient or Responsive, there is also possible to have a Quick supply chain according to Chibba (2007) which refers to supply chain that deals with innovative products often with a high technical level and a demand that is difficult to forecast, meanwhile the products are in the introduction (and decline) stage of the product lifecycle.

3.2.3 Approaches for strategy alignment

It is critical for a company to understand not only which type of supply chain strategy to match their business, but also how to align such strategy within the company and relate to the supply chain partners appropriately. Lee (2002) claims three important factors that affect a company to align the right supply chain strategy:

1) The strategy needs to be tailored to meet specific needs of the customers.
2) Different product types should be managed in different supply chain solution.
3) Internet as a powerful tool to support or enable supply chain strategies for products with different demand and supply uncertainties.

Researchers have developed different methods, approaches, or frameworks to guide such supply chain strategic alignment. In this session, the classical Fisher's approach, the broadly accepted top-down approach of strategic fit, with one representable model proposed by Chopra and Meindl (2007), as well as one of the most up-to-date framework named 'CSAR' offered by Perez-Franco (2016) will be further introduced.

Fisher's approach

We start again from the classical model proposed by Fisher (1997). While he states the ideal strategies are to be either physical efficiency or market responsiveness corresponding to two typical product type, a set of decision elements to configure relevant supply chain strategy are given in Table 3.10 below:

Table 3.10: Exemplify the decision aspects to align an efficient or a responsive supply chain (Source: Fisher 1997)

Decision aspect	Cost efficient supply chain	Market-responsive supply chain
Primary purpose	Supply predictable demand at efficient way and lowest possible cost	Respond quickly to unpredictable demand in order to minimize stock-outs, forced markdowns, and obsolete inventory
Manufacturing focus	Maintain a high average utilization rate	Deploy excess buffer capacity
Inventory strategy	Generate high turns and minimize inventory throughout the supply chain	Deploy significant buffer stocks of parts or finished goods
Lead-time focus	Shorten Lead-time as long as it doesn't increase cost	Invest aggressively in ways to reduce lead time
Approach to choosing suppliers	Select primarily for cost and quality	Select primarily for speed, flexibility, and quality
Product-design strategy	Maximize performance and minimize cost	Use modular design in order to postpone product differentiation for as long as possible

These decision aspects are given in the way of examples, which mean that we can receive inspirations about what an efficient supply chain could be aligned through certain decision aspects, yet through the literature it is ambiguous whether these aspects cover all that an efficient supply is about, or are there more decisive elements to be taken into account when aligning the cost-efficient supply chain? So does the responsive supply chain. This is due to the lack of consensus with regard to what a supply chain strategy is about, in other words, what systems and policies are included in its decision framework.

Top-down approach of strategic fit

Chopra and Meindl (2007) develop a three-steps approach to achieve the supply chain strategic fit based on their review that covers both Fisher's model (1997) and Lee's study which offers the classification of four types of supply chain strategy: efficient, responsive, risk-hedge and agile supply chain (2002). This is a top-down approach as the key principle is to align a company's supply chain strategy with its competitive strategy. The logic is that competitive strategy will specify one or more customer segments that a company hopes to satisfy. Based on such customer segments specified either explicitly or implicitly by the competitive strategy, the company will be able to follow the three steps approach interpreted in details as below (Chopra and Meindl 2007, p26). The authors believe that there is a right supply chain strategy for a given competitive strategy and the drive for strategic fit should come from the highest levels of the organization.

- *Step one: Understand the customer and supply uncertainty*

This is to understand the customer need according to its segment, and identify the extent of the unpredictability of demand, disruption, and delay that the supply chain must be prepared for. Demand uncertainty is different from implied demand uncertainty, while the former one reflects the uncertainty of customer demand for a product, the later one, in contrast, is the resulting uncertainty for the portion of the demand that the supply chain plans to satisfy and the attributes the customer desires. Variables affect implied demand uncertainty include the customer need in terms of the required range of demand quantity, lead time, a variety of products required, number of retail or distribution channels, the rate of innovation, level of service needed and so on.

Supply uncertainty is influenced by various factors of the supply source including the frequency of breakdowns, quality, supply capacity, the flexibility of supply capacity, and evolving production process and so on. Some product might have regional restrict in terms of, for instance, rainfall, weather although the demand for such products could be very stable.

Based on above information, the company is able to measure the implied uncertainty

from the customer side and the supply chain, to combine and map them on the implied uncertainty spectrum, which is shown in Figure 3.15 as below:

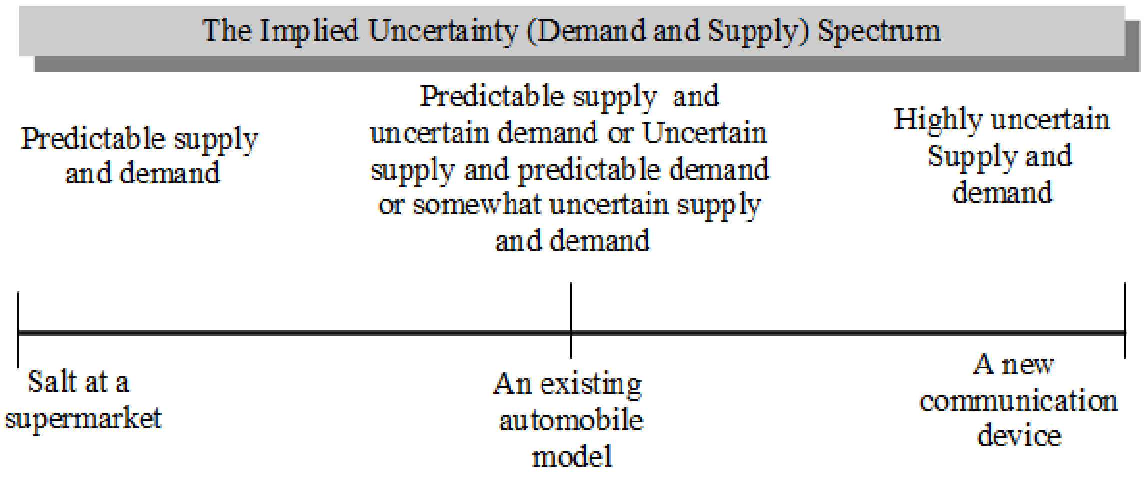


Figure 3.15: The implied demand and supply uncertainty Spectrum (Source: Chopra and Meindl 2007, p29).

- *Step two: Understand the supply chain capabilities*

Given the uncertainty a company faces, creating strategic fit is all about creating a supply chain strategy that best meets the demand it has targeted. The supply chain capabilities in here are mainly evaluated according to its abilities in acting responsiveness, recall the indicators as below:

- Respond to wide ranges of quantities demanded
- Meet short lead times
- Handle a large variety of products
- Build highly innovative products
- Meet a high service level
- Handle supply uncertainty

The more of these abilities a supply chain has, the more responsive it could be, and for every strategic choice to increase responsiveness, there are additional costs that lower efficiency. Based on this evaluation of supply chain capabilities, as well as trade-offs to efficiency, the level of responsiveness it seeks to provide can be mapped in the responsiveness spectrum, shown in Figure 3.16.

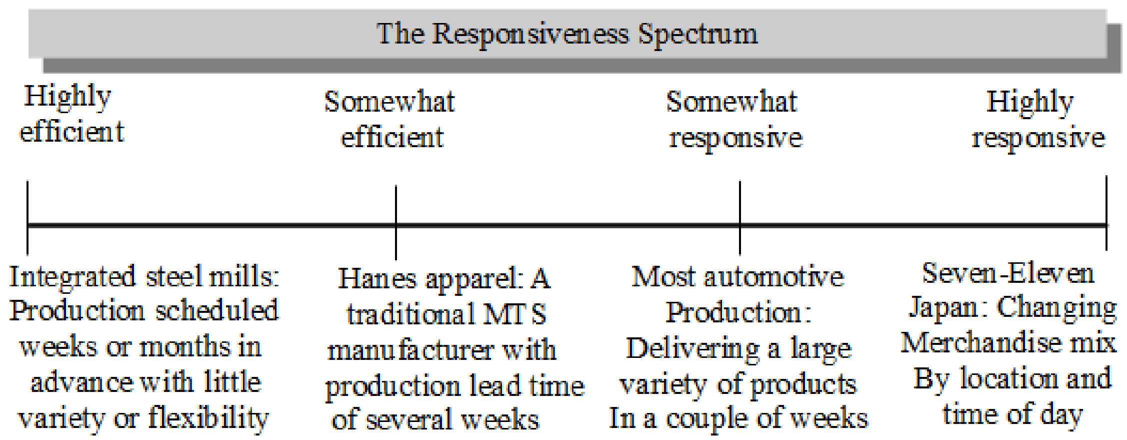


Figure 3.16: The responsiveness spectrum (Source: Chopra and Meindl 2007, p31).

- *Step three: Achieve the strategic fit between SCSs and competitive strategy*

Based on above two steps, the strategic fit zone can be given in Figure 3.17:

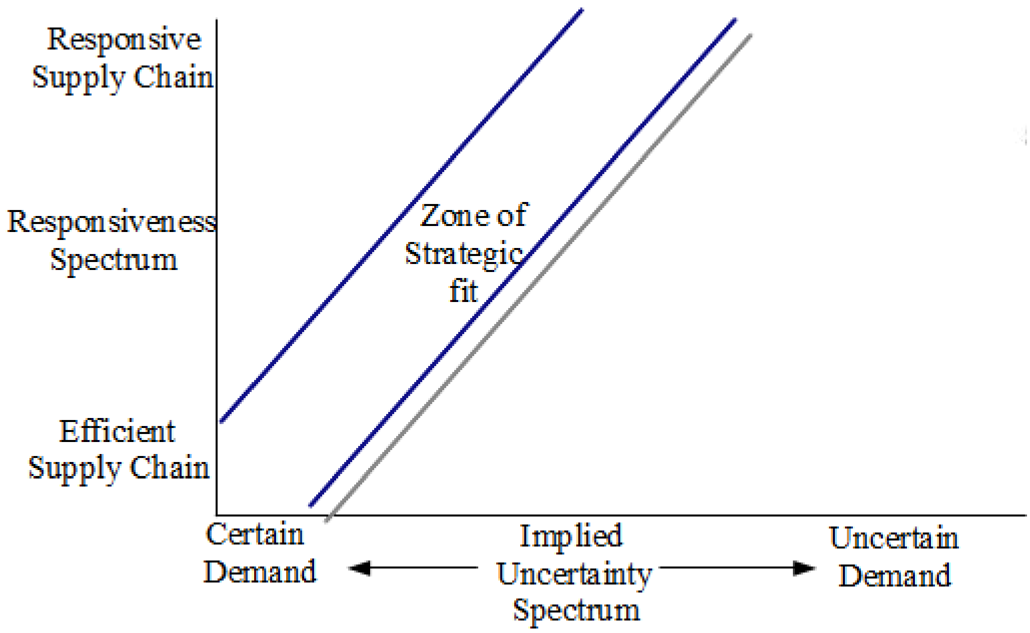


Figure 3.17: The zone for supply chain strategic fit (Source: Chopra and Meindl 2007, p32)

Accordingly, companies that find a strategic fit positioned within the zone are believed to have a high level of performance. However, such successful fit relies on proper communication between the groups and coordination by high-level management such as the CEO through top-down strategic fit approach.

Importantly, the authors state that the desired level of responsiveness required across the supply chain may be attained by assigning different levels of responsiveness and efficiency to each stage of the supply chain. In more details, for a determined level of responsiveness, a company may have different possibilities for how its supply chain look like in different stage or may choose the best fit based on each supply chain partners' capability. Examples are illustrated in Figure 3.18.

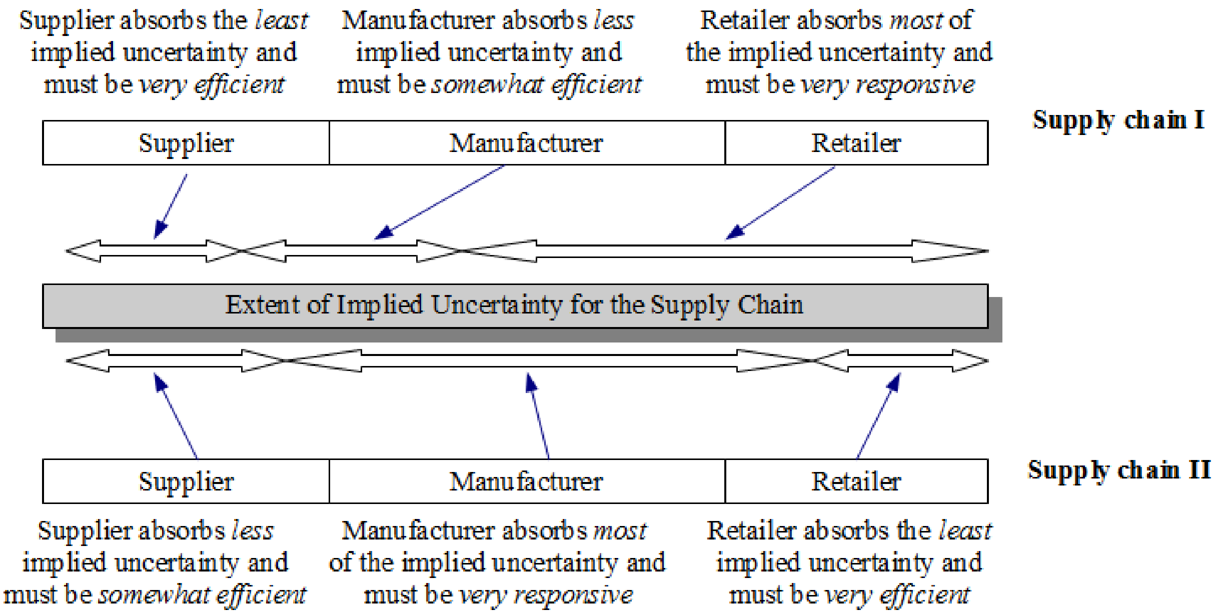


Figure 3.18: Different roles and allocations for a given level of supply chain responsiveness (Source: Chopra and Meindl 2007, p33).

In this example, both the supply chain I and supply chain II can achieve the same level of responsiveness to the market, but different partners take the uncertainty along the supply chain at a different level. IKEA, for example, is a type of supply chain I. Their stores absorb most of the uncertainty and being responsive, allowing the suppliers to absorb very little uncertainty and being efficient; England, Inc., a furniture manufacturer located in Tennessee, have their supply chain according to the type of supply chain II in above figure. England's retailers allow customers to select from an extensive variety of styles and promise relatively quick delivery. However, the retailers do not carry much inventory but pass most of the implied uncertainty on to England, Inc. who has a very flexible manufacturing process and can absorb the most implied uncertainty.

This approach proposed by Chopra and Meindl (2007) may have at least three downsides. First, in the first step, the implied uncertainty spectrum covers both supply and demand uncertainty. But in the third step while the strategic fit zone is provided, the abscissa axis, however, represent only demand uncertainty, which tends to be unclear and cause confusions. Second, it is still based on the dualism of efficiency and responsiveness, without other factors such as supply chain integration to be discussed as an attribute, or other trade-offs to be considered in its strategic design. Third, the influence and interactions with any other functional strategies are rarely discussed in this three-step approach.

Top-down approaches to align supply chain strategy with competitive strategy are popular about strategic fit or match. An up-to-date study performed by Basheer and Gazanfar (2017), for instance, still stick to this important principle.

CSAR framework

CSAR refers to 'conceptual system assessment and reformulation' according to Perez-Franco et al (2016), who thinks (2010), and re-think the supply chain strategies as a conceptual system. The authors argue that supply chain strategy requires us to consider multiple dimensions (2016):

The first dimension runs from supplier to consumer and the overall task of a supply chain strategy accordingly is to match demand and supply successfully.

The second dimension is to cut across all the supply-chain relevant business functions, alone which, the authors call it a thematic range. The overall task of a supply chain strategy along this dimension is to balance the efforts of all the supply-chain related functions in the fulfilling the business strategy.

The third dimension runs from the top down, from lofty statements of the business strategy down to the activities and operations of the supply chain, along what it is called the strategy-operations continuum. The overall task of a supply chain strategy along this third dimension is to serve as a logical bridge from top to down. Accordingly, the strategy-operations continuum is divided into a series of levels of abstraction, illustrated in Figure 3.18.

In Figure 3.19, the number of concepts multiplies as move down the levels of abstraction. In the business strategy, there is the Strategy Core, which is a brief core statement, and the Strategy Pillars which refers to a set of three to five general statements of strategic intent. In the supply chain strategy, the concepts are arranged in three levels of abstraction: a level of general objectives (Principles) in different supply-chain relevant functions or areas; a level of specific objectives (Imperatives) that support the principles above them, and a level of more concrete decisions (Policies and Choices) that implement the imperatives above them. The policies and choices are then executed in the form of Activities within the supply-chain relevant functions and areas.

Figure 3.19: Strategy-operations continuum (Source: Perez-Franco, et al. 2016)

In this continuum, the supply chain strategy of a business unit is viewed as a logical bridge between its business strategy and the activities of its supply chain: each concept at a lower level of abstraction enables the one(s) it is connected to in the immediately higher level. Conversely, each concept at a higher level of abstraction provides guidance for one or more concepts it is connected to in the immediately lower level.

When a company is to define or reformulate its supply chain strategy, this continuum is to be followed and completed in a top-down manner, described in the following steps:

Start point: conduct the conceptual map of the current supply chain strategy, in terms of the strategy-operations continuum.

Strategic area and sequence: the team defines the areas of decision for the new strategy (Task 1), as well as the sequence/priorities in which these areas will be considered (Task 2).

Preserving good features: For each area of decision and level of abstraction, the team shall then, evaluate the figured out areas of decision are good enough or need to do better ones (Task 3), this can follow the CSAR evaluation criteria listed in Table 3.11 below. If the criteria are satisfied, the concept can be kept.

Table 3.11: CSAR goodness criteria for a conceptual system evaluation (Source: Perez-Franco, et al. 2016)

Clarity	Each concept in the system must be *clear* to those working with it. Clarity refers to *unambiguity* in meaning, and does not imply specificity: a high-level concept can be both clear and general.
Feasibility	Each of the concepts in the system must be *feasible*, i.e. must be possible within the constraints of the setting and resources of the business unit. A feasible concept is one that can be realized in practice.
Sufficiency	Every concept in the system should be satisfied, i.e. fulfilled or realized, by the combined net support it receives from concepts under it.
Parsimony	A concept in the system should only use the *necessary* resources to provide the desired support level. *Ceteris paribus*, when two alternatives provide the same support, the one requiring fewer resources is better.
Coverage	The thematic range of a conceptual system must address, or *cover*, each and every one of the areas of decision that matter for the supply chain strategy of the business unit. Lacking coverage leads to blind spots.
Compatibility	Each concept in the system must be *compatible* with every other concept in the system. That is to say, any two concepts in the system must be able to co-exist as far as possible. (Compare this criterion with *Coherence* and *Synergy*.)
Synergy	It is desirable for a concept in the system to *reinforce* and augment, whenever possible, the support that other concepts provide to the system; especially if this positive reinforcing relationship is reciprocal. This is an extension of *compatibility* in that two concepts not just coexist but also enhance the value of each other.
Support	Every concept in the system must *support*, i.e. must enable or help realize, at least one concept in a higher level of abstraction. A concept that supports no other concept above it should be eliminated.

Generate several new concepts (Task 4): This is about bringing innovative and creative thinking into the strategizing process. The team is asked to generate new concepts as alternatives to the current concept in current area and level.

Select the best concept (Task 5): In this step, the team should bring rigorous and selective thinking into the process. Best concept for this area and level are selected — still in terms of the CSAR criteria shown in Table 3.11. Once a concept has been agreed upon for this area, move to the next area in the sequence, and repeat tasks 3, 4 and 5 for it.

Verify level-wide sufficiency (Task 6): When tasks 1–5 have been done for all areas in a level, examine whether the concepts at that level are sufficient to satisfy the ones in the higher level. If they are not, revisit Tasks 1 through 5 as needed, and when the entire level was done, move to the level below it and perform the same sequence from Tasks 1 to 6 for that level.

Complete: Once all tasks are complete for all the levels, the so-called 'Progressive Formulation' (Perez-Franco et al. 2016) is completed.

Comparing with earlier years' top-down approach, this CSAR framework has developed further and gone beyond the dualism and 'type-and match' strategic alignment. Multiple dimensions are taken into account and the strategy differentiation or diversity will be achieved by following this methodology in developing or reformulating supply chain strategy. The limits of this model might be that, since it is a conceptual model, the idea is pretty abstractive or ideal, will need to be further tested in practice. Besides, it encourages much the brain-storm, innovative and creative thinking, while the process is quite complicated and there are many decision areas covered, the difficulties and uncertainty of evaluation according to the provided criteria will be significantly increased. This implies, mistakes or important considerations might be neglected/forgotten in some aspects, or trade-offs are not fully considered, which results that all areas of decisions might be workable and harmonious, but the outcomes are just not maximized due to that some activities are not pulled from the same direction.

3.2.4 Decision categories

Through the literature review until this session, a quite apparent shortage is found: the decision categories within supply chain strategy are the most under-developed part of different research in this field.

In Fisher's model (1997), there are six key attributes exemplified as decision categories while choosing a type of supply chain. They are Primary purpose; Manufacturing focus; Inventory strategy; Lead time focus; Approach to selecting suppliers; and Product-design strategy (not the R&D, but more about the CODP). When reviewed by Chopra and Meindl (2007, p23-24), purchasing and transportation is added. It suggests that supply chain strategy consists of the following categories:

- Manufacturing
- Inventory
- Lead time
- Purchasing
- Transportation

Chopra and Meindl (2007, p25) have exemplified the selection of supplier, carrier selections, and transportation mode, as well as the inventory level policy, etc. based on different supply chain needs to be addressed by relevant supply chain strategy. These decision categories are not further specified with comprehensive decision policies and choices.

DELL 4 SCss (Simchi-Livi et al 2013)., has a different configuration in aspects of customer relationships which point at customer segments, products, production batch size, production strategy, finished goods inventory, lead time and planning horizon, etc.

Sillanpää and sillanpää (2014) listed decision categories related to different types of SCSs, including Facilities; Inventory; Transportation; Information; Sourcing; Organization; Quality; Customer service; Product development. However, these aspects are typically given through the same way as in Fisher's model. They are addressed as examples to distinguish what an efficient or responsive supply chain should focus on, rather than developed or integrated into a comprehensive framework and detailed decision policies and choices of SCSs.

All in all, this part of knowledge is usually provided in a fragmented and incomprehensive way. This, in turn, makes the 'type-and-match' less actionable, and makes strategic alignment unclear and ambiguous with its range or framework of relevant decisions. Therefore, to develop a decision framework covering explicit decision categories and details within each category is believed a premise and priority, which has become the first research question of this thesis and will be answered in the analysis chapter.

3.3 Interactions between OSs and SCss.

The studies regarding interactions between operations strategy and supply chain strategy are far insufficient considering the significance of it. Qi et al. (2017) figured out, one of the major weaknesses in the field of operations strategy is that the OS theory fails to make contextual considerations in terms of supply chain and so does the research in supply chain strategy. Melnyk et al. (2010) state that supply chain design and management should be tailored to operating conditions. The integrated process of strategy formation suggested by Kim et al. (2014) indicates the roles of OS in forming SCS. Qi et al (2017) argue that supply chain strategy should play important roles in defining firm's operations strategy and a firm should extend internally-oriented operations strategy to supply chain-oriented supply chain strategy. According to organizational capability theory, internal OS capabilities can directly improve external SCS capabilities. Because on the one hand, both operations and supply chain strategies capabilities are dynamic capabilities (Hayes et al. 2005, p61-62; Qi et al. 2017). On the other, internal OS resources provide a base to develop external SCS resources, and when a firm has a high level of absorptive capability to understand OSs, the firm will be more likely to learn from external partners and understand their businesses to facilitate the implementation of SCSs (Qi et al. 2017).

Qi et al (2017) have developed a strategic alignment connects supply chain strategy with operations strategy. The general thought is to, first of all, identify customer needs for different product and translate them into order winners and order qualifier for operations: mainly include cost strategy, quality strategy, delivery strategy and flexibility strategy. Here, the order winners are attributes that differentiate the products from its competitors, while order qualifiers bring their products to the market. The next, based on the order winners and qualifiers, the operations infrastructures and capabilities are built accordingly, these operations point to an appropriate supply chain strategy development. The authors name this approach as SEM model refers to structural equation modeling. The connections between operations strategy in terms of order qualifiers and order winners with appropriate supply chain strategy are equated through statistics correlations test. Figure 3.20 presents this model with results from an empirical data collected among Chinese manufactures:

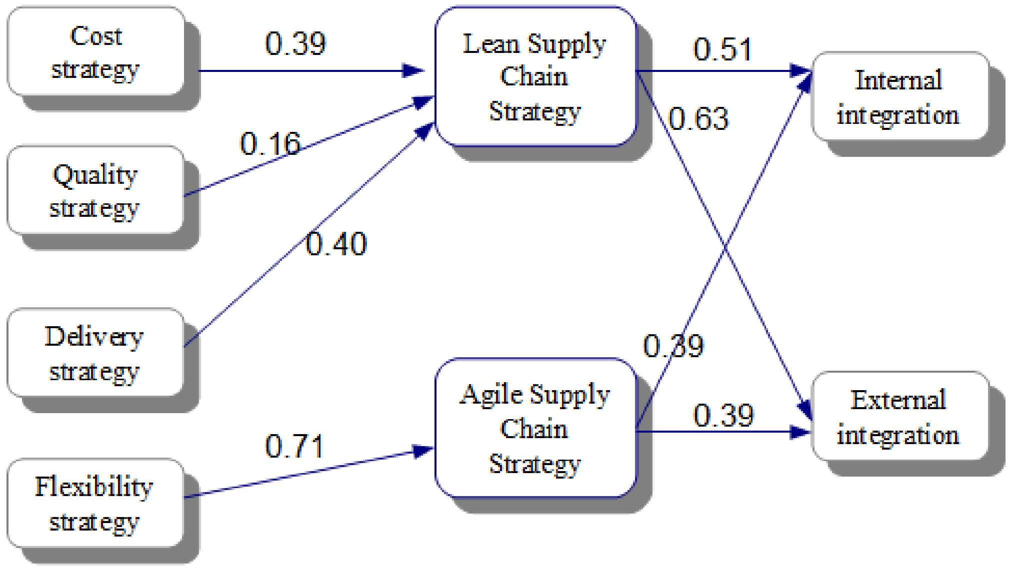


Figure 3.20: Interactions between Operations strategy and Supply chain strategy (Qi et al. 2017)

The results prove that OSs concerning cost, quality and delivery are positively related to lean SCSs, while flexibility is significantly related to agile SCSs, and is not significantly related to lean SCS in the authors' study. Based on the correlations, the appropriate supply chain strategy in corresponding with operations strategy in the left is revealed. For instance, when a firm aims to have an operations priority focuses on flexibility, agile supply chain strategy is appropriate. If a lean firm moves to pursue flexibility, it should cumulate lean supply chain strategy to the hybrid leagile strategy first. Likewise, manufacturers with a lower-cost OSs should increase their use of a lean supply chain rather than an agile supply chain. Another interesting finding of this model shows that no matter which SCS is used by a firm, the supply chain integration in terms of both internal and external integration practices are important for the firm, just Lean SCss requires slightly more on external integration and Agile SCss has a similar level of both internal and external integrations. The key difference between Qi et al. (2017) and previous researchers is that Qi et al. (2017) imply in their study how the internal OSs can be related to external SCSs and link both strategies within a company.

The limit of this model may be the simplicity and context reliant. As operations strategy is a broader set of goals than these four attributes could cover, and there aren't just two three types of supply chain strategy and the 'type-and-match' solutions had drawn critics as we have discussed in previous sessions. Moreover, this results or conclusions may not be sufficient to be generalized to other contexts. Giving an example, this result shows weak correlations between quality strategy and agile supply chain strategy in the context of Chinese manufacturers and suggests that a Chinese firm pursues quality performance should go for a lean supply chain strategy. Yet in another study tested in Swedish manufacturing context, conducted by Rudberg and Olhager (2003), the result conversely argues that quality criteria can be obtained from either Responsive or Physical efficient supply chain strategy defined by Fisher (1997).

4 Analysis and conceptual models

This chapter performs a thorough analysis of the theories structured in the previous chapter to develop conceptual framework regarding supply chain strategic decision framework and conceptual models regarding the interactions between OSs and SCSs. The framework and models are properly elaborated and clarified.

4.1 Decision framework for SCSs

Based on the literature review of supply chain strategies in terms of its definitions, classifications and decision categories, this session comes to analyze and propose a conceptual framework regarding concrete choices and policies to be put in place to support supply chain objectives. Namely, the decision categories included in SCSs.

4.1.1 Adapting the definition of SCSs

According to Perez-Franco et al. (2016): *'supply chain strategy is the collection of general and specific objectives set for the supply chain of the BU, and the policies and choices put in place to support them, with the purpose of supporting the business strategy, given the BU's context and the environment'*. In this thesis, it is considered that SCS may not always relate to BU, as BU is often used for larger companies, it could be an individual company or an organization, etc. Therefore, the definition used in this thesis would be: 'Supply chain strategy is the collection of general and specific objectives set for the supply chain of a business entity in the form of an individual company, a business unit, an organization, or a plant, etc., and the policies and choices put in place to support them, with the purpose of supporting the higher level of strategy such as business unit/competitive strategy, given the business entity's context and the environment'.

4.1.2 Key attributes or drivers for determining SCSs

According to previous reviews, the type-and-match strategies have a central focus on figuring out what specific type of supply chain is appropriate for a company. Besides, the decisions to figure out the appropriate strategy are often based on specific attributes, these attributes, together with relevant decisions discussed by the authors could be briefly summarized in Table 4.1 in below:

Table 4.1: Summary of the type-and-match supply chain strategies (Source: From different researchers, summarized by the author)

Type of SCSs	Representative authors	Key attributes/drivers	Relevant decision area
Efficient (Lean), responsive	(Fisher 1997)	Product types	Primary purpose, manufacturing focus, inventory strategy, lead-time, supplier selection, product-design strategy.
Efficient, responsive, risk-hedged and agile supply chain	(Lee, 2002)	Demand and supply uncertainty	Information exchange and sharing, early and tight collaboration, supplier hubs, etc.
Arcs of supply chain strategy	(Frohlich and Westbrook, 2001)	Degree and direction of supply chain integration	Level of forward physical flow of delivery integration and backward coordination of information integration.
ETO, MTO, ATO, MTS, MTF supply chains or DELL's four supply chains	(Martinez-Olvera and Shunk 2006; Simchi-Livi et al. 2013)	Resource, customer segment, product, and process	Choose appropriate business model
Push, pull or hybrid supply chain	(Harrison et al 2003)	Production and execution method/direction, customer orders	Should production be driven by forecast or customer orders, or use combined effect of both strategies

Nevertheless, these type-and-match of supply chain strategies are classified under a quite loosely established supply chain strategy concept, this results that each type-and-match supply chain strategy can be extended to many supply objectives or configured to different supply chains (Sillanpää and Sillanpää 2014; Chopra and Meindl 2007).

4.1.3 Decisions for configuring SCSs

Besides the relevant decisions indicated by different authors according to above table, it is also possible to summarize other decision categories for configuring the supply chain strategy based on previous literature review. This is given in Table 4.2 as below:

Table 4.2: Summary of main decision categories for SCSs (Source: From different researchers, summarized by the author)

	Fisher (1997)	Chopra and Meindl (2007)	Simchi-Livi et al. (2013)	Sillanpää and Sillanpää (2009)
Primary purpose	√			
Sourcing/purchasing	√	√		√
Production	√	√	√	
Inventory	√	√	√	√
Transportation		√		√
Lead-time	√	√	√	
Customer			√	√
Products/ product development			√	√
Facilities				√
Information				√
Organization				√
Quality				√

Comparing these contingent decision areas, there are some categories that cover by most of the authors, such as manufacturing/production, inventory, sourcing/purchasing, as well as transportation. These are most common aspects that a supply chain covers and are believed necessary to be included in supply chain strategic decisions which will be further elaborated in next session named 'four functional decision categories'. There are also some decisions not a consensus among these authors and are considered beyond SCSs and belong to other strategies. For example, the facilities, organization and quality mentioned by Sillanpää and Sillanpää (2014) are usually defined as infrastructural decisions within OSs; and customer relationships or service (Simchi-Livi et al. 2013) could fall to the SBU/competitive strategy in a higher level (Hayes et al. 2005, p34-35). Thus, the key functional decision categories shall cover Sourcing/supplier strategy, production/manufacturing, inventory, and transportation.

Customer needs are often viewed as the driver to determine a SCS, in other words, customer need comes first as input, and then a relevant SCS was tailored to it (Lee (2002). Products are drivers or attributes for SCS differentiation (Fisher 1997) while product development is often defined for R&D strategy than SCS (Hayes et al. p35).

Information according to Sillanpää and Sillanpää (2014) mainly refers to information sharing and integration, thus it is about cross-functional supply chain integration according to Frohlich and Westbrook (2001); Lead-time is another cross-functional decision area.

4.1.4 Conceptualized decision framework of SCSs

Called by the research question one, and based on these previous literature studies and analysis, a conceptual framework can be offered to address supply chain strategy with more concrete decision policies and choices. This framework is first of all presented in Figure 4.1 and will be further elaborated. From the construction, it includes the primary purpose/goals which are to be determined as the first step; then four functional decision categories to support the primary purpose/goals; as well as some decisions to be determined or collaborated across all the four functional areas. This indicates that SCS is mainly viewed as a functional strategy as Sillanpää and Sillanpää (2014) emphasized, while within production and inventory, there will be an overlapped decision area with OSs which will be further addressed. Yet SCS also includes cross-functional decisions, and inter-organizational decisions in terms of supply chain integration. The details will be further elaborated in the coming sessions.

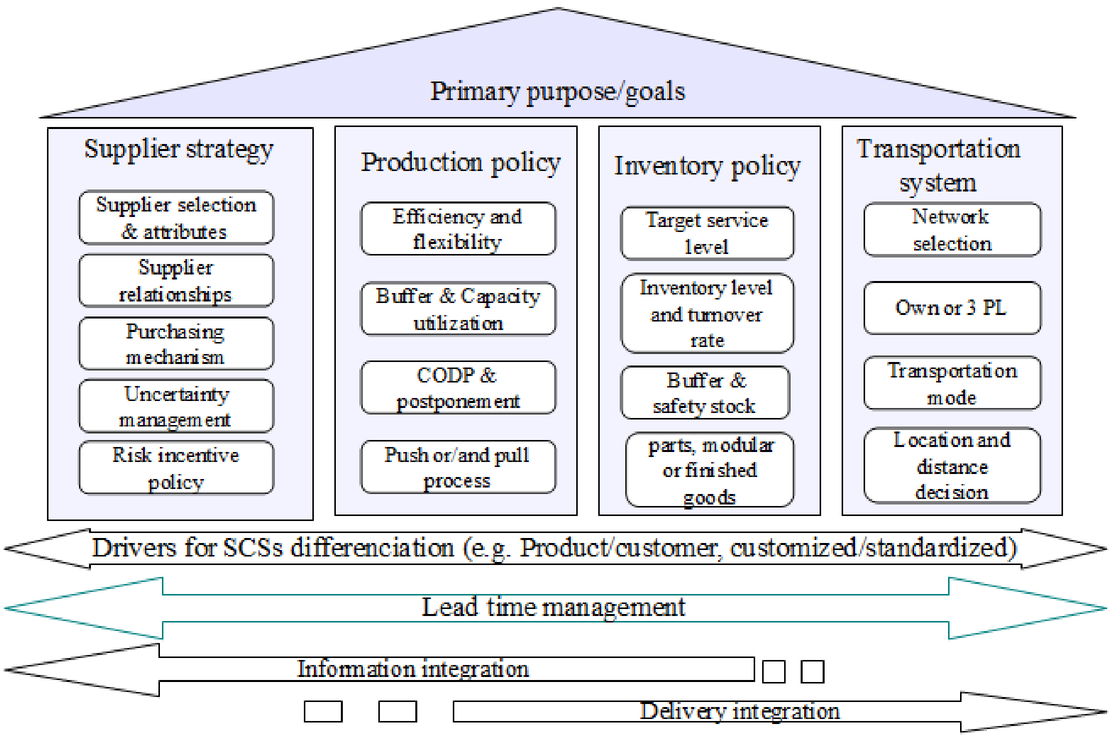


Figure 4.1: Conceptual framework of decisions in SCSs (Source: Proposed by the author)

Primary purpose/goals

In Fisher's classical model regarding SCSs (1997), the primary purpose was mentioned as a decision area. The primary purpose/goals should clearly state the general objectives set for the supply chain of the organization, which is defined according to the SCSs definition (Perez-Franco et al. 2016). The supply chain type such as Efficient, Responsive, Risk-hedging, and

Agile or else that ever introduced in previous sessions shall be implied in this stage. Yet the primary purpose/goals could be clearer addressed in more details using sentences to give general objectives, which is similar to the Principles in the ‘Strategy-operations continuum’ in Figure 3.18 (Perez-Franco et al. 2016). Only based on these primary purpose/goals, further specific objectives and detailed policies and choices are possible to be correctly configured.

Four functional decision categories

Under the primary purpose/goals, there are four supply-chain relevant functions or categories consist of Supplier strategy, Production policy, Inventory policy, and Transportation system. Within each category, the specific objectives need to be addressed as implied by the SCSs definition chosen in this thesis. These are similar to the Imperatives suggested by Perez-Franco et al. (2016) in their ‘Strategy-operations continuum’ in Figure 3.18. For instance, what should the supplier strategy look like in order to support the supply chain primary purpose/goals? How should the production and inventory managed to align with the supply chain primary purpose/goals, etc.? Importantly, these objectives should be fully discussed and assessed through a cross-functional base instead of being separated by each functional department.

Based on these specific objectives, further detailed policies and choices under each category could be configured. The followings are detailed policies and choices for each decision category:

- *Supplier strategy*

When the general and specific objectives are set, the policies and choices for suppliers are implied to realize these objectives. For different supply chain objectives, the attributes for choosing suppliers may be different. For instance, prices, speed, lead-time, quality, reliability, flexibility, stability, etc. are different attributes, once the supplier strategy is defined, the prior or preferred attributes could also be identified to compare and assess suppliers’ qualification (Fisher 1997; Chopra and Meindl 2007, P25); A purchasing mechanism is necessary to facilitate the purchasing activities; Supplier relationships/cooperation and uncertainty management are required to deal with the supply chain uncertainty (Lee, 2002), relevantly, the risk incentive policy is suggested and added to this category by the author.

- *Production policies*

Different degree of efficiency and flexibility/responsiveness are often discussed and required by different supply chain strategies and operations, once the objectives are set, the required level of efficiency and flexibility are indicated, which will further figure out the policy of buffer and capacity utilization rate (Fisher 1997); besides, the CODP and postponement decisions as well as the push/pull production process are critical decisions in the production and have been used to differentiate SCSs (Martinez-Olvera and Shunk 2006; Harrison et al 2003). CODP and postponement decisions are conceived to have an overlapped area with the schedule production, while push/pull process decisions overlapped with the shop-floor activity control, which are under 'Planning and control' of operations infrastructural strategies. To include CODP & postponement decisions and push/pull process decisions in SCSs mean that there will be an overlapped area between OSs and SCSs, yet this is conceived a better way to have a holistic view of SCSs. These decisions are often driven by customer segment, market volatility and so on (Lee; 2002; Simchi-Livi et al. 2013). That was why the specific objectives for each functional category should be discussed through cross-functional supply chain base.

- *Inventory policies*

Inventory as one decision category under supply chain strategy is broadly accepted by different researchers (Fisher 1997; Chopra and Meindl 2007; Simchi-Livi et al. 2013 and Sillanpää and Sillanpää 2014, etc.). Yet inventory is also discussed under operations strategies ((Hayes et al. 2005, p41 & 79; Hill et al 2009, p327). That means they could also be overlapped by OSs and SCSs in a way. The inventory policies are often corresponding to production policies and customer strategy, For instance, the policy regarding CODP and postponement indicates whether the items should be stored in terms of parts, modular or finished goods; the required or targeted customer service level influences the inventory policies and safety stock, etc. Cost and tied-up capital is another important attribute to involve when determining the detailed policies such as the inventory level, turnover rate and so on; the supply chain objectives in terms of efficiency and responsiveness also set different priorities on inventory level and turns (Fisher 1997; Lee 2002).

- *Transportation system*

Transportation is also conceived to belong to supply chain strategy as clearly stated by some researchers (Chopra and Meindl (2007, p23-25; Sillanpää and Sillanpää (2014). In this category, the distribution network in terms of centralization or decentralization needs to be determined; Further, whether to own the transportation activities or outsource to third PL, and location of facility such as centralized warehouse, as well as the transportation mode (Chopra and Meindl (2007, p25) need to be well discussed together with the supply chain relevant features such as the costs, product attributes, lead-time requirements, market features/structure; geopolitical factors etc. and support the overall supply chain strategic objectives. For example, a cost-efficient supply chain also calls for a highly effective logistics system, and for products with stable demand, it is often possible to ship them directly from the manufacturing place to the customer without going through distribution centers (Lee, 2002).

Additional cross-functional aspects

Mainly referred to the literature that summarized in Table 4.1, some additional cross-functional decisions are believed important for SCSs.

First, Lead-time management is a decision policy that relevant for most of the four functional categories elaborated above, it is therefore drawn under the four decision categories across the entire supply chain means that each category should set its lead time and collaborate with each other.

Second, product types and customer segments are most critical drivers for supply chain segmentation (Fisher 1997, Chopra and Meindl 2007, p26; Martinez-Olvera and Shunk 2006), they are figured out in the framework as SCSs key drivers, means that certain supply chain strategy is often related to certain product types or customer segments, yet there are other possible drivers existing.

Third, supply chain integration (Frohlich and Westbrook, 2001) is also realized through a cross-functional base. As suggest by Qi et al (2017), any type of SCSs have a correlation or requirement on a certain degree of supply chain integration, while Frohlich and Westbrook, (2001) prove that wide arcs of outward-facing supply chain integration give best supply chain performance level. Therefore, the degree of supply chain integration is not limited to specific SCSs, rather, a company may strive for the most achievable and appropriate degree according to the culture and relationships with its supply chain partners, yet keep a balance between backward information integration and forward delivery integration.

4.2 Conceptual models for aligning OSs and SCSs

Both OSs and SCSs aim to support the company's business or competitive strategy (Sillanpää and Sillanpää 2014). The right alignment between these strategies and their interactions are therefore vital to a company's success. Follow the logic of relations with competitive strategy, the top-down approach is mainly proposed for developing the interaction models. Top-down approach is one of the most widely used approaches as found in the literature studies for both OSs and SCSs alignments (Marucheck et al., 1990; Menda and Dilts, 1997; Schroeder et al., 1986; Ward et al., 1996; Ward and Duray, 2000; Hayes et al. 2005; Hill et al 2009; Chopra and Meindl 2007; Kim et al. 2014; Perez-Franco et al 2016, etc.). However, a combination with bottom-up approach is proved useful to act as contemporary of top-down decisions (Kim et al. 2014). Thus it is also integrated to the models and will be further elaborated.

There are two conceptual models proposed regarding the OSs and SCSs strategic alignment and interactions and will be presented in the following sessions:

4.2.1 The 'Inside-out' model

Some researchers such as Melnyk et al. (2010) and Qi et al. (2017) argue that supply chain design and management should be tailored to operating conditions; Supply chain strategy should play important roles in defining firm's operations strategy, and a firm should extend internally-oriented operations strategy to supply chain-oriented supply chain strategy. Besides, organizational capability theory suggests that internal OS capabilities can directly improve external SCS capabilities. Therefore, the 'Inside-out' model is developed based on the understanding of these theories. In this model, the OSs should be aligned first, and SCSs are to be tailored to the OSs (Melnyk et al. 2010; Qi et al. 2017). When the company has its manufacturing operations to some extent large or complex, for instance, with a higher degree of vertical integration, this model is particularly appropriate. The 'Inside-out' model is illustrated in Figure 4.2 and elaborated in the following:

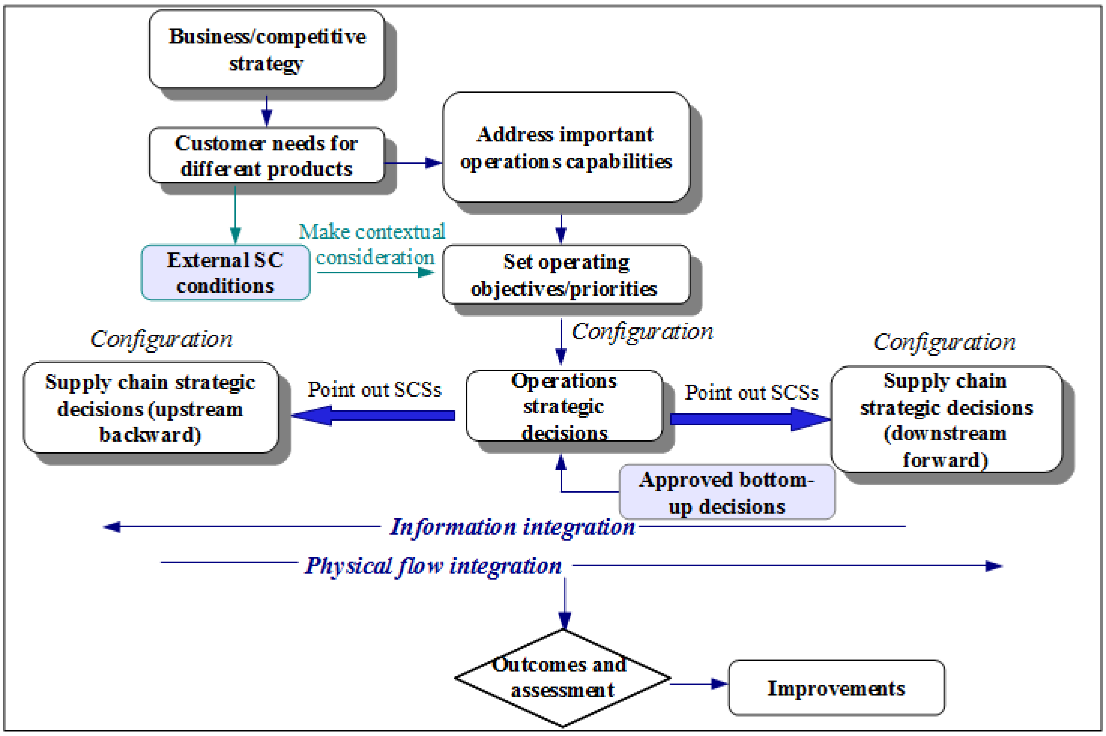


Figure 4.2: The 'Inside-out' interaction model: OSs determines SCSs (Source: proposed by author)

The model includes six key steps which are elaborated as following.

- *Step 1: Identify customer needs*

Deriving from the higher level of competitive strategy, the company's target customer segments are implied for different products, while same customer segment tends to have similar customer needs (Gattorna 1998, referred by Godsell et al. 2011). Accordingly, customer needs could be identified.

- *Step 2: Address the operations capabilities*

Any company has its operations competitiveness and weakness (Skinner 1969; Hayes et al. 2005), the company should make comprehensive understanding of its existing capabilities, weakness, and where to grow the dynamic capabilities (Hayes et al. 2005, p61-62) to meet and cultivate customer needs and sustain the competitiveness.

- *Step 3: Set feasible operations objectives/priorities*

Based on previous steps, customer needs and the company's desired capabilities can be further linked with operations priorities, these priorities could be referred as order winner and order qualifiers (Qi et al. 2017) for the customer needs, or manufacturing objectives for competitive capabilities (Kim et al., 2014). Importantly, the operations priorities need to be feasible not only based on current operating capabilities, but also by taking the supply chain situations into account. So that they are achievable on the one hand, and on the other hand, the company has an awareness of how they will make changes to the supply chain and whether these changes are appropriate and not unexpected considering the costs, etc.

- *Step 4: Configuration of OSs*

Based on the operations priorities, the OSs could be configured with strategic decisions and choices in the structural and infrastructural decision areas. A principle suggested here is to consider both the structural and the infrastructural decisions equally important and each decision needs to be evaluated fully to avoid further changes due to wrong configurations (Hill et al. 2009, 302-303).

During the practice, some operations managers/lower level managers will learn from the practical experience and come up with some important thoughts or improvements of the operations. They could arrange small scaled operations and demonstrate the value-generating potential through early successes. For those are proved with value-generating potential, they could be included in the decisions as well, as proposed by Kim et al. (2014), and centralized versus decentralized organizational structure plays as a contingency factor that affects the balance of these top-down and bottom-up decisions.

- *Step 5: Configuration of SCSs*

When the operations infrastructures and capabilities are built, it will point at appropriate SCSs development (Qi et al., 2017). This comes to the next step about SCSs configuration. The configurations cover the SCSs decision framework proposed in the last session, include primary purpose/goals, the four decision categories, and the supply chain integrations in terms of backward information integration and forward physical flow integration. Crucially, the SCSs should be matched and tailored to the OSs with careful and full evaluations. The CSAR approach regarding 'goodness criteria for a conceptual system evaluation' that provided by Perez-Franco et al. (2016) is regarded as a useful evaluation process.

- *Step 6: Outcomes assessment and improvement*

At last, the management board at the company also organizes the assessment of the adopted decisions with their outcomes during certain period, to address potential improvements or changes required according to the changing market and customer needs for the products Kim et al. (2014).

4.2.2 The 'Outside-in' model

When the company's operations are relatively simpler, for instance, with a low degree of vertical integration but more outsourcing and supply chain external partners (more complicated supply chain), an 'Outside-in' model is adaptable, which means the SCSs are aligned first, then the OSs are configured after it. Accordingly, the 'Outside-in' is illustrated in Figure 4.3 below with relevant explanations.

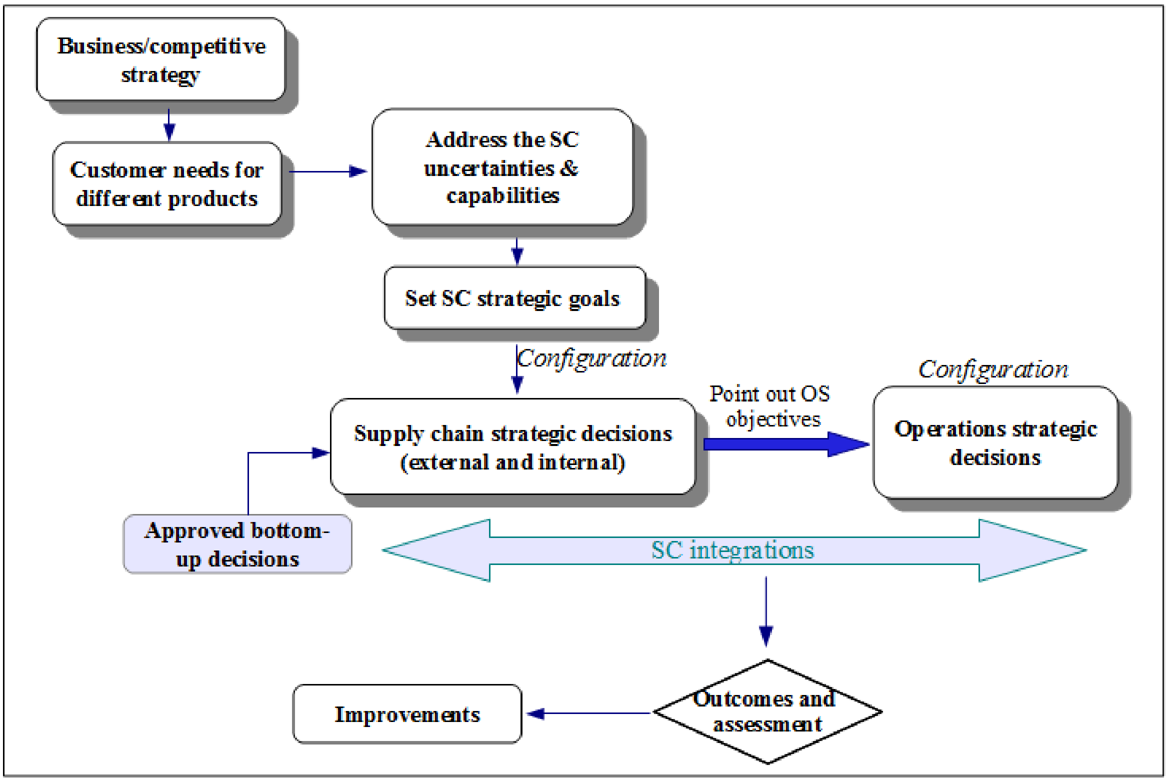


Figure 4.3: The 'Outside-in' interaction model: SCSs determines OSs (Source: proposed by author)

- *Step 1: Identify customer needs (*same as that in model 1).
- *Step 2: Address the SC uncertainties and capabilities*

Based on the customer needs, the company could measure the implied supply and demand uncertainties that the company's supply chain must be prepared for; and then evaluate the capabilities mainly about its abilities in acting responsiveness (Chopra and Meindl 2007, p26).

- *Step 3: Configuration of SCSs*

The SCSs configurations shall go through the entire SCSs decision framework proposed before. First, based on step 2, the company could figure out its supply chain strategic goals/primary purpose. The 'zone for supply chain strategic fit' proposed by (Chopra and Meindl 2007, p32) and given in Figure 3.16 in the theory chapter is one way to define this strategic goal as an example. Second, four decision categories need to be configured appropriately. Third, supply chain integrations are usually important and required. Additionally, inspired from Kim et al. (2014), lower managers within the company may also come up with their thoughts as an input for SCSs decision-making, this is considered as 'bottom-up' approach to be jointly considered with value-generating potential decisions to be added to the categories.

- Step 4: *Configuration of OSs*

Once the broad SCSs are set, the internal operations or manufacturing strategies are revealed to support and tailor to the SCSs to achieve the company's competitive strategy. OSs shall cover both required structural and infrastructural decisions which are equally important (Hill et al. 2009, 302-303).

- Step 5: *Outcomes assessment and improvement (*similar to that in model 1).

4.2.3 Contingency factors

It could be summarized that the degree and complexity of operations would be a contingency factor to influence on the choice of the two proposed models. For instance, different degrees of vertical integration like virtual integration, strategic alliances, etc. (Hayes et al. 2005, P120) could result in different supply chain and complexity of operations. If there are lots of operations or/and are complicated, 'inside-out' model is appropriate, while if the supply chain partners and relationships are more complicated and have a significant impact on the relatively simpler internal operations, the 'outside-in' model might be more relevant. Kim et al. (2014) have also figured out that the degree of centralization is a contingency factor influencing the balance between 'top-down' and 'bottom-up' approach to decision makings.

5 Case study at Alfa Laval Lund AB

In this chapter, the case study at Alfa Laval is presented and analyzed through pattern matching method, to compare with the framework and models developed in last chapter and to address important findings.

5.1 General about Alfa Laval

Alfa Laval is a world leading company in the key technology areas of heat transfer, separation, and fluid handling. The company evolved from AB Separator that started in 1883 by Gustaf de Laval and his partner Oscar Lamm Jr. Today's Alfa Laval has been developed into a worldwide organization with around 17000 employers mainly located in Sweden, Denmark, India, China, the US, and France. Alfa Laval's products are involved in treating water, reducing carbon emissions and minimizing water and energy consumption, as well as heating, cooling, separating and transporting food. These areas remain the core of Alfa Laval's expertise, and the company reaches different customers from nearby 100 countries worldwide Alfa Laval, 2017).

Regarding organization structure, the company Alfa Laval is divided into three divisions: the Marine Division, the Food & Water Division, as well as the Energy Division. Besides, there is a particular organization responsible for Global Sales & Service. Alfa Laval's global sourcing, manufacturing and distribution/logistics activities supply the sales organization with the right quality products at the right time. These activities are organized in Operations. Accordingly, the organization chart is available in Figure 5.1 as below (Alfa Laval, 2017):

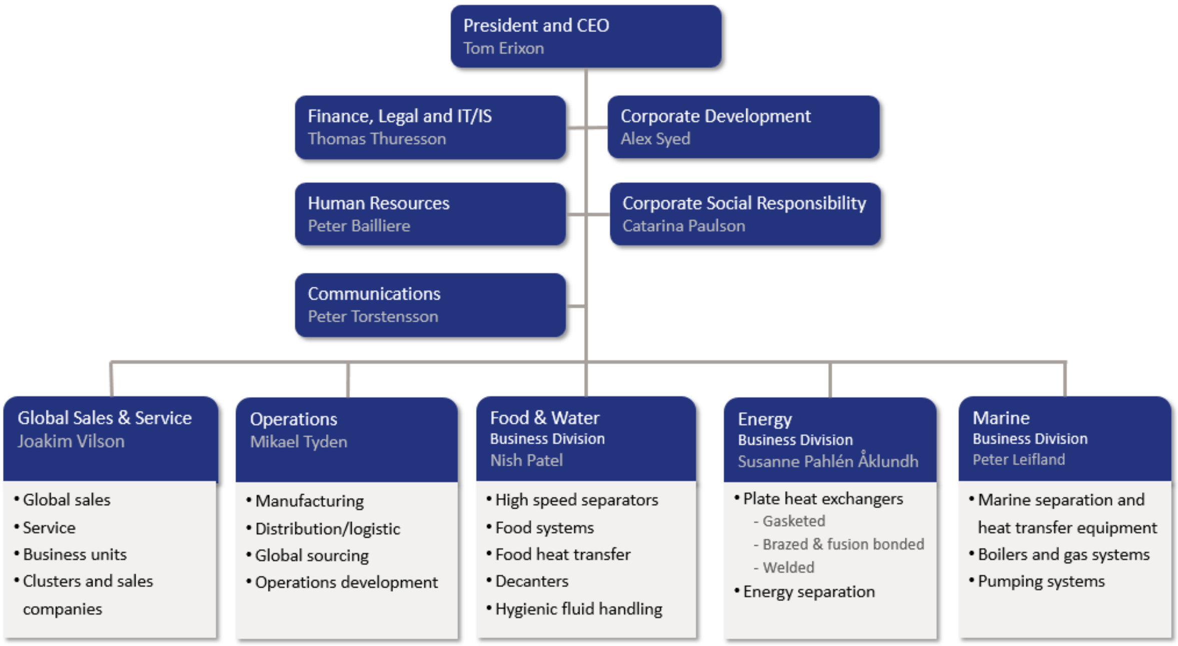


Figure 5.1: Organization chart of Alfa Laval (Source: Alfa Laval, 2017)

5.2 Different levels of strategies at Alfa Laval

The OSs and SCSs at Alfa Laval are linked with or related to four different levels of strategies within the company group: They are corporate level, business units (BUs) level, product group (PGs) level, and factories level.

Corporate Level of strategies: Any strategy may start with some kind of vision, and in Alfa Laval's case, it begins with the corporate vision as well. To go in that direction, the company sets up some targets for 3-5 years, they have to find out the present situation and see the gap between the present situation and the targets. After that, they make strategies to meet these goals based on the current situation, and this is Alfa Laval's corporate strategy (Richter, Alfa Laval Lund AB).

Meanwhile, there is a mission for operations, and thus some central operations strategies (Central OSs) are formulated at the top level as well. Operations Development Organization (OD) works a lot to develop these central OSs and the strategies mainly cover four areas as following (Kristensson & Richter, Alfa Laval Lund AB):

- People / mindset
- Technology
- Operational
- Supply Chain

Importantly, SCSs at Alfa Laval are within operations, so operations is equal to or consist of SC. Historically the SC focus at Alfa Laval was more about logistics, so typically it focused on order-management, call-off, warehousing, and transportation. But now in the new strategy that the company is about to launch in 2018, there will be a SCS as a part of OSs, not a separate one. Hence, one of the four focus areas of central OSs as described above is about SCSs (Kristensson, Alfa Laval Lund AB).

The global sourcing organization (GS) and the global parts, distribution and logistics organization (PDL) are responsible for the global sourcing and distribution and are organized within Operations. The central sourcing and PDL strategies are formulated and carried out respectively by these two organizations which get input from the corporate Alfa Laval strategy as well as the central OSs. GS serves both the BUs and the PGs across the company while PDL mainly serves all PGs and some specific BUs across the company (Kristensson & Richter, Alfa Laval Lund AB).

BU level of strategies: Before proceeding to further levels of strategies, it'll be necessary to present the relevant levels of organization structure at Alfa Laval: Under the three divisions, there are 12 business units (BUs) in total. The BUs have strong connections with the customers and markets. In strong collaboration with the BUs, there are 7 product groups (PGs) and PGs are responsible for the operations. PGs and BUs are somewhat directly linked in one-to-one relation. Thus, the manager at a PG is part of its BU management team. Further, there are several factories below each PG within operations. Again, the GS and PDL organizations are supporting across the factories. Such structure is shown in Figure 5.2 as below (Kristensson & Richter, Alfa Laval Lund AB), the number and positions of BUs and PGs under each division may not be precise in the figure for it just presents the general idea of the structure:

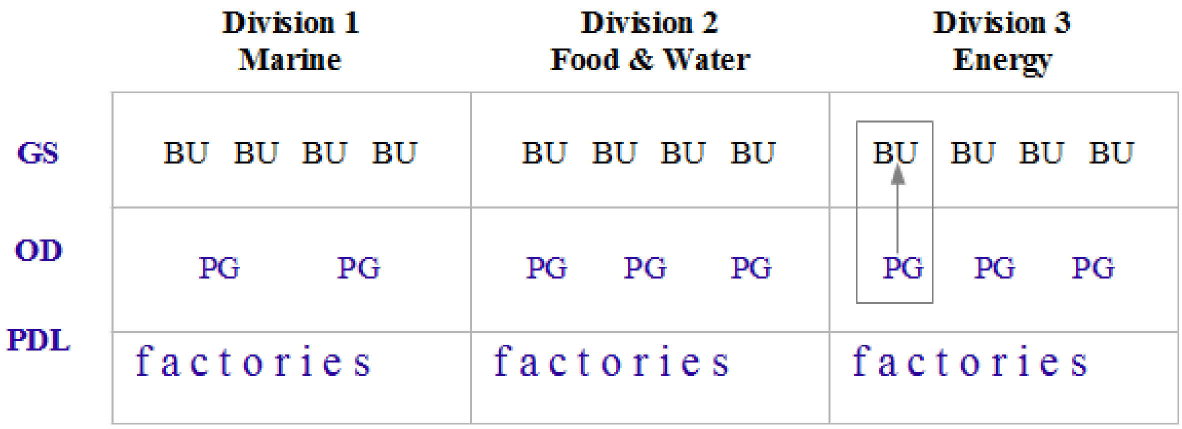


Figure 5.2: The organization structure related to the three divisions (Source: The interview)

The BU makes their strategies by breaking down the corporate targets/strategy. Growth targets, return on sales, return on capital targets are set at the corporate level, then the different BUs set their targets based on the corporate targets and the vision for the BU. Then they formulate their own strategies, which are similarly also 3-5 years out. Basically, the BU strategies are about Customers, Product, and Service (after sales) (Richter, Alfa Laval Lund AB):

PG and factories level of strategies: From here, the strategies are functional strategies (Hayes et al. 2005, p34-35). Taking one of the PGs named PHE (Plate Heat Exchangers) as example, the formulation or configuration of PG and factories level of strategies will be presented in further session of 5.3.2 with related to the interaction model.

5.3 Comparisons and analysis

5.3.1 Compares with the conceptual SCSs framework

It is addressed that the decisions from the conceptualized SCSs framework need to be taken somewhere at the organization PHE (and other PGs), yet they are made up of different level of strategies at the company. In a word, it is a mix of centralized and decentralized decisions. More details are discussed and presented linking to the conceptual framework recalled in Figure 5.3.

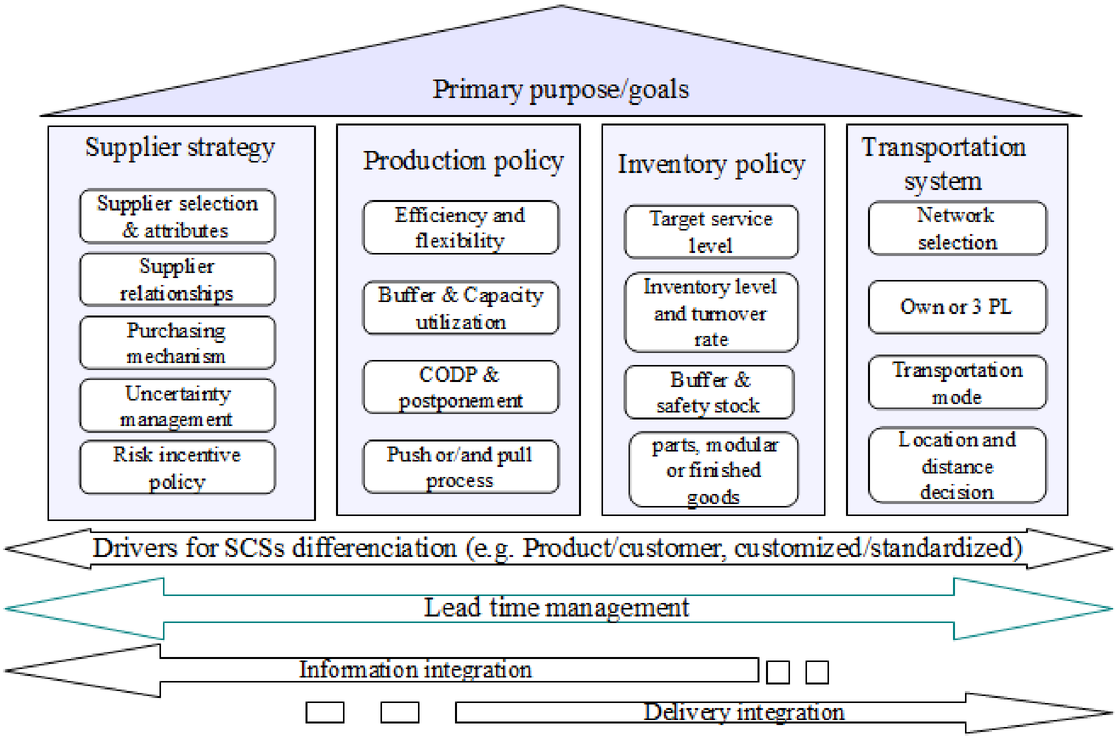


Figure 5.3: Conceptual decision framework for SCSs (proposed by the thesis author)

Primary purpose/goals: at the central OSs, the area of SC has set responsive and competitive as an overall mission. Naturally this mission should be broken down to the PG and further to the factories. Kristensson (Alfa Laval Lund AB) took lead time as an example, she illustrated that lead time could be a target for Operations and generic for everybody, then it comes top-down, but what to do and how to work to reach that would be very much local depending on different PGs and their factories.

Supplier strategy: This decision category about supplier strategy is primarily determined by the GS, except that there are a few local suppliers taken by the local factories, and the day-to-day basis of supplier relationships still rely on the factories' everyday performance. Otherwise, these decision areas are much about the corporate level of decisions. In more details, taking the sourcing as an example, there is a sourcing manager in the PG, who is the link between the global sourcing organization and the PG factories, there are some suppliers only supply the local plants, but the GS owns the regional or global suppliers. So, the PG sets their sourcing strategies. They use the available global/regional/local suppliers and if needed they add or subtract suppliers in agreement with GS (& Richter, Alfa Laval Lund AB).

Production policy: The production policies and decisions at PHE are much about local level (factories level), yet there is a central evaluation system regarding the efficiency and flexibility. As looking back to the area of OP Focus within the central OSs, 'leadership in lean' has been set as one of the focuses, when it's broken down to the production in the factories, it is mainly in corresponding to the 'efficiency' within this category. The CODP and postponement are also relevant, and most orders at PHE are MTO or ATO, by pull production process. (Kristensson & Richter, Alfa Laval Lund AB).

Inventory policy: Similarly, the SC decisions in the PGs inventory area are also much local level relevant according to the managers Kristensson & Richter (Alfa Laval Lund AB). A difference from the framework is that at Alfa Laval's Operations they use 'inventory days of supply' (IDS) instead of the 'target inventory service level (fill rate)' or 'turnover rate.' Corresponding to MTO or ATO, mainly there are components and raw material rather than finished goods stored as inventory. The after-market spare parts are stored and managed with the central PDL organization. The managers mentioned that there is a 'make or buy' decisions regarding the components at Alfa Laval, which is at the PG or even central OSs level. Considering this decision is about vertical integration within the consensus of OSs structural decision, it may not require being added to this SC framework.

Transportation setup: The central transportation responsibility is organized at the central level by the PDL as clarified in the last session. Alfa Laval's global transportation organization normally makes decisions on, e.g., preferred AL transport mode, forwarders, measure the CO_2 emissions, etc.

Importantly, customer strategy is as an input to design or formulate a SCS, but it's not the PG at Alfa Laval to create this input. Instead, it is the BU together with the PG who has that responsibility (Kristensson & Richter, Alfa Laval Lund AB). This information provides important evidence that the customer strategy or market strategy is outside the SCSs framework, SCSs should be tailored to customer needs (Lee (2002).

Additional cross-functional aspects: The aspects in the bottom of the SC framework are mainly determined at higher levels at Alfa Laval: Lead time management is a BU/PG level of strategy; SC integration regarding information backward and delivery forward is about central OSs level of strategies in the areas of digital backbones and leadership in lean etc. Further, PHE has as many local SCSs as they have factories since each factory has a SCS set for them.

The product would be a basis for differentiation of both the SCSs and OSs, yet it is customers who use the products. Like at PHE, it serves a lot of different customers, could be very standardized, or customized with customer unique designed components, these finally require different OSs and SCSs (Kristensson & Richter, Alfa Laval Lund AB).

To generalize, the supplier & transportation policies are more central strategies while the production and inventory policies are more PG and Factory specific. In the same way the cross-functional aspects in the bottom of the framework are more centrally decided.

5.3.2 Comparing with the conceptual interaction models

Comparing the strategic alignment at PHE with the interaction models proposed in the last chapter, it was figured out that PHE does fit in the 'inside-out' model. As SC is considered part of operations at Alfa Laval, in other words, it organizationally belongs to operations, the SCSs at PHE and other PGs are mainly tailored to their operations conditions. Therefore, the 'outside-in' or any other possible 'integrated' models do not conform to Alfa Laval's today's strategic decision-making and strategies interactions between OSs and SCSs (Kristensson & Richter, Alfa Laval Lund AB). 'The route in the model is pretty much as what we do,' confirmed by the manager Richter (Alfa Laval Lund AB). The followings address the key steps regarding this strategic route at PHE at Alfa Laval:

Link to BU Strategies and customer needs: The customer needs at Alfa Laval are identified by the BU, but managers at PG are part of the management team at BU and involved in the BU strategies formulation. So it confirms that there is a cross-functional team to determine the strategies, typically the BU strategies. Richter got involved in the BU strategies so that they get to know about them. Afterwards, they make the PHE strategies to achieve it. Those strategies should be linked (though historical they did not have to be tied). Now the BU and PG are really tight (Richter, Alfa Laval Lund AB).

Address operations capabilities and set objectives/priorities: As mentioned before, the corporate and the BU strategies both emphasized on that the targets should be based on understanding the current states or where they are now. These indicate that the operations capabilities and contextual consideration of the SC situations are noticed and recognized by the team when setting their feasible targets or objectives from top-down.

Configuration of the OSs: When the BU strategies are determined based on above steps, the managers at the PHE, together with their management team, make their PG strategies. According to the relations between PG and BU, PG must support BU strategies. Thus, the PHE made operations strategies to support and coordinate with its BU strategies. Nevertheless, PHE as a PG, which is organizationally belonging to the Operations part, needs to look at/committed to both the BU strategies and the Central OSs when they work out their strategies for the next three years to come. These PHE strategies should be further divided down to its eight factories, and the factories will have to do what they called 'operational plans' (what is actually needed to be carried out for each factory). It should be rather sharp, very detailed, usually for the next 6 months or 12 months, typically (Richter, Alfa Laval Lund AB).

Configuration of SC strategies: As Alfa Laval doesn't have a separate Supply Chain function, the SCSs at the PG and factories mainly are part of the operations strategies. Nevertheless, as analyzed in last session 5.3.1, part of the SCSs decisions especially within the sourcing and logistics are determined by central functions like GS and PDL, and there are other centrally determined decision such as the digital backbone (standardized ERP system and processes) implementation which is mandatory, etc. From the organization chart in Figure A, we learn that Global sourcing and distributions also belong to operations and these strategies are made from central OSs It indicates that, although the SCSs at PHE or any PG cover a broader range of strategic levels than the PG OSs, the SCSs are always tailored to operations at Alfa Laval, and this is what the researchers Melnyk et al (2010) and Qi et al (2017) argue and what the 'inside-out' model essentially supports.

Regarding bottom-up decisions: The organizations at Alfa Laval are also operated in a certain degree of decentralization, and there are also bottom-up approaches to strategic decision making. For example, on the one hand, when the OD develops the central strategies they consider what the "bottom" has to say/add, on the other hand, when the PG makes strategies, they also consider input from the local factories.

Assessment and improvement: At Operations, there are also evaluation systems regarding the efficiency and performance measurement systems. For example, there are IDS (inventory days of supply) targets connected to the ROCE (return on capital employed) in the corporate targets, this target actually goes all the way to the factories. It is measured at the corporate level, operation levels, and the factories levels. So there are some balanced scorecards consolidated at the three levels, and one of the targets is the IDS (how many days it can supply). Further, once the strategies were determined, it rarely encourages changes unless something happens. So the last year of the 3 years' period would be time to create the next 3 years' strategies based on the outcomes and thoughts for improvements.

According to these key steps and the session in 5.3.1 regarding the SCSs, the interaction model at PHE at Alfa Laval could be illustrated as Figure 5.4 below, which is an inside-out model and modified from the conceptual model proposed in the previous chapter.

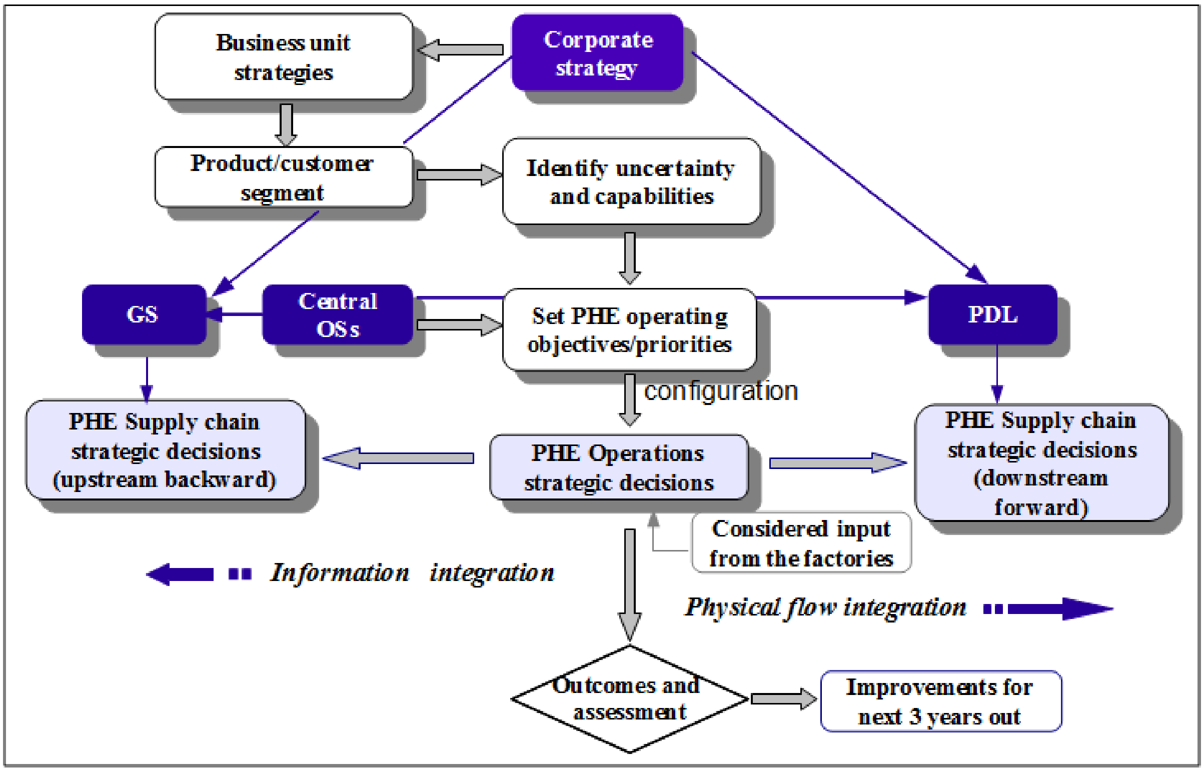


Figure 5.4: Interaction model between OSs and SCSs for PG PHE at Alfa Laval (Source: drawn by the author).

The model above visualizes that at the higher level of strategies, the GS and PDL, who serve PHE across the factories, come after the Central OSs; while the PHE and factories level of SCSs are tailored to the PHE OSs. Both levels of strategic interactions follow the way of 'inside-out'.

6 Discussions and conclusions

Based on the investigation design and relevant results presented in previous chapters, further discussions and conclusions could be drawn in corresponding to the two research questions; contingency factors are addressed; the study is evaluated with contributions, limits and further research pointed out.

6.1 Discussion of the SCSs definition and decisions framework

This session of discussion is corresponding to the **Research question 1:** *What is a supply chain strategy and what detailed strategic decisions and elements constitute it?*

6.1.1 The definition of SCSs

As there is still not a jointly agreed definition of a supply chain strategy (Rose et al 2012; Birhanu et al., Lanka, and Rao 2014), this paper chose and adjusted the SCS definition initially from Perez-Franco et al. (2016) who limited SCSs to a BU. The paper redefined that *'Supply chain strategy is the collection of general and specific objectives set for the supply chain of a business entity in the form of an individual company, a business unit, an organization, or a plant, and the policies and choices put in place to support them, with the purpose of supporting the higher level of strategy such as business unit/competitive strategy, given the business entity's context and the environment'.* Accordingly, a detailed decision framework was built based on this definition. From the study at Alfa Laval, the SCSs is not entirely limited to an organizational boundary, as there are GS and PDL being responsible across different BUs and PGs, it means different factories share some same decisions made at the corporate level, yet there are also local sets of SCSs for each plant. This definition of SCSs at Alfa Laval doesn't prove that SCSs is just a functional strategy that suggested by Sillanpää and Sillanpää (2014) and some other scholars, as a functional strategy is typically below a SBU strategy (Hayes et al. 2005 p35) and positioned in the bottom level of strategy for a firm (Waters 2009). This indicates that since SCSs is largely cross-functional based, it would be more practical and appropriate to define or determine SCSs beyond certain organizational boundaries. In the case of Alfa Laval, beyond the PGs and factories. The definition adopted in this thesis is appropriate.

6.1.2 The conceptualized decisions framework of SCSs

Regarding the decisions framework of SCSs, similarly, it is learned not to limit it to just one level of strategies. Like in Alfa Laval, these decisions are commonly achieved by both central levels and PGs and factories levels of strategic decision-making. The contents of detailed decisions within this framework were proved to be highly relevant regarding what constitute a SCS, based on the evidence from literature studies and the case study at Alfa Laval because these decisions need to be made somewhere at Alfa Laval at different management levels. Nevertheless, the way to name and structure these decisions may vary from one to another, like that at Alfa Laval, their SC information integration is called 'digital backbones', the structure of their SC strategic decisions is also composed in a different way to corresponding to their organizational structure at the company. Thus, from a general and theoretical point of view, this conceptual framework of SCSs is proved to be valid and highly relevant, research question 1 is answered, but in the practice, it would be critical to use it flexibly as a reference and adjusted or restructured according to the company's organizational structure.

6.2 Discussion of the interaction models between OSs and SCSs

This session of discussion is corresponding to the **Research question 2:** *How can supply chain strategy and manufacturing operations strategy interact and be related to each other to realize the company's strategic objectives?*

6.2.1 The 'Inside-out' model

The interaction between OSs and SCSs at Alfa Laval is based on the 'inside-out' model. In the end of last chapter, the interaction model for Alfa Laval was composed according to their practice. When this was compared with the initial 'Inside-out' model built in the phase of conceptual works, the key difference is that at Alfa Laval, there are two strategic decision levels: The corporate or central level, and the PGs and factories level that linked to the business unit's strategy. This is mainly because of the organizational structure at Alfa Laval since it is a multi-national corporation with different divisions, BUs, PGs and many factories. Thus their strategic decisions and layouts would be more complicated and more than just one level. The empirical results support that the 'Inside-out' conceptual model is an effective theoretical work regarding how the OSs and SCSs are interacting and could be related to each other to realize the company's strategic objectives. However, 'Outside-in' model and contingency factors should also be considered when looking at the model and answering the research question 2.

6.2.1 The 'Outside-in' model

When the 'outside-in' model was built, there isn't empirical data to support the rationality and application of this interaction model. Therefore, the supporting reason is still based on theoretical arguments that such a model is appropriate for companies who have simpler and fewer operations, but broader and more supply chain activities and partners. Namely, it depends on the contingency factor. However, based on the discussion in above sessions, it would be logical to state that in this 'Outside-in' model, it is also necessary to use it flexibly to corresponding to the company's organizational structure, and as a result, the model could be adjusted in practice.

6.3 The contingency factors

According to previous analysis of conceptual works and the analysis and discussions based on the case study, two contingency factors should be noted. The first factor is the company's organizational structure. This could influence on how the conceptual framework and models might be changed or modified according to the practical needs. The other factor is the complexity of the operations, which to some extent influences which of the 'Inside-out' and 'Outside-in' interaction models, is more appropriate for the company. Normally, if the operations are rather simple and just a few, but the supply chain is more complicated, the 'outside-in' model would be more adaptable. Otherwise, in most of the case, supply chain design and management should be tailored to operating conditions and a firm should extend internally-oriented operations strategy to supply chain-oriented supply chain strategy (Melnyk et al. (2010) and Qi et al. (2017). The organizational capability theory also suggests that internal OS capabilities can directly improve external SCS capabilities (Qi et al. 2017), so the OSs and SCSs should be aligned according to the 'Inside-out' model.

6.4 Conclusions

Using an abductive approach, this research conducts an extensive literature review in OSs and SCSs as well as their interactions, a conceptual decision framework for SCSs according to a preferred definition of SCSs, and two interactions models between OSs and SCSs are built.

The SCSs decisions framework is constituted by primary purpose/goals in the top or the roof of the structure; and four functional categories to support it: they are supplier strategy, production policy, inventory policy, as well as transportation system/setup, while the detailed policies and choices within each category are clearly addressed; the framework also includes some cross-functional aspects including SCSs differentiation drivers, lead time management, and SC integrations.

The framework is mainly a theoretical work, yet has been tested and compared at a case company Alfa Laval which gives empirical support about the reliability and validity of its contents. The influencing factor would be organizational structure when to determine how the decisions may be structured and what decisions are made by which management team, etc.

Regarding the interactions between OSs and SCSs, two models are proposed, the 'Inside-out' model refers to extending internal OSs to external SCSs to exploit and grow dynamic capabilities. This model was also adapted at Alfa Laval, which supports the validity and the value of it from empirics. The 'Outside-in' model refers to building the SCSs first then directing it to the internal operations afterward considering if the operations are relatively simple and less, while the supply chain is more complicated. While the 'Inside-out' model is adapted by Alfa Laval which has a lot of operations, it reflects from an indirect way that this is a contingency factor that affects which interaction model to choose. The interaction models are also theoretical work when it is applied by a company, it should be tailored to the organizational structure properly.

6.5 Main contributions

The two research questions in this study answered properly with arguments in above discussions and conclusions. These research questions were formulated to fill the weak part of research in SCSs, and bridge the gap of interactions between SCSs and OSs in the research area, therefore, the work and results contribute to the research in these areas. The theoretical works in logistics engineering mainly target to guide or serve the practices in the industry, thus, the work and outcome of this thesis have a potential to benefit companies in the industry. However, the contributions are not achieved by an individual. It relies on consistent further research to generalize or improve the built conceptual frameworks and models.

6.6 Limits and further research

Within the time frame for a thesis project, two limits mainly exist in this study. The first is the number of case company been studied. Normally it needs more empirical data conducted with many different companies to increase the stability of the results and conclusions, or to be able to generalize the findings. In this thesis project, one company was reached to test the result. Though it basically supports the theoretical works and central interaction model, it still encourages further research to conduct more empirical learning to compare with the conceptual works built here to generalize essential findings. The other limit is the delimitation of interactions with other strategies to have a moderate complexity for a thesis. However, research to involve more strategies, especially with different functional strategies could also be interesting.

Reference

Alfa Laval AB (2017). Our company. [online] Available at: http://www.alfalaval.se/om-oss/our-company/[accessed Oct 20 2017].

Anderson, J. (1989). Operations strategy: A literature review. *Journal of Operations Management*, 8(2), pp. 133-158.

Andrews, K.R. (1987). *The Concept of Corporate Strategy*. Homewood, IL: Irwin.

Barnes, D. (2002). The complexities of the manufacturing strategy formation process in practice. *International Journal of Operations & Production Management*, 22(10), pp. 1090–1111.

Basheer, A., and Gazanfar, A. (2017). Strategic alignment between competitive strategy dimensions and Suppl y Chain Strategy Dimensions. *FWU Journal of Social Sciences,* 11(1), pp. 44-55.

Bergman, B., & Klefsjö, B. (2010). *Quality from Customer Needs to Customer Satisfaction*. Lund: Studentlitteratur AB.

Birhanu, D., Lanka, K. and Rao, A. (2014). A Survey of Classifications in Supply Chain Strategies. *Procedia Engineering*, 97, pp. 2289-2297.

Björklund, M. and Paulsson, U. (2014). *Academic papers and theses, to write and present and to act as an opponent.* Translation by: Christina Nilsson-Posada. , Lund: Studentliterature AB

Bruce, M. Daly, L. and Towers, N., (2004). Lean or agile: a solution for supply chain management in the textiles and clothing industry? *International Journal of Operations & Production Management.* 24(2), pp. 151-170.

Chibba, A. (2007). *Measuring supply chain performance: prioritizing performance measures*, Licentiate Thesis. Gothenburg: Chalmers University.

Chopra, S. and Meindl, P. (2007). Supply Chain Performance: Achieving Strategic Fit and Scope. Chapter 2 in Chopra, S. and Meindl, P., (2007) *Supply Chain Management, Strategy, Planning and Operations*, pp. 22-43. Berlin: Springer.

Christopher, M. (2000). The Agile Supply Chain. *Industrial Marketing Management*, 29(1), pp.37-44.

Christopher, M., Peck, H. and Towill, D. (2006). A taxonomy for selecting global supply chain strategies. *The International Journal of Logistics Management*. 17(2), pp. 277-287.

Cigolini, R., Cozzi, M., & Perona, M. (2004). A new framework for supply chain management. *International Journal of Operations and Production Management.* 24(1), pp. 7-41.

Cousins, P. D., and Menguc, B. (2006). The Implications of Socialization and Integration in Supply Chain Management. *Journal of Operations Management* 24 (5): pp. 604-620.

Creswell, J. (2002). *Research Design: Quantitative and Qualitative Approaches*. 2nd Edition. Thousand Oaks, CA: Sage.

Denscombe, M. (2009). *Forskningshandboken - för Småskaliga Forskningsprojekt inom Samhällsvetenskaperna*. 2 nd Edition. Lund: Studentlitteratur AB.

Durach, C. F., Kembro, J. and Wieland, A. (2017). *Journal of* Supply Chain *Management.* 53(4), p67-85.

Fine, C.H and Hax, A. C. (1985), Manufacturing Strategy: A Methodology and an Illustration, *Interfaces* 15: 6 November-December, pp. 28-46.

Fisher, M.L. (1997). What Is the Right Supply Chain for Your Product? *Harvard Business Review*, March-April, pp.105-116.

Flynn, B., Huo, B., & Zhao, X. (2010). The impact of supply chain integration on performance: a contingency and configuration approach. *Journal of Operations Management*. 28 (1), pp. 58–71.

Frohlich, M. and Westbrook, R. (2001). Arcs of integration: an international study of supply chain strategies. *Journal of Operations Management*, 19(2), pp.185-200.

Godsell, J., Harrison, A., Emberson, C. and Storey, J. (2006). Customer responsive supply chain strategy: An unnatural act? *International Journal of Logistics Research and Applications: A leading Journal of Supply Chain Management*. 9(1), pp. 47-56.

Harrison, T.P. Lee, H.L. and Neale, H.L. (2003). *The Practice of Supply Chain Management*. New York: John Wiley & Sons.

Hax, Arnoldo C. and Majluf, Nicolas S. (1984). *Strategic Management: An Integrative Perspective.* New Jersey: Prentice-Hall.

Hayes, R. G., Pisano, D. Upton, and Wheelwright,S. (2005). *Operations, Strategy, and Techn ology Pursuing the Competitive Edge.* New York: Wiley.

Hopp, W. J. (2003). *Supply Chain Science*, New York: Mc-Graw Hill.

Hill, A. and Hill, T. (2009). *Manufacturing operations strategy–3rd edition*. London: Palgrave Macmillan.

Hilletofth, P. (2008). *Differentiated Supply Chain Strategy-Response to a fragmented and complex market.* Gothenburg: Chalmers University of Technology.

Höst, M., Regnell, B., & Runeson, P. (2006). *Att genomföra examensarbete*. Lund: Studentlitteratur AB.

Ivanov, D. (2010). An adaptive framework for aligning (re)planning decisions on supply chain strategy, design, tactics, and operations. *International Journal of Production Research*, 48(13), pp. 3999–4017.

Jacoby, D. (2010). *Guide to supply chain management: How getting it right boosts corporate performance.* London: Profile Books LTD.

Jubenkanda, R. R., and Marume1, S. B. M. (2016). Centralization and Decentralization. *Journal of Research in Humanities and Social Science*, 4(6), pp: 106-110.

Kim, S.H., Fowler, J.W., Shunk, D.L., & Pfund, M. E. (2012). Improving the push–pull strategy in a serial supply chain by a hybrid push–pull control with multiple pulling points. *International Journal of Production Research*, 50 (19), pp. 5651-5668.

Kim, Y.H., Sting, F.J., Loch, C.H. (2014). Top-down, bottom-up, or both? Toward an integrative perspective on operations strategy formation. *Journal of Operations Management.* 32 (7-8), 462–474.

Lee, H.L. (2004). The Triple-A-Supply Chain. *Harvard Business Review*, Oct, 82(10), pp. 102-112.

Lee, H. (2002). Aligning Supply Chain Strategies with Product Uncertainties. *California Management Review*, 44(3), pp.105-119.

Lindroth, R. (2001). *Reflections on Process-based Supply Chain Modelling and Analysis.* [online] Available at https://lup.lub.lu.se/record/618137 [accessed Nov 11 2017]

Lo, S.M., Power, D., (2010). An empirical investigation of the relationship between product nature and supply chain strategy. *Supply Chain Management: An International Journal*, 15(2), pp. 139-153.

Lyons, A. C. (2014). An examination of multi-tier supply chain strategy alignment in the food industry. *International Journal of Production Research*, 52(7), pp. 1911–1925.

Martinez-Olvera, C., Shunk, D. (2006). Comprehensive framework for the development of a supply chain strategy. *International Journal of Production Research*, 44(21), pp. 4511–4528.

Mason-Jones, R., Naylor, B. and Towill, D. (2000). Lean, agile or leagile? Matching your supply chain to the marketplace. *International Journal of Production Research*, 38(17), pp.4061-4070.

Melnyk S.A., Davis E.W., Spekman R.E and Sandor, J. (2010). Outcome-Driven Supply Chains, *MIT Sloan Management review*, 51(2), pp. 33-38.

Miltenburg J. (1995). *Manufacturing strategy: How to formulate and implement a winning plan*. Portland, OR: Productivity Press.

Minnich, D., and Maier, H. (2007). Responsiveness and efficiency of pull-based and push-based planning systems in the high-tech electronics industry [online] Available at https://www.systemdynamics.org/conferences/2007/proceed/papers/MINNI334.pdf [accessed Jun 11 2017]

Muhammad Shakeel Sadiq Jajja, Vijay R. Kannan, Shaukat Ali Brah, Syed Zahoor Hassan, (2016). Supply chain strategy and the role of suppliers: evidence from the Indian sub-continent, *Benchmarking: An International Journal.* 23(7), pp.1658-1676.

Narasimhan, R., Kim, S., and Tan, K. (2008). An empirical investigation of supply chain strategy typologies and relationships to performance. *International Journal of Production Research*, 46(18), pp.5231-5259.

Naylor, Ben J., Naim, M. and Berry, D. (1999). Leagility: Integrating the lean and agile manufacturing paradigms in the total supply chain. *International Journal of Production Economics*, 62(1-2), pp.107-118.

Norrman, A. (2017). Lecture 4: Supply chain strategy and configuration. [online] Available at:

https://liveatlund.lu.se/departments/tlog/MTT240/MTT240_2017VT_100_1_NML__1281/CourseDocuments/MTT240_2017_Le_4_Supply%20chain%20strategy%20and%20configuration_HO.pdf [accessed Jun 12 2017].

Operations management (2017) [online] Available at: https://ids355.wikispaces.com/Ch.+5+Strategic+Capacity+Planning+for+Products+and+Services [accessed Jun 11 2017]

Olhager, J. (2003). Strategic positioning of the order penetration point. *International Journal of Production Economics*. 85 (3), pp. 319-329.

Olhager, J., and Rudberg, M. (2003). Manufacturing networks and supply chains: an operations strategy perspective. *Omega*, 31(1), pp. 29-39.

Olhager, J., and Selldin, E. (2007). Linking products with supply chains: testing Fisher's model. *Supply Chain Management: An International Journal*, 12(1), pp. 42-51.

Perez-Franco, R., Phadnis, S., Caplice, C. and Sheffi, Y. (2016). Rethinking supply chain strategy as a conceptual system. *International Journal of Production Economics*, 182, pp. 384-396.

Qi Yinan, Huo Baofeng, Wang Zhiqiang, and Yeung H. Y. (2017). The impact of operations and supply chain strategies on integration and performance. *International Journal of Production Economics*, 185, pp. 162–174.

Rose, W., I. J. Singh Mann, and Rose, S. (2012). A Strategic Perspective and Taxonomy of Supply Chain Strategies.' *Journal of Operations Management*, 11 (3), pp. 6–42.

Ramdas, K. and Spekman, R.E. (2000). Chain or shackles: Understanding what drives supply-chain performance. *Interfaces*. 30(4), pp. 3-21.

Samson D. (1991). *Manufacturing and operations strategy*. Sydney: Prentice-Hall.

Schnetzler, M. J., A. Sennheiser, and P. Schönsleben. (2007). A Decomposition-Based Approach for the Development of a Supply Chain Strategy. *International Journal of Production Economics*, 105 (1), pp. 21–42.

Sillanpää I., and Sillanpää S. (2014). Supply Chain Strategy: Empirical Case Study in Europe and Asia. *Management,* 9 (2), pp. 95–115.

Simchi-Levi, D., Kaminsky, P. and Simchi-Levi, E. (2003). *Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies*. Boston: McGraw-Hill.

Simchi-Livi, D., Clayton, A., & Raven, B. (2013). When One Size Does Not Fit All. *MIT Sloan Management Review*, 54(2), pp. 15-17.

Skinner, W. (1969). Manufacturing-missing link in corporate strategy, [online] Available at: http://cm.nsysu.edu.tw/jhuang/phd-2/phd18-1.doc [accessed Jun 11 2017]

Skinner, W. (1996). Three yards and a cloud of dust: Industrial management at century end. *Production and Operations Management*, 5(1), pp. 15-24.

Stevens, G.C. (1989). Integrating the supply chain. *International Journal of Physical Distribution & Logistics Management*, 19(8), pp. 3-8.

Storey, J., Emberson, C., Godsell, J. and Harrison, A. (2006). Supply Chain Management: Theory, Practice and Future Challenges. *International Journal of Operations and Production Management,* 26 (7), pp. 754-74.

Taco van der Vaart, Dirk Pieter van Donk, (2006). Buyer-focused operations as a supply chain strategy: Identifying the influence of business characteristics. *International Journal of Operations & Production Management*, 26(1), pp.8-23.

Tranfield, D., Denyer, D., and Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, 14, pp. 207-222.

Özkir, V. and Demirel, T. (2011). *A comprehensive analysis for the metrics of supply chain design strategies,* 15th International Research/Expert Conference on Trends in the Development of Machinery and Associated Technology, Prague.

Waters, D. (2009). *Supply Chain Management: An Introduction to Logistics.* London: Palgrave Macmillan.

Yin, R.K., (2003). *Case Study Research*: Design and Method. 3rd Edition. London: Sage.

Zdravkovic, J., Rychkova, I., Speckert, T (2014). *Requirements for IT Governance in Organizations Experiencing Decentralization.* [online] Available at: https://www.researchgate.net/publication/280046669_Requirements_for_IT_Governance_in_Organizations_Experiencing_Decentralization [accessed Nov 11 2017].

Appendix

Appendix A: The interview guide

Operations Strategies and Supply Chain Strategies

Master thesis at Department of Industrial Management and Logistics, LTH, Lund University, 2017.

Student: Tingting Wang, Supervisor: Jan Olhager

Emails: sma14twa@student.lu.se; jan.olhager@tlog.lth.se

Background

Operational excellence plays a vital role in achieving an organization's success (Hayes et al 2005), while supply chain strategy was recognized significant for a company to balance the conflicts among different functions and handle various issues along the supply chain, inter-departmental conflicts and the challenge of goal restructuring (Stevens 1989; Perez-Franco et. al. 2016). More importantly, both operations and supply chain strategies capabilities are dynamic capabilities (Hayes et al 2005, p61, p91; Qi et al. 2017). It implies that, with excellent strategic alignment, Operations strategy (OSs) and Supply chain strategy (SCSs) can be used as a useful weapon in accomplishing an organization's competitiveness. However, there is still not a consensus on what a SCSs is, and it is still unclear regarding how these two strategies can be tailored and how are they related to each other to better exploit and develop the dynamic capabilities. Therefore, a call for a relevant research in filling this gap needs to be answered. The purpose of the thesis is to review the literature on manufacturing OSs and SCSs, with a strong focus on conceptualizing SCSs mainly in aspects of its decision framework; also the thesis work includes developing models that can describe how these two types of strategies are related in the strategic fit process. The work will be mostly theoretical, but expect to compare the framework and model(s) with industry practice in one or a few larger corporations to understand the similarity or difference, as well as the contingencies, etc. to draw conclusions.

Semi-structure interview guide

Based on literature studies, the conceptual framework and interaction models are proposed by the thesis author. Interview questions are designed in three parts accordingly to compare the developed theoretical models with reality in practice.

1. Operations strategy
2. Supply chain strategy
3. Interaction between operations and supply chain strategy

Part 1: Questions regarding operations strategy:

A decision framework of operations strategy is available in Table A-1 for reference:

Table A-1: Operations Strategy Decision Categories (Source: Adapted from Hayes et al., 2005, p41)

Structural decisions, and decision area
• **Capacity**-amount, type, timing • **Sourcing and vertical integration**-direction, extent, balance • **Facilities**-size, location, specialization • **Process technology**- drivers of process development, approaches of process technology
Infrastructural policies & systems, and decision area
• **Human resource systems-**employee selection, skills, payment & reward system, etc. • **Organization-**challenges, centralized vs. decentralized, etc. • **Quality systems-**tasks & responsibilities, quality management approach, quality assurance & control, quality improvement & culture, etc. • **Planning and control systems-**production schedule, material planning, shop floor activity control, inventory, etc.

Q1: What are the main decision categories or decision areas in the operations strategy (e.g., compare with Table 1 above)?

Q2: Do you have one or more operations strategies? If two or more, what is the basis for differentiation between operations strategies (e.g., different product types, different markets)?

Q3: How are the company's operations strategies determined, (by whom, top-down or bottom-up? What are the key attributes, etc.). How often a change or a new decision is made? Based on what reasons and process?

Part 2: Questions regarding supply chain strategy:

The decision framework about supply chain strategy is proposed and given in Figure A-1:

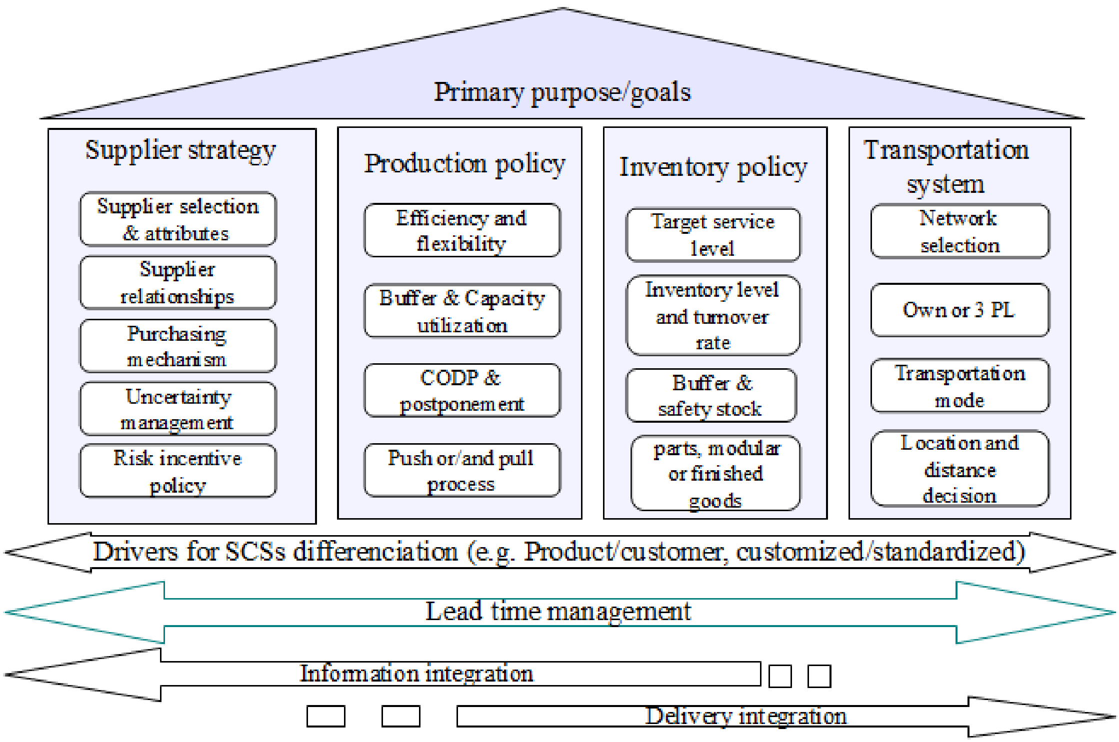


Figure A-1: Conceptual decision framework for supply chain strategy (Proposed by the thesis author)

Q1: Which decision categories or decision areas are considered as part of the supply chain strategy?

Q2: Do you have one or more supply chain strategies? If two or more, what is the basis for differentiation between supply chain strategies (e.g., different product types, different markets)?

Q3: How are the company's supply chain strategies determined, (by whom, top-down or bottom-up? What are the key attributes, etc.). How often a change or a new decision is made? Based on what reasons and process?

Part 3: Interactions between SCSs and OSs:

There are two possible interaction models between a company's SCSs and OSs, as proposed by the thesis author and given in the following:

Figure A-2: The 'Inside-out' interaction model: OSs determines SCSs (Source: proposed by author)

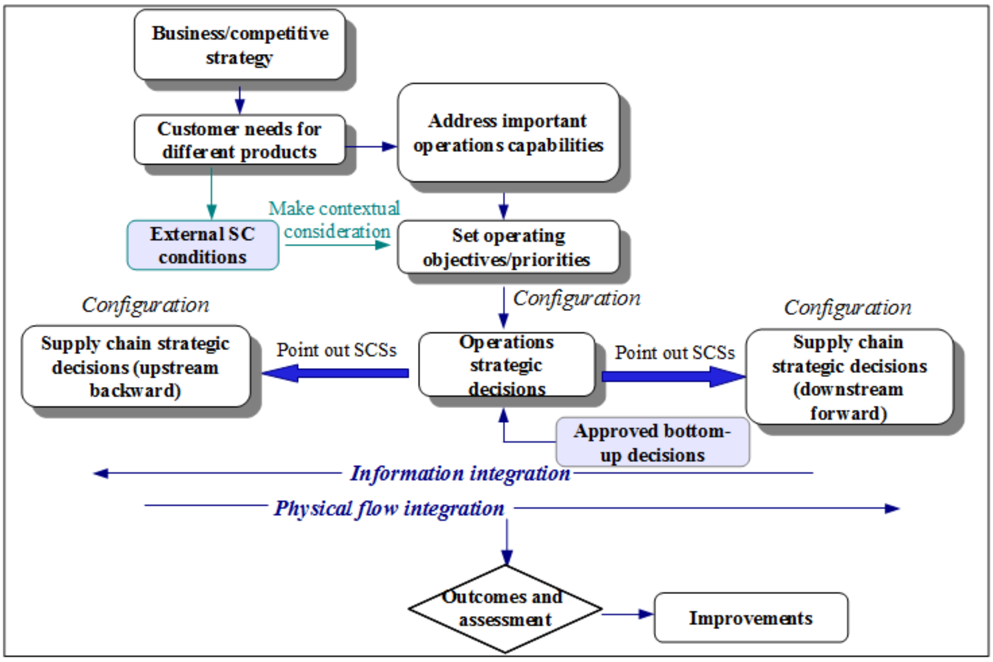
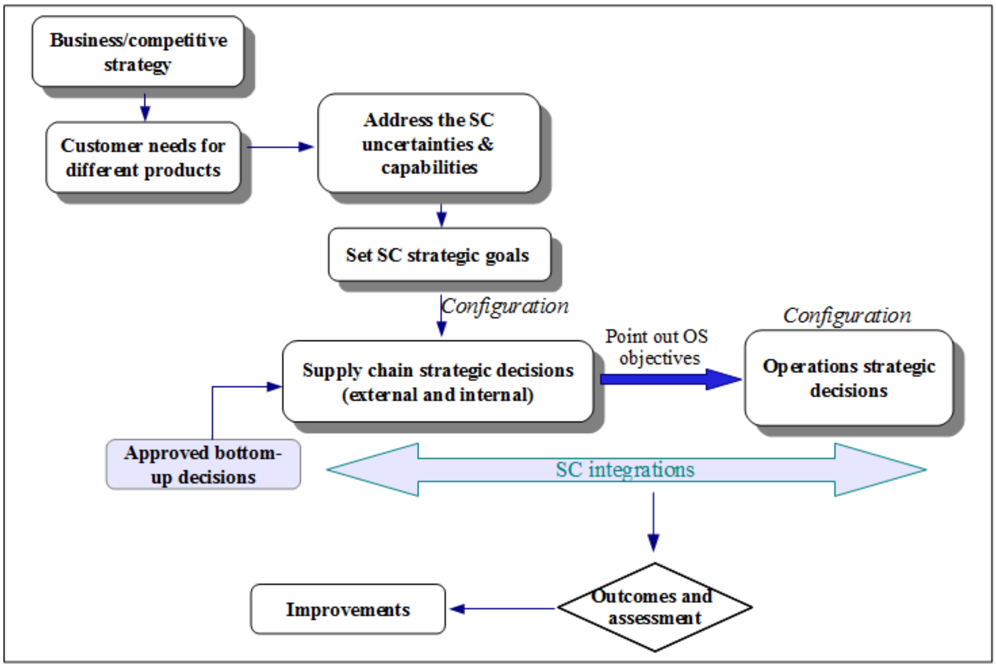


Figure A-3: The 'Outside-in' interaction model: OSs determines SCSs (Source: proposed by author)



Some researchers such as Melnyk et al (2010) and Qi et al (2017) argue that supply chain design and management should be tailored to operating conditions; Supply chain strategy should play important roles in defining firm's operations strategy and a firm should extend internally-oriented operations strategy to supply chain-oriented supply chain strategy. According to organizational capability theory, internal OS capabilities can directly improve external SCS capabilities. Accordingly, the thesis author conceives that the model 1 is adaptable for a large number of companies, while the model 2 is also possible for a few companies. For instance, companies have less complicated operations and/or a horizontal structure of facility networks.

Q1: Does the company define that both OS's and SCS's are functional strategies? And, there might be an overlapped area of decisions but neither is properly included by the other?

Q2: In the company's strategic alignment process regarding OS's and SCS's, which strategy comes first and why? How is the other related to it?

Q3: In the company's strategic alignment process OS's and SCS's, what are the key attributes that influence the configuration of strategies (e.g., product, demand pattern, or customers, etc.)?

Q4: Is there a written/agreed upon strategic alignment process for these two strategies at the company? How is it similar to or different from the models proposed here?

Q5: Is there a cross-functional team at the company for the strategic alignment, could you describe the way it works? How are the outcomes assessed or measured?