Supply Chain Design

Creating an Initial Framework for New Products and Services

HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

Bachelor's thesis

Valkeakoski, Industrial Engineering and Management

Winter 2018

Vivian Leung

HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

Industrial Engineering and Management
Valkeakoski Campus

ABSTRACT

Author Vivian Leung **Year** 2018

Subject Supply Chain Design: Creating an Initial Framework for new Products and Services

Supervisor(s) Susan Heikkilä

ABSTRACT

In February 2017, a commissioning company was launching a new product. They had no existing data and infrastructure and had to build the supply chain from scratch. Their primary goal was to create the preliminary draft of a handbook that the company could use as a reference should anyone have questions about their supply chain operations. This thesis tries to help them address this business challenge by seeking to discover if there is an underlying, universal framework that the company could use to build their supply chain correctly from the very beginning.

Much of the theoretical literature available, however, focused on supply chain redesign instead of building supply chains from scratch. Some of the literature researched also suggested that because of the complexity of supply chains, the best approach to designing a supply chain would differ from case to case. This became especially clear when several authors, who are notable experts in their field, came up with very different supply chain design frameworks. One common theme found in all the literature was the need to create a good SC (supply chain) strategy. However, there were again several approaches that could be taken in this process.

The original plan then had to be modified, and the commissioning company selected a pre-existing framework to help build a tailor-made framework. A workbook was made instead of a handbook because the commissioning company did not have time to tailor the framework. The framework they selected, however, appeared to be a mismatch for the company since they did not end up using it.

Because there were no clear patterns in the research literature that could be discovered, it had to be concluded that no universal framework for SC design exists at this time. However, there do appear to be some common elements in well-designed supply chains. With further research, a universal framework could be uncovered.

Keywords supply chain, supply chain design, strategy, framework, model

Pages 39 pages

For more information about the workbook created for the commissioning company, please contact the author via LinkedIn (www.linkedin.com/in/vivianleung8)

CONTENTS

1 INTRODUCTION

The way the world does business and moves goods and information is continuous and ever-evolving. Consumers are now more demanding and fickler than ever, the business competition stiffer than ever, and the environmental and political landscape more unpredictable than ever. The increase of choices for consumer goods, along with dynamic business models that are disrupting more traditional business strategies have contributed significantly to this tough business environment. Add the fact that global warming is bringing natural disasters, and that political conflicts are turning trade deals upside down in a flash, and even the mightiest of corporations can fall if they are not careful.

Designing robust supply chains has never been more important to helping businesses overcome these challenges. But even though supply chains have existed since civilization has begun trading, it is only recently that supply chain management (SCM) has been recognized as a separate field, and one crucial to a business's success. Compared to its counterparts, such as operations management and quality management, SCM is a significantly less-evolved and less-researched field. At least, that is what Brann discovered when he began to research the field (2008).

While the idea of building a supply chain might seem "intuitively obvious," Brann points out that if this were the true, there would not be so many existing businesses with mismatched and poorly-designed supply chains (2008). On the other hand, another reason for the lack of mature supply chain design theory could be because of how complex the subject is. Choosing the right tools and methods that work for a company can be a tricky task when there are so many different factors involved. A solution that works well for one company does not necessarily work well for another. The failures of the many companies that have tried to mimic the brilliantly-designed SC (supply chain) of companies like Toyota and Walmart are a testament to this fact.

Nevertheless, there are surely some elements that successful supply chains have in common. While a direct copy-paste of the tools and techniques of a company may not work, maybe the essence of the supply chain design could somehow be captured. If so, it could be turned into a basic set of guidelines or framework that all companies could use to make the process of SC design less painful. It could then become a model or standard material of reference, much like the way Juran's Quality Handbook is the standard for quality control.

Brann attempted in his dissertation to discover a conceptual model for designing supply chains. Unfortunately, after a significant amount of research, he could not find a complete or definitive model at the time (2008). This thesis will see if anything has changed since Brann has done his research and attempt to answer the following question:

Is there a universal process or framework for designing a standard supply chain? If so, does it work and if not, is it possible to develop/refine one?

It is important to note that unlike Brann, who was completing his PhD and had substantially more time to explore the topic, there was significantly less time allocated for this thesis (5 months). Therefore, the aim of this thesis is not to create a complete conceptual framework, but to discover if there is one available, to test how well it works, and if it does not, see if there is potential for refining a complete conceptual framework in the future.

2 SCOPE OF RESEARCH

It is important to note that while the field of SCM and logistics may seem like a highly specialized topic, in reality it covers a broad field of operations. Each major business operation that falls under this category (e.g – purchasing, transportation, inventory management, warehousing) could be its own individual field. A person can study and work in their whole life in one of these specific fields and still never master it.

When designing a supply chain, there are 3 levels of decision making. The first is the strategic level: here, all the major long-term decisions are made that will determine the direction a company will take for years to come, such as your mission, business strategy, and supply chain or logistics strategy. Changing these decisions after the fact require lots of resources and are very costly. The next is the tactical level: here you make more detailed decisions about the different logistics areas that will affect your operations in the coming months or year. Finally, there are the decisions you make at the operational level: these decisions affect your day-to-day operations and are significantly less costly to change than strategic decisions (Waters, 2003, p. 60). The research scope of this thesis will deal primarily with decisions being made at the strategic level.

2.1 Supply Chain Management vs. Logistics

The terms “supply chain management” and “logistics” are often used intermittently and have many different meanings. It is therefore important to establish the definition that will be used for this thesis before diving deeper into the topic of SCM.

Many industry professionals, according to Dr. Marien, believe that the term supply chain is just a new hat for the word logistics. Others feel that SCM is a more evolved form of logistics, encompassing a much broader scope, and that logistics is a sub-category of SCM (Dr. Marien, 2003). For the most part, experts appear to lean more towards the latter definition, and that is the definition that will be used for this report. There appears to be no official or universal definition for logistics and supply chain management, but the definitions as stated in the 15th edition of the APICS Dictionary can offer us some insight into the differences between the two terms.

> **Logistics** – 1) In a supply chain management context, it is the subset of supply chain management that controls the forward and reverse

movement, handling, and storage of goods between origin and distribution points.
2) In an industrial context, the art and science of obtaining, producing, and distributing material and product in the proper place and in proper quantities.
3) In a military sense (where it has greater usage), its meaning can also include the movement of personnel

Logistics Management – The part of supply chain management that oversees the planning and execution of forward and reverse flows of goods and related information between points in the supply chain to meet customer requirements.

Logistics system – The planning and coordination of the physical movement aspects of a firm's operations such that a flow of raw materials, parts, and finished goods is achieved in a manner that minimizes total costs for the levels of service desired.

Supply Chain – The global network used to deliver products and services from raw materials to end customers through an engineered flow of information and physical distribution, and cash.

Supply Chain Management – The design, planning, execution, control, and monitoring of supply chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand, and measuring performance globally.

(Pittman & Atwater, 2016)

Reading these definitions, we clearly begin to see that logistics focuses on the execution of the different operations primarily at the business organization level. SCM, however, deals with all of the organizations involved from beginning to end. As Don Waters explains, this requires a different mindset to the way business has traditionally been done in the past. Whereas before most businesses focused only on maximizing their own individual profits, they now have to work with partners upstream and downstream in order to maintain a truly competitive edge. Organizations need to compete not necessarily as "company against company, but rather as supply chain against supply chain" (Waters, 2010, p. 4).

Hence, while logistics and supply chains are very closely related, they are indeed different. While logistics involves a series of activities that moves goods and materials in and out of an organization, "a supply chain consists of the series of activities and organisations that materials move through on their journey from initial suppliers to final customers" (Waters, 2003, p. 7). These

differences, while they might seem small, should be kept in mind throughout the duration of this thesis.

2.2 **Initial Plan**

My commissioning company at the time was in the process of building and designing a supply chain for what they believed to be an innovative and new product. They were just beginning to branch out into a new business sector, and therefore had no pre-existing infrastructure for this product. However, because the profit margins were so small, their product would have to be very robust and well-designed. Hence, they needed to have a basic framework from which they could build their supply chain to help them avoid making the typical costly mistakes that usually go with designing a supply chain from scratch.

Of course, designing a supply chain is a massively complex task and takes more than the five months allocated to a bachelor's thesis. My commissioning company understood this, hence why their aim was to create only the basic framework. The goal, therefore, was to create a handbook or manual from which the company could continue to work and build upon, rather than a complete standalone manual. In other words, a development-oriented thesis which would help in creating new work practices.

In order to accomplish this, the original plan was to use article-based research methodology to create an initial generic supply chain framework. Then, to test how well it worked, the plan would switch to a practice-based research method where the new framework would be applied to my commissioning company's new supply chain. The process was meant to be iterative in nature, meaning the framework would be presented to the company, they would make suggestions, the framework would be refined based on the suggestions, and this process would be repeated for as long as possible. By the end, the generic framework should have been validated, and my commissioning company would have the beginnings of a working supply chain handbook. They hoped that the work could also help answer come critical SC design questions they had (e.g. – where to locate their facilities, what parts to outsource, what to make in-house, at what stage should they change their strategy, etc.). However, there was no expectation that the work would answer these questions. Unfortunately, as explained in chapter 2.3, it was not possible to execute this plan.

2.3 **Research Project in Practice**

As already explained in chapter 2.2, the intention was to create a development-oriented thesis that would help with implementing new work practices. The original plan was to use article-based research methods to create an initial framework. The thesis would then switch to a practice-based methodology and work with my commissioning company to create the final model. Unfortunately, I was unable to execute the plan in this manner for several reasons.

First of all, I discovered based on my literature review that there were many different ways to build an SC Framework. Many of the authors had different perspectives and suggestions for how to approach the initial planning phase, and some even acknowledged that there are many ways a company can approach the problem and still build an excellent supply chain. Second, many of the frameworks were approaching the situation from the idea that the company had a pre-existing supply chain and that their business operations were generally established. It was therefore more of a supply chain redesign. This most likely works better for medium-sized to large enterprises than for small startups. Therefore, it made it very difficult to create one singular universal framework. Third, there was the fact that the task was simply too large of an undertaking for a bachelor's thesis. Someone doing their master's or PhD would probably have been more suitable. Finally, creating the right supply chain would have required extensive consulting and joint work with my commissioning company, which they did not have time for because, ironically, they were too busy trying to get their supply chain up and running.

Therefore, instead of attempting to use my research to propose one single framework I presented the company with my research results (as shown in chapters 4 to 7) and asked them how they would like to proceed. Once they had selected a framework, the next step was to begin working on making the "handbook" that they desired to build their supply chain with.

Issues continued to arise with regards to executing the second phase of the original plan, which was to work with the commissioning company using a practiced-based methodology. After the results of the initial research were presented to the commissioning company, they selected Frazelle's LMP Methodology (chapter 6.4) because felt that the framework matched the end result that they wanted. The framework was then broken down into its essential components and presented to them in a more compact form.

The feedback the company gave was generally positive. Many of the processes explained in the framework were already established within the company, they just needed to be clearly defined and written down on paper, and Frazelle's framework seemed to be the perfect fit to do that. It was just a matter of tailoring the framework that had been created to my commissioning company's situation. I therefore suggested that we would need to sit down together to go over each chapter of the framework to see how their current supply chain operations fit the ideal situation. This would help them identify areas that they need to work on, and clearly outline pre-existing processes.

Unfortunately, no one in the company had time to meet and go through this process with me. So once again, the original plans were modified: I turned the handbook into a workbook.

Each chapter of the framework, instead of containing details of what that specific area should contain, consisted of a series of questions that the company could ask itself in order to determine if they had clear definitions and/or guidelines on that specific area. If they did not have it, did they need it? This way, the company would have the framework they needed to create their handbook, without a 3rd party such as myself needing to sit down and work through it with them.

Figures 1 and 2 illustrate a sample of what can be found in the workbook.

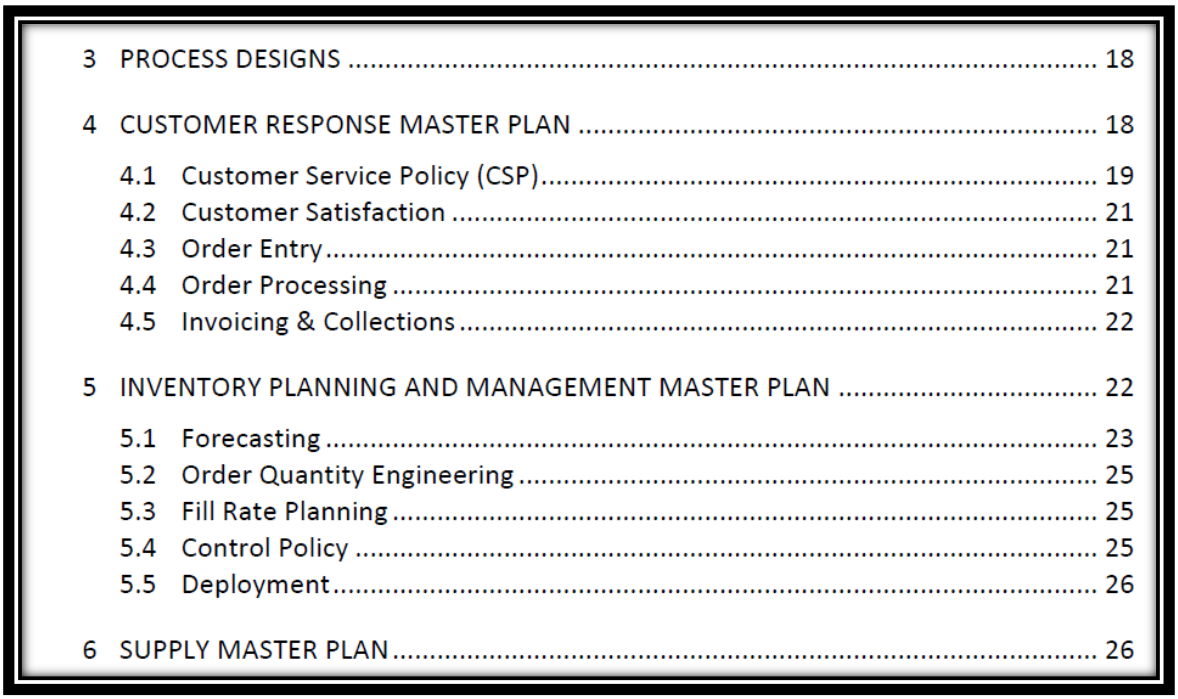
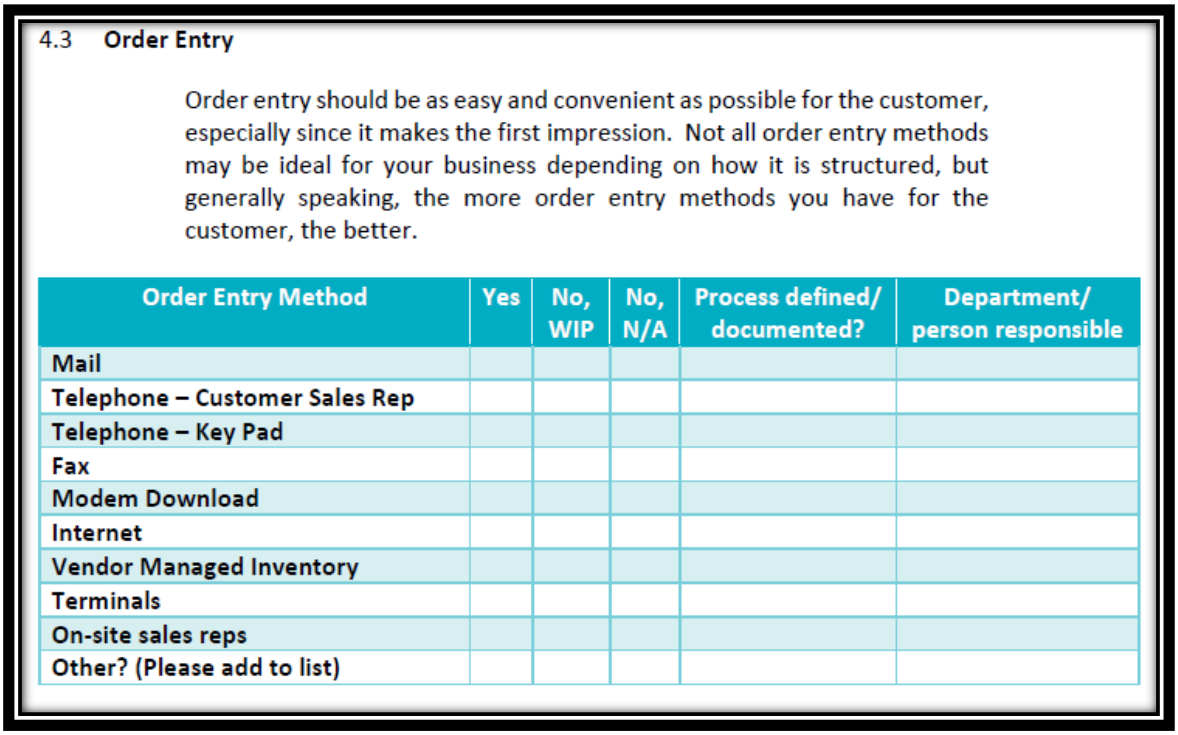


Figure 2 - Sample of the workbook table of contents



4.3 **Order Entry**

Order entry should be as easy and convenient as possible for the customer, especially since it makes the first impression. Not all order entry methods may be ideal for your business depending on how it is structured, but generally speaking, the more order entry methods you have for the customer, the better.

Order Entry Method	Yes	No, WIP	No, N/A	Process defined/ documented?	Department/ person responsible
Mail					
Telephone – Customer Sales Rep					
Telephone – Key Pad					
Fax					
Modem Download					
Internet					
Vendor Managed Inventory					
Terminals					
On-site sales reps					
Other? (Please add to list)					

Figure 1 – Sample of the workbook section

For those interested, a copy of the full workbook can be requested by contacting the author of this thesis directly.

3 RESEARCH RESULTS

From the literature reviewed thus far, there are many different ways a supply chain can be designed, and many different theoretical models and frameworks that have been designed by various experts in the industry. From this result, it appears that at the time this research was conducted that there is no universal, singular correct way to design a supply chain. The right design will depend on what the needs of the organization are.

There are, however, some common characteristics that well-designed supply chains have. Unfortunately, these characteristics are not specific enough to develop a universal framework. Chapters 4 to 6 summarize these ideas in more detail.

4 STRATEGY

One thing that each framework had in common, however, was that the first step involved establishing the company's business or competitive strategy (if they have not done so already). The next step was then designing a supply chain strategy that is in alignment with this business strategy. How this strategy should be developed becomes the major question and should be the first step in designing any supply chain. The chapters following will go over the basic definitions of strategy and present some potential frameworks which companies can use to determine their SC strategy.

4.1 Strategy as a Concept

Before diving into supply chain (SC) strategy, we will first briefly review what strategy is. In terms of basic definitions, Michael E. Porter probably says it best: "Strategy is the creation of a unique and valuable proposition, involving a different set of activities" (Porter, 1996, p. 3)

Companies often make the mistake of believing operational effectiveness is strategy. However, while operational effectiveness can result in some gains, those gains are usually short-lived because tools and techniques can quickly be replicated by other companies.

A good strategy will differentiate a company from its competitors. It involves either performing different activities from rivals, or performing the same activities but in a different way. A good strategy also correctly addresses the needs of its customers.

According to Michael Porter, there are 3 types of needs that companies can serve when creating their strategy: a few of the needs of many customers, the many needs of a few customers, and the many needs of many customers in a niche market. (Porter, 1996, p. 3)

Creating a strong strategy also means compromise. In other words, picking and choosing between what a company should and should *not* do. And finally, a strategy should be a good "fit" for whatever the company's activities may be (Porter, 1996). These are the things we should keep in mind as we discuss strategy throughout this report.

4.2 **Evaluation of the Market**

The ultimate goal of a supply chain, in theory, is quite simple: to respond accurately to the demand of the market. Trying to predict this demand, of course, is a special challenge in itself. When it comes to demand planning, managers spend rigorous time creating forecasts only to know in the end that they will never be 100% accurate, and there could very well be a volatile swing in demand for whatever reason (e.g – political, social, economical, force majeure, etc.). Nonetheless, the more information a company has with regards to its market and the type of the demand, the much easier it is to design the appropriate supply chain. Companies might even find that demand for their target market has changed and wish to re-evaluate their markets to make sure their supply chain is still in alignment.

4.2.1 Functional vs. Innovative

Is your product (or service) functional or innovative? In 1997, Marshall Fisher created one of the earliest frameworks for helping companies determine the appropriate supply chain for their company. Functional products are those which have relatively steady demand, such as common household goods. However, because competition is stiff, the margins are relatively low. Innovative products, on the other hand, have very volatile demand, but because they are unique to the market, can command relatively high margins. Of course, products do not have to be strictly functional or innovative: they can also be a combination of the two in varying degrees. In fact, it is often the case that a company's product will transition from functional to innovative or vice versa, without the company realizing it. Hence why there is so often a mismatch between supply chains and the company's strategy.

Which type of supply chain should be used for which product? There are, of course, many different designs available to companies, but at the time of the article's publishing, Fisher recommended an *efficient* supply chain for functional products, which placed and emphasis on keeping cost down and *responsive* supply chains which can react quickly to sudden changes in demand. Efficient supply chains tend to be slower, while responsive supply chains tend to be more expensive. And like with the functional and innovative categories, a supply chain can be both a mix of efficient and responsive (Fisher, 1997).

4.3 **Competitive Strategy, Supply Chain Strategy, and Strategic Fit**

The competitive strategy (also known as business strategy, corporate strategy, corporate mission, etc.) is the strategy that sets the precedence for all other strategies. It is therefore crucial that a company have their competitive strategy clearly in place before creating their SC strategy, because the SC strategy, and all steps of SC design thereafter, will be designed with the competitive strategy ultimately in mind. While literature tends to differ on the steps necessary after a company has created their strategy, they are unanimous on the idea that a company must create an SC strategy that is in line with their competitive strategy, and that it will serve as the basis for every design decision thereafter. SC strategy will also sometimes be known as the supplier strategy, operational strategy, or logistics strategy within a company. All of those strategies fall under the umbrella of the SC strategy.

It is also important to note, as Chopra explains, that all of the functional strategies within a company (e.g – product development strategy, marketing strategy, etc.) must support one another. For this report, the focus will mainly be on the components of the SC Strategy and determining the nature of the service, distribution, and operations areas as seen in figure 3.

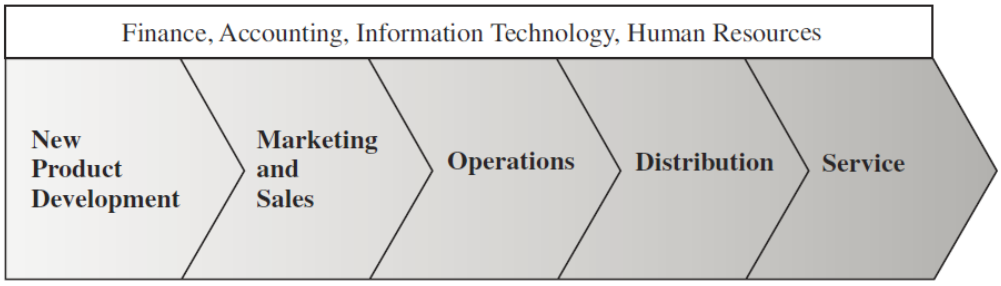


Figure 3 – The value chain (Chopra & Meindl, 2016)

4.3.1 Decision-Making and the Stages of the Supply Chain

As mentioned in the research scope, Chopra (2016, p. 6) and Waters (2003, p. 60) split the supply chain into 3 major stages for which different types of decisions are to be made.

The first stage is supply chain strategy and design. This is the stage where all of the major strategic decisions are made. The planning horizon in this stage is long-term, and the changes made to this stage after the fact are usually very resource-intensive, time-consuming, and expensive.

The next stage is the planning stage, where many of the tactical decisions are made. The planning horizon for this stage is mid-term: usually one quarter or a few months in length. Based on the constraints given by the initial stage, the planning stage will develop policies for the more short-term operational functions to follow, and usually involve activities such as long-term forecasts. Changes made during this stage are less expensive than in the first stage, but more expensive than in the operational stage.

The final stage is the operation stage, where the operational decisions are made. The planning horizon is short-term, usually a week or less. This stage deals with the many everyday decisions that happen from week to week. Changes made during this stage or for decisions that fall under this category are the least expensive of all the stages and can be made relatively quickly.

This is why properly determining and aligning the supply chain strategy with the business strategy is so important: concepts developed at this first stage affect all other stages and can be very hard to correct after the fact.

4.3.2 MIT SC2020 Project: The 'Perfect' Supply Chain

In 2004, MIT undertook a long term study into supply chains in an attempt to identify the main characteristics of the 'perfect' supply chain, called the SC2020 project. So far, they have discovered that the best supply chains have a clear competitive/business strategy in place, along with a properly aligned supply chain strategy. It is then followed by a well-matched operational model. Merely copying and pasting the strategy of another successful company will not necessarily work, hence why many attempts to re-create the successful supply chains of companies like Toyota and Walmart have constantly failed. A perfect supply chain, according to the SC2020 project, avoids trying to do everything well and focuses "on a limited number of consistent and cross-optimized business practices" (Waters, 2010, p. 18). Furthermore, these practices mutually reinforce one another, and relate directly to the ultimate goals of the company.

Another result of this project was Perez-Franco's thesis on realigning strategy (see chapter 6.1), and portfolio of tools which companies could use to help develop their SC strategy.

Table 1 - The eight tools developed by MIT (Perez-Franco, 2011, p. 3)

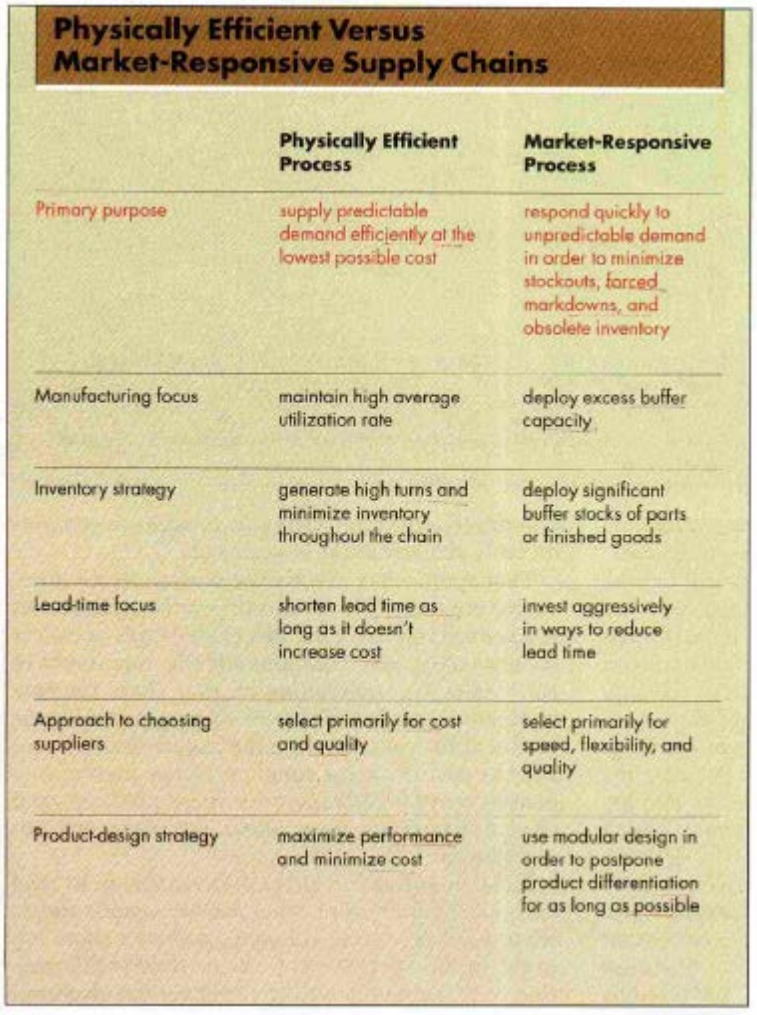
	mid-term focus	*long-term focus*
workshops	Strategy Alignment Workshop	Scenario Planning Workshop
exercises	Strategy Capture Exercise Strategy Evaluation Exercise Mid-Term Reformulation Exercise	Assumptions Capture Exercise Scenario Generation Exercise Long-Term Reformulation Exercise

5 TYPES OF SUPPLY CHAIN STRATEGY

While supply chain strategies should be tailored to suit each company's needs, many of them fall under the same general categories. Below are some of the major categories that supply chain strategies can fall under. Keep in mind that these are not the only types of supply chain, and over time new types of strategies might be developed that are, for example, a combination of the ones listed.

5.1 Efficient vs. Responsive

As mentioned already in chapter 4.2.1, the efficient and responsive supply chains are the brainchild of Marshall Fisher. They are meant to be matched accordingly with either a functional or innovative product.



Physically Efficient Versus Market-Responsive Supply Chains

	Physically Efficient Process	Market-Responsive Process
Primary purpose	supply predictable demand efficiently at the lowest possible cost	respond quickly to unpredictable demand in order to minimize stockouts, forced markdowns, and obsolete inventory
Manufacturing focus	maintain high average utilization rate	deploy excess buffer capacity
Inventory strategy	generate high turns and minimize inventory throughout the 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

Figure 4 - Comparison Chart (Fisher, 1997, p. 107)

5.2 Lean, Agile, or Leagile Supply Chains

Building upon the Fisher's earlier framework, Ambe et al extends the framework to include a lean, agile, or leagile supply chain. The lean supply chain, in this case, being an extension of the efficient supply chain, and the agile supply chain being an extension of the responsive one.

Figure 6 illustrates how the decision-making process would work for Ambe et al's framework. Step 1 and 2 start out much like Fisher's matrix. First the company must determine the needs of the customer that they are trying to fulfil, and then splits the product into either functional or innovative. The company then determines if their own supply chain is efficient or responsive. However, instead of ending with either an efficient or responsive supply chain, companies can choose also to be lean or agile. And for those that don't quite fit into those 2 categories, they have the 3rd option of a leagile supply chain, which is a combination of the lean and agile supply chains. (Ambe & Badenhorst-Weiss, 2011)

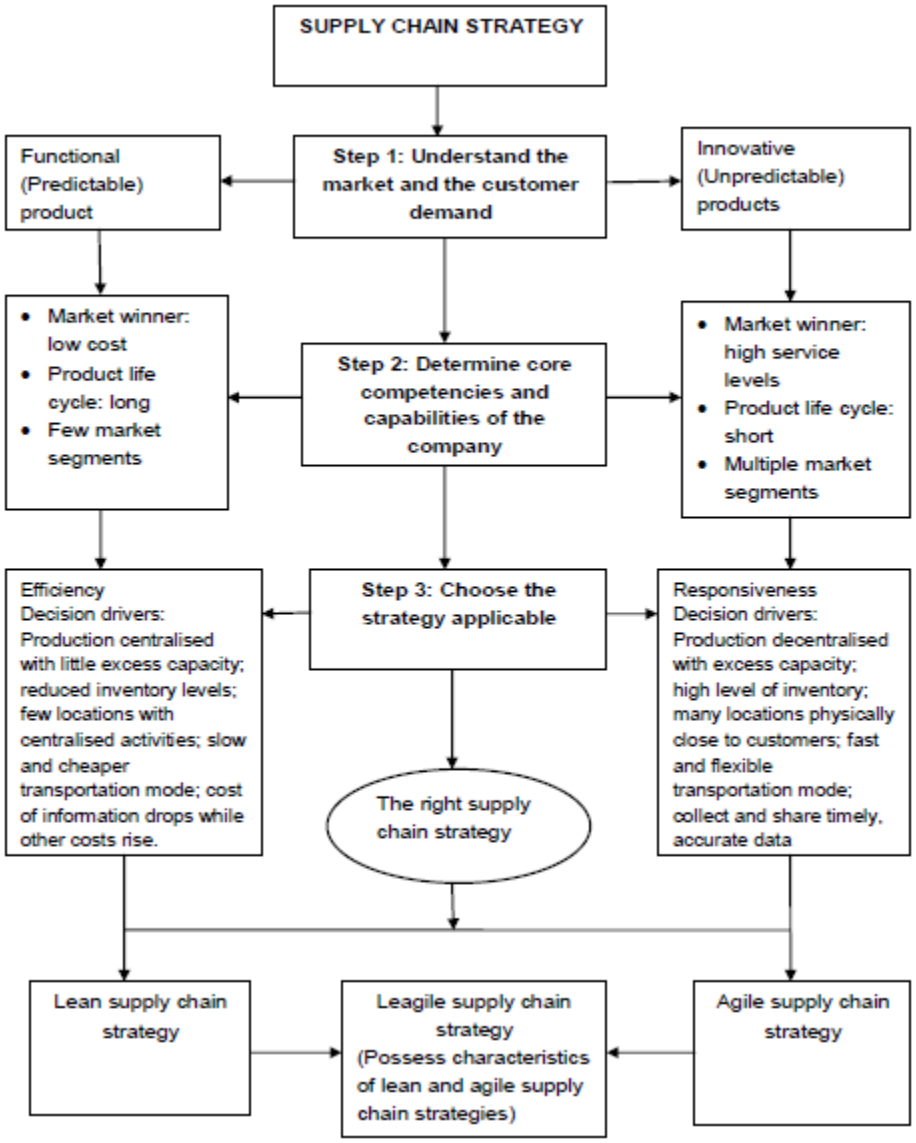


Figure 5 - Ambe et al's more expanded framework for choosing supply chain strategies (Ambe & Badenhorst-Weiss, 2011, p. 13395)

Table 2 – A comparison of the different supply chains (Ambe & Badenhorst-Weiss, 2011, p. 13394)

Distinguishing attribute	Lean supply	Agile supply
Typical products	Commodities	Fashion goods
Marketplace demand	Predictable	Volatile
Product variety	Low	High
Product life cycle	Long	Short
Customer drivers	Cost	Availability
Profit margin	Low	High
Order winner	Cost	Time, availability

Table 2 explains how the lean and agile supply chains differ when it comes to various distinguishing attributes. Because they are an extension of Fisher's original efficient and responsive supply chains, they naturally have very similar characteristics. Where they may differ, however, is in their approach to creating this type of supply chain since there are many new tools and techniques that have come popular since Fisher first published his work in 1997.

It is important to note, though, that Ambe et al.'s framework limits supply chains to only 3 types. It does not take into account other popular supply chain strategies that have come about in recent years, such as the Triple-A or sustainable supply chain.

5.3 Five Objectives

This supply chain places an emphasis on performing 5 different operations in the supply chain well: quality, dependability, cost, speed and flexibility. How well a company performs each one of these operations will determine their success (Trang, 2016, p. 20).

5.4 Triple-A Supply Chain

Unlike the other strategies, the triple-A supply chain moves away from the emphasis on cost-efficiency and speed and places emphasis on supply chains being competent in 3 key areas: agility, adaptability and alignment. Note that the 3rd area, alignment, is the concept that really makes the Triple-A supply chain different from the others. The idea being that the hidden information between supply chain network partners, hidden actions, or improperly designed incentives, are one of the main causes of poor supply chains (Trang, 2016, p. 21). Waters also mentions these three characteristics as being very common in the best-performing supply chains (2010, p. 177).

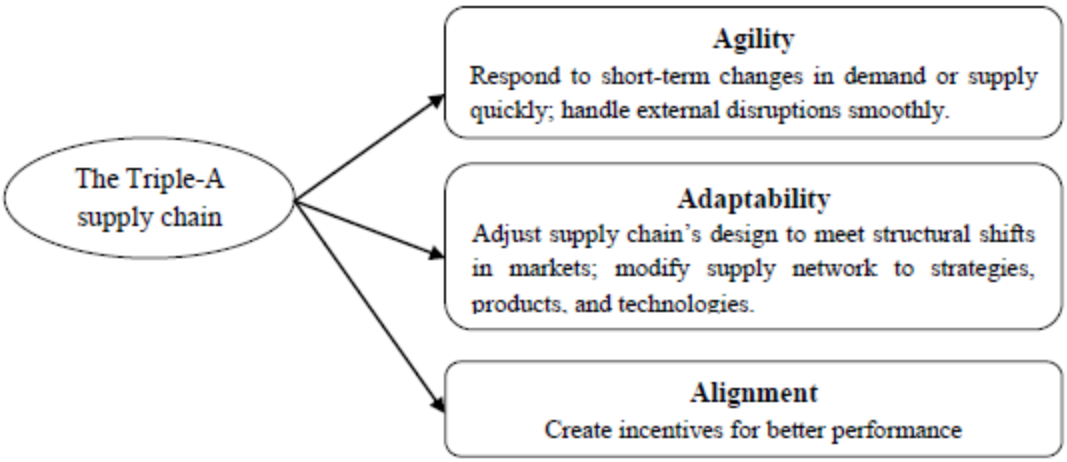


Figure 6 - Main features of the Triple-A Supply Chain (Trang, 2016, p. 24)

5.5 Sustainable Supply Chain

A sustainable supply chain conducts practices in a manner so that present needs are met without destroying or compromising the ability of others to meet their own needs as well, especially those of future generations. Contrary to popular belief, designing a sustainable supply chain can be profitable. Some possible benefits include but are not limited to: effective utilization of resources, increased efficiency, product differentiation, reduced risk of being fined for anti-environmental practices, and increased product quality, not to mention a better corporate image. The primary difference in the design of a sustainable supply chain is that it incorporates life-cycle management and engineering (LCM) into its many different stages. (Emmett & Sood, 2010, p. 4)

5.6 Integrated Supply Chain

Integrated supply chains focus on effectively co-ordinating supply chain processes through smooth information flow. It calls on supply chain partners to share data and collaborate more closely than they have done in the past. Walmart is a prime example of a well-integrated supply chain. Elements of the integrated supply chain can also be seen in other supply chain strategies as well, since those too involve close collaboration with network partners. (Trang, 2016, p. 22)

6 FRAMEWORKS FOR SELECTING AND CREATING THE SC STRATEGY

Even with a good competitive strategy, it can be difficult to define the SC strategy. The literature suggests several different frameworks for helping companies decide. Some are much more detailed than others, but in general they follow the framework presented by Ambe et al in figure 8.

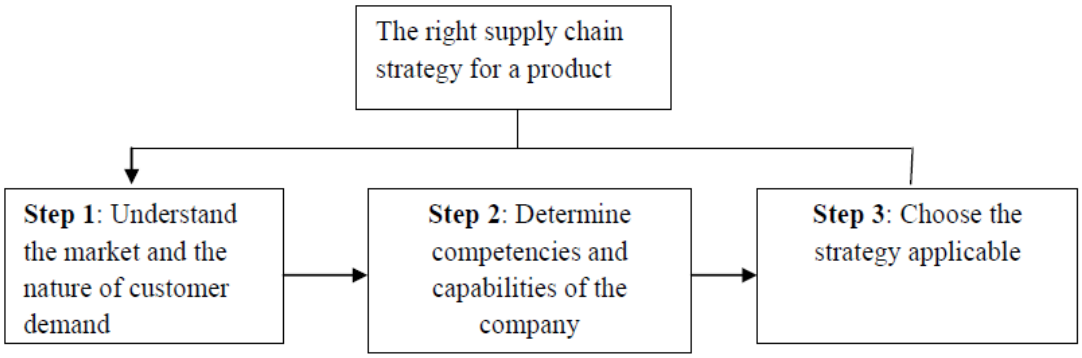


Figure 7 – A framework for choosing SC Strategies (Ambe & Badenhorst-Weiss, 2011, p. 13392)

While the information presented in figure 8 might seem like obvious common knowledge, the continuous incidences of companies with misaligned SC strategies prove otherwise. It is also important to note that sometimes the simplest concepts are the ones that are the most difficult to grasp. Therefore, this general framework should be kept in mind as we go through the more detailed frameworks that companies can use to help properly develop the correct SC Strategy.

6.1 Capture, Evaluate, and Reformulate Strategy by Perez-Franco

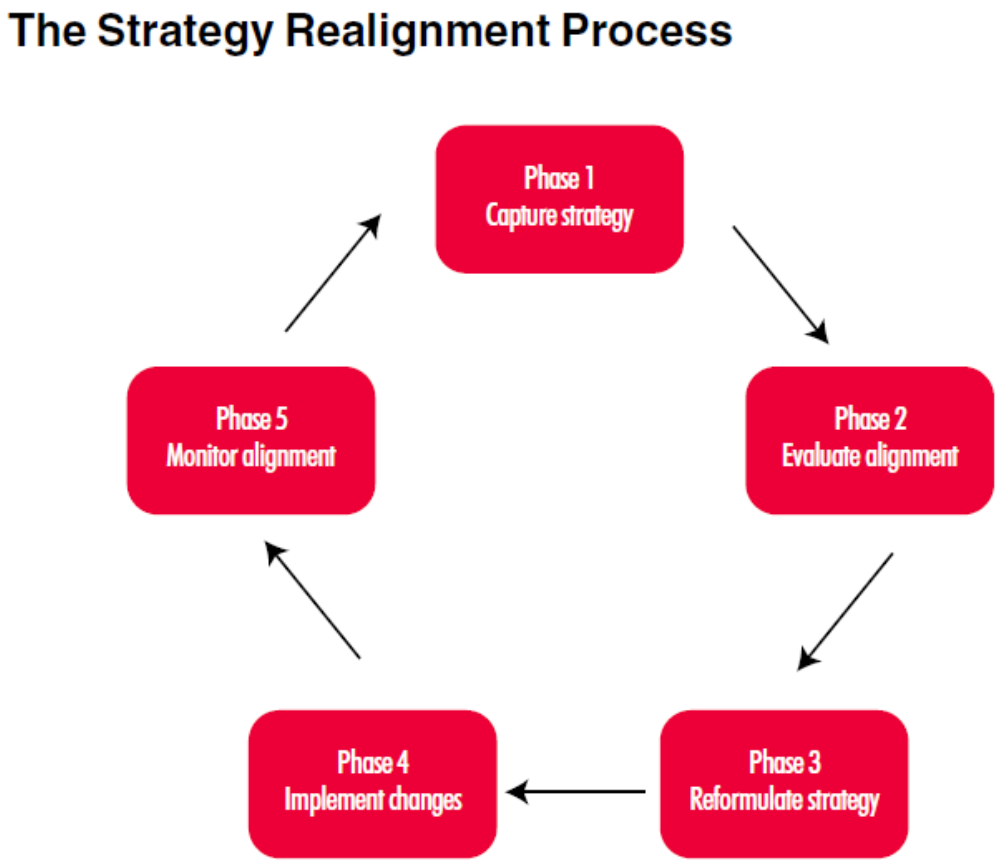


Figure 8 - (MIT Center for Transporation and Logistics, 2008, p. 3)

Based on extensive research and data collection, Perez-Franco composed an SC realignment strategy consisting of 3 phases: capture, evaluate, and reformulate illustrated in figure 9.

In the capture phase, the company attempts to unveil their strategy and transform it into a conceptual model. In the evaluate phase, the company then determines the strengths and weaknesses of their current SC strategy by analysing 3 dimensions: "alignment, coverage and sufficiency." Finally, in the reformulate phase, Perez-Franco suggests a new approach to redesigning the supply chain which improves upon the aforementioned dimensions of alignment, coverage, and sufficiency.

This method was developed at MIT and is the result of analysing multiple case studies, interviews, panel discussions, and questionnaires. The strategy map shown below is an example of one of the tools companies can use to develop their strategy (Perez-Franco, 2010, p. 94).

Sample Strategy Map

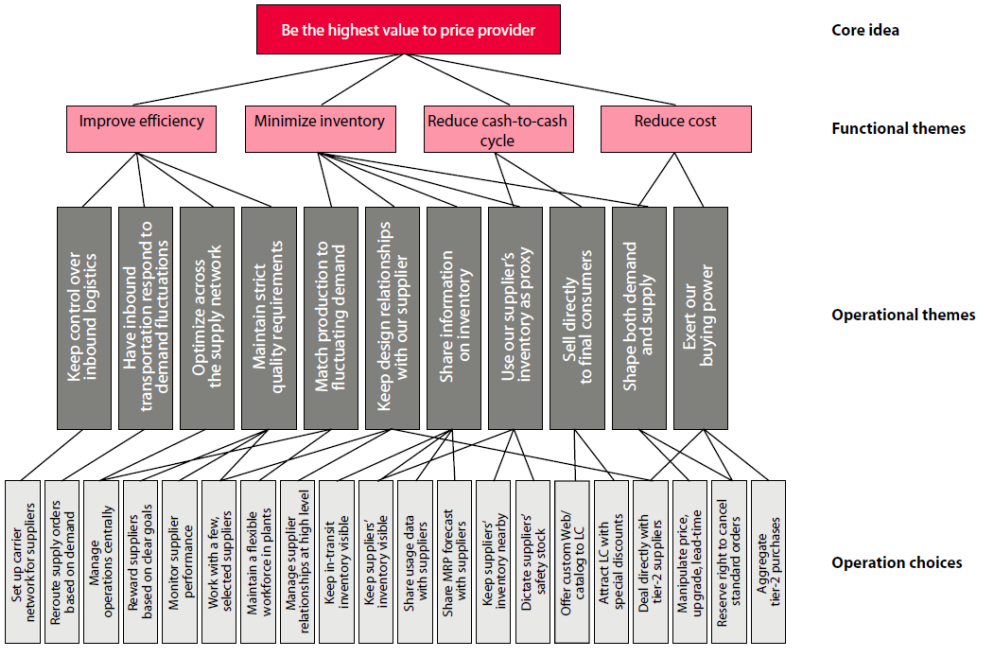


Figure 9 - (MIT Center for Transportation & Logistics, 2008, p. 5)

6.2 The Functional vs Innovative Matrix by Marshall Fisher

After determining what type of product you have, Fisher (1997) recommends using a matrix such as the one in figure 11 to see whether your current supply chain is in line with your product type. Companies that are initially a match can sometimes move into an area that is a mismatch. For example, a company can move from having a functional to innovative product by adding new features to their product. They will then have an efficient supply chain for an innovative product, resulting in a mismatch that can cost them lots of money.

Therefore, it is important that companies are continuously checking whether their supply chain strategy matches with the type of product they have for this very reason.

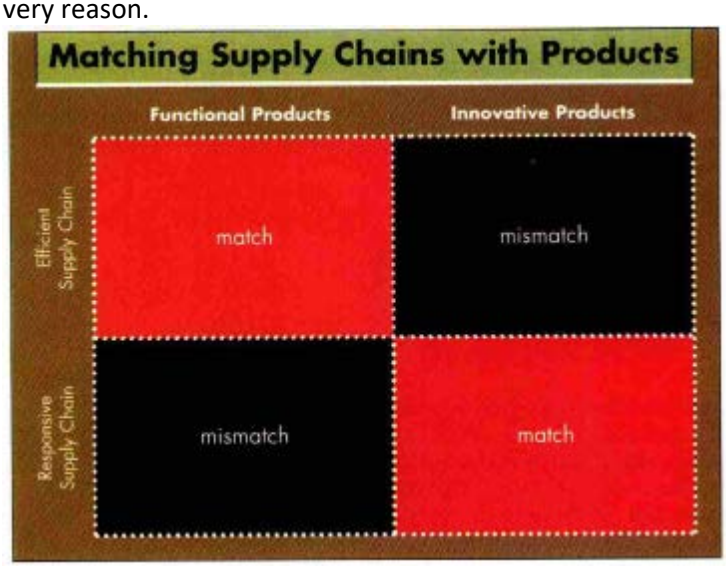


Figure 10 – The matrix used to determine whether a company's supply chain matches with their product (Fisher, 1997, p. 109).

6.3 SC Operations Framework by Michael Hugos

Michael Hugos (2011) approaches the definition of SC Strategy slightly differently. Before creating the strategy, he suggests that a company should evaluate whether they are leading, on par, or behind their competitors in the following 4 categories:

- Customer Service
- Internal Efficiency
- Demand Flexibility
- Product Development

(Hugos, 2011, p. 151)

Afterwards, a company can then start creating the SC strategy by analysing the 4 major SC operations: Plan, Source, Make, Deliver. He then recommends a brainstorming session for how to improve each of these areas. Once there are a handful of good ideas, the company can then decide on which business operations to improve and what kind of performance targets to meet. By the end, the company will essentially have their SC strategy.

6.4 The LMP Methodology by Ed Frazelle

Taking a very heavy logistics-oriented approach, Frazelle (2002) nevertheless emphasizes the need for developing strategy before designing your operations. With Frazelle's methodology, however, the first steps consist of heavy internal analysis. First, a company should sit down with its team and creates a formal definition of logistics. Afterwards, Frazelle implements his LMP (Logistics Master Planning) Methodology. Frazelle's LMP Methodology consists of 3 major steps: investigate, innovate, and implement.

The first phase is the investigation phase serves as the equivalent framework for creating the SC strategy. The investigation phase is further broken down into the profile, measure, and benchmark steps. The 'profile' step consists of a company examining its current logistics activities, collecting data and creating a profile of each of its major logistics activities. The 'measure' step establishes the performance metrics that are to be used when monitoring logistics activities, and the 'benchmark' step sets the goals which the company needs to achieve with its strategy relative to the market. (Frazelle, 2002, p. 17)

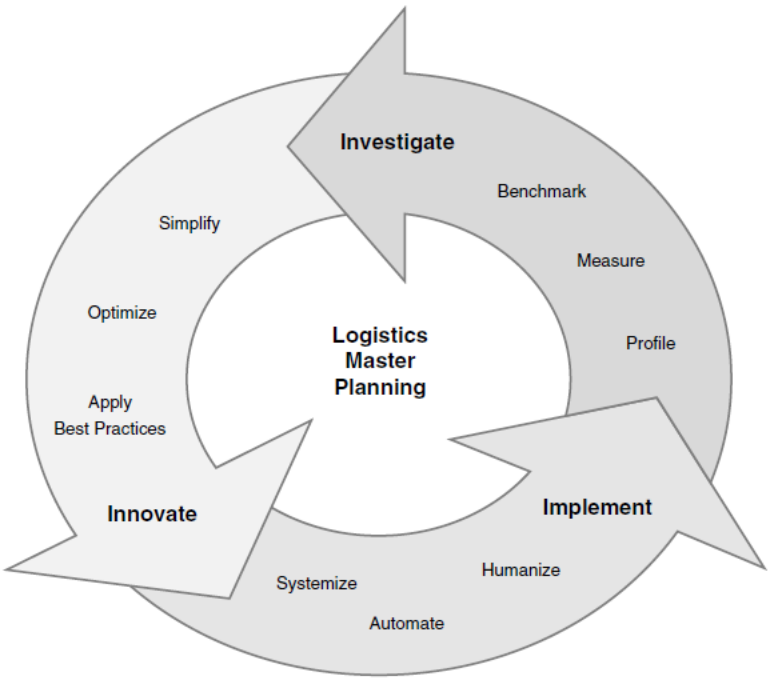


Figure 11 - The basic steps to Frazelle's LMP Methodology (Frazelle, 2002, p. 18)

7 FRAMEWORK MODELS

After a company's SC strategy has been determined, experts have completely different approaches as to how to design the supply chain. They split the supply chain into different categories and use different selection criteria. Furthermore, even though they might ultimately be designing the same business operations (i.e. – purchasing, receiving, shipping, etc.), each model might design them at different stages. Some have these frameworks have already incorporated determining the SC strategy into them, and some of them have not.

Chapter 7 contains the list of potential frameworks I presented to my commissioning company.

7.1 Ed Frazelle and the RightChain Framework

Ed Frazelle's (2002) framework consists of four major phases that are meant to answer the following questions:

Phase I: ASSESSMENT
PERFORMANCE ASSESSMENT
-How does my supply chain performance compare with my business strategy and industry norms?
-Where and how large are the gaps?
-What's the value added for closing the gaps?
PRACTICE ASSESSMENT
-How does my supply chain practice compare with my business strategy and industry norms?
-Where and how large are the gaps?
-What's the value added for closing the gaps?
PROJECT ASSESSMENT
-What time, resources and investment are required to close the gaps?
-Is there sufficient return on investment to move forward on one or more initiatives?
-What is the best project plan to move forward?

Phase II: DESIGN
MISSION and METRICS
-What metrics and targets define our success?
-What supply chain service strategy makes us successful?
SUPPLY
-What level of inventory should we carry and where?
-Who should we source from and in what quantities?
LOGISTICS
-What transportation nodes, modes, and loads optimize our supply chain?
-What warehouse configurations optimize our supply chain?
SUPPORT
-What activities should we outsource and to whom?
-What level and type of technologies best support our supply chain?

MANAGEMENT
-How should our supply chain be organized and developed?
-What planning methodology optimizes our supply chain?

_____

Phase III: IMPLEMENTATION
-What vendors are best suited to provide technology and outsourced services for our supply chain?
-What contract form and terms create a win-win relationship between us and our supply chain service providers?

_____

Phase IV: SUPPORT
-What on-going analytics, education, and facilitation are required to sustain our gains and keep our supply chain strategy optimized our business strategy?

(Right Chain Incorporated, 2017)

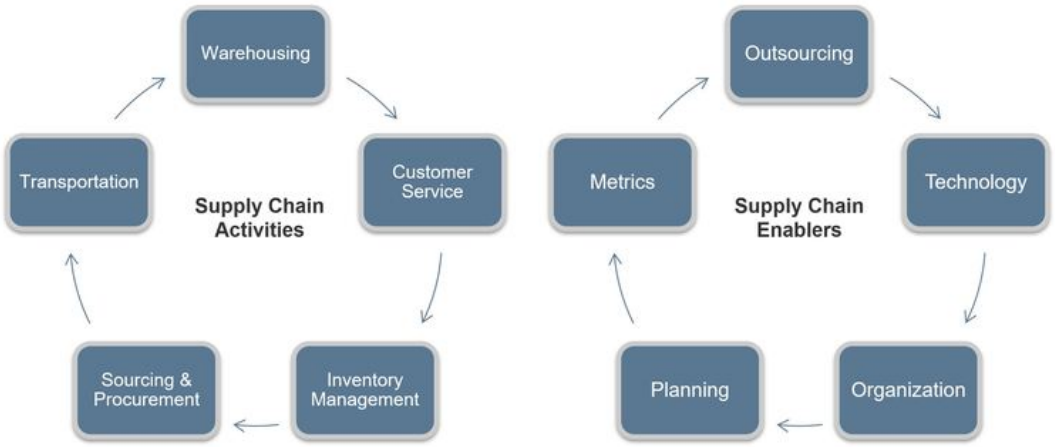


Figure 12 – Frazelle's Supply Chain Framework (Right Chain Incorporated, 2017)

Placing an emphasis on logistics, Frazelle builds a framework for design for the 5 major areas as shown in figure 13. Customer response being at the top of the list after creating the strategy mentioned in chapter 4.4. Keep in mind that the LMP methodology is used throughout the framework shown in figure 14.

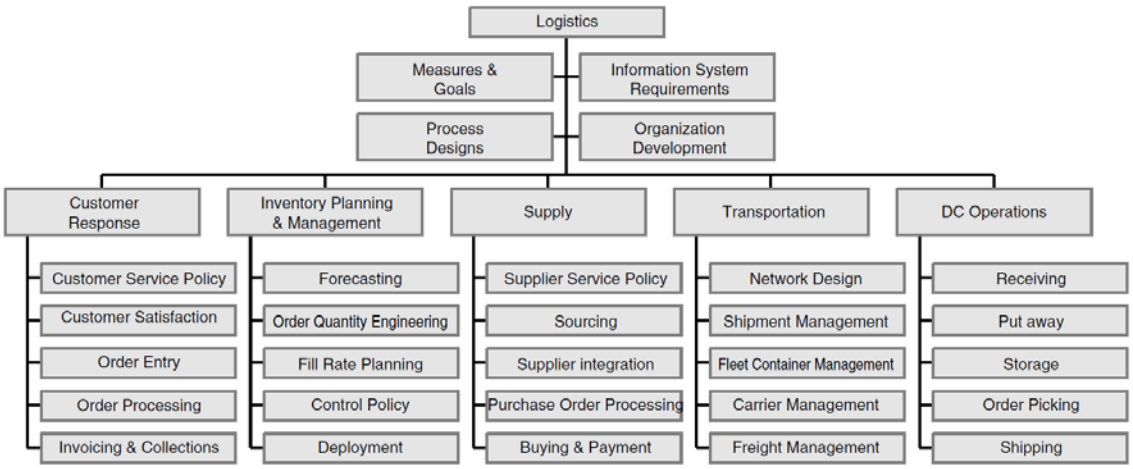


Figure 13 - A more detailed look at Frazelle's design framework (Frazelle, 2002, p. 72)

7.2 Logistics Strategy by Don Waters

While Waters (2003) reminds us that there is no "right way" to develop a supply chain strategy, he does list a systematic approach in his literature that is similar in nature to Frazelle's. He recommends first that the company do an investigation of its internal processes, and consists of 8 steps:

1. Conduct an external logistics audit
2. Conduct in internal logistics audit
3. Start designing the generic elements of the supply chain (e.g – network design, facility location, capacity planning, etc.)
4. Set goals for each logistics activity
5. Create the organizational structure
6. Create benchmarks for your logistics activities
7. Implementing logistics strategy by creating the parameters needed to make the lower-level operational decisions.
8. Measure performance, practice continuous improvement, get feedback.

(Waters, 2003, p. 76)

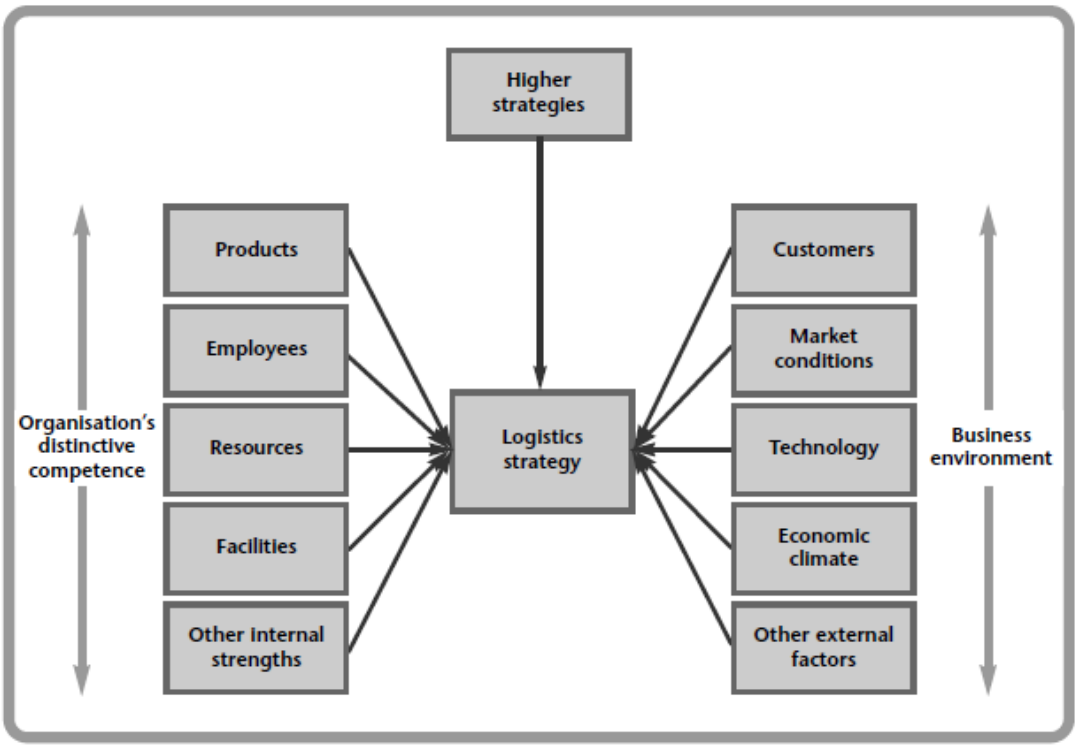


Figure 14 - Donald Waters framework for building an SC Strategy. Note that after creating the higher strategies and logistics strategy, there is no correct order for designing the next areas. (Waters, 2003, p. 74)

Hopefully, if a company has done all of these things, they should have a logistics strategy by the end. A company should then be able to compose their *logistics plan.* These are usually incredibly detailed and have many components, but they should at least have the following elements according to Waters:

- a broad summary, giving an overview of the logistics strategy and how this relates to other parts of the organisation
- the aims of logistics within the organisation, what performance levels are needed and how these can be measured
- a description of the way that logistics as a whole will achieve these aims, what changes are involved and how these will be managed
- a description of how the separate functions of logistics (procurement, transport, inventory control, materials handling, and so on) will contribute to the plan, the changes involved and how operations can be integrated
- projections to show the resources needed by the strategy
- projections of the costs and financial performance
- a description of the way that this strategy affects the rest of the business, particularly in terms of performance achieved and contribution to customer value and satisfaction.

(Waters, 2003, p. 77)

7.3 **Dynamic Alignment by Don Waters**

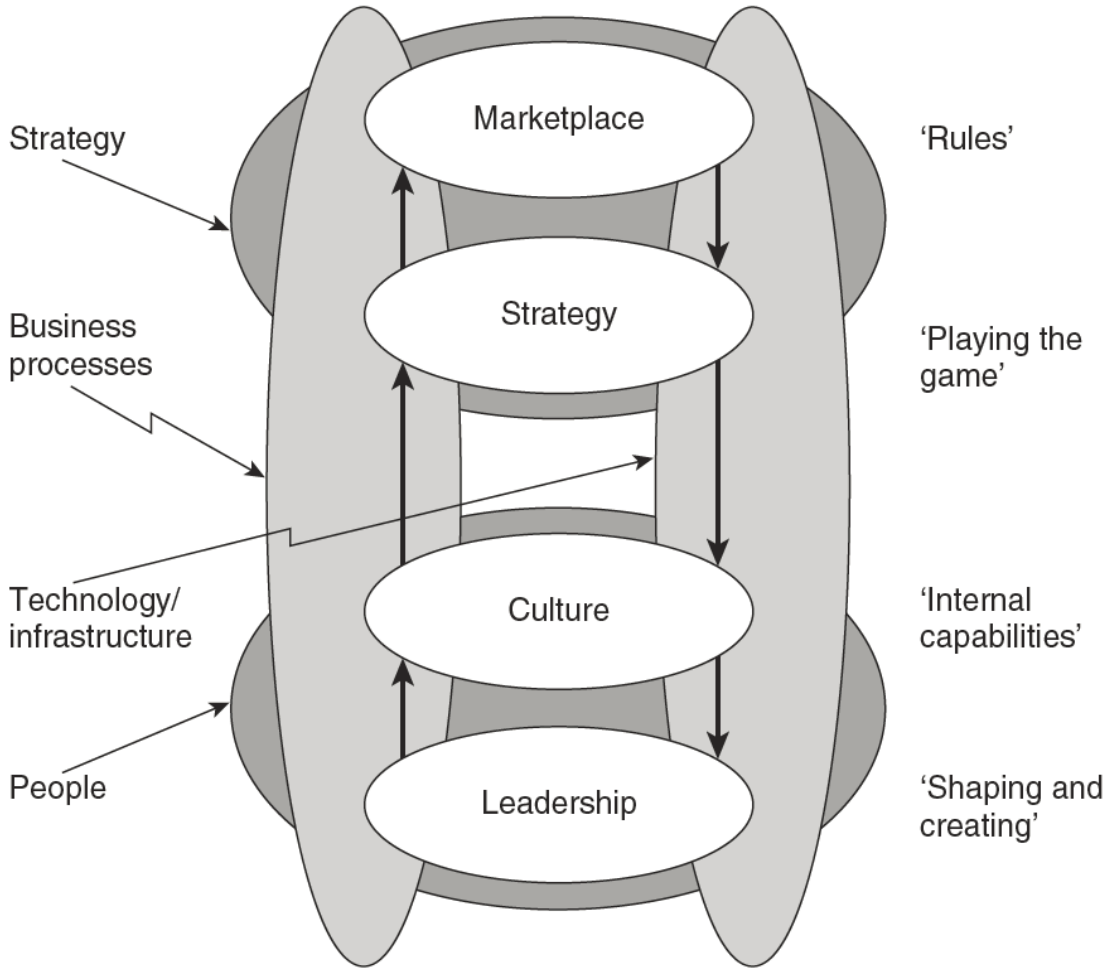


Figure 15 - Main elements of the 'dynamic alignment' framework (Waters, 2010, p. 125)

In his newer work, Global Logistics, Waters (2010) addresses several new challenges that supply chains face. He therefore introduces several new frameworks to help tackle these different areas. During his research, he developed what he now calls the 'Dynamic Alignment' Strategy. Which is not so much a supply chain strategy as a "multidisciplinary business model." This framework emphasizes a company needing to have strong performance in 4 categories: "customers, strategy, internal cultural capability and leadership style" (Waters, 2010).

Traditionally, segmenting marketplaces, particularly for a global supply chain, has been particularly challenging. Based on this model, Waters has found that the simplest way to segment a market is based on its behavioural patterns. There are 16 different behavioural patterns, and only 3 or 4 patterns a company needs to address for its product. Once a company has identified these behaviours, a company can "reverse engineer" its supply chain, as demonstrated in the figures 17, 18, and 19.

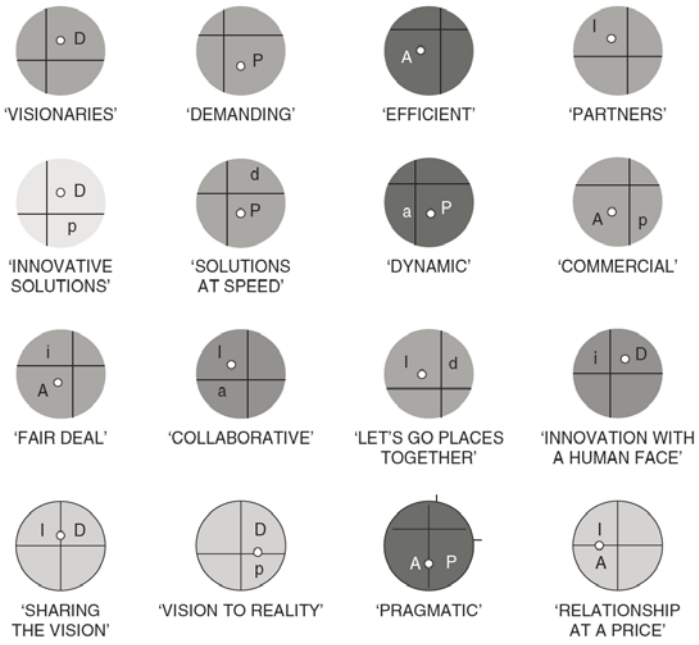


Figure 16 - The 16 behavioural patterns (Waters, 2010, p. 127)

Collaborative	*Efficient*	*Dynamic (QR)*	*Innovative Solutions*
Close working relationships for mutual gain	Consistent low-cost response to largely predictable demands	Rapid response to unpredictable supply and demand conditions	Supplier-led development and delivery of new ideas
Ia	A	Pa	Dp
▪ Mostly predictable ▪ Regular delivery ▪ Mature or augmented products ▪ Primary source of supply ▪ Trusting relationship ▪ Teamwork/partnership ▪ Information sharing ▪ Joint development ▪ Forgiving ▪ Price not an issue	▪ Predictable demand within contract ▪ Regular delivery ▪ Efficiency low-cost focus ▪ Multiple sources of supply ▪ Little sharing of information ▪ More adversarial ▪ Standard processes ▪ Power imposed ▪ Transactional ▪ Very price sensitive	▪ Unpredictable demand ▪ Commodity relationship ▪ Time priority/urgency ▪ Opportunity focus ▪ Ad hoc source of supply ▪ Low loyalty, impersonal ▪ Fewer processes ▪ Outcome oriented ▪ Commercial deals based on pragmatism ▪ Price aware	▪ Very unpredictable demand ▪ Higher risk ▪ Flexible delivery response ▪ Innovation focus ▪ Rapid change ▪ Individual decision making ▪ Solutions oriented ▪ Management of IP ▪ Incentives/ego ▪ No price sensitivity

Figure 17 - The most common behavioral patterns (Waters, 2010, p. 128)

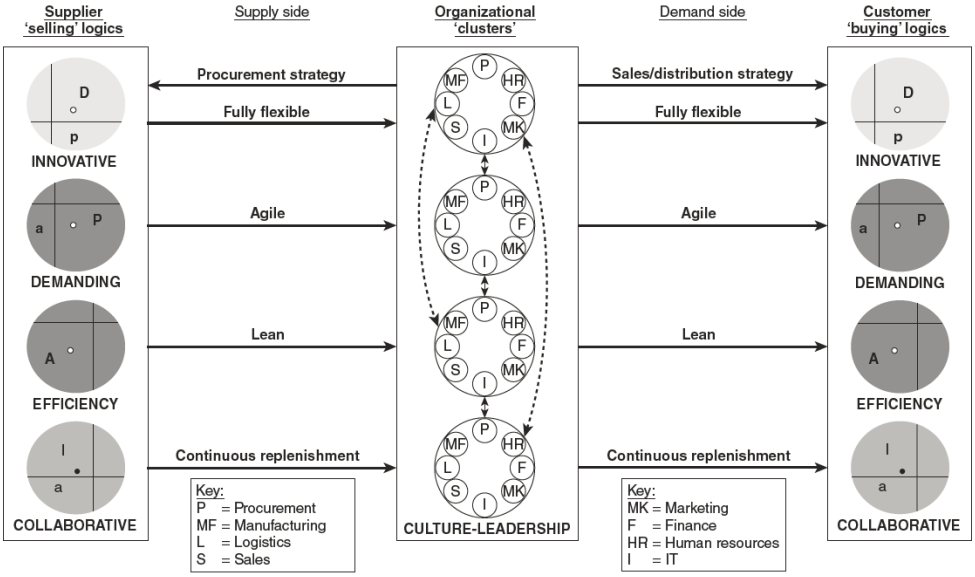


Figure 18 - The new business model for supply chains (Waters, 2010, p. 139)

7.4 Green Supply Chain Framework by Stuart Emmett and Vivek Sood

According to Emmett and Sood (2010), the 'green' supply chain is divided into 7 key areas:

- Green Supply Chain Planning
- Green Procurement and Sourcing
- Green Supply Chain Execution
- Carbon Management
- Green Supply Chain Migration Strategy
- Green Supply Chain Continual Improvement
- Green Supply Chain Performance Evaluation

(Emmett & Sood, 2010, p. 13)

As mentioned earlier, each stage would incorporate some form of life-cycle management or engineering design. Figure 20 is a simplified form of the framework, while figure 21 provides a much more detailed roadmap management can use to guide them through the process.

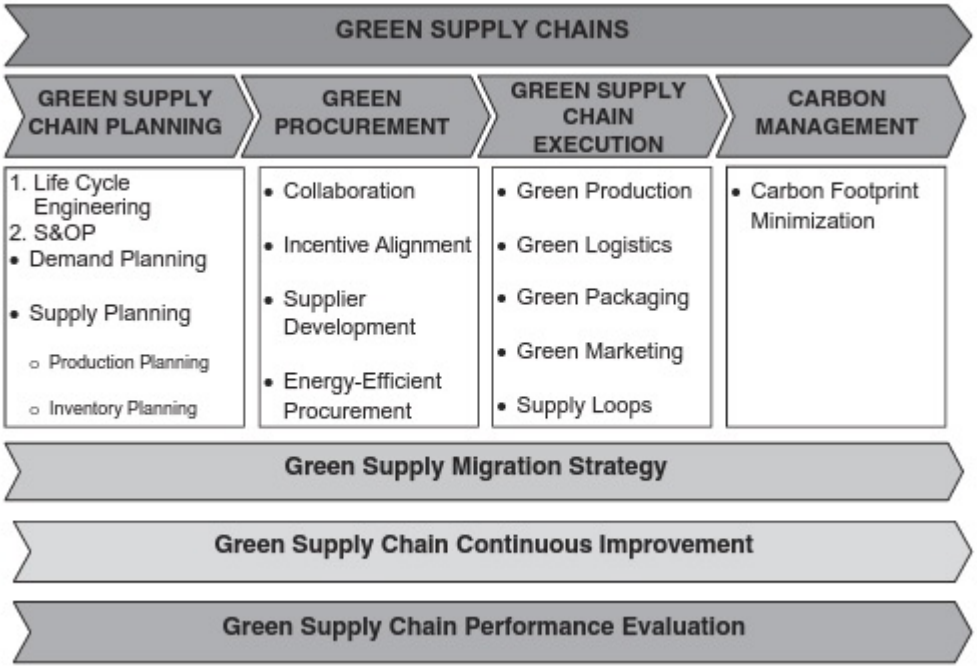


Figure 20 - The Green Supply Chain Framework (Emmett & Sood, 2010, p. 14)

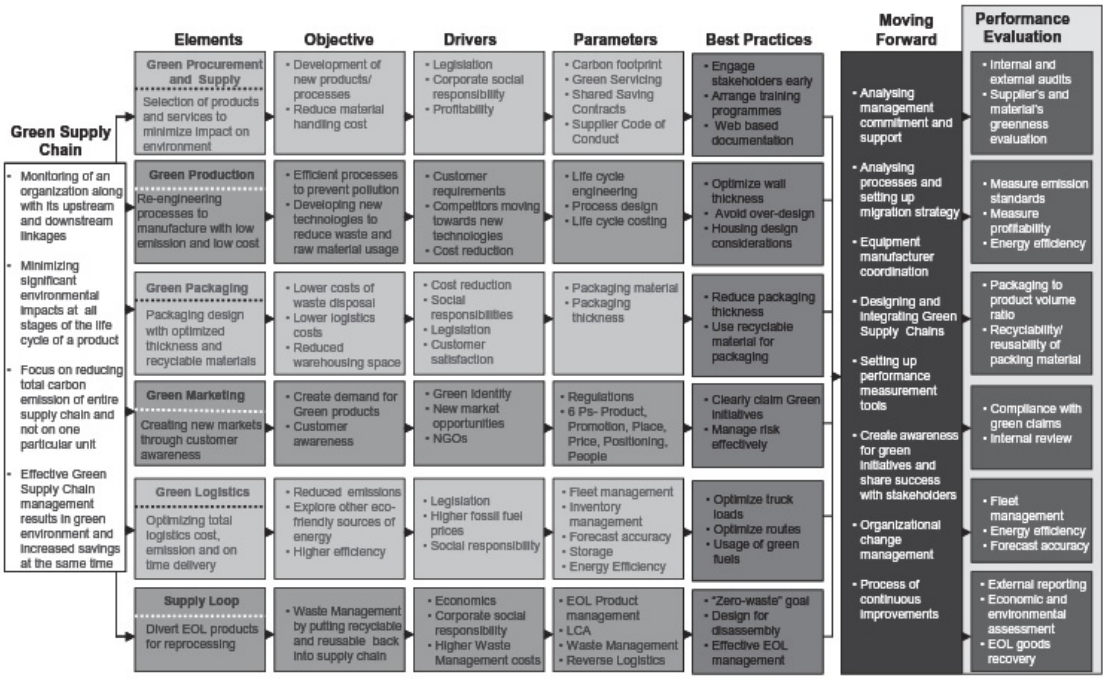


Figure 19 - A more detailed green supply chain roadmap (Emmett & Sood, 2010, p. 15)

8 IMPLEMENTATION STRATEGY

No matter how detailed, thorough, and brilliant a plan is, it unfortunately does not mean much if it is not executed properly. Strategies, after all, "only become effective when they are IMPLEMENTED" (Waters, 2003, p. 83). This means that the long-term aims that were created must be somehow interpreted and executed at the lower levels of the business hierarchy. Therefore, having an implementation strategy or plan must be in place to ensure that the new supply chain strategy that planners have worked so hard to compose is carried out properly. It is during this phase where many of the tactical and operational decisions that need to be made come into play.

A common mistake that companies often make is to think about the implementation plan after the fact. A more effective way to mitigate any conflicts between the theoretical strategy and the implementation process is to think about the implementation plan while designing the strategy. Including management and workers in the process as well will help address potential problems sooner, leading to less chaos and confusion after the fact (Waters, 2003, p. 85).

Regardless of whether there is a good strategy in place, however, people are naturally resistant to changes, and even more so if they are done too hastily. Therefore, it is a good idea to have someone in charge of change management to spearhead the implementation process (2003, p. 95). Don Waters also gives a list of suggestions to help better align the implementation plan with the strategy. When designing the SC strategy and plans, companies should try to create:

- an organisational structure that is flexible and allows innovation
- formal procedures for translating the strategy into reasonable decisions at lower levels
- effective systems to distribute information and support management decisions
- open communications which encourage the free exchange of ideas
- control systems to monitor progress

(Waters, 2003, p. 85)

Furthermore, planners need to:

- [accept] that strategies are not fixed, but continue to evolve over time
- [convince] everyone that the strategy is beneficial, so they conscientiously play their part in implementation
- [develop] an organisational culture that supports the strategy.

(Waters, 2003, p. 85)

9 LITERATURE REVIEW: ANALYSIS OF FINDINGS

After a significant amount of research into the topic, I could not find any common patterns to the proposed frameworks by the different experts in the field. Unlike fields such has quality management, who have established individuals such as Stewart and Deming as their founding fathers, and have standardized literature such as Juran's Quality Handbook, there appears to be no clear winners in the field of SCM and logistics. Even the APICS Supply Chain Council has no such handbook for SC design. The SCOR framework they created, while an industry standard and often referred to by other supply chain experts, stated that their framework is primarily meant for benchmarking processes and not meant to be used to make strategic decisions.

As shown in the previous research results chapters, various frameworks were discovered from credible sources meaning that it is difficult to select one framework over the other. Donald Waters, for example, has over 30 years of experience. He has published a couple of well-known books on the topic of SCM and logistics and is a visiting professor at various universities. Sunil Chopra and Peter Meindl also have extensive experience researching and teaching in the field, and their textbook is considered not only a standard textbook at many universities but is also frequently cited in other academic literature. Ed Frazelle was the founder of the logistics institute at Georgia Tech university, owns his own consulting firm and has also written a couple of books on the subject. Each author created a model or framework that could be used to help design the supply chain but looks remarkably different from the others. This simply shows just how difficult creating an underlying common model for supply chains can be.

Even when it comes to the first step of creating and designing the SC Strategy, which many authors did agree upon, there are many different frameworks and methodologies that can be used. There is Marshall Fisher's Matrix, which has been a simple and established framework that has been around since 1997. There is Michael Hugos's framework, which focuses on the 4 major SC operations of plan, source, make, and deliver. His work, however, stems less from academic research and more from hands-on work experience. His work also does not appear to be as well established as the works of, for example, Chopra and Meindl. He also does not list his sources. This may make his research less credible than others'.

Then there is Perez-Franco's capture, evaluate, and reformulate strategy which he developed and tested extensively with the help of 20 case companies as a part of the MIT SC 2020 project. While Fisher's Matrix can be admired for its simplicity, strategies such as those developed by Perez-Franco might be needed for more modern times, where global supply chains are becoming increasingly competitive and complex.

It appears also that there is no consensus on how the different supply chain strategies should be categorized. There is, of course, the Functional vs. Innovative supply chain mentioned by Fisher. Ambe et al appear to extend upon that framework by including a lean vs agile supply chain, which can be

even combined into a leagile supply chain. Trang divides the supply chain into a five-objectives, Triple-A, sustainable, or integrated supply chain.

While established authors like Fisher are probably much more credible than Ambe et al and Trang, especially since they cite Fisher in their works, none of them are necessarily wrong. A simple google search will show that plenty of literature has been written about all of the different supply chain strategies they mention.

If anything, my research shows that supply chain design is still a complex and ever evolving topic. This is because there are so many factors to consider in supply chain design that creating "the underlying model or framework that would guide supply chain design [would] also be a complex undertaking" (Brann, 2008, p. 8). Jeremy Brann attempted in his PhD dissertation to discover a conceptual model for SC Design. Despite having more time, expertise, and doing a significantly more thorough review of the subject in 2008, much of his work only led to more questions. He believed that much more research needed to be done on the topic. However, it most likely needs to be done at the master's or PhD level to make any significant gains.

And as technology and innovation changes the way we do business, even more possible strategies, frameworks, and models may arise. Why are there so many different frameworks and models? One reason could be is that experts in the field have not come to an agreement on the subject. Another more likely reason could be, however, is that the best way to design a supply chain "will differ for each supply chain design project" (Brann, 2008, p. 53). As mentioned by Waters, just like there is no single correct way to create a strategy, there is no single correct way to design a supply chain (2003, p. 73).

10 RESULTS AND DISCUSSION

10.1 Deliverables

In the end, the original plan mentioned in chapter 2.2 could not be executed for numerous reasons. However, the final result the company had originally requested was achieved. They asked for an initial SC framework that the company could build upon and refine. Ideally, this framework would come in the form of a handbook. If it could help answer some critical questions they had been asking, such as where to locate their facilities and when to outsource or make their parts in-house, that would be considered a bonus. They were given Frazelle's framework to use as an initial base model for their supply chain. And while a handbook was not delivered, the means to create the handbook and framework and potentially answer some of their major strategic questions was. In addition, the company was especially pleased that they did not have to disclose any confidential information, and that the workbook could be used to build other supply chains within their company as well.

However, while following up with the company 6 months later, they stated that they had not used the framework, and had no plans to use it in the future. Since the CEO did not have time to go into further detail it is still unclear as to

why they could not use it. Further testing would need to be done, perhaps with other case companies in order to determine the reasons why it was not useful (e.g. – language too difficult to understand, unclear ideas, no one had time to go through it, etc.).

10.2 **Common themes, but no clear framework**

Even though there are many ways to build a supply chain, it should also be pointed out that there were a couple of common themes in the literature researched. One of the biggest themes was the need to determine a company's supply chain strategy. All of the sources appeared to be in consensus that a company needed to decide what type of supply chain strategy was best for them, and that the best supply chain strategy also matched the business strategy. The next question in that case becomes: how does a business determine what the best supply chain strategy is? While this thesis attempted to answer this question, it came up much like Brann's with several possible approaches to determining the SC strategy. Once again, the approach will depend largely on the type of case study.

In the literature written by the MIT SC2020 project, for example, researchers suggested that doing a supply redesign would take about a year and a half because of the need to get input from all departments running the different business operations. The duration of this bachelor's thesis is only supposed to last 5 months. So while the most logical thing to do would be work with my commissioning company in order to determine what the best supply strategy was, it was not an option in this case due to time constraints. Furthermore, the company was in a huge rush to get the product into production since they had already delayed the release of the product for over a year. In fact, before the research for this thesis had even been started, they were already planning on delivering their first order.

Nevertheless, however businesses approach choosing their supply chain strategy, researchers also agree that the supply chain strategy must be aligned with the business strategy. It is often the misalignment of these two strategies that often results in failure.

The MIT SC2020 project further reinforces these statements and adds that a business then must come up with an appropriate operational model which allows for the perfect execution of the supply chain strategy (and in turn the business strategy). Often the business will build custom-made activities in order to fulfil these goals. As Don Waters summarizes, "a perfect supply chain is characterized by a focus on a limited number of consistent and cross-optimized business practices, which mutually reinforce each other and are strictly tied to the operational goals of the company" (2010). In other words, rather than attempting to do everything well, they focus on doing a few things well. Resources are primarily allocated to those activities which are deemed important based on the company's overall strategy and goals. So while there is not necessarily a common framework or format that can be found across the world's best supply chains, there are common elements.

Admittedly, these elements of success are quite vague, and many approaches can be taken to accomplishing the aforementioned goals. It is no wonder that

companies have such a challenge properly designing or redesigning their supply chain. The idea of simply copying-and-pasting the strategies of more well- known companies like Toyota seems all too tempting, even though it has rarely worked. The lack of a clearly defined strategy is seen in Dr. Perez Franco's work. Amongst the 20 case companies he was working with, all of who technically had excellent supply chain practices, only 2 of them were able to clearly define their supply chain strategy (2010, p. 21). Therefore, while the best supply chains do possess common characteristics, the SC 2020 project appears to only reinforce the Water's idea that there is no singular correct way to build a supply chain. (2003, p. 73)

10.3 **Frazelle's LMP Methodology and RightChain Design**

Although it was not the original aim of this thesis, one thing that came out of the result of this work was the invalidation of Ed Frazelle's framework. Brann, in fact, had compared Frazelle's supply chain framework to 2 other notable frameworks, and found it to be lacking in the detail necessary in order for it to be used for practical purposes. For his research, Brann had determined that there are 13 dimensions that a supply chain framework should address. In comparison to the other 2 frameworks, Frazelle's was "the least complete of the three" and had "a heavy logistics focus" (2008, p. 50).

This lack of a complete framework was perhaps in many ways further reinforced when my commissioning company selected it to become their framework. They liked the framework because that is how they wanted their handbook to look after everything was said and done (e.g. – here is our chapter detailing our supplier policy, here is our customer policy, transportation policy, etc.). Perhaps for someone with an already complete supply chain, it is a nice framework for redesign. However, this situation was not a redesign, and the company had many big questions that needed answering. While it was not a requirement of my thesis, they wanted to know, for example, where they should locate their factories and whether all parts should be manufactured in-house or outsourced. If parts are outsourced, how long should they continue to outsource? What would be the best suppliers for each part? The questions they needed to answer to were incredibly complex and required more data and an understanding of their supply chain strategy than the company had at the time.

Frazelle's framework, while good for helping a company establish their logistics processes and operations, does not address how to answer these complex questions. Hence why the company ultimately ended up not using it. Frazelle's framework would either need to be modified again or combined with another framework in order to make it more practical for an initial SC design application.

10.4 **Limitations**

The first and most obvious limitation of my research is the lack of case studies. Only one company was used to conduct this research, and that company was too busy to follow the originally intended plan of working on the framework together. Furthermore, when following up with the company 6 months later, they never explained why they never bothered to use the framework given to

them, only that they did not plan to use it. Reasons for the framework not working could be numerous.

Another limiting factor was time. Not only did I have limited time as a researcher, but the commissioning company was in a rush. For example, one primary reason why the framework may have failed to work was because the company did not dedicate any time into truly identifying and defining their supply chain strategy as had been recommended during our discussions. They simply reviewed the research and picked a framework without taking the time to discuss or verify with other members of the company if that would truly be the best framework. Furthermore, the company never was able to clearly state their supply chain or business strategy when prompted and could only give a vague idea of what they wanted to achieve. So even though the company stated that the workbook I gave them was exactly what they requested, when the time came to use it, it did not match with their goals or strategy.

A possible solution for future case studies conducted like this might be to make sure the supply chain strategy is clearly defined before presenting the company with various frameworks. Another one could be to simply not bother with finding a universal framework, such as what I and Brann attempted to accomplish. Perhaps research should focus on developing the more appropriate SC strategy for a company's supply chain, as Perez-Franco's work did, and from there selecting the best framework for the strategy.

11 RECOMMENDATIONS

Much of the research I examined focused on supply chain redesign rather than designing supply chains from the ground up. Frazelle's framework, for example, started by asking the company to look at their previous logistics data and previous demand history. Naturally, the commissioning company did not have any of this data because they were only just starting to launch their product. Perez-Franco's work, as it clearly states, is a method to "capture, evaluate, and reformulate" the SC strategy [2010]. These three words clearly imply that the company already has some form of established supply chain.

Furthermore, many of the case studies appear to have been done with businesses that had well-designed supply chains in order to determine what common characteristics they had. Research could be done, for example, on how to build supply chains for start-ups. These companies, like my commissioning company, most likely do not have any pre-existing setups or a significant amount of demand data, and therefore must tackle SC design in a different manner. By working with start-ups, one can also see if there is a way to avoid the common challenges and mistakes that are made when first building a supply chain, and contribute to helping create the universal underlying model.

Other possible areas of research could involve testing how well the current frameworks, such as those proposed by Waters, Chopra and Meindl, and Frazelle, work in practice. Brann only compared notable frameworks in his work and did not attempt to test them in practice. Putting these frameworks

to the test, regardless of their success or failure, could offer additional insights into what works for supply chain design and what does not.

Researchers should also ensure that if they choose to work with a commissioning company, that the commissioning company is willing to commit the time and effort to conduct the study together. Otherwise, the study will most likely fail.

12 CONCLUSION

In 2008, Jeremy Bran sought to create a conceptual model for supply chain design. However, it was quickly discovered that the field of SCM was less established than other similar fields such as operations management, and that while there was a lot of research into the field of supply chain redesign, there was very little for designing a brand-new supply chain. This thesis came to a similar conclusion. There appeared to be no distinct patterns between the various proposed frameworks, nor could any of them deemed to be completely invalid.

However, additional literature such as that contributed by experts like Don Waters and Ed Frazelle, as well as the MIT SC 2020 project, have allowed us to shed some light on some of the common elements that perfect supply chains possess. All exemplary supply chains, for example, have a clearly defined supply chain strategy which is aligned with their business strategy and has established the right operational guidelines to accomplish the tasks of both strategies. These supply chains also understand that they cannot do everything well and so they focus resources on those tasks important to accomplishing their goals. This appears to be where the common relationship ends, however, as activities after this are then tailor-made to fulfil their operational goals, the approach to creating these elements varies from supply chain to supply chain.

This made creating the handbook that my commissioning company desired a difficult task, especially since they did not have the time to sit down and meet with me, explain their operations in great detail, and clearly define the supply chain and business strategy they desired for the product they were launching. This could also be one of the main reasons why my commissioning company was unable to use the workbook formulated for them.

It is also important to make a clear distinction between the fields of SCM and logistics, as the two terms are often mixed up and can lead to mismatches. Frazelle's book, for example, with its title "Supply Chain Strategy" looked like a very promising book to address the questions my company had but was ultimately too logistics focused.

While research right now shows there is no correct way to design a supply chain, advancements in technology, data-analytics, and research may help unearth more common patterns in well-designed supply chains. These in turn will create methods which will lead to an increased likelihood of success. Continued research into the subject could lead to accelerated development of robust supply chains. This could potentially mean in less dramatic swings in the

global economic environment, and maybe in the case of emergency disaster situations, save lives.

Possible suggestions for future researchers could be working with start-up companies who have not clearly defined their supply chain yet and ensuring the companies are committed to working with the researcher. They might also try to approach the issue from the assumption that there is no universal SC model. In that case, the first step is determining which model and strategy is best for that company.

With the economy becoming increasing global, consumer demand more volatile, and the unpredictable nature of elements such as politics and climate change, it has become more important than ever for businesses to design a robust supply chain which can handle these constantly fluctuating factors. While the perfect formula for creating an excellent supply chain has yet to be found, businesses can still benefit from the research done so far by making sure their business and supply chain strategy are clearly aligned. As research progresses, a better understanding of how successful supply chains work could one day help create the elusive universal framework that was sought out in this study. It is a difficult and daunting task but, in my opinion, still a worthy investment in the long run.

REFERENCES

Ambe, I. M., & Badenhorst-Weiss, J. A. (2011, December 30). Framework for Choosing Supply Chain Strategies. *African Journal of Business Management, 5*(35), 13388-13397. Retrieved from http://dx.doi.org.ezproxy.hamk.fi/10.5897/AJBMX11.016

Brann, J. M. (2008). *Supply Chain Design: A Conceptual Model and Tactical Simulations.* Texas A&M University, Information and Operations Management. Ann Arbor, MI: ProQuest, LLC. Retrieved from https://search-proquest-com.ezproxy.hamk.fi/docview/304355641?accountid=27301

Chopra, S., & Meindl, P. (2016). *Supply Chain Management: Strategy, Planning, and Operation.* New York City: Pearson Education, Inc.

Dr. Marien, E. J. (2003, February 01). *SCM & Logistics: What's the Difference*. Retrieved from Inbound Logistics: http://www.inboundlogistics.com/cms/article/scm-and-logistics-whats-the-difference/

Emmett, S., & Sood, V. (2010). *Green Supply Chains.* Hoboken: John Wiley & Sons, Inc. Retrieved from https://ebookcentral.proquest.com/lib/hamk-ebooks/detail.action?docID=564974

Fisher, M. (1997). What is the Right Supply Chain for Your Product? *Harvard Business Review, 75*(2), 105-116.

Frazelle, E. (2002). *Supply Chain Strategy: The Logistics of Supply Chain Management.* New York, NY: McGraw-Hill Companies.

Hugos, M. (2011). *Essentials of Supply Chain Management.* Hoboken, New Jersey: John Wiley & Sons.

MIT Center for Transporation and Logistics. (2008). Making the Right Connections Between Supply Chain and Strategy. *Supply Chain Strategy, 4*(2), 2-4.

MIT Center for Transportation & Logistics. (2008). Align Your Supply Chain with Change. *Supply Chain Strategy*, 4-5. Retrieved from www.MITsupplychainstrategy.com

Perez-Franco, R. J. (2010). *A Methodology to Capture, Evaluate, and Reformulate a Firm's Supply Chain Strategy as a Conceptual System.* Cambridge, MA: Massachusetts Institute of Technology.

Perez-Franco, R. J. (2011). *A brief introduction to the SC2020 Methodological Toolkit.* Cambridge, MA: Massachusetts Institute of Technology.

Pittman, P. H., & Atwater, J. B. (2016). APICS Dictionary. Chicago, Illinois, United States of America: APICS.

Porter, M. E. (1996, November-December). What is Strategy? *Harvard Business Review*, 61-79.

Right Chain Incorporated. (2017, April 24). *Methodology - Right Chain*. Retrieved from Right Chain: http://www.rightchain.com/methodology/

Trang, N. T. (2016, April). Design an Ideal Supply Chain Strategy. *Advances in Management, 9*(4), 20-27. Retrieved from https://search-proquest-com.ezproxy.hamk.fi/docview/1778674546?accountid=27301

Waters, D. (2003). *Logistics: An Introduction to Supply Chain Management.* New York, New York: Palgrave Macmillan.

Waters, D. (2010). *Global Logistics - New Directions in Supply Chain Management.* Sonipat, Haryana, India: Kogan Page Limited.