

Improved Sourcing Flexibility through Strategic Procurement

A Case Study in a Global Manufacturing Company

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**KTH Industrial Engineering
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Abstract

Background – Increase in global competition, technological changes and demanding customers have resulted in more knowledge-intensive, unstable, complicated and an uncertain environment. In order to overcome these demand uncertainties and tough circumstances, manufacturers are required to investigate methods to increase flexibility. To achieve the flexibility improvements, each component of supply chain such as suppliers, manufacturing plants, warehouses, and distributors must possess the potential to be flexible. Theory implies that the main link between company’s upstream supply chain namely suppliers and its own business unit are the sourcing strategy. Usually sourcing practitioners distinguish between sourcing strategies using portfolio models. They normally categorize purchased items based on the strategic importance of the item and characteristics of its supply market. It is a critical issue to explore how different sourcing strategies, for different categories of procured items, can influence sourcing flexibility.

Purpose– The purpose has been diagnosed as to study how the prerequisites of Bombardier’s procurement procedures along with its associated strategies, can affect the flexibility that can

be provided through sourcing namely sourcing flexibility. This study desires to investigate the concept of sourcing flexibility with considerations on category level. It can be beneficial to investigate how different strategies, related to different categories of procured component, can influence the level of sourcing flexibility specified to that category. This would lead us to two key questions: How can sourcing flexibility be defined in Bombardier and why is it required? How can sourcing strategies influence sourcing flexibility considering different categories of components?

Methodology– To provide appropriate definitions for sourcing flexibility and strategic procurement, this study went through a comprehensive review on the relevant literatures. By a deep analysis, accompanied with several unstructured interviews on one of the undergoing projects in the company, the drivers for the sourcing flexibility have been diagnosed. The procured components have been categorized into four categories of strategic, bottleneck, leverage, and noncritical through 4 different structured quantitative questionnaires. 33 diverse individuals with purchasing and/or engineering background answered those questionnaires. The categorization criteria have been extracted out from two models suggested by Kraljic (1983) and Olsen & Ellram (1997). Four independent components, one from each category, were selected for further observations. Finally, the links between sourcing strategies and sourcing flexibilities were expansively analyzed through 9 semi structured interviews with company's strategic purchasers and suppliers' representatives.

Conclusion– Sourcing flexibility can be defined from two perspectives. First one refers to the capability of the focal firm to change the structure of its upstream supply chain. Second aspect refers to the ability of company's suppliers to provide it with flexibility in three dimensions of delivery, volume and product. Both two aspects along with related dimensions can be measured in three different conditions of required, actual and potential by using range, mobility and uniformity as measuring elements. The results showed that the first perspective has a direct relationship to the sourcing strategies that focal firm may apply for different categories of procured component. Furthermore, the availability of second perspective is highly dependent on the relationship between the focal company and its suppliers, where strategic procurement plays an indispensable role. Based on the results the required level of sourcing flexibility, related to each category, differs significantly with other categories. The findings also suggested that the levels of delivery, volume and product flexibility have a close connection to the diverse strategies and attributes of the four different categories. Additionally they are well dependent on the internal operational capabilities of the suppliers along with the established relationship between buyer and supplier.

Originality/Value– Main portions of previous studies have explored the concepts of sourcing flexibility and strategic procurement separately. Although, there exists some narrow numbers that have analyzed the relationship between sourcing strategies and sourcing flexibility to some limited extent. This study tries to contribute to the existing literature by empirically exploring the principal reasons for companies necessitating to increase sourcing flexibility. It investigates how sourcing flexibility can be improved through strategic procurement. The main contribution is to consider sourcing flexibility from the category perspective. Latter is a subject that has been neglected in the previous literatures. It is extremely hard to find literature which has analyzed sourcing flexibility at the category level. This report analyses the level of sourcing flexibility specified to different categories of strategic, bottleneck, leverage, and noncritical components. It suggests some factors that may influence the

selection of a specific sourcing flexibility strategy regarding different component categories. Finally, it may introduce some extra elements that can be influential on the level of sourcing flexibility dimensions. Some examples of those influential elements are bargaining power and establishment of a close relationship.

Key-words

Sourcing flexibility, Strategic procurement, Sourcing strategies, Purchasing portfolio models

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Section 1 Introduction

This section provides the reader with a general background regarding the area of research and discusses the problem that is sought to be addressed. Based on the problem formulation, two research questions are formulated, after which the purpose of this report is presented. Preliminary definitions of supply chain flexibility, sourcing flexibility, strategic procurement, and connection between sourcing flexibility and strategic procurement have been gathered up in order to help the reader get acquainted with the key research areas of study. A hypothetical research model has been developed and elaborated in this section. That model is the basis research plan that this study would apply. The section ends with the delimitations and the intended contribution of this study complemented by how the report is going to be carried out.

1.1 Background

Increase in global competition, technological changes, and demanding customers have resulted in more knowledge-intensive, unstable, complicated, and an uncertain environment. In order to overcome the tough circumstances, manufacturers are required to investigate methods to increase flexibility (Zhang et al., 2002). Flexibility is being considered as one of the major indications for competitiveness in today's intensive competitive marketplace (Pujawan, 2004). As Suarez et al (1995) pointed out high competition in the market can cause uncertainty which in consequence makes customers request higher level of adaptation to their up and down requirements. This situation makes it difficult for the firm's supply chain to initially predict customers' requests and further adjusts its business process according to those customers' requests (Suarez & Cusumano, 1995). Several literatures highlighted the importance of flexibility as a factor contributing to competitive advantage of firms. Because it enables firms to make rapid and cost-effective responses according to changes occurring in specific customer requests (Gunasekaran, 1999).

Major bodies of literatures have underlined flexibility from manufacturing aspect. This is while the potentially more fundamental concept of supply chain flexibility has been neglected (Pujawan, 2004). Achieving the level of flexibility, that suits customers' requirements (i.e. quick delivery of a variety of high-quality and low-cost products), necessitates organizations to consider wider aspects rather than solely manufacturing flexibility (Zhang et al., 2002). Manufacturing flexibility has a multi- dimensional nature. It specifies the requirement of different types and levels of flexibility in supply chain organizations. These types and levels can be adapted according to strategic objectives of related organizations. Consequently, manufacturing flexibility is not generic. For achieving customer value-added level of flexibility, companies must look beyond merely manufacturing flexibility (Kumar et al., 2006). A key point concerning the supply chain flexibility is that the whole process must be viewed as one incorporated system. The level of flexibility and performance associated with

each component of supply chain such as suppliers, manufacturing plants, warehouses, customers, and etc. is undeniably influencing the overall flexibility level and the performance of the entire supply chain (Duclos et al., 2003). The component of manufacturing flexibility plays an indispensable role in providing supply chain flexibility. However, as the supply chain ranges beyond the enterprise borders, the same approach is true regarding supply chain flexibility too. It must also extend beyond one firm's internal flexibility (Stevenson & Spring, 2007). Supply chain flexibility implies the importance of relationship between different nodes in supply chain whereas the performance of each stage is dependent on up and down stages in value stream (Fantazy et al., 2009).

Sourcing flexibility is a crucial dimension of supply chain flexibility (Vickery et al., 1999; Duclos et al., 2003; Sanchez & Perez, 2005; Lummus et al., 2005; Kumar et al., 2006). According to Kumar et al. (2006) it can be defined as "the ability of the supply chain partners to control the supply levels (increasing or decreasing) economically and with no additional time to meet customer demand". The role of supplier is highly significant in this type of flexibility (Pujawan, 2004). The importance of establishing an alliance between business organizations and their up and downstream partners has been widely realized among companies. Firms have taken several courageous steps in order to eliminate inter- and intra-firm barriers for forming alliances. These actions are being considered as attempts to decrease associated uncertainty and also enhance control over supply and distribution channels (Gunasekaran et al., 2004). The concept of forming efficient and effective alliances with suppliers is being referred to as strategic procurement management (Kumar et al., 2006).

The main link between company's upstream supply chain namely suppliers and its own business unit is the sourcing strategy (Kim et al., 1995). Supply base is one of largest resources associated with a company's capabilities (Narasimhan & Das, 1999). The strategic importance of the purchasing function in overall corporate performance necessitates firms to pay close attention to purchasing functions. This will bring up attempt aiming to improve the supplier networks management (Kim et al., 1995). Supply strategies are required to be linked with appropriate types of relationships with suppliers in order to produce desired business outcomes (Cousins & Lawson, 2007). Portfolio models have been extensively used in strategic decision-making purposes. Their aims have been to support resource allotment decisions among strategic business units (Olsen & Ellram, 1997). Two broadly used purchasing portfolio models have been distinguished as the models presented by Kraljic (1983) and also Olsen and Ellram (1997). The primary aim of purchasing portfolio models is the development of a portfolio model that can enable the firm to manage supplier relationships. (Olsen & Ellram, 1997).

As mentioned earlier flexibility can be a source of competitive advantage for firms. So in order to achieve that advantage; purchasing unit, as a strategic component contributing to firm performance, must develop proper strategies and action programs aimed at achieving flexibility objectives (Narasimhan & Das, 1999). This report investigates the possibility of achieving the higher level of sourcing flexibility through applying appropriate sourcing strategies relevant to each category of procured items. Initially proper purchasing portfolio model should be applied. The model is being used to categorize procured items in accordance to their strategic importance and the characteristics of their supply markets. The assumption is when firms apply appropriate sourcing strategies it can result in higher level of sourcing flexibility. This can be achieved by making precise considerations on relevant factors and dimensions. Primary purpose of this study has been formed on the basis of these requirements. Purpose has been diagnosed as to study how the prerequisites of the company's procurement procedures along with its associated strategies, can influence the flexibility that can be provided through sourcing namely sourcing flexibility. This approach has been extensively explained in following parts of the report.

Even the scholars who have explicitly measured supply chain flexibility (e.g. Vickery et al., 1999; Pujawan, 2004 ; Lummus et al., 2003) have not concentrated in detail on recognizing the drivers and sources of volume flexibility. Therefore, this study has selected to do a more extensive study on the drivers and sources of sourcing flexibility more than what have been done to date. The main output of this report can be to identify and measure fundamental drivers and sources of sourcing flexibility. That can result in improvements in performance and/or distinctive competitive advantages. This study can bring further insights together into the drivers and sources of sourcing flexibility from the strategic sourcing point of view.

1.2 Problem formulation

Bombardier Transportation, Västerås Propulsion and Control (VAPPC), is a project-based company. VAPPC's is procuring its main internal customer, Bombardier vehicle builder, by approx. 80 % of its business. The remaining 20 % goes to external vehicle builders. Currently they are facing pressure from top management in order to be more responsive towards customer demands. New directive says that VAPPC will always need to adapt to requested changes from the customers without any substantial incurred extra costs. Based on this requirement, they are pursuing approaches to provide them with higher level of flexibility. It is necessarily to include supply chain flexibility as a core of the analysis in order to be able to meet the demand for higher level of flexibility. As mentioned earlier, an essential aspect of supply chain flexibility has been distinguished as sourcing flexibility, which is highly dependent towards suppliers. In general premise, sourcing flexibility rests on mainly supplier

capabilities and also the structure of relationship between buyer and supplier. Considering the mentioned aspects, it is particularly influential how Bombardier has formed its relationships with its suppliers in a way that highlights the strategic requirement of flexibility. In addition, it is not cost-efficient to apply same sourcing strategy towards every supplier and for all kinds of procured items. So the primary challenge here for Bombardier is to primarily distinguish the categories of procured items. Then, their sourcing strategies should be adapted with considerations over business unit strategy. Currently providing flexibility towards customer's requests is being sought as one of the strategic objectives from Bombardier's top managements' point of views. The question is that whether the existent sourcing strategies support that strategic direction. Thus, the next step is to examine whether its current forms of relationships with suppliers encourage Bombardier's strong demand for flexibility or not. If not, reasonable procedures should take place in order to modify the relationship based on strategic requirements.

1.3 Research questions

To approach the problem mentioned above the following research questions have been defined:

Research question 1: What is the definition of sourcing flexibility?

Research question 2: How is sourcing flexibility connected to strategic procurement?

- How can different types of sourcing strategies for different types of procured items (strategic, bottleneck, leverage and noncritical) influence sourcing flexibility related to that category?
- How do the drivers of sourcing flexibility differ between different categories of procured item (strategic, bottleneck, leverage and noncritical)?
- How do the sources of sourcing flexibility differ between different categories of procured item (strategic, bottleneck, leverage and noncritical)?
- Do the current purchasing practices with the suppliers highlight the flexibility needs? What kinds of purchasing practices can be applied in order to achieve a higher level of sourcing flexibility through suppliers?

1.4 Purpose

The purpose of the report is to examine and distinguish between relevant theories and practical tools in order to help Bombardier Transportation to achieve a higher level of sourcing flexibility. The strategic alignment of the

procurement function with Bombardier corporate strategy will be analyzed empirically. The findings will be examined to be applicable to the company. In addition, their contribution towards purpose will be investigated in deeper extent. Covering previously mentioned research questions will lead to fulfillment of the purpose.

1.5 Hypothetical research model

This paper is trying to address some gaps that have been observed in the literatures during the in-depth review of materials related to strategic sourcing and supply chain flexibility. Preliminary concern is around the rationalization of the definition of the supply chain flexibility or more specifically sourcing flexibility. Second concern is related to the connection between sourcing strategies, connected with different kinds of component, and sourcing flexibility. This connection has rarely been investigated via an empirical research. Second concern is significantly tied up with exploring the role of flexibility in sourcing strategy. Latter is of greater importance for this report. This importance is due to the main purpose of the report which is to investigate the effects of strategic procurement on potentially achieving the higher level of sourcing flexibility. The alignment between sourcing strategy and business unit strategy is being referred to as strategic procurement. Based on the above identified gaps the following hypothetical model has been depicted (figure 1). The empirical research is a mean to check the relevancy of the proposed model.

1.5.1 Model illustration

Making analysis over the current supply structure of a focal firm will provide opportunities to investigate the uncertainties associated with the procedure. This analysis may also explore the actual and potential level of flexibility that the existent structure can handle. By distinguishing uncertainties, one can figure out the motivation behind a requirement of the specific kind of flexibility. The focus of this report is on the sourcing flexibility so by assessing the uncertainties, the drivers of the sourcing flexibility can be determined. The drivers are potential factors that necessitate the requirement of sourcing flexibility. Since the characteristics of the components that are being placed in the different categories (strategic, bottleneck, leverage and noncritical) are dissimilar, their flexibility drivers are diverse and divergent. Based on the realized drivers, the required level of sourcing flexibility can be conceived. This required level is the magnitude of flexibility that a sourcing procedure needs in order to satisfy the drivers. The required level of sourcing flexibility violates across the different categories of components due to the same reason mentioned previously.

Actual level of sourcing flexibility can be realized by investigating the current structure of supply network. This is the degree of sourcing flexibility which currently exists. Potential level refers to inherent magnitude of flexibility which is accessible considering the current structure. The gaps can be distinguished by

comparing the three elements of required, potential, and the actual level of flexibility. These gaps can be tried to get mitigated later on by aligning sources of sourcing flexibility with the required degree of flexibility.

The premise of the model is that the concept of strategic procurement is being considered as one of main sources of sourcing flexibility. Furthermore, sourcing efficacy, defined as a fit between procurement strategic objectives and sourcing capabilities (Gonzalez-Benito, 2007), has a positive effect on sourcing flexibility. When a company establishes its functional strategies, it is crucial to consider the uncertainties and characteristics of suppliers. According to Kraljic (1983) different categories of procured items (strategic, bottleneck, leverage and noncritical) necessitate the application of different sourcing strategies. These differences may result in diverse sources for sourcing flexibility engaged with each category. The required level of sourcing flexibility is dissimilar for each category of the procured items. Evaluating the required level, while simultaneously considering the potential accessible sources of sourcing flexibility, may result in an improved level of sourcing flexibility.

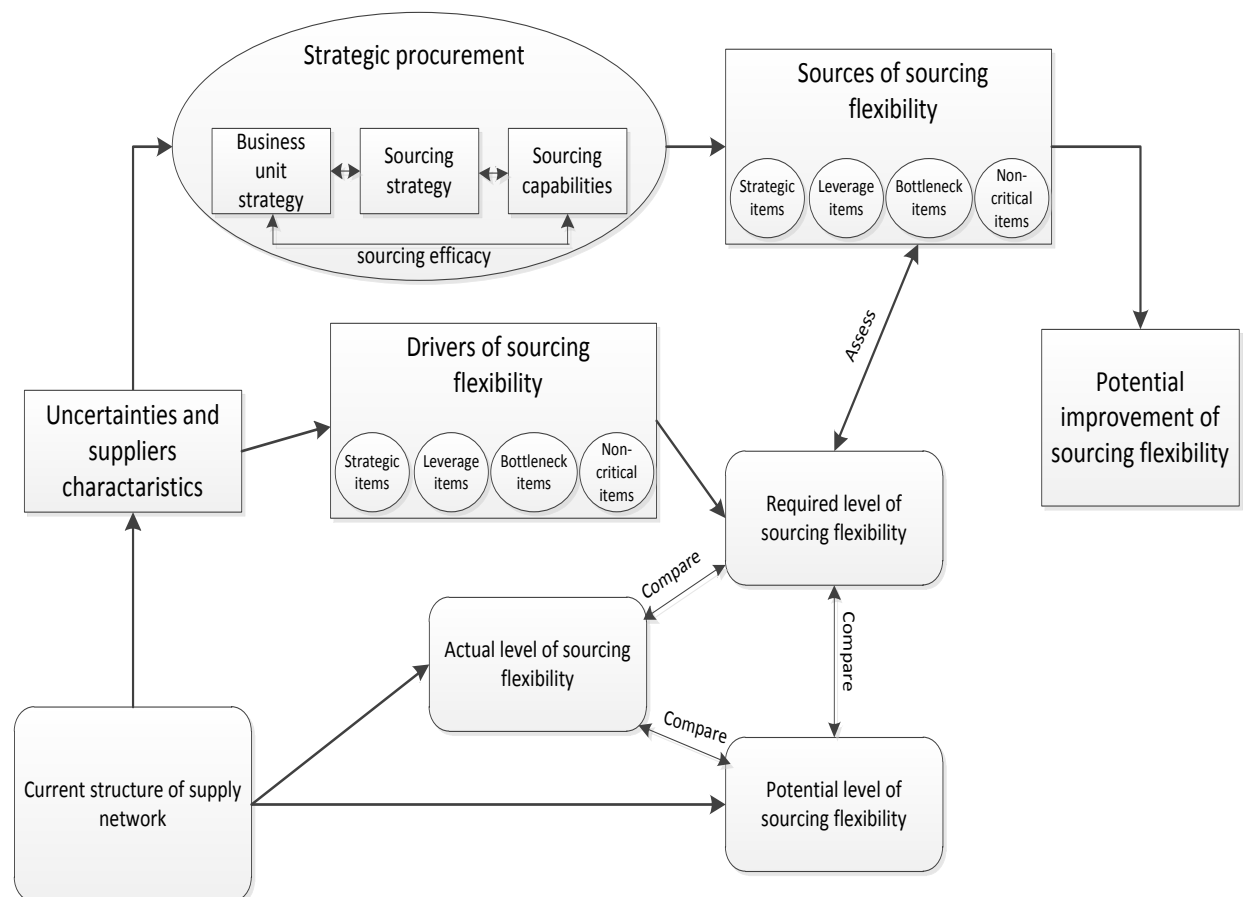


Figure 1- Conceptual Model Adapted from Kraljic (1983), Gonzalez-Benito (2007) and Fantazy, et al (2009)

The above-mentioned model is going to be investigated considering the fact that flexibility is a relative factor. In another word, the desired level of flexibility is always meaningful in trade-off with other aspects such as associated cost. Since the definition of flexibility is highly subjective (Upton, 1994; Vickery et al., 1999). It has constantly been tried to consider different perspectives, regarding interrelated trade-offs, in the definition of sourcing flexibility. So in the case of the investigated company the trade-off between cost and flexibility level form the strategic direction of Bombardier. This aspect will persistently be considered through the whole procedure of analysis.

1.6 Delimitations

As it will be discussed later, supply chain flexibility consists of several dimensions but the only dimension that this report intends to focus is on sourcing flexibility. This means that other dimensions such as new product flexibility, manufacturing flexibility and logistics flexibility have been identified as out of scope. This delimitation does not necessarily indicate that those non-regarded dimensions are less prominent; it just defines the scope of this study. As it mentioned earlier supply chain flexibility emphasizes the systematic overview on supply chain. Also, it points out that the performance of each step in the chain is influential on the other stages. So the other dimensions carry the same level of significance as sourcing flexibility. Because of time shortages and in order to maintain the accuracy of the report, just one area of focus has been found relevant to the purpose of the study.

It has decided to investigate only one ongoing project at the case company. The Bombardier's projects are all large ones and analyzing more than one would exceed the time limitations of this study. Furthermore, since this study has been done in just one firm, active in the restricted industry, the generalizability of the results is limited.

1.7 Contributions

There are two main target groups for this study. The first is individuals, on a managerial level and/or employees within the procurement department at Bombardier that have the ambition to improve customer responsiveness through sourcing flexibility. The second target group is students at The Royal Institute of Technology (KTH) as well as other universities that have an interest in supply chain management especially in strategic procurement and sourcing flexibility. Also, this study can be of interests to people working at other functional or strategic departments of organizations in order to observe the linkages between different partners of supply chains.

The aim of study is more specifically to contribute to the following parts:

- An increased understanding why companies are required to provide sourcing flexibility
- An increased understanding how strategic procurement can influence sourcing flexibility
- An increased understanding how purchasing portfolio models can contribute to improve sourcing flexibility at the category level
- An increased understanding how the company in the study can benefit from the power-dependence perspective between the buyer and supplier in order to improve sourcing flexibility

1.8 Disposition

The study consists of 8 main parts, which are outlined as figure 2. These parts do not necessarily replicate the chronological order of study execution, but it provides the reader with a sketch of the general practical understanding of the work.

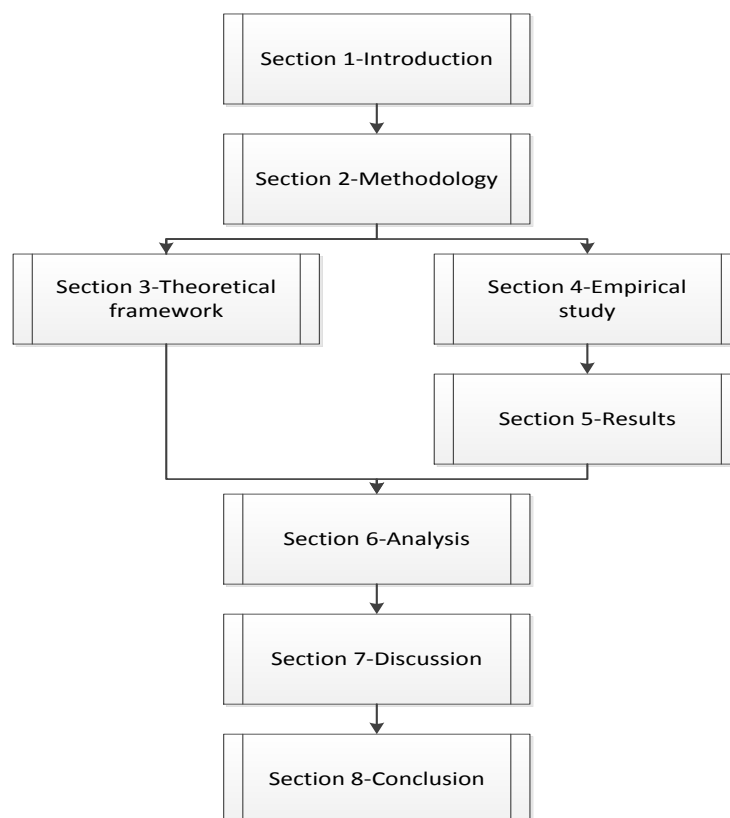


Figure 2-Guide to the thesis

Section one includes the introduction of the thesis; containing background, problem consideration and formulation, purpose as well as delimitations and the intended contributions. The second section is regarding the descriptions of the applied methodology. This chapter designates the scientific framework of used

references, the problems that have ascended and the approaches taken when directing this study. These initial two sections form the foundation for the report and offer the reader the critical information to evaluate the quality, reliability and validity of the material. This is of high significance since these materials outline the basis for the analysis.

The third section comprises the theoretical framework, consisting of theories related to supply chain and sourcing flexibility, strategic procurement, and supplier relationship complemented with other theoretical concepts of relevance. The following section contains the empirical study. This section provides the reader with required information about the case company. This information includes a brief description of the company, introduction of underexamined project, organizational structure, flow of processes, and depiction of strategic procurement at Bombardier. Result section compliments the empirical study section. Result section is delineating the executed surveys and questionnaires and also exhibits the results of categorization of procured items. It tries to gather empirical evidence for the previously developed hypothetical model. These three parts deliver a theoretical and empirical foundation to the reader. This will smooth the comprehension of the subsequent analytical part of the study.

The last three sections contain the analysis, discussions, and the relevant conclusions. Here, the theoretical framework and the results are linked together followed by the outcome of the in-depth interviews. Subsequently, the conclusions are drawn from the previous facts and information. The conclusion section covers the general summary of the whole study. It investigates the explored answers for the research questions and discusses the managerial implication. The report will be complemented by introducing the possible areas for future investigations.

Section 2 Methodology

In this section, the approaches regarding the procedure of selecting methods on how this study is carried out will be presented. This may make it possible for further researcher to replicate this study and execute a critical assessment of the performed study. Also, discussions regarding validity, reliability, and scientific credibility of the study will take place in this section. The findings reported in this paper are drawn from a large in-depth study of one totally project-based company active in the transportation industry, Bombardier Transportation. In this section, the research paradigm to which this study belongs is presented along with the chosen methodologies.

2.1 Classification of research

According to Collis & Hussey (2009), researches can be classified according to their purposes, processes, logics, and outcomes. Depending on purpose of one research, it can be described as exploratory, descriptive, analytical or predictive (Collis & Hussey, 2009; Sachdeva, 2009).

When there are remarkably few or somehow no earlier studies on related research problem that can be used as references, then the conducted research methodology is exploratory. The aim here is to look for new patterns, ideas and hypotheses rather than testing or confirming ones. The focus is mainly on gaining insights and familiarity with the subject for further investigation at later steps. Descriptive research will be conducted in order to describe phenomena as they are. It takes deeper approach rather than a exploratory research to depict the characteristics and specifications of a particular issue. Researcher in analytical research goes beyond merely describing the characteristics of the issue. The research here analyses and explains why or how the under investigation issue is happening. Analytical research aims to understand phenomena by discovering and measuring casual relations between them. Finally, predictive research even takes deeper approach than analytical one and aims to generalize from the analysis. It tries to forecast the probability of occurring similar situation elsewhere by predicting certain phenomena on the basis of hypothesized, general relationships (Collis & Hussey, 2009).

Considering the purpose of this study, it will be mainly classified as analytical research. The initial approach is to develop adapted definition of sourcing flexibility specifically relevant to company under observation. There exists some literature on concept sourcing flexibility. So this study gathers the information, analyses and adapts them according to requirements of the company. Further, it develops a specific definition for the concept. The consequent steps regard investigating the relationship between different sourcing strategies and their influence on sourcing flexibility. There also exist sufficient literatures on developing efficient sourcing strategies for different kinds of components. The aim here is to analyze different kinds of sourcing strategies and explore their impact on level of sourcing flexibility. Then considering the nature of

underexamined sourcing strategy, it can be allocated to the appropriate category. By category, this study means the introduced categories of components by Kraljic (1983). These categories are namely strategic, bottleneck, leverage, and noncritical components. This subject has been discussed in detail in section 3.3 of this report.

This study desires to address a specific issue existent in the case company and makes deep investigations in order to propose some potential guidelines and solutions relevant to the issue underexamined. Considering this, it can be placed in applied research category where studies are being characterized to apply their findings for solving a specific, existing problem (Collis & Hussey, 2009). The emphasis here is on immediate application of findings in a practical situation. During the study, it has been tried to base the research both from a theoretical point of view and, even more, on reality.

2.2 Research Paradigm

The approach, that researcher takes toward science, governs how research is conducted in each case. Each study should be placed in the spectrum between positivism and interpretivism in order to clarify foundation for the chosen methodology.

Positivism assumes that social reality is singular and objective. Based on this view, what is studied is separated from the student and free from bias values (Collis & Hussey, 2009). From this assumption, only phenomena that are observable and measurable can be considered science. The research process in a positivist study should be as free as possible from personal values. Furthermore, the studied object exists both before and after it has been studied. An interpretivistic view of science is based on the fact that the interpretation of social reality that exists in the minds cannot be ignored. It will always involve some form of subjectivity and multiple interpretations (Collis & Hussey, 2009). Studies made from this assumption agree and reveal the personally valued interpretations that are given by the studied object.

This presented study is in its ontological assumption positivistic when the truth that is presented is to be impartial and independent of the observer. The purpose of this study is to shape a more certain magnitude of knowledge in compare to what has been previously shaped. The research has been done by articulating research questions, which are answered through different scientific methods, i.e. the survey investigations, theoretical analysis, and several in-depth interviews. This scientific view has been selected; if possible, to confirm the theories and let them face the reality to further be formed.

2.3 Implemented methodology

Bryman & Bell (2011) stated that when conducting a research, a connection should be established between existing theories and practical situation. This approach has caused researches to get divided to two categories of inductive and deductive. The inductive approach concentrates more on understanding and interpreting processes. In inductive approach, empirical findings are being used as a basis for producing new theories (Collis & Hussey, 2009).

On the other hand, this study pursues the deductive approach. Based on the existent literatures related to relevant subjects, conceptual and theoretical structure is going to be developed and then tested and approved by empirical research. This is also a definition of deductive research (Bryman & Bell, 2011; Collis & Hussey, 2009). For achieving the purpose, this report has been divided to three phases. Different methodological approaches have been taken into consideration for implementing of each phase.

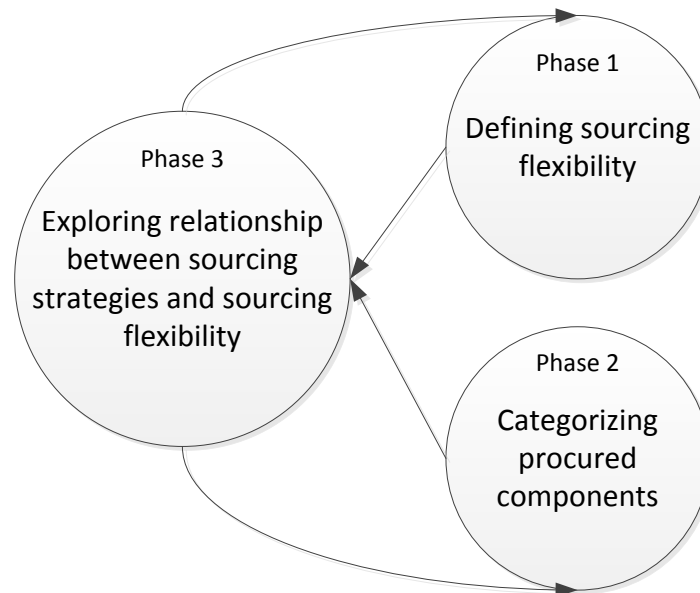


Figure 3-Research phases

The first phase regarded the development of appropriate definition for sourcing flexibility. The first phase uses qualitative data collection approach. Several literatures are being reviewed. Relevant theories got adapted according to the requirements of Bombardier in order to provide the definition for sourcing flexibility. Study went through an intensive literature review on supply chain flexibility in order to meet the first phase's purpose of the report. It investigates several aspects of supply chain flexibility such as definitions, dimensions, measurements, requirements, and implementation. Then the study got narrowed

down to sourcing flexibility and above mentioned aspects have been also investigated for sourcing flexibility. In this way, the framework of reference for the analysis was formed.

The second phase has been shaped around procedure of categorizing the procured component groups. During the report' start-up phase, several questions and criteria were formed within the research area. Many of these questions and criteria have later on been used in both surveys' and interviews' questionnaires. Based on the selected theories three survey forms with three distinctive questions were developed. These surveys were also aiming at three different groups of respondents. In order to categorize procured item, they should be positioned on a two-dimensional plot. This report defined the vertical axis of the plot as "strategic importance of procured items" and the horizontal axis as "complexity of supply market". For analyzing the position of the procured components on the vertical axis, one survey was sent to 17 managers and another survey was sent to 13 strategic purchasers. The purpose of the survey that was sent to managers was to find the importance weight of 5 previously defined criteria. The aim of the survey sent to strategic purchaser was to distinguish the actual level of importance of each criterion for each procured component. For analyzing the position of the procured items on the vertical axis, a distinctive survey was sent to strategic purchaser. The aim was to distinguish the actual level of importance of each criterion for each procured component. Finally, 13 surveys were sent to component engineers in order to check the validity of previous surveys sent to strategic purchasers. The definitions of criteria related to each axis along with detailed information about applied theory for categorizing procured components have been brought together in part 3.3 of this report.

The third phase aims to establish a connection between relevant theories and empirical study. It investigates the potential relationship between sourcing flexibility and sourcing strategies at the category level. In order to check this relevancy, first 4 procured components were selected, one from each category. Then 9 interviews were executed in order to analyze the relationship between sourcing strategy and sourcing flexibility at the category level. 5 interviews were done with strategic purchasers specific to each of selected component. 4 additional interviews were accomplished with sample supplier of each component.

It has been tried to generate a largely valid and as objective study as possible. It was expected to be able to discover support within accessible theories, as well as the reality of the field company, and consequently be able to examine the issue and possibly to influence it.

The arguments, used later in the study as a basis of the final solution, have been proposed in the form of the hypothetical model. The model has been tried to get approved and confirmed by using relevant theories, practical observations, and interpretation of gathered empirical data. Based on the observations, new conclusions and interpretations have been drawn. Conclusions have been confirmed or invalidated through in-depth interviews. It was tried to provide circumstances where both empirical and theoretical studies have the same opportunity to influence the practical approach.

Considering the process of research, it can be divided into two categories of qualitative and quantitative. The determination with qualitative research is to realize the context of an occurrence or a definite experience. In comparison quantitative researcher determinedly try to understand how all parts function together in order to generate a clear picture of the issue under study (Bryman & Bell, 2011). Researcher exhibits more control over the research subject and the study is more formalized and structured in the quantitative method. Furthermore, the analysis of quantitative research is based on statistic method and consequently has a higher degree of generalizability. The analysis of qualitative research , on the other hand, is more based on interpretative method and complex contexts (Collis & Hussey, 2009). The aim is to achieve a deep understanding of a definite phenomenon in the context. For gaining more precise results, the researcher must get close to the information source and make the analysis on the basis of understanding and interpretation (Bryman & Bell, 2011).

In order to answer this study's research questions effectively, the mixture of qualitative and quantitative method have been used while more concentrations were on qualitative ones. This study used the in depth qualitative approach in order to be able to clarify the dynamics between actors and other relevant aspects in the studied contexts. The work has its foundation in quantitative as well as qualitative methods. The findings from the interviews were qualitatively impacted by attitudes which can be a source of error regarding the results. A comprehensive picture was attained with the help of interviewing people from the different functions. Execution of several interview supported the report to cover many aspects of interest. This fact was constantly remembered that different functions have different goals. This was highly considered during and after the interviews. In this way, the potential sources of error when interpreting the interviews were minimized. Furthermore, it was believed that a mixture of qualitative and quantitative data was supportive when trying to catch an objective tool.

2.3.1 Data collection

Primary data are the data that have been collected from an original source by researcher itself. On the other hand, secondary data are data that have been collected from a previously existing source (Collis & Hussey, 2009). Both types of

data have been gathered and applied in the course of this study. Followings are the descriptions of the methods that have been used for collecting data to meet the purpose of this report.

2.3.1.1 Primary data collection

Primary data are being gathered to tackle a particular research objective. Those kinds of data can be collected using methods such as surveys, questionnaires, direct observations, experiments and etc. Primary data are reliable ways to collect data because the researcher knows the exact sources of data and how it has been gathered and analyzed since it is being collected by the researchers themselves. Primary sources necessitate the researcher to interact with the source and extract information form it (Sachdeva, 2009). First, a brief introduction of the methods employed in this thesis has been provided in the following.

Surveys

Survey research is one of the most critical areas of measurement in an applied research. Surveys can be divided into two broad categories of questionnaires and interviews (Sachdeva, 2009). In questionnaires, sample of respondents are being asked to answer a list of carefully structured questions (Collis & Hussey, 2009). It is usually in written format that the respondents complete it. There exists several number of distribution method for questionnaires such as by post, telephone, online and face-to-face (Collis & Hussey, 2009; Sachdeva, 2009). It is based on this fact that the information sought is standardized. Survey characteristic is that the researcher can measure a certain phenomenon by asking pre developed and structured questions (Bryman & Bell, 2011). The main steps involved in designing a questionnaire have been summarized in Figure 4.

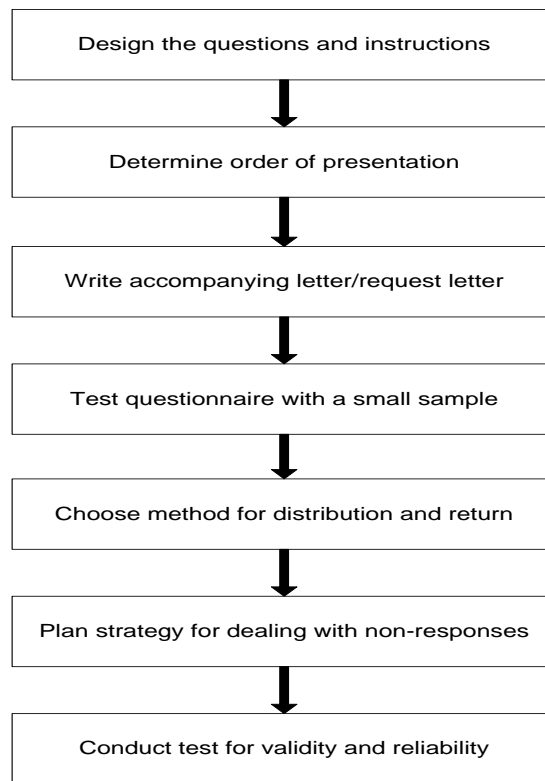


Figure 4- Designing a questionnaire (Collis & Hussey, 2009)

Since, in the course of conducting surveys, all respondents answer exactly the same questions, they are subjects to the same type of motivations and provocations. This leads to satisfactory conditions for accomplishing a reliable quantitative processing and analysis of the gathered responses (Bryman & Bell, 2011). To meet the objective of the second phase of this study (i.e to categorize the component category), four distinctive surveys were developed and distributed to relevant people for their responses. VAPPC has divided the items that it purchases to different groups based on the mechanical nature of those items. These groups referred to as component groups. All surveys were designed in a way to produce information that is required to place each component group in its relevant category.

In order to initially find the weight of each factor, found influential on the strategic importance of component categories, a survey was developed containing one question. The survey was asked respondents to rank the factors in order of importance from their point of view. A specific number was assigned to each position in order that the relative importance of each factor in comparison to the rest can be calculated (Appendix 1). The second survey was designed in a way to extract detailed information about the factors required for placements of the component groups on the vertical axis of the plot (Appendix 2). As mentioned earlier the vertical axis was defined as “strategic importance”. The third survey was designed in a way to extract the detailed information about the factors required for placements of the component groups on the horizontal

axis of the plot (Appendix 3). As pointed out earlier, the horizontal axis was defined as “complexity of supply market”. The fourth survey was designed in order to check the validity of some factors related to both vertical and horizontal axes (Appendix 4). The method used in formulating the surveys was based on 1 to 5 Likert scales (where 1 was low and 5 was high).

The respondents

As discussed previously, each survey was aimed for different respondents. Following table shows the related respondents for each survey in addition to the achieved response rates. The importance of response rate is highlighted for checking the validity of the report.

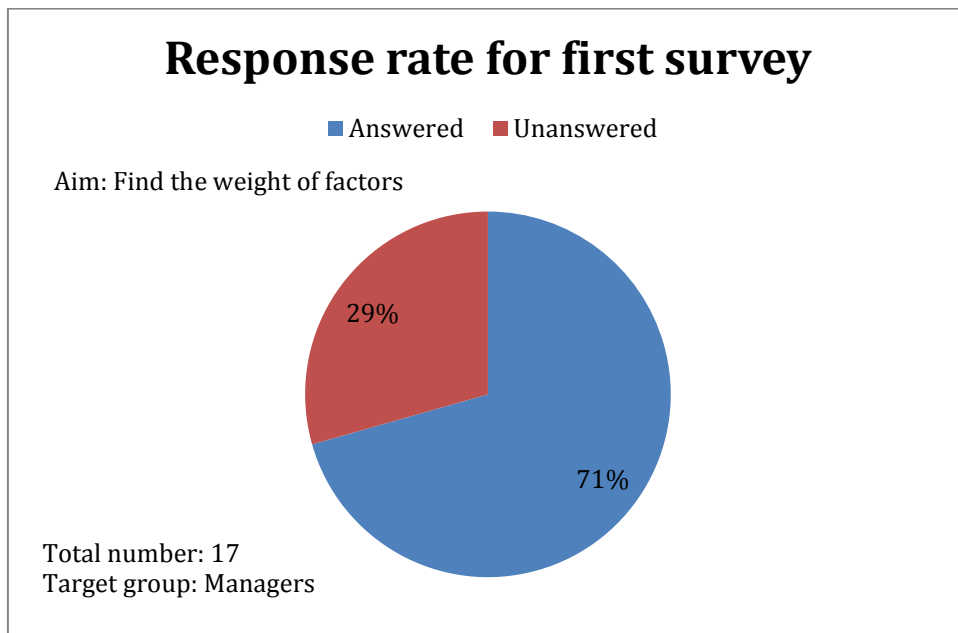


Figure 5-First survey response rate

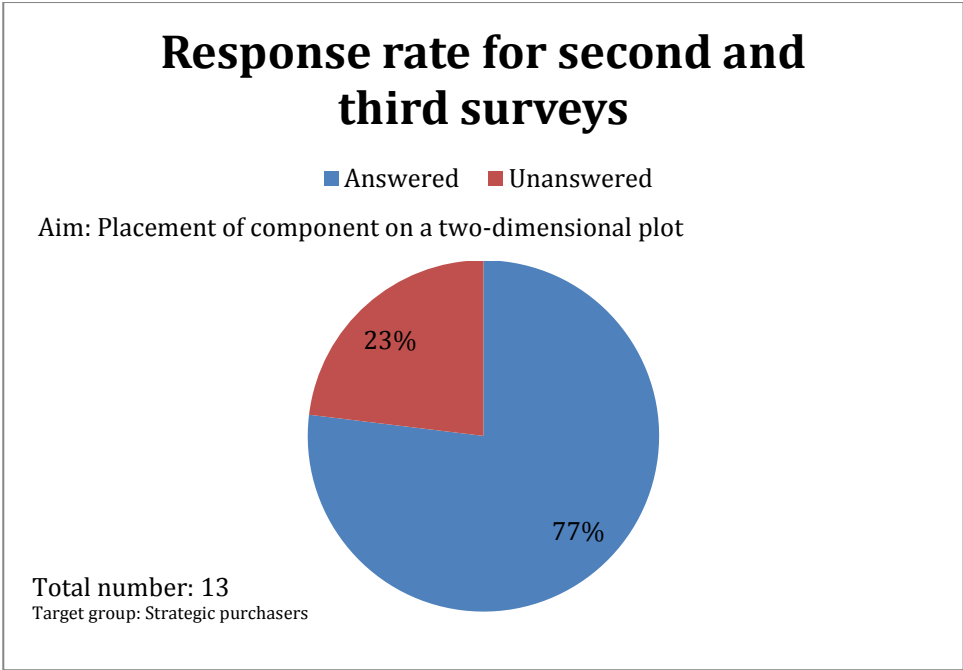


Figure 6-second and third surveys response rates

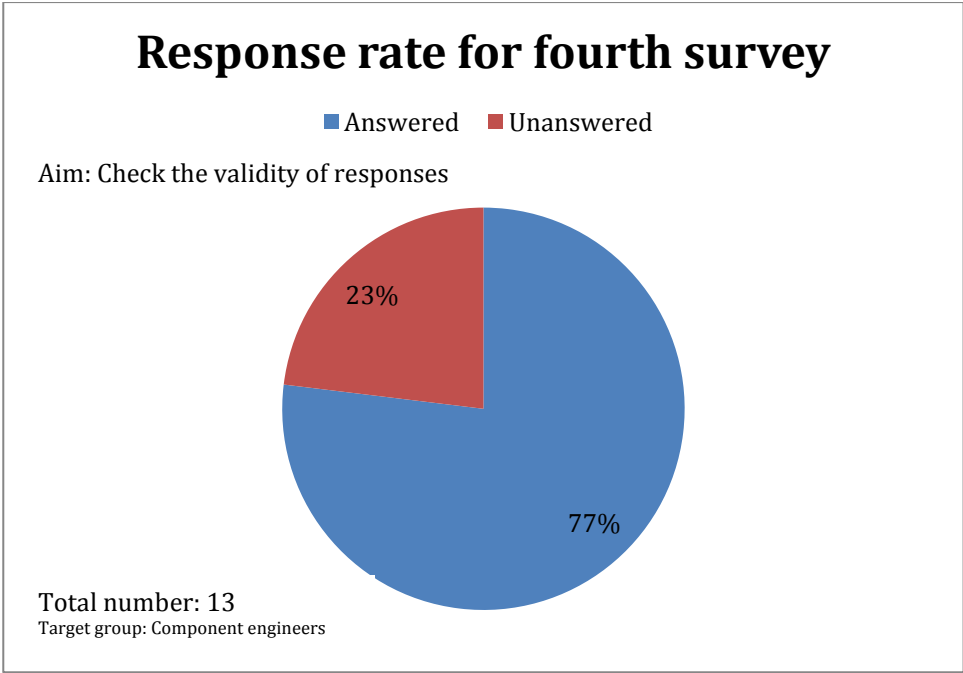


Figure 7-Fourth survey response rate

Interviews

When working with interviews, there are two basic principles that researchers should consider: the level of standardization and structuring. Former refers to the extent that the researcher decides to stick to the predetermined order and construction of the questions. The level of structuring refers to the level that respondent has the freedom to interpret questions considering respondent’s previous experiences and competence (Bryman & Bell, 2011).

Semi-structured interview is an analytical form of in-depth interviews. By conducting that the interviewer tries to investigate a specific group of topics in order to penetrate particular questions even further (Collis & Hussey, 2009). After categorizing the component categories into four groups, some areas of further exploration have been distinguished. Some new questionnaires were formulated from an initial analysis of the data gathered. These concerned certain sourcing strategies, flexibility challenges, and key success factors when sourcing from suppliers. Particular parameters associated with these questionnaires needed further penetrations and explanations in order to go into detail of the issue and clarify the stances. To do that and get required further information, 9 semi-structured interviews were executed. Five with strategic purchasers responsible for sample component, selected from each category, and four with relevant persons from the supplier side of those components. Four focused individual interviews were conducted through telephone. Each interview took more than 2 hours and in total, almost 20 hours were spent on the interviews. To minimize any potential misunderstandings, the supporting documents containing the desired questions were sent to the respondents in advance. The interviews were also recorded so that quotes can be replicated correctly. The questions that were asked during the interviews have been brought together in appendix 5 for further references.

2.3.1.2 Secondary data collection

According to definition of secondary data, presented previously, they are usually less expensive and easier to collect and access in comparison to the means of collecting primary data. In addition, it is decidedly timesaving. The secondary data make it feasible to continuously return to the source of origin and assess its relevance. The secondary data also exhibits some limitations despite the many benefits that they potentially offer. Since it has been collected for a different purpose than the existing one, it may be difficult to perfectly fit them with the current issue under study and/or relate them to the primary data that actually were gathered. An additional limitation is the risk of subjectivity that jeopardizes secondary sources. The only way to solve this problem is to use multiple sources when conducting a research (Aaker et al., 1995).

The theoretical framework of this study has been mainly based on literatures, periodical articles, information from the internet and Bombardier's internal portal. This actually indicates that the secondary data used are chiefly associated with the theoretic investigation that has been implemented. Journal of purchasing and supply chain management, journal of operations management, journal of production economics, and Sloan management review are some examples of scientific journals been used in the course of this study. The libraries of Royal School of Technology (KTH), Stockholm University and Stockholm School of Economics were used to search for applicable literature. Additional

information was collected through databases such as Elsevier, Wiley online Libraries and Emerald.

The existing theories have been collected in different steps through the study. In the initial step, the aim was to get a general comprehension of strategic sourcing and supply chain flexibility. Eventually the theoretic study became more specific and detailed as a greater level of knowledge and understanding was evolved. The detailed evolution of the each step of work has been extensively explained in part 2.5.

2.3.2 Data Analysis

This report applies the following structure for the procedure of analyzing the collected data.

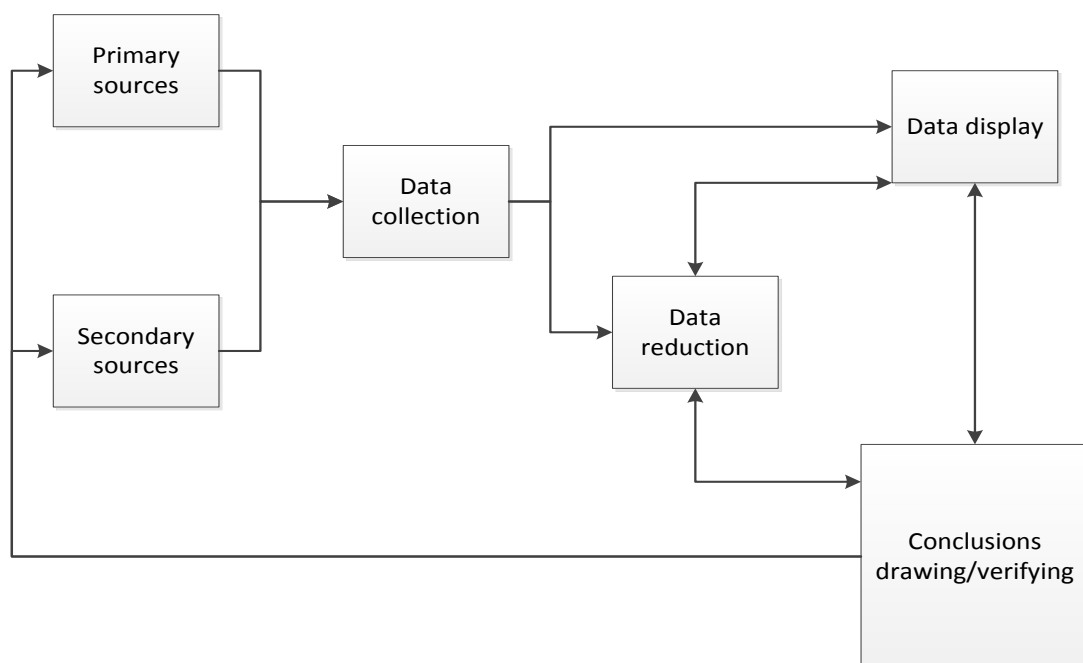


Figure 8-Procedure of data analysis

The data are being collected both from theory and at the site. Then it will be filtered down according to the actual requirements. Then the filtered data are being categorized into sections which would refer to the relevant theories that are going to be used. The analysis is being steered grounded on the collected data and then those data can be presented and visualized as results. Eventually from the analysis of the collected data, conclusions and recommendations can be made.

2.4 Applied method for categorization of components

This study applies a weighted factor score method for categorizing the component groups. This method consists of a number of factors for each dimension. This method allows for a fully customized approach. Researchers can

decide on factors, weights, and sometimes even scores. Total scores per dimension can be calculated in the both ways of an additive model or the average model. For calculation of the factors' scores related to the vertical axis, this study uses the average model while for the scores related to the horizontal axis, the study applies additive model.

In the case of Bombardier, there exist several key factors that should have been considered in the procedure of categorization. In addition, there was a high requirement for customization and flexibility related to the methods that was supposed to be used for categorization. These two were the chief reasons for application of weighted factor score method.

2.5 Organization of the work

Figure 9 depicts the actual organization of this report. Detailed explanation of each step has been brought into attention afterwards.

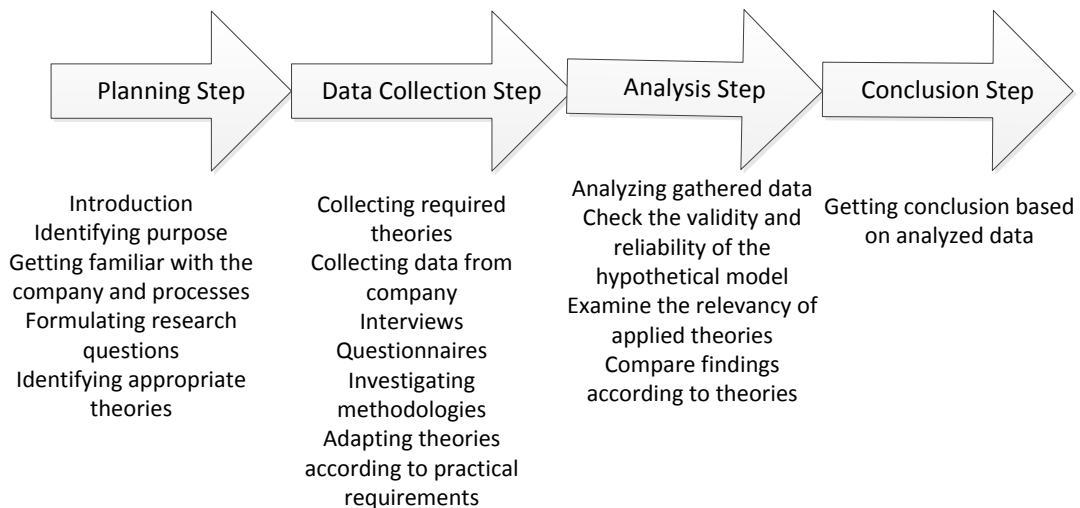


Figure 9- Organization of the work

2.5.1 Planning step

The concentration of the planning step was first of all to gain a general understanding and overview over the problem that this thesis was formed to address. To be able to do that, it was essential to take grasp over Bombardier's activities and procedures specifically the ones related to the relationship between purchasing department, customers and suppliers. Therefore, a sample project was selected for further analysis. The selection of sample project was based on the extent of volatility of customer requirements. It has been tried to select the project that was extremely unstable in order to achieve satisfactory overview over the need of required flexibility and its importance. Several interviews with different people, involved in the project, were taken place to understand the processes. The interviewees were holding different positions such as project manager, production planner, operative buyer and etc.

Furthermore, information also was gathered from Bombardier's internal network and also some observatory trips to manufacturing site were made. With improved knowledge over the company and information gathered about problem under study, the purpose of the study clearly discussed with supervisor inside the company and got finalized.

Parallel with collecting data for the general overview, a pile of potential useful theoretical literatures were gathered. The search for relevant theories was mainly concentrated on supply chain flexibility, sourcing flexibility, purchasing theories somewhat related to purchasing portfolio approaches and the linkage of purchasing strategies to corporate strategies. The literatures reviewed were mostly scientific journal articles and books, but also some other sources such as conference proceedings were being considered. The detailed summary of theories, which have been found applicable, has been brought up together in the theoretical framework section of this report.

The theoretical framework made it possible to brighten the purpose of the thesis and define the problem more clearly. By revising the research questions in a more precise manner, the problem could be delimited into a manageable size. Accordingly, the distinctive steps towards finding a solution were formed more precisely.

2.5.2 Data collection step

Throughout this step data was collected. In order to select and bring in the information needed, specified for Bombardier, the data collection step consisted of several different tools such as surveys and interviews. It was essential to make sure that no significant point had been left out from the lists of possible factors. At the same time, it was vital that the factors be relevant for Bombardier. Further the respondents' opinions regarding prioritization of factors, from importance point of view, were collected. The aim was to ensure the coverage all perspectives of interest and, therefore, interviews took place with individuals working as strategic purchasers and also representatives of suppliers. The interviews were mainly structured, but the intention was also to provide a situation that the respondent can think independently. Thus, the interviews carried out in a semi-structured but still flexible form. The respondents were contacted in advance, and the appointments were fixed at their convenient time.

The investigations regarding the relevancy of applied methodologies along with assuring the validity of selected theories took place at this step. In this step, a huge amount of data was collected from a different department inside the company. The portion of collected data which found irrelevant were reduced in order to increase the accuracy of the work.

2.5.3 Analysis step

The analysis was based on the information gained in the data collection step in addition to studied theories. The goal of the work was to investigate the potential relationship between sourcing strategies and sourcing flexibility at the category level. To be able to grasp the nature of this relationship and get background information about that a synthesis of the different studied theories was done. The facts that the studied items were sample components and that there was an awareness regarding the purchasing portfolio models at Bombardier, were also taken into account at this step.

The factors derived from the theories, surveys and interviews in the previous step are needed to be further studied continuously. A compilation was done after the surveys, and interviews to ensure that mutual understandings of what was stated were realized. The results of the categorization phase were also evaluated with Director of Supply Chain at Bombardier. The different answers were discussed from the wide perspectives and an analysis over the roots was made. The analysis led to a broad understanding regarding the relationship between sourcing strategies and sourcing flexibility at the category level. Finally, the step was reached where the results in the form of conclusions and recommendations could be presented.

2.5.4 Conclusion step

In this step, the results from both the sourcing flexibility defining phase and the categorization of component phase were summarized and reflected on. The categorization procedure and the sourcing strategies development were brought together and observed upon as a combined structure for improving sourcing flexibility. Finally, some thoughts about the degree of generalization and possibilities of the further investigations were also shared.

2.6 Method Criticism

2.6.1 Validity

Validity is the extent to which the research findings accurately reflect the phenomena under study (Collis & Hussey, 2009). The data collected through all the interviews was validated through respondent validation (Bryman & Bell, 2011), hence the participants were asked for corroboration. The questions were emailed to the interviewees in order to make them prepared beforehand and get the information validated. In general, all the structured questions were designed in the way to be sincere and clear for respondents and an introduction of the interviewer and the topic of the study were to start with (Bryman & Bell, 2007). Furthermore, the validity of gained data was enhanced and checked using convergent validity test. Thus, level of consistency found between interviewees' actual choice of product and acquired data. Throughout the report, it was tries to facilitate the development of the quantitative methods by

the qualitative research (Bryman & Bell, 2007). The quality of the data gathered from the questionnaire also got checked through performing different validation measures. Further, an important aspect in order to get decent external validity is to have high response rate. A considerable amount of time has, therefore, been put on the cover letter and design of the questionnaire in order to enhance the ease of responding.

2.6.2 Reliability

Reliability refers to the absence of differences in the results if the research were repeated (Collis & Hussey, 2009). Reliability of this study is supported by using reliable sources of information, namely a large number of academic journals specific to the area under study, supply chain management. The reliability of the interviews is maintained by having the interviews with both suppliers and strategic purchasers. This helps to cross-check information and excludes bias from both sides' replies as people are often biased towards the way they do their business.

The capabilities of the researcher are highly influential on the reliability while conducting interviews or observations. Both the interviewer and the interviewee are prone to make subjective judgments when registering the answers. When conducting surveys, the ability to ensure reliability in advance is restricted. It cannot be decided that the whether the survey is reliable or not before receiving actual results. However, this study tried to minimize the risk of misinterpretation and also to improve reliability by preparing comprehensive instructions, accurate design of the questions, and a pilot survey of respondents who were not directly engaged. Furthermore, the report used structured observations and standardized interviews to enhance and control reliability.

To conclude the reliability in the analysis is hard because this work was influenced by the researchers' interpretations. The aim is that to secure the reliability, as much as possible, through support in theory and continuous feedback from people involved.

Section 3 Theoretical Framework

In this section, the theories that have been used in order to construct the theoretical arguments of this paper will be presented. It consists of three main sub-sections with the flexibility focus and its related materials as the first one, analysis of strategic procurement as the second that will be complemented by the comprehensive review on purchasing portfolio models. In the last section, the connection between these two aspects will be the main focus of investigation. Later in the report, the analysis will be formed based on the integration of these theories.

3.1 Supply Chain Flexibility

3.1.1 Definition

Although different definitions for flexibility have been proposed by several authors, no cohesive concept has been widely accepted, and there still exists many unanswered questions about flexibility (Upton, 1999). It is generally noticed as an adaptive reaction to environmental uncertainty (Gerwin, 1993). Upton (1994) defined flexibility as “the ability to change or react with little penalty in time, effort, cost or performance”. Therefore, flexibility is being observed as a proactive trait designed into a system, rather than a reactive one which may actually result in deficiencies in time, efforts, cost and performance (Gosling et al., 2010). Flexibility is being considered as a relative attribute, in contrast to an absolute one. It means that it can be evaluated in comparison with other attributes. Also, flexibility can be referred to as potential or actual. Whereby it is easier to measure actual one (Koste & Malhotra, 1999). It may also be considered as having two distinguishing elements. Internal factors to the business that describe system behaviors. External elements related to customers or suppliers which conclude the actual or perceived performance of the company (Oke, 2005).

Zhang et al (2002) defined flexibility as the organization’s capability to encounter a growing variety of customer requirements while concurrently keeping costs, delays, organizational disruptions and performance losses at or near zero. In another view over the definition of flexibility, Prater et al., (2001) defined it as the degree of firm’s capability to adjust the time that goods can be received from suppliers or be shipped to customers. The expansive definitions of flexibility can be generalized in accordance to the concept of supply chain (Zhang et al., 2002).

Vickery et al. (1999) presented a broad definition for supply chain flexibility. It has been defined as a concept incorporating those flexibility dimensions that directly influence firms’ customers and are the shared responsibility of two or more functions along the supply chain. These aspects cover both internal (marketing, manufacturing) and external (suppliers, channel members) side of the value chain (Vickery et al., 1999).

Kumar et al. (2006) have defined supply chain flexibility as “the ability of supply chain partners to restructure their operations, align their strategies, and share the responsibility to respond rapidly to customers’ demand at each link of the chain, to produce a variety of products in the quantities, costs, and qualities that customers expect, while still maintaining high performance.”

Stevenson & Spring (2007) presented five elements that are required in order to provide a thorough definition for the flexible supply chain. These elements along with their descriptions have been brought up together in Table 1.

Elements	Description
Robust network or rigid flexibility	The range of events that the existing supply chain structure is able to cope with
Re-configuration flexibility	The ease(mobility) with which the supply chain can be re-configured (adaptability). The need to re-configure is largely determined by the range (or resilience) of the existing supply chain structure.
Active flexibility	The ability to act as a chain either as a response to, or in anticipation of, changes/events (i.e. a reactive or proactive capability)
Dormant or potential flexibility	The flexibility of the supply chain is partially a contingent resource, i.e. it does not have to be a demonstrable capability
Network alignment	Entities are focused on aligning their capabilities in order to meet the objectives of the supply chain and compete as a chain, i.e. internal goals are subordinated to those of the supply chain

Table 1- Determining elements for defining flexible supply chain (Stevenson & Spring, 2007)

These elements are going to be applied as the basis for defining sourcing flexibility further in the report.

3.1.2 Dimensions of Supply Chain Flexibility

For a global organization desiring world-class performance having a pleased and satisfied customer is of exceptionally high importance (Gunasekaran et al., 2004). That point of view, necessitates all activities within a supply chain to be aimed or concentrated towards fulfilling consumers’ requisities. Accordingly supply chain flexibility taxonomy ought to be considered from the viewpoint of the whole chain value-adding system (Kumar et al., 2006).

Advocators of this perspective suggest examining supply chain flexibility from an integrative, customer-oriented point of view (Vickery et al., 1999). Consequently required supply chain flexibility taxonomy incorporates those dimensions of flexibility that have a direct impact on the firm’s customers (Kumar et al., 2006). A comprehensive definition for the domain of supply chain flexibility should include all those flexibility dimensions that integrate all supply chain participants to successfully meet customer demands (Duclos et al., 2003).

Each author may present dissimilar dimensions of supply chain flexibility. However, the flexibility dimensions must include all the activities inside supply chain and be relevant to supply chain functions. This covers a wide range from procuring raw material to delivering a product through to the hand of customer. The usual steps here includes procuring the raw materials and parts (sourcing), developing new products, manufacturing/production, inventory, order management, distribution methods engaged in delivering of the finished product, and information systems linking all these together (Duclos et al., 2003; Pujawan, 2004). The schematic view of typical supply chain has been presented in Figure 10.

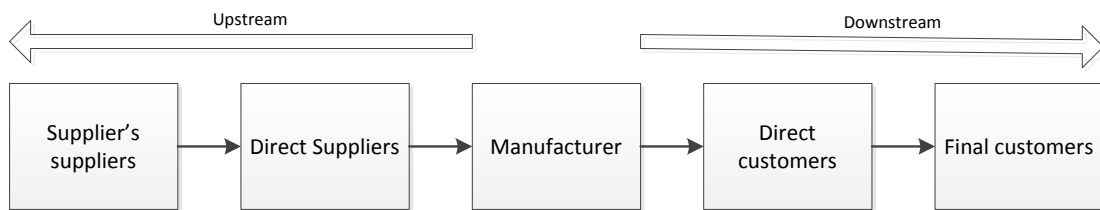


Figure 10-Typical supply chain

Duclos et al. (2003) developed a conceptual model of supply chain flexibility consisted of six components. This model has been refined by Lummus et al. (2003) to five components. These are: operational systems, logistics processes, supply network, organisational design and information systems flexibility (Lummus et al., 2003).Figure 11 exhibits the graphic presentation of these components.

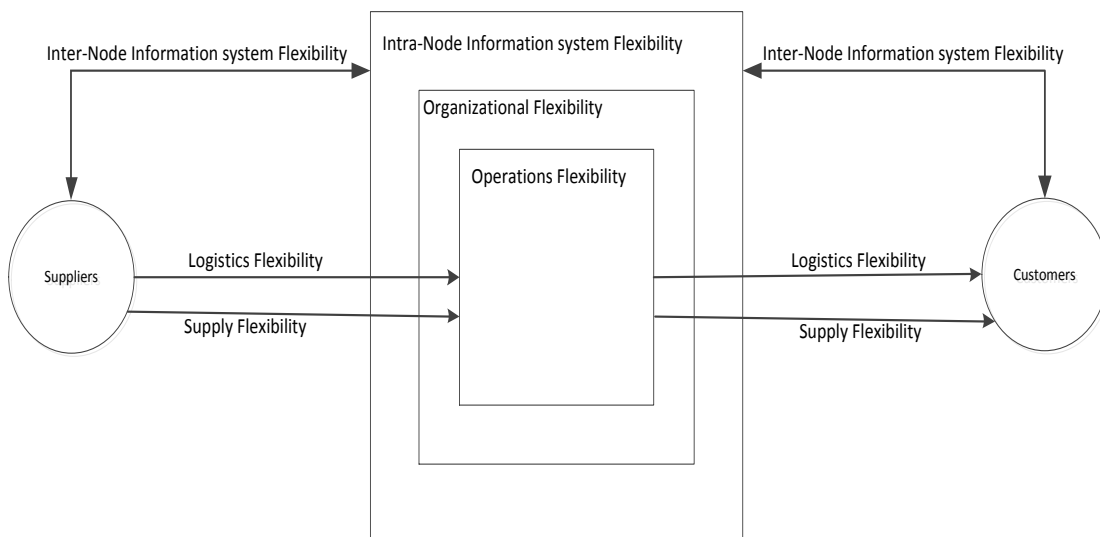


Figure 11- Dimensions of supply chain flexibility (Lummus et al., 2003)

Considering other aspects, some alternative recent studies have distinguished four determinants of supply chain flexibility: supply(sourcing), manufacturing(production), distribution(delivery) and product development

(Swafford et al., 2006; Pujawan, 2004).This view over dimensions of supply chain flexibility is consistent with the dimensions that Kumar et al., (2006) presented in their article. They suggested five dimensions of sourcing, developing new products, product customization, responsiveness, and delivering the finished products. Their proposal over this taxonomy has been based upon integrative, customer-oriented perspective (Kumar et al., 2006). The Table 2 summarize the studies that have proposed several conceptual models to elaborate the dimensions of supply chain flexibility.

As it can be observed from the table, it is difficult to detect a totally consistent view over the dimensions of supply chain flexibility in diverse literatures. The view that this study takes along the supply chain flexibility is to consider it as cross-functional and cross-business nodes of firms engaged with each other to deliver cost efficient and high performing product or service to the final customer. Furthermore, this consideration should be in a way that covers all the activities that take place over the supply chain, whether between internal department within an organization or between external partners.

Dimensions of supply chain flexibility	Vickery et al. (1999)	Duclos et al. (2003)	Lumnus et al. (2003)	Pujawan (2004)	Sanchez & Perez (2005)	Kumar et al. (2006)	Swafford et al. (2006)
➤ New product development/ Launch	×			×	×	×	
➤ Product/ Customization	×				×	×	
➤ Supply/Sourcing/ Procurement		×	×	×	×	×	×
➤ Production/ Operation system/ Manufacturing		×	×	×			×
➤ Logistics/ Delivery/ Distribution/ Access	×	×	×	×	×	×	×
➤ Responsiveness/ Market	×	×			×	×	
➤ Volume	×				×		
➤ Trans-shipment					×		
➤ Organization		×	×				
➤ Information		×	×				

Table 2-Summary of literate on dimensions of supply chain flexibility

As a result of taking integrated and customer-oriented perspective, seven dimensions distinguished relevant for supply chain flexibility. These dimensions are: Operations system, Organizational, Information systems,

Logistics(distribution), Sourcing, Responsiveness and New product development. All of these dimensions are linked together, and flexibility performance at each node is directly dependent on the performance level of other partners. The schematic view, that this study uses for the conceptual model of supply chain flexibility, has been depicted in Figure 12.

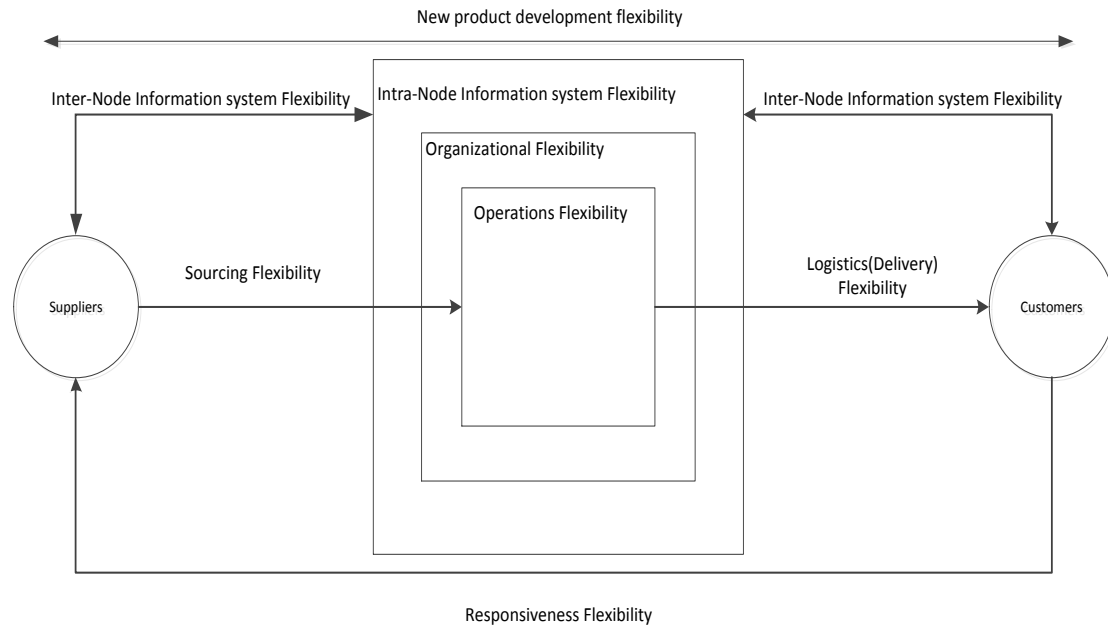


Figure 12-applied model for dimensions of supply chain flexibility

Although all above mentioned aspects are entirely joined together and their effectiveness will be realised by operating as a linked chain, the focus of this study is mainly on sourcing flexibility. The benefits of sourcing flexibility can be highlighted in terms of deferred order administering, responding to changes in demand dissemination across the supply chain nodes, promptly reacting to potential errors in forecasting, boosted efficiency in order filling, tracking and managing supplies (Christopher et al., 2006).

3.1.3 Sourcing Flexibility

If consider the supply chain from the perspective of meeting customer orders, it will be resulted that no single part is able to reduce customer lead-time significantly by operating alone (Zhang et al., 2002). The only attempts that can increase flexibility and reduce uncertainties are cross-functional and cross-company ones. Merely those can result in the level of performance that is required for building a competitive advantage (Kumar et al., 2006). Many firms understood the importance of this factor and have taken bold steps to break down both inter- and intra-firm barriers to form alliances, with the objective of reducing uncertainty and enhancing control of supply and distribution channels (Gunasekaran et al., 2004).

One key aspect for reaching supply chain flexibility is to make flexibility available in activities associated with procurement of materials. Many times it is the case that the ability of the suppliers restricts manufacturer's capability in making prompt responses to customer requirements (Christopher, 2000).

Procurement functions are playing a critical role in establishing a connection between supplier's production activities and manufacturer's production activities. It makes manufacturing firms capable of adjusting internal production demands with required materials and components at the precise time (Pujawan, 2004).

Sourcing flexibility is the firms' supply chain's structure competence to adapt to changes; to readjust or reinvent the chain in response to market uncertainty and change in customer requirements; to promptly send and receive products cost effectively, and to design information systems with present supply chain units to encounter changing information requirements (Stevenson & Spring, 2007).

Zhang et al. (2002) defined purchasing flexibility as "the ability of the organization to provide the variety of materials and supplies needed by manufacturing quickly and performance-effectively through cooperative relationships with suppliers". Duclos et al. (2003) defined supply flexibility as "the ability to meet the changing needs of customers, changing the supply of the product, including mix, volume, product variations and new products". Swafford et al. (2006) defined sourcing flexibility as "the availability of a range of options and the ability of the purchasing process to effectively exploit them so as to respond to changing requirements related to the supply of purchased components".

Sourcing flexibility includes the ability to ramp up production rapidly, the capability of the supplier to adopt its production process to specific requirements for some products, the capability to downscale and the capability to gather up several partners that can be substituted according to changes in customer needs (Duclos et al., 2003). The most salient part of the sourcing flexibility is to provide flexibility in establishing relationships with partners. Companies have a wide range of options in the domain of relationship from soliciting short-term bids, establishing long-term and strategic supplier relationships, forming joint-ventures, creating problem-solving inter-firm teams or even integrating vertically. Providing flexibility in forming these relationships along with efficient and effective management of them are key factors for successfully meeting changes in customer requirements (Duclos et al., 2003; Bensaou, 1999).

The definitions presented above may hold some fundamental limitations. First, they have unchanged consideration over flexibility regarding all types of procured components. As a result, they do not take this fact into consideration that different procured components may ask for different levels of sourcing

flexibility and accordingly different sourcing strategies. Second, these definitions did reflect on the different level of sourcing flexibility. A more appropriate definition can make the connection between sourcing flexibility and dimensions of uncertainty (e.g. volume, customization and delivery). Furthermore, applying this approach may motivate the employment of certain practices instead of others (Tachizawa & Thomsen, 2007).

The importance of supply management has been highlighted in several recent empirical studies on supply chain (Chen & Paulraj, 2004). Consequently, this has led to emphasized recognition of impact of sourcing practices on supply chain flexibility (Swafford et al., 2006). Therefore, it got decided to put the concentration of study on sourcing flexibility, which, according to Tachizawa & Thomsen (2007), has been defined as the ability of the procurement function to respond in a timely and cost effective manner to changing requirements of procured components, in terms of volume, delivery date and product.

3.1.3.1 Drivers of sourcing flexibility

For assessing the required degree of flexibility at each functional dimension of supply chain, the drivers of the flexibility at the relevant function should be evaluated (Pujawan, 2004). In another word, in order to properly analyze the supply flexibility structure of a focal firm, it is essential to distinguish why this type of flexibility is needed (Tachizawa & Thomsen, 2007). A flexibility driver is “a factor that determines the need for flexibility” (Pujawan, 2004). D’Souza & Williams (2000) illustrated that flexibility drivers that determine the necessity for providing sourcing flexibility, can be classified into external factors and internal intra-firm factors. Internal ones are correlated with the characteristics of the focal company and external ones are affiliated with the characteristics of the firm’s upstream and/or downstream supply chain (Tachizawa & Thomsen, 2007).

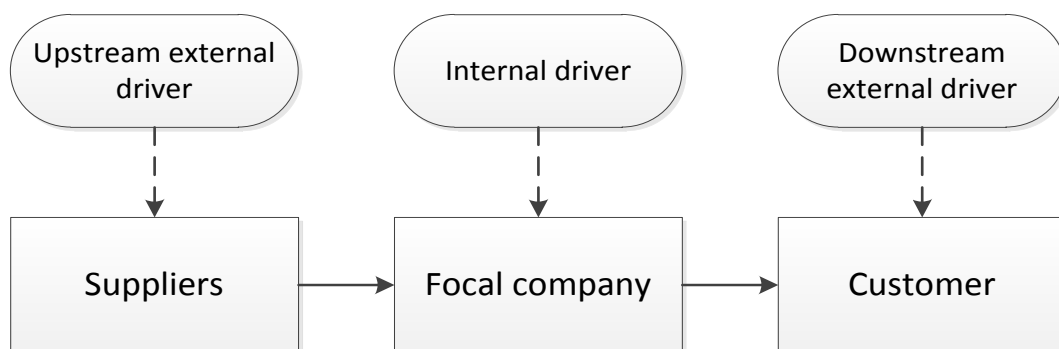


Figure 13-Nature of sourcing flexibility drivers (Tachizawa & Thomsen, 2007)

Flexibility drivers are directly connected to uncertainty because most of the times flexibility is being considered as a reaction to an uncertainty (Tachizawa & Thomsen, 2007). Christopher (2000) diagnosed three main types of uncertainty:

- 1) Volume uncertainty: The level of uncertainty associated with:
 - the actual volume needed of a specific component
 - the real volume of a specific component that will be received from supplier
- 2) Mix uncertainty: The level of uncertainty associated with the precise specification of a component
- 3) Delivery uncertainty: The level of uncertainty associated with the date that a component will be:
 - needed
 - received from supplier

Flexibility drivers clarify the motivations and reasons that exhibit why sourcing flexibility is required. Pujawan (2004) introduced 5 driving factors that stimulating the need for sourcing flexibility. These drivers have been brought into the explanation as followings.

- Supply uncertainty

The factors such as competition in procurement of material, the existent of alternative sourcing method, and the nature and accessibility statues of raw material are typical elements contributing to supply uncertainties. The characteristics of supply items directly influence the requirement for sourcing flexibility.

- Component commonality

Component commonality can be high, medium or low dependancy on the quantity of common component or material that a company uses in its finished products. Component commonality makes impacts on several performance prospectives of production system.

- Product life cycle

Product life cycle is a measurement on how long a typical product will stay in the market before it got obsolete and be replaced by new product or newer generations. This also can be the case that the product will not be able to penetrate the market and necessitates other approaches. A short product life cycle would indicate that the changes in product design are fast and production is required to adjust itself to the evolutions in a timely and cost-efficiently manner. Achieving this entails the suppliers to be able to cope with the changing requirement of materials so product life cycle can be a driver of sourcing flexibility.

- Customer requirement disparity

This is being defined as the different speed and service level which may be required from different customers.

- Order stability

Order stability is being defined as the stability levels of the orders have been placed by customers considering their due dates, quantity and specifications. This is frequent case that customers change due dates, quantity and product specifications of the orders that they place. These changes, especially when they are not being communicated at the early stages, can cause several disturbances if the supply network does not carry the required flexibility.

(Pujawan, 2004)

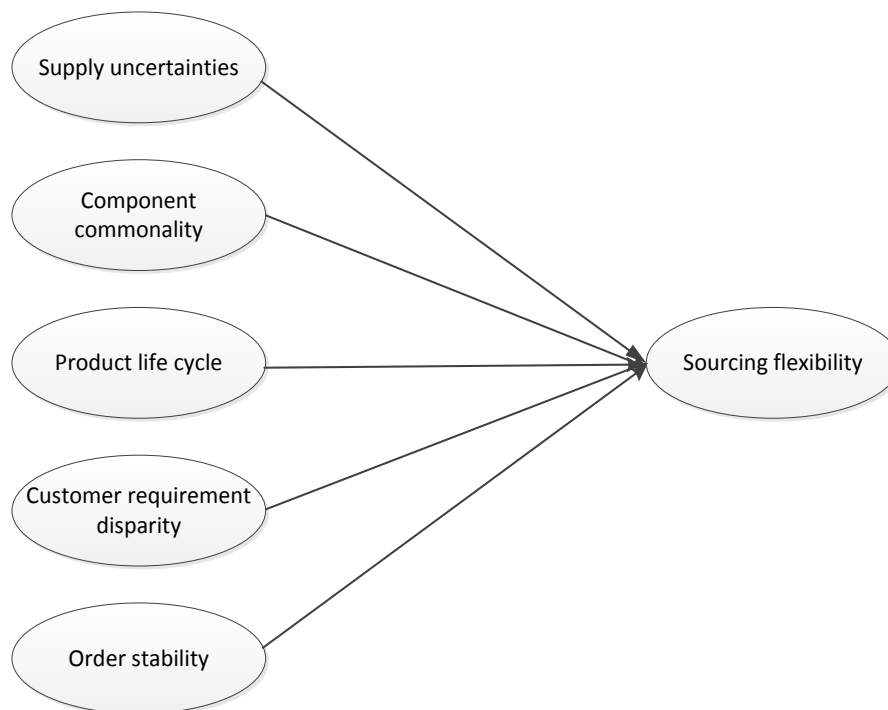


Figure 14-Drivers of sourcing flexibility (Pujawan, 2004)

3.1.3.2 Sources of sourcing flexibility

Besides analyzing the reasons that why sourcing flexibility should be sought, it is of high importance to investigate how it can be achieved in diverse situations (Tachizawa & Thomsen, 2007). Different literatures offer different definitions for flexibility sources. Jack & Raturi (2002) defined it as “specific actions to generate flexibility”. Tachizawa & Thomsen (2007) defined it as a “practice in the purchasing function that allows an increase in sourcing flexibility”. The definition for sourcing flexibility that this report will take into consideration is the one that has been presented by Tachizawa & Thomsen (2007).

Industry, product and supply market characteristics may be considered as primary indications for sources of sourcing flexibility (Bensaou, 1999). Furthermore, an appropriate deployment of sourcing strategies can be regarded as a powerful source for sourcing flexibility. Latter will be explored further in the discussion section of this report.

3.1.3.3 *Dimensions of sourcing flexibility*

If the sourcing function has adequate extra supply capacity in order to foresee abrupt rises in the volume of required materials or components, the suppliers have the capability to manage both rushed and delayed orders, and suppliers are able to make changes in materials specifications in efficient and timely manner, then the sourcing function is said to be flexible (Pujawan, 2004).

Sanchez & Perez (2005) proposed a hierarchical model regarding taxonomy of supply chain flexibility dimensions. They constructed their model based on bottom-up classification of flexibility as it can be found in manufacturing systems. These classifications are basic, system and aggregate types. That made them able to suggest different types of the supply chain flexibility dimensions. Basic flexibility is related to capabilities at shop-floor level which can influence supply chain. System flexibility considers capabilities at company level and finally aggregate flexibility takes capabilities engaged with supply chain structure into considerations (Sanchez & Perez, 2005).The first two levels can be interpreted as operational level and the last one can be interpreted as strategic level (Christopher et al., 2006).

This report took the same approach as Sanchez & Perez (2005) regarding a taxonomy for the dimensions of sourcing flexibility. It considers sourcing flexibility from three flexibility types of basic, system and aggregate with the same definitions that have been proposed by Sanchez & Perez (2005). The flexibility dimensions, that have been found relevant in relation to sourcing flexibility, are namely: supply chain structure, product, delivery, and volume. The selection of the first dimension, supply chain structure flexibility, is mainly due to considerations over the defining elements regarding flexibility that has been presented in the first part of this section (Table 1). Referring to table 1, the second element that should be consider, in order to make comprehensive definition over supply chain flexibility, is re-configuration flexibility (Stevenson & Spring, 2007). The definitions of that element (Table 1) led to development of the supply chain structure flexibility dimension. Following figure depicts a schematic view over the sourcing flexibility dimensions that this report aims to propose (Figure15).

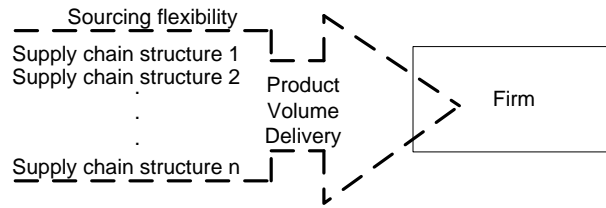


Figure 15- Schematic exhibition of sourcing flexibility dimensions

Figure 16 depicts the above proposed dimensions from the perspective applied by Sanchez & Perez (2005). The first two flexibility dimensions are related to shop floor capabilities (basic flexibility) which are product and volume. The following one dimension, delivery, is hierarchically positioned at company level (system flexibility). The top flexibility dimension is perfectly linked to the structure of the supply chain (aggregat flexibility).

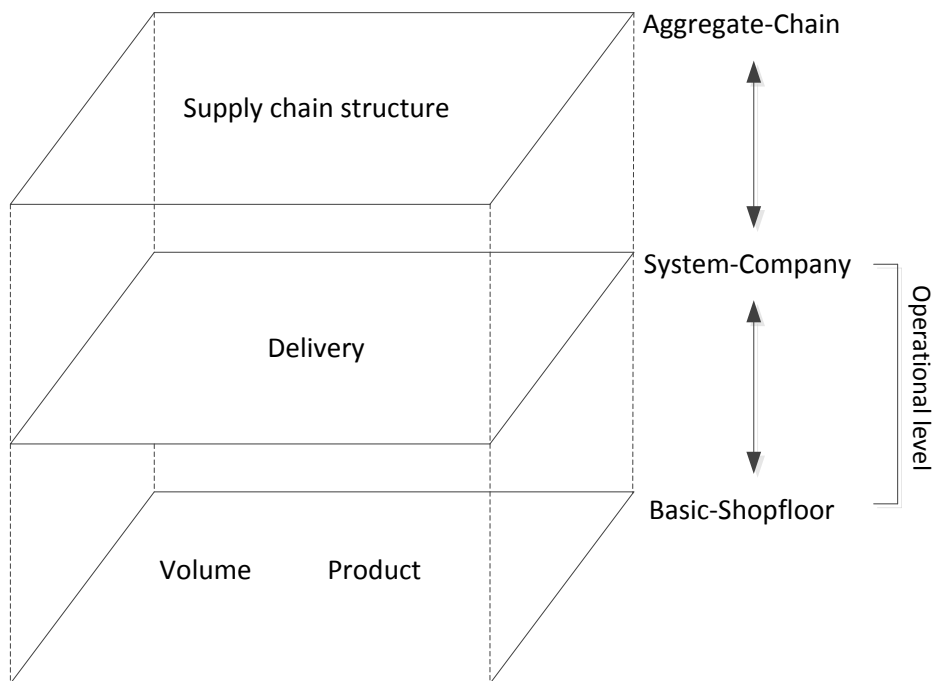


Figure 16-Hierarchical exhibition of sourcing flexibility dimensions (Sanchez & Perez, 2005)

The definitions of the proposed four dimensions have been brought into attention in Table 3.

Flexibility dimension	Definition
Supply chain structure	The ability of the focal company to chain the structure of supply chain (e.g. add or remove suppliers, selecting appropriate suppliers, usage of alternative transportation and inventory methods, etc) economically and in a timely manner to meet customers' requirements
Product flexibility	The ability of the suppliers to produce customized product or upgrade existing ones economically and with no additional time to meet customers' required specifications
Volume flexibility	The ability of the suppliers to control the supply levels (increasing or decreasing) economically and with no additional time to meet customer demand
Delivery flexibility	The ability of the supplier to deliver both rushed and delayed orders, considering date of delivery, economically and with no additional time

Table 3-Dimensions of sourcing flexibility inspired from Kumar et al., (2006) and Lummus et al. (2005)

3.1.4 Measurements and requirements

As pointed out in several literatures, one of the first stages in grasping the importance and refining a competitive capability such as quality or flexibility is developing the ability to measure it (Koste & Malhotra, 1999). In the existing conceptual literature in the field of flexibility, three elements have been mainly used to define any flexibility dimension. These elements distinguished as range, mobility, and uniformity (Upton, 1994; Watts et al., 1993; Zhang et al., 2002). The potential indicators for these three elements have been provided in Table 4.

Elements	Indicators
Range	Number of options
Mobility	Transition penalties-time, cost, effort of transition
Uniformity	Similarity of performance outcomes-quality, costs, time, etc.

Table 4-Elements and indicators of flexibility dimensions (Upton, 1994; Koste & Malhotra, 1999; Duclos et al., 2003)

Range is being characterized as the number of different situations, or flexible alternatives that can be realized for a particular flexibility dimension. Mobility denotes the level of simplicity with which the organization changes from one state to another. It corresponds to the ability to suffer small transition penalties

within the range. These penalties are not concerned with the costs associated with the acquisition or developing the range of flexibility. They merely describe the efforts of organization in order to move within the range and evaluate the complications of employing a flexible alternative (Upton, 1994). Transition penalties can be considered as legitimate indications for flexibility. If a company incurs lower degree of them for the same level of achievements in the number and variation of options, then it can be claimed to be more flexible. Some examples for those kinds of penalties could include but are not limited to the time and cost of applying transition, the rescheduling attempts required regarding the transition and etc. (Gupta & Somers, 1992; Upton, 1994). Mobility can be improved by recognizing the tradeoffs between time and cost and making efforts to increase the net sum of transition penalties (Koste & Malhotra, 1999).

The final element is uniformity. It grasps the similarity in performance outcomes for the different flexible options within diagnosed range. Existence of several volatilities in performance outcomes of different options specifies the less flexible system (Upton, 1994). These performance differences are not one-time consequences like transition penalties, unless they may hold their effects during the whole period of adopting alternative option (Koste & Malhotra, 1999). Uniformity can be evaluated by using a large number of performance measures. These include efficiency, productivity, quality, processing times and product costs (Upton, 1994).

Same approach can be applied for developing a framework for analyzing the dimensions of sourcing flexibility.

The scopes of the value chain flexibility drop into two categories: capability and competence (Stalk et al., 1992). Watts, et al., (1993) named these two categories in a different way as primary flexibility and secondary flexibility relatively. This classification scheme can assist managers in identifying flexible capabilities critical to their customers and flexible competences that support these capabilities. Flexible competences, which are internally focused, provide the processes and infrastructure that enable firms to achieve the desired levels of flexible capabilities. Flexible capabilities, which are externally focused, can be viewed as a linkage among corporate, marketing, and manufacturing strategy (Watts et al., 1993).

3.1.5 Implementation

Gerwin (1993) has proposed some directions on the flexibility implementation issues. These directions have been mainly suggested for manufacturing flexibility but they can also be generalized to other kinds of flexibility. Implementation process is being discussed as a four-step approach. The first stage concerns distinguishing the flexibility dimensions that require examination. The second one regards measuring the gaps in the process of implementing and managing

flexibility. The third stage is engaged with choice of an appropriate method for closing the gap. The final stage, which is being considered as the most notable one, has certainly been based on continuous assessment (Gerwin, 1993). The implementation framework suggested by Kumar et al (2006) is a three-stage approach that its stages are in consistency with Gerwin's (1993) framework. Their proposed framework consists of the required flexibility identification process as a first step which will be followed by implementation and shared responsibility, and feedback and control as a final step of this cyclical approach (Kumar et al., 2006). The first and final step of both frameworks are actually implying same view and procedure. In the second step, Kumar et al (2006) have integrated the second and third phase of Gerwin's (1993) in to one step.

The first phase of Gerwin's (1993) approach necessitates involvement of senior managers in order to analyze the particular aspects of flexibility that are required to be on the central focus. An organization requires evaluating its external environment, uncertainties, and its relationship with suppliers and customers in order to perceive and articulate its competitive strategy. This is a prerequisite step to the development of other practical strategies, specifically: marketing strategy, manufacturing strategy and other functional strategy (Kumar et al., 2006). Virolainen (1998) has proposed a general framework for formulation of the relevant procurement strategies. The procedure he suggested is remarkably similar to the procedure in step 1 of Kumar et al's (2006) framework for implementation of flexibility. In Figure 17 and 18, these two procedures have been brought up together in order to generate an integrated framework.

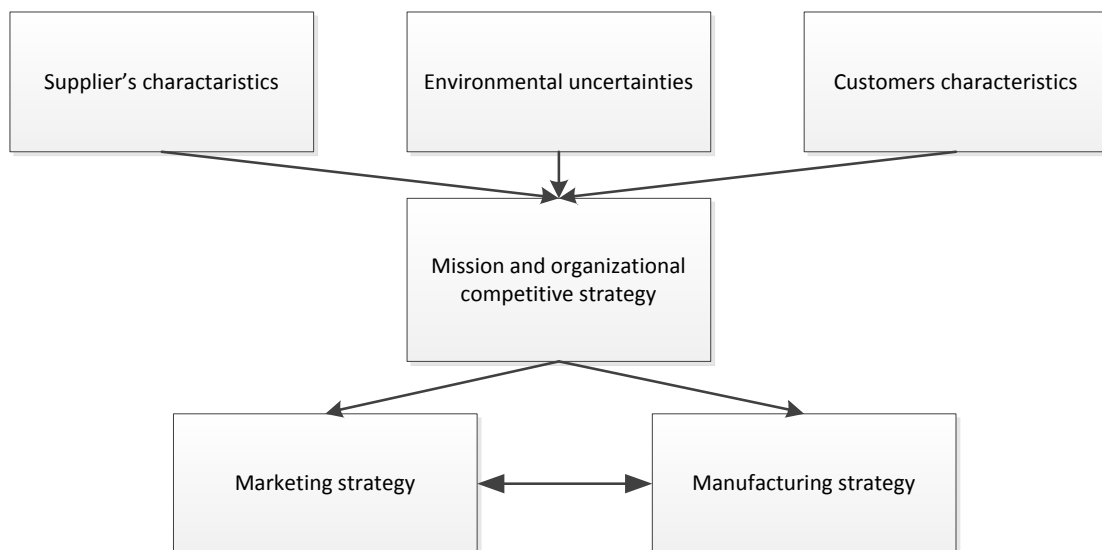


Figure 17- Step 1 of Kumar et al's (2006) framework for implementation of flexibility

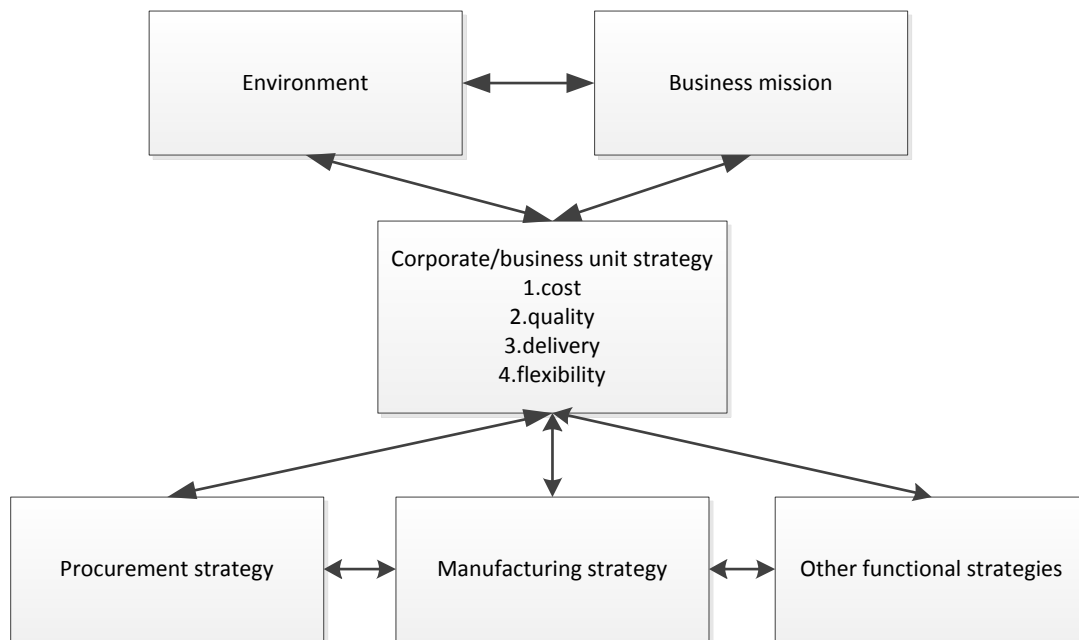


Figure 18- Virolainen (1998) framework for purchasing strategy formulation

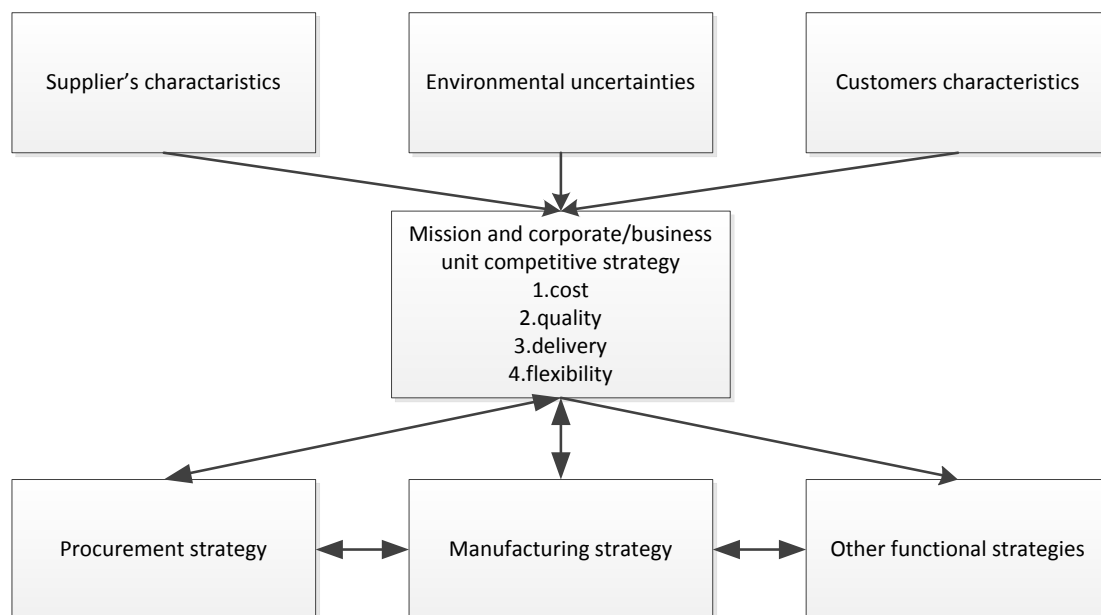


Figure 19-Step 1 of Kumar et al's (2006) framework for implementation of flexibility integrated with Virolainen (1998) and Krause et al., (2001) framework

The evaluation of environmental uncertainties along with the supplier's and customers' characteristics is based on this assumption that these aspects are needed to compete in terms of range and speed (Gerwin, 1993; Kumar et al., 2006). Environmental uncertainties imply a situation where organization is encountering some planned and unplanned changes. These uncertainties force organizations to consider some contingency plans that should be also incorporated in business strategy. In other words, due to the existence of these uncertainties organizations must consider and implement different types of

flexibilities (Kumar et al., 2006). Furthermore, the requirement for the excess flexibility should be considered in this stage. The required, actual and potential level of needed flexibility types are being investigated in the first step by managers (Gerwin, 1993). Yibing & Quanxi (2008) have proposed following explanation for required, potential and actual level of flexibility.

Required flexibility: Considering the existing uncertainties in supply chain, it denotes the level of flexibility needed to mitigate those uncertainties. It does not regard the configuration of system flexibility, but the level and aim which system flexibility may reach.

Potential flexibility: Considering the current structural characteristics of supply chain, it refers to the level of flexibility that is inherent in that the existing structure.

Actual flexibility: It refers to the level of flexibility currently existent in supply chain considering supply chain's structural characteristics and level of management.

(Yibing & Quanxi, 2008)

The potential and actual flexibility defined above are in complete consistency with dormant and active element proposed by Stevenson & Spring (2007) orderly. Those elements are two of five defining elements that according to Stevenson & Spring (2007) should be taken into consideration when to define flexibility. The definitions of those elements have been previously been presented in Table 1.

In order to formulate an accurate purchasing and manufacturing strategy, it is needed to analyze the supplier's characteristics (Pujawan, 2004 ; Virolainen, 1998). These characteristics can include but not limited to number of suppliers, average size of the suppliers, level of specific investment in supplier, degree of information sharing, and specifications of the contracts. This will help to analyze the requirements and strengths of suppliers more comprehensively (Kumar et al., 2006). As mentioned before all activities within a supply chain need to be aimed or concentrated towards fulfilling consumers' demands so evaluating customers' characteristics forms and indispensable part of strategy formulation (Kumar et al., 2006; Gunasekaran et al., 2004; Virolainen, 1998). Based on the supply chain functional strategies that have been distinguished in the first step, the required supply chain flexibility types and level can be identifies (Kumar et al., 2006).

In the second stage actual and required level of flexibility, that have been identified in the first step, are being compared with each other. Then the possible gaps can be measured. Required levels of flexibility are being identified by mainly surveying customers and analyzing their demands. Potential flexibility

levels are being evaluated based on the capabilities of organization and according to defined dimensions and elements of needed flexibility types. Finally, the actual levels of flexibility are gained from the data concerning the current performance of the organization. After measuring the gaps, appropriate methods are needed to be developed for closing the identified gaps, between the required, potential, and actual levels of flexibility (Gerwin, 1993). This can be achieved by applying required flexibility tools such as information technology systems, relationship with key supplier and customers, etc. Electronic data interchange (EDI), customer relationship management (CRM), and enterprise resource planning (ERP) are examples of some of the well-known information technology systems. Furthermore, the shared responsibilities among different supply chain partners must be defined in order to implement and manage the required supply chain flexibility (Kumar et al., 2006). For example in the case of sourcing flexibility, usually it is the capability of the suppliers that restricts the capability of a manufacturer to promptly respond to the demands of the customers (Christopher, 2000). But from supply chain perspective it is the shared responsibility of the both supplier and manufacturer for implementing and managing the sourcing flexibility (Kumar et al., 2006).

Continuous assessment is the final stage in both frameworks. It is required to continuously monitor and control any potential changes in the required levels of flexibility types (Gerwin, 1993). The main principle here is to constantly observe and assess the strategic and operational fit between perceived flexibility types and implemented flexibility types (Kumar et al., 2006). Suarez et al. (1991), suggested that the perceived and required flexibility must be compared to warrant that there is satisfactory fit. If implemented flexibility fits required flexibility (there exists alignment between them), then it is expected that this results in improvements in the business performance. If they do not fit this is the responsibility of the monitoring mechanism to trigger an alarm. This is a warning indicating that there needs some further modifications in the required flexibility types or at the implementation phase in order to boost business performance (Suarez et al., 1991).

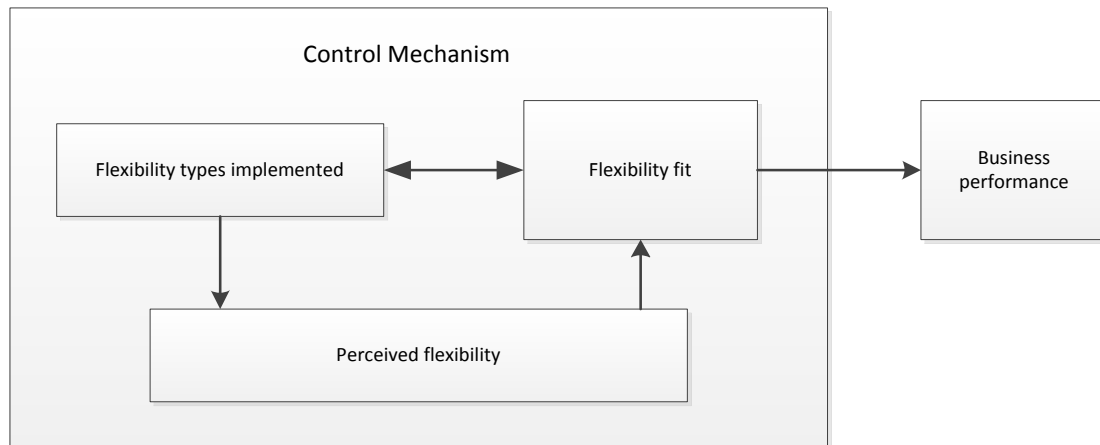


Figure 20- Step 3 of Kumar et al's (2006) framework for implementation of flexibility

3.2 Strategic procurement

Procurement refers to all activities that one company goes through in the process of acquisition of products and services. Purchasing constructs the operational part of procurement where the actual process of buying is held. On the other hand, sourcing constitutes the strategic dimension of procurement where sourcing strategies were developed and relationship with suppliers being defined and analyzed (Favre & Brooks, 2002)

The main premise regarding strategic procurement is that the activities of the procurement function should be based on strategies that are in alignment with the corporate strategic plans. The aim here is to support the efforts of the firm in order to accomplish its long-term objectives. The procurement can only be interpreted as a strategic function if it has an integrative role in the business unit's strategic planning process (Carr & Pearson, 2002). The degree that procurement is being characterized as strategic is highly dependent on how top management views it as an important resource of the firm. There exists several internal factors such as management style, the depth of procurement's other responsibilities, firm's policies and the distribution of power, which influence the perception associated with procurement (Ellram & Carr, 1994).

Strategic sourcing challenges many of the present ideas about how procurement strategies are aligned with organizational ones, how the suppliers are being selected and involved in projects and decision making processes regarding the required strategic focus while making procurement attempts. The aim of strategic sourcing process is to assure highest total value and most objective outcomes for the company (Favre & Brooks, 2002). Its particular focus can be drawn on effective management of the supply base by detecting and selecting suppliers appropriate for strategic long-term cooperation, getting involved into supplier development initiatives by effectively distributing resources to boost

supplier performance, delivering benchmarks and regular feedback to suppliers, and also interfering in activities regarding omitting unfavorable suppliers (Talluri & Narasimhan, 2004).

Favre & Brooks (2002) presented an extensive definition for sourcing processes. Figure 21 exhibits a schematic description of sourcing processes, where it initiates, where it finishes, and the procedures associated with each step.

When supply chain sourcing is aligned with strategy, it is capable of influencing organizational performance. It is noteworthy that supply chain must be designed as an integrated system where entire chain is being viewed as one whole entity, and measured extensively across the whole chain (Lau et al., 2003).

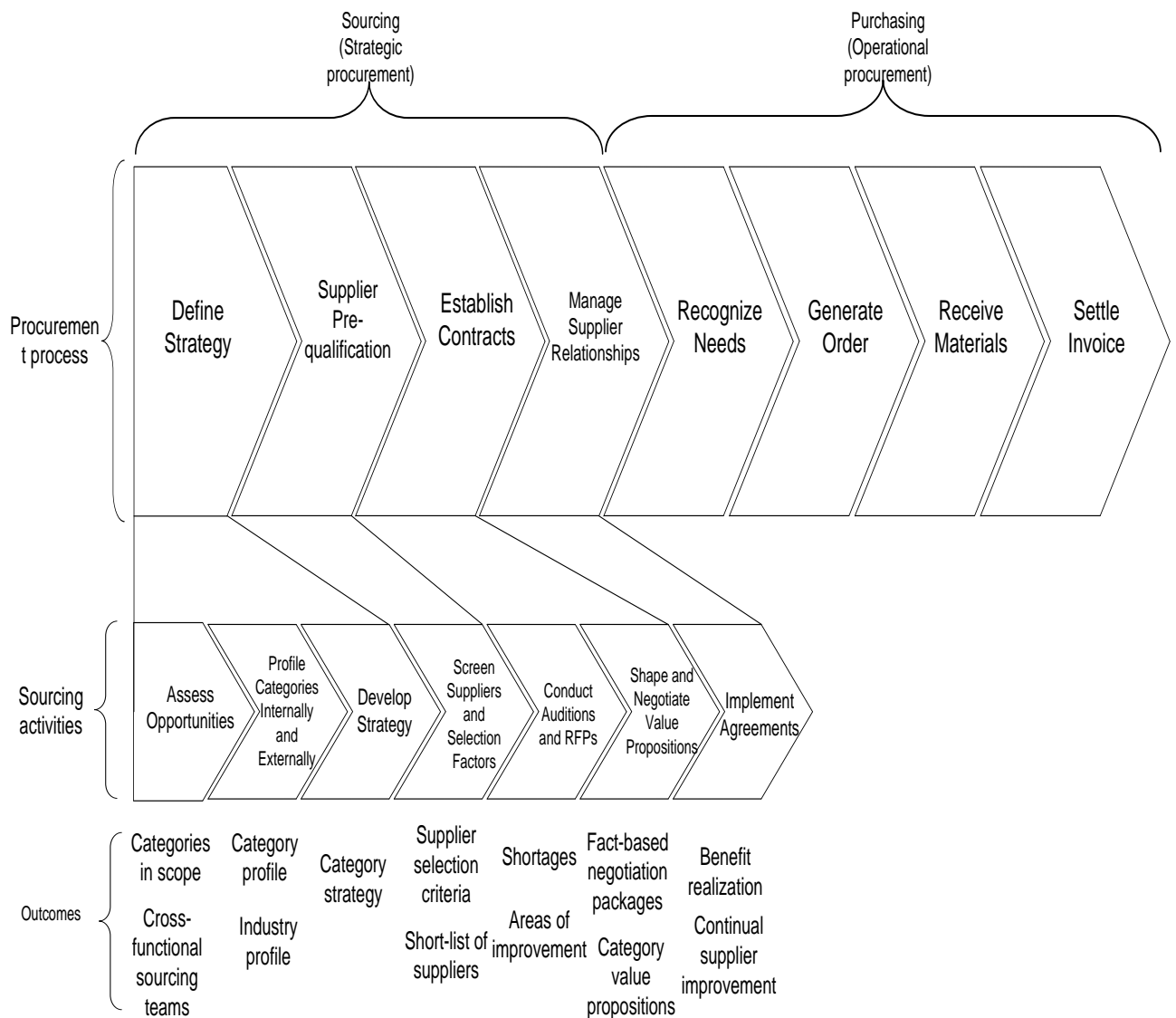


Figure 21- Strategic sourcing processes (Favre & Brooks, 2002)

3.2.1 Define strategy

A company's competitive strategy preferably expresses how the company is going to compete in the market and acts as a driver of the diverse functional strategies. A functional strategy indicates how a functional department is going to back up the firm's business strategy and how it will supplement or foster the other functional strategies (Krause et al., 2001). First step in taking any sourcing initiative is to evaluate the firm's strategic and tactical procurement requirements (Favre & Brooks, 2002). Corporate competitive priorities – such as reducing total costs, being innovative, quality and performance differentiation and/or enhancing the level of flexibility – are the main factors that shape the basis for suppliers' evaluations (Favre & Brooks, 2002; Krause et al., 2001).

Segmentation of the procured items is the first step for the development of a tailored sourcing strategy (Stolle et al., 2008). Commonly, a product-category analysis is required in order to segment purchases into a practical number of segregated groupings (Favre & Brooks, 2002). It is the responsibility of sourcing practitioners to certify the mission and scope of each product category in cooperation with other departments such as manufacturing and R&D. (Ref) Historical procedures that have been applied for procuring components along with their supply market characteristics can be suitable starting points to initiate component analyses (Kocabasoglu & Suresh, 2006).

Subsequently, the company has to generate and evaluate, for each category individually, different sourcing strategies and decide on the requirements and criteria for the selection of suppliers which procuring differentiated segmented items (Stolle et al., 2008; Favre & Brooks, 2002). These strategies are being developed based on parameters such as price, quality and flexibility equipped with insights about the organization's strategic priorities and the industry's environment (Pagell et al., 2010).

3.2.2 Pre-qualify suppliers

One nifty tool for executing this step is to build out supplier information matrices. Those can be concentrated on supporting the strategic and tactical procurement goals related to each procured items category (Favre & Brooks, 2002). Furthermore, the performance data of the suppliers that the firm is already making business with them is a reliable indication for making supplier evaluations. Based on making considerations on the firm's strategic procurement goals, firm is able to distinguish several relevant factors that are influential on its aim to reach those goals. One beneficial step here is to assign relative importance to each factor. Based on those weights and observatory data generated from supplier information matrices, sourcing practitioners can prepare a short list of prequalified suppliers to compete for a specific contract. Additionally those data

can lead to strengthen the company's supply base toward the company's strategic directions (Pagell et al., 2010).

3.2.3 Establish contracts

Depending on the characteristics of the product and the supplier industry, buyers have several sourcing options. Companies may select only one supplier out of the supplier competition or most of the times they may usually choose to contract with a multiple number of suppliers. This would be done in order to mitigate supply risk and over dependence on one company. Regardless of whichever way would be taken most contracts necessitate further negotiations to settle lawful details and business procedures (Favre & Brooks, 2002).

3.2.4 Manage supplier relationships

On a continuous basis, procurement practitioners must be capable to track the performance of suppliers. This is a necessary procedure for making future evaluations. On-going assessment on the performance of suppliers will make firms able to appropriately manage their future relationship with the suppliers, follow-up compliance with the contracts; recognize and fix problems with products or delivery, and collect the necessary information that will be required when a contract approaches for renewal (Favre & Brooks, 2002).

3.3 Purchasing Portfolio Models

Portfolio models have primarily been used in strategic decision making to support resource allocation decisions, by identifying which groups of products, suppliers, or relationships that require greater attention than others. It is thereby also seen as a useful management tool (Olsen & Ellram, 1997). From the perspective of the purchasing function, it is a relevant approach to consider purchasing portfolio models in order to support decisions regarding establishing different kinds of supplier relationships (Wu & Barnes, 2011). For defining the portfolio concept the following description has been found relevant:

“The portfolio concept reflects the importance for balance in a collection of individual elements. [...] The basic idea is simplification of a complex problem (1) by classification of objects/subject in a (usually) two dimensional matrix and (2) by providing (strategic) recommendations for each cell of the matrix.” (Gelderman & Weele, 2000).

The main purpose of portfolio models in purchasing management is being considered to improve the allotment of limited resources. This can be done via a presumably efficient method to recognize which groups of products, suppliers, or relationships necessitate higher level of attention than others (Olsen & Ellram, 1997). Kraljic (1983) introduced the first comprehensive portfolio approach for purchasing and supply management (Gelderman & Weele, 2003). Olsen & Ellram

(1997) developed a model based on Kraljic (1983) which aims to understand how to manage supplier relationships.

Study of the models proposed by Kraljic (1983) and Olsen & Ellram (1997) shows that they took somehow same approach to analyze a company's supplier relationships. This approach includes three steps applied by both authors while the steps have different terms by the different authors. These three steps are:

- Analyze the purchased items and classify them in order to determine the ideal relationship types for different categories of procured items
 - Analyze the current relationship of the company with supplier
 - Develop action plans in order to adapt its current strategies (step 2) to the ideal situation(step 1)
- (Kraljic, 1983; Olsen & Ellram, 1997)

3.3.1 Categorization

In order to devise a tailor-made supply strategy, while maximizing the buying power and at the same time decreasing the supply vulnerability Kraljic (1983) recommends the following approach.

The first phase is called classification and aims at differentiating the purchased material. According to Kraljic (1983) a company's supply strategy depends on two factors; the importance of purchasing and the complexity of the supply market. The definition of purchasing importance can be made in terms of volume purchased, percentage of the total purchase cost, impact on product quality, impact on profitability etc. The supply market complexity, on the other hand, is assessed in terms of the number of suppliers, availability, competitive demand, substitution possibilities, logistic aspects, complexity and so forth. After selecting suitable criteria for both dimensions, all purchased items are evaluated and positioned into one of the quadrants of the Kraljic portfolio model (Kraljic, 1983). Following the work of Kraljic (1983), Olsen & Ellram (1997) suggested a portfolio model with the "strategic importance of the purchase" and "the difficulty in managing the purchase situation" as the two key classification dimensions. The factors that Olsen & Ellram (1997) described for two dimensions of their model are remarkably close to the factors introduced by Kraljic (1983).

Both Kraljic (1983) and Olsen and Ellram (1997) have one dimension demonstrating the company's internal circumstances and one dimension expressing the external environments. After comparing these two authors' dimension pairs, these dimensions have been found quite similar and possible to combine. In order to form the foundation of classification, the subject titles that should be defined for each dimension in the portfolio matrix should be decided. This thesis defines the subject titles for the dimensions as "Strategic Importance of Procured Items" on the vertical axis and "Complexity of Supply Market" on the

horizontal axis. These are inspired by the ones developed by Kraljic (1983) and Olsen and Ellram (1997). Furthermore, the portfolio matrix would be divided into four quadrants. The names of quadrants have been defined in the same way as Kraljic (1983) and Olsen and Ellram (1997). These quadrants are namely non-critical, leverage, bottleneck and strategic. The foundation of the categorization tool is depicted in Figure 22. Each of the quadrants has a separate purchasing approach which requires information of a different kind for developing a suitable supply strategy. Also, the tasks for the four groups are diverse with regards to the differences in purchasing and supply risks (Kraljic, 1983).

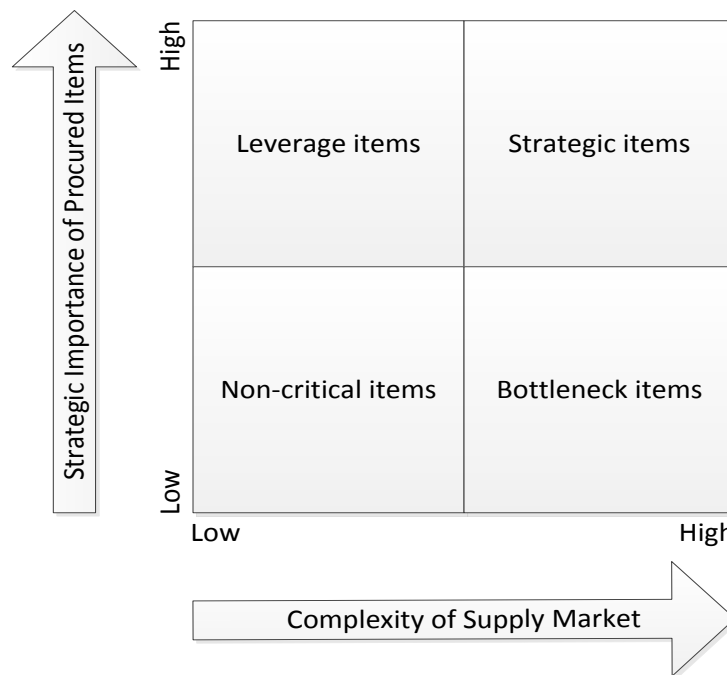


Figure 22- Foundation of categorization tool inspired from Kraljic (1983) and Olsen and Ellram (1997)

Table 5 summarizes the relevant factors that this study used for the “Strategic Importance of Procured Items” dimension. This dimension focuses on internal factors to the firm.

Factors influence the strategic importance of procured items
<ul style="list-style-type: none"> • Degree of contribution to the cost of the final product • Degree of influence on the quality of the final product • Length of leadtime • Degree of influence on the on-time delivery of the final product • Level of technological competence

Table 5-Factors influence the strategic importance of procured items

Table 6 summarizes the relevant factors that this study used for the “Complexity of Supply Market” dimension. This dimension concentrates on external factors to the firm.

Factors influence the complexity of supply market
<ul style="list-style-type: none"> • Number of available alternative suppliers • Degree of technological request on supplier • Level of difficulty to switch suppliers • Logistic cost and complexity • Cost of non on-time delivery • Degree of impact of customer request on selection of the supplier

Table 6- Factors influence the complexity of supply market

3.4 Relationship between strategic sourcing and sourcing flexibility

The impact of specific sourcing practices on sourcing flexibility has been investigated by several authors. However, there still exists a deficiency in studies that illustrate how these numerous practices can be combined in order to escalate and improve sourcing flexibility. Additionally it can be the case that under some circumstances, considering product or supply market characteristics, a set of sources could play a supportive role in relation to another (Tachizawa & Thomsen, 2007). The principal objective of strategic

sourcing is to reduce uncertainty and making improvement in flexibilities when system encounters supply, competitive, and demand uncertainties (Jack & Raturi, 2002).

As cited in Pujawan (2004), Chang et al (2001) conducted an empirical study on the relationships between business strategy and manufacturing flexibility. They applied six dimensions of manufacturing flexibility. These were; product, product mix, product modification, volume, delivery, and service. They proposed that companies should select proper dimensions of manufacturing flexibility and related those dimensions with the suitable strategy in the firm. Their study suggested that developing manufacturing flexibility and business strategy will provide firms with competitive advantages. Therefore, firms should devote time and resources to cultivate manufacturing flexibility that can fit into their business strategies (Pujawan, 2004). The same approach holds true regarding sourcing flexibility and firms can assign resources to develop sourcing flexibility that can fit into their business strategies.

A more integrated analysis over sourcing practices (i.e. recognizing strategies constructed on sets of sourcing practices) can be found in the literatures regarding purchasing portfolios (Tachizawa & Thomsen, 2007). Several authors have proposed some frameworks in order to categorize suppliers and the corresponding sourcing strategies (Kraljic, 1983; Olsen & Ellram, 1997; Bensaou, 1999). Two of these models have been explained in above texts.

In this research, sourcing fit is being defined as the perfect strategic consistency between a product's specifications along with supply and demand characteristics (such as predictability of demand, product's length of life-cycle, product variety, lead-times, specific market requirements, and explicit inherent characteristics of products) and sourcing strategies (such as inventory strategy, and supplier selection methods).

Section 4 Empirical Study

The study's empirical data was collected from a case company, Bombardier Transportation Västerås. To catch an understanding of the business needs of the purchasing flexibility, this section first presents the background of the company along with the overall organization and its supply chain and how the organization is working on this. Furthermore, brief descriptions of four different chosen items are presented. Then available dimensions of sourcing flexibility in company's procurement department have been investigated. Data on the available flexibility collected, from each dimension of sourcing flexibility, by describing how the process works in order to gain access to that dimension. For each dimension, the section discusses finally how the company works to create that dimension of sourcing flexibility internally and also upstream in the supply chain.

4.1 Company background

Bombardier is a global transportation company that operates in two industry-leading businesses: aerospace and rail transportation. The company was founded in 1942 by Joseph-Armand Bombardier to build snowmobiles. The company designs, manufacture, sell and support products in these two sectors (Bombardier Internal Portal, 2012).

Oil scarcity, escalating energy price, environmental awareness, urbanization, and population growth are few drivers fuelling the evolution of greener mobility. By 2025, the planet's top 600 middleweight and mega cities will have two billion inhabitants and generate nearly 60% of the world's gross domestic product (Dobbs et al., 2011). China only presents a enormous opportunity to connect its many large cities with segment-leading regional trains. Investing in sustainable mobility is crucial to ensuring these centers' quality of life, productivity and long-term competitiveness.

The unique dual focus, Bombardier has, will contribute maintaining the freedoms of movement and help cities breathe. Bombardier's industry-leading international capability is based on their strong local roots and the global knowledge they foster among their sites. Bombardier is present in more than 60 countries, with 76 production and engineering sites among them and have over 70 000 employees (Bombardier Internal Portal, 2012).

4.1.1 Bombardier Transportation

Bombardier Transportation is the global leader in the rail industry. They offer a broad portfolio of efficient products and services, covering the full spectrum of rail solutions, ranging from complete trains to sub-systems, maintenance services, system integration and signaling. These rail transportation solutions are divided in six divisions:

- Rail vehicles

- Propulsion and controls
- Bogies
- Services
- Transportation systems
- Rail control solutions

4.1.2 Propulsion and controls

This division has approximately 3000 employees worldwide, which are divided to 10 sites present in eight countries. The headquarter is placed in Zurich, Switzerland.

Without propulsion and control equipment, no railway vehicles can move. The propulsion system in a train is responsible for bringing in the required power that makes the trains move to the required speed. In the end, this equipment defines the vehicle performance. It is often mentioned as the heart, muscles and brain of the train.

4.2 Organizational structure

Figure 23 depicts the organization structure of Bombardier on its path to meet the requirement of customers.

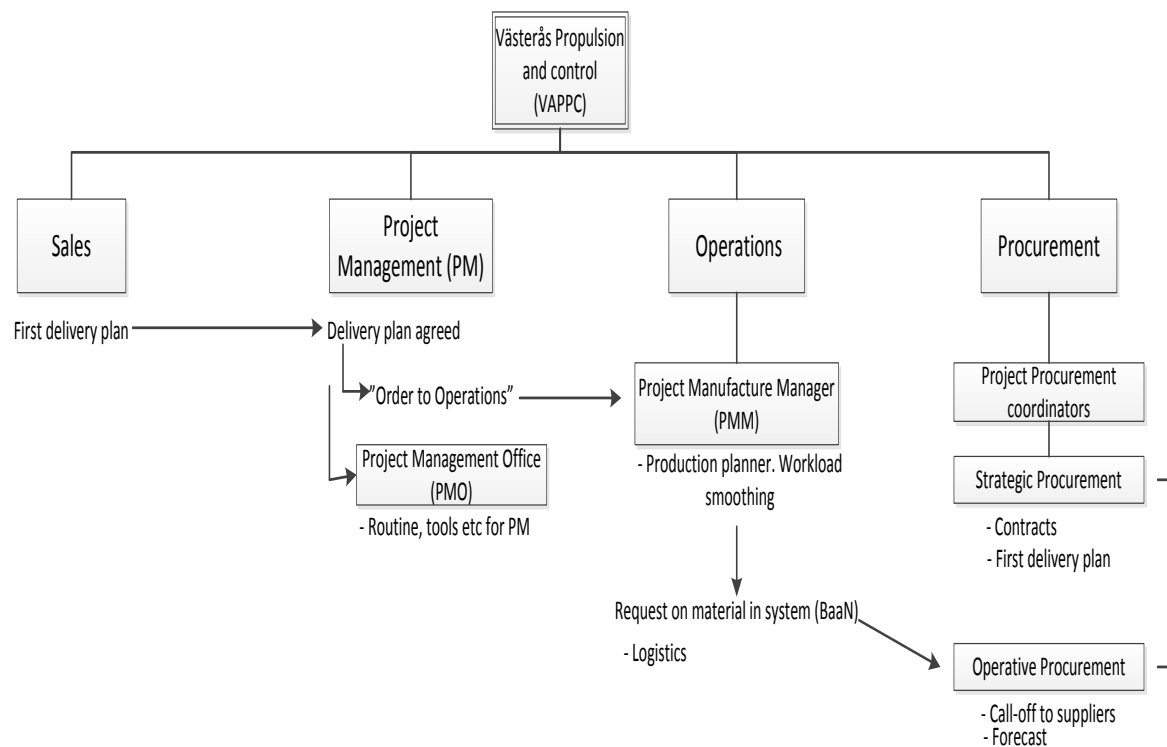


Figure 23-Organizational structure of projects

People from sale department agree the first delivery with the customer. This draft version of the delivery plan will be sent to Project Management department and assigned project managers related to each project. They develop and set the order to operation. Project manufacture managers do the production planning and smooth the workload and make the required allocations. Based on the planned production, the requirement of materials, needed for carrying out the production, would be determined. Operative purchasers follow up the delivery of material according to pre-scheduled plans.

4.3 Procurement strategy

The purchasing organization and strategy of Bombardier is divided into the numbers of different groups of commodities. Each group has operational purchasers, strategic buyers, and global buyers with different responsibilities. Operational buyers manage the daily contact with suppliers and the ongoing planning of materials. A strategic buyer manages the long-term relationship with suppliers, evaluates and develops the principle of these relationships. Global buyers have global responsibility for a group of the purchaser and they ensure long-term relationships but also for the procurement strategies of Bombardier.

Within all commodity groups, the strategy relies on long-term supplier relations that will enhance and sustain a number of performance indicators, which are quality, delivery, cost and innovation. Quality is continuously evaluated through a failure rate, less than 500 ppm (part per million), which the suppliers must achieve. Delivery is measured by the percentage of deliveries from the supplier that is departing on time (On Time Delivery, OTD). Bombardier desires suppliers to have a standard of 98 percent over the long term to be presented as vendors. Cost of purchased item shall incessantly be reduced by joint improvements that will increase the supplier's productivity through developed production, organization and design. Innovation will help to improve the product and improve the other priorities. Supplier will do this through sharing of ideas of how product design, specifications and tolerances can be altered to improve the product.

Based on the complexity of an article's supply market, the availability of in-house expertise, and the share of annual purchasing volume Bombardier has categorized its suppliers in different levels. The following levels are available:

- Supplier A – The supplier delivers strategic component groups. It has a volume share of more than 1% of the annual purchasing volume.
- Supplier B1 - The supplier delivers leverage component groups. It has a volume share of more than 0.5% of the annual purchasing volume.
- Supplier B2 - The supplier delivers leverage component groups.

- Supplier C - The supplier delivers noncritical component groups. It has a volume share of less than 0.5% of the annual purchasing volume.
- Supplier D - The supplier owned by (contracted by) another part of Bombardier.

4.4 Analyzed project

This project has elapsed since 2006 and the final delivery is planned to be in august 2014. The objectives for the project are to design, manufacture and deliver propulsion equipment for a large European public transportation company. All equipment for the 172 trains that are to be delivered needs to be homologated and tested before. The trains are gradually delivered and come with two years warranty support. The customer is free to define final layout up to six months after receiving the notice to proceed. Several modules proposed, among which the customer will determine their final choice of interior and layout. This layout will be fixed for the 50 first trains, and after these the customer can choose a new layout for minimum 30 trains, and so on. Bombardier has put up reliability targets in different levels, if these can not be attained penalty fees are charged depending on the level of the target. There are five stakeholders who stand to gain or lose from the success or failures of this project:

- The users and owner of the trains
- The supplier of the trains with propulsion
- The supplier of the bogies with gears and motors from PPC
- PPC Division
- PPC Project, the team developing and delivering the propulsion and drives equipment

By creating a collaborative, mutually beneficial relationship it allows these stakeholders to deepen mutual understanding about issues at hand, explore and integrate ideas together and, generate new options and solutions that mat not been considered individually. It will also help the project to identify and resolve areas of conflict and ensure the long-term availability of resources to achieve mutual goals.

4.4.1 Deliverables

There exist two types of deliverables to the customers. The first category is the products that are being manufactured in-house by VAPPC. The second one is related to components that are being delivered to customers directly from the suppliers. VAPPC does not do any kind of operation on the second group, and this group is being called as by-pass components. Both of these types are fully

customer order driven. The lead time for internally-manufactured products is around 26 weeks.

4.5 Supply chain structure

Following figure depicts the supply chain structure of the analyzed projects. It exhibits the engaged processes and steps in delivery of deliverables to final customers.

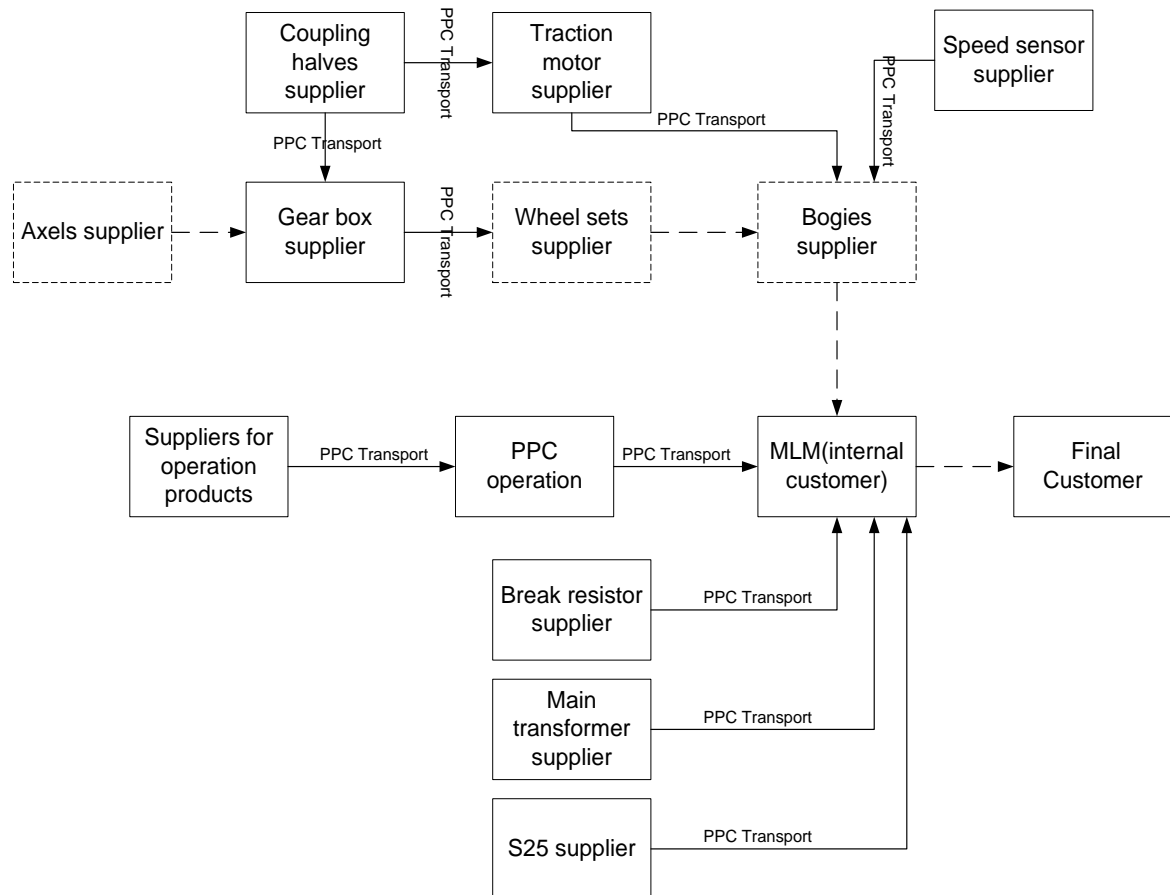


Figure 24-Supply chain structure of the studied project

4.6 Selected items

In this part, brief descriptions about the items that were selected for further analysis have been brought together.

4.6.1 Item 1-Speed Sensors

Speed sensors for sensing toothed wheel targets are available in a wide range of types. Almost any installation requirement can be accommodated with different cable and connectors. For example, a wheel speed sensor or vehicle speed sensor (VSS) is a type of tachometer. The most basic use of these is to provide information about the speed to the speedometer. This information is also used by the cruise control system and to measure engine revolutions per minute (rpm).

Many of the subsystems in a rail vehicle, such as locomotives or multiple units, depend on reliable and precise rotary speed signal. This applies in particular to traction control, door control, train control, registration, wheel slide protection etc.

For the early analogue sensors, they often functioned unsuccessfully or were not reliable enough, and gave rise to vehicle faults. Even digital models were affected, mainly due to the extremely harsh operating conditions encountered in rail vehicles.

4.6.2 Item 2-Low Inductive Busbar

A busbar is a strip or bar of copper, brass or aluminum that conducts electricity within electrical apparatus such as switchboard, distribution board, and substation or battery bank. These bars are used in place of wire that would be hard to bend and fit into tight spaces. They are easily formed into abnormal shapes to accommodate connections of the incoming power source to internal equipment. The bars can also easily be extended if another section is in need of future expansion.

4.6.3 Item 3-Connectors

Connectors are electro-mechanical devices that exist on the end of electrical conductors and are intended to facilitate interconnection with other leaders. They come in two variants, male plug and female receptacle. The connection may be temporary or as a permanent electrical joint between two wires or devices. There are multiple types of connectors and the technology level is quite low.

4.6.4 Item 4-Power Semiconductors (IGBT)

Power semiconductors, also known as Insulated Gate Bipolar Transistor (IGBT), is a device primarily used as an electronic switch and in newer devices is noted for combining high efficiency and fast switching. These switches are to be found everywhere in modern appliances like trains, refrigerators, lamps, computers etc. At VAPPC, IGBTs are used for mainly two reasons:

1. Controlled rectifiers – convert AC to DC
2. Controlling AC motor – convert DC to AC

4.7 Changing volume and delivery schedule

Figure 25 depicts the procedure that Bombardier is going through when the order's volume or delivery date is being modified by the customer.

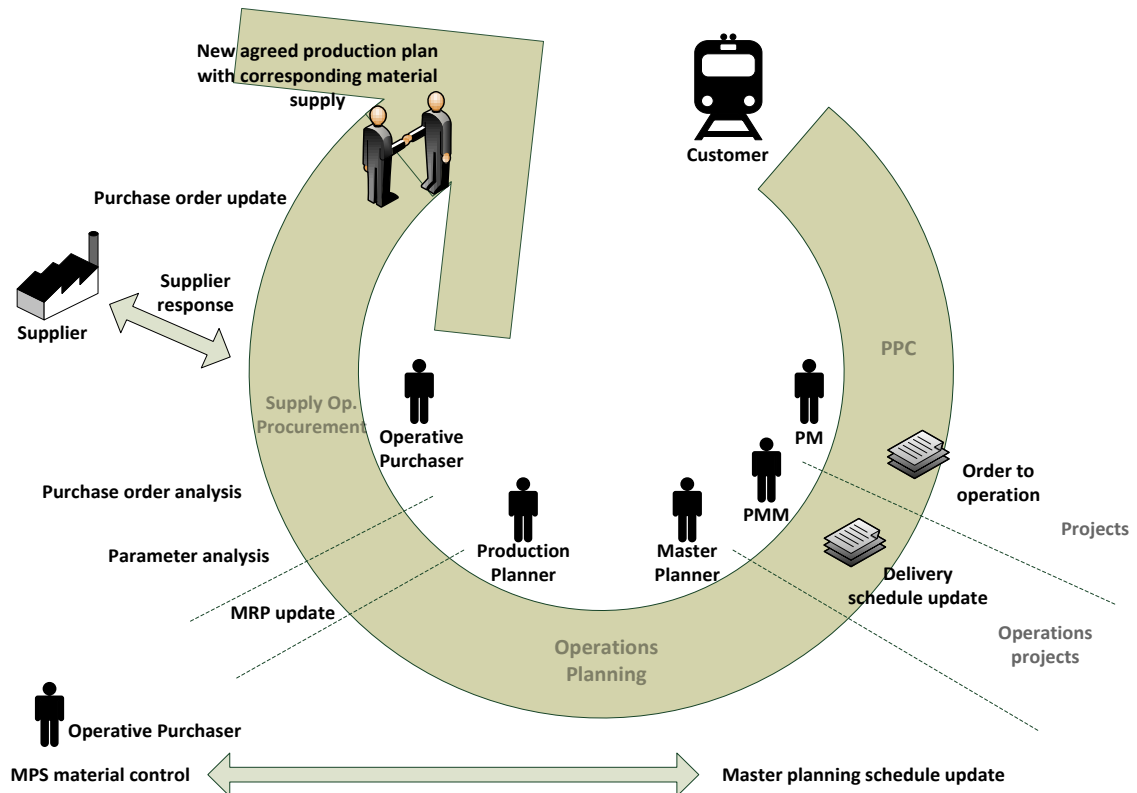


Figure 25-Schematic exhibition of process of changing volume and delivery date

The procedure is extremely close to the initial steps of launching a new project. First customer should announce its required changes in the form of MPS (master production plan). Then project managers assess the feasibility of requested changes. If they find that changes are possible to take place, it would be directed to PMMs (project manufacture managers). They reschedule the production plan according to requested changes and consequently new delivery date and volume for materials from suppliers would be resulted. Operative purchasers negotiate the feasibility of this new delivery date and volume with the suppliers. If it get confirmed then delivery plan for the customer would be changed according to customers' requests. It should be noted that there always exists a frozen window for requested changes in delivery volume and dates. This frozen window is around two months. It means that requested changes from the customer that regarding the delivery dates and volume in the period of two months from request date, cannot be applied.

4.8 Changing product specification

Changes in product specification can root from two factors. First can be the requirement of the customer or designer to make improvements and second can be related to the existence of some kinds of malfunctionality in current specifications. The procedure of approving the requested changes in the component specification may take up to 6 months. The process is usually as following. First a modification request is being released either based on customer request or due to vulnerabilities or opportunities found by production specialists. Then a meeting would take place to justify the requirement. Accordingly several feasibility tests and investigations would be executed to approve the changes. When the changes approved, from that point of view the new requirements would be set for the suppliers.

4.9 Changing structure of supply chain

Table 7 exhibits the typical procedure associated with adding new supplier and changing the structure of supply chain. This process consists of three main section which are (1) market analysis (2) selection of suppliers (3) negotiation and signing contracts. The sub procedures associated with these three main steps are totally fluctuating according to the characteristics of components. This procedure can take up from approximately 5-6 month for noncritical components to more than 1 year for strategic components.

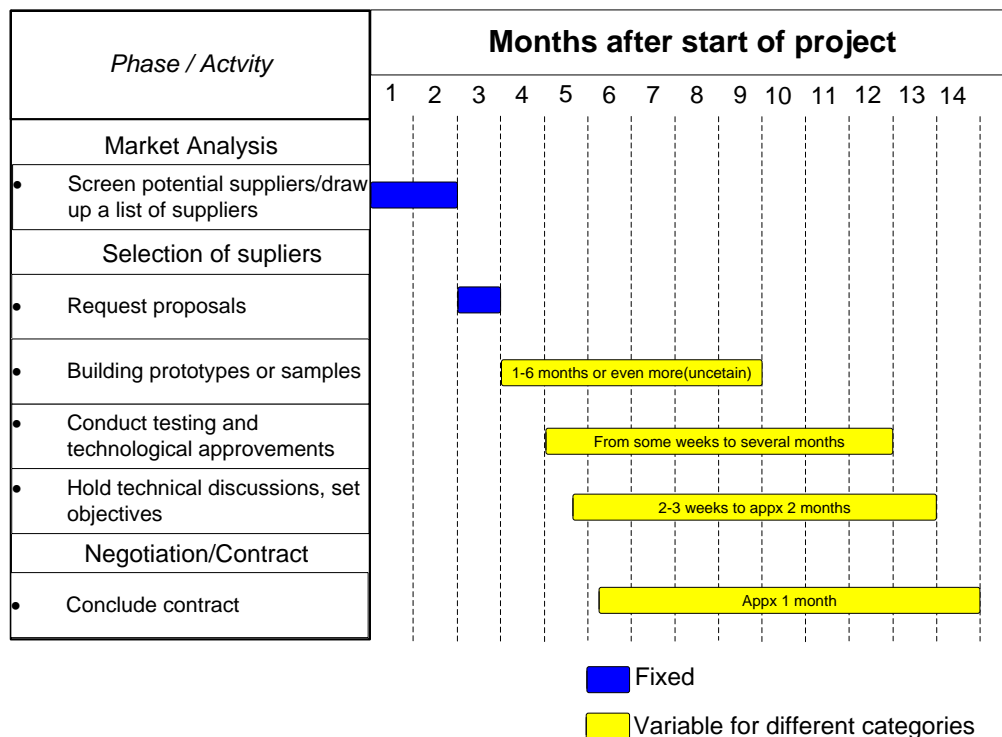


Table 7-Summary of procedures for changing the structure of supply chain

Section 5 Results

In this chapter, the results from the case study will be described. The results section of the thesis is dedicated to explaining Bombardier's current procurement strategic direction and the results of attempts which have been done in order to categorize the procured components.

5.1 Procurement strategic direction

Figure 26 presents the results of the first survey. This survey aimed to grasp the importance of 5 factors in relation to each other. The target respondents for this survey were 17 managers at to organizational level. They were asked to rank 5 factors of cost, delivery, flexibility, quality, and delivery based on their order of strategic significance regarding purchasing functions. A sample example has been illustrated as following in order to make the figure more understandable. The columns show the number of individual that have put one specific factor in related ranks. For example, if the 1st place column would be considered, it shows that 9 different individuals placed quality in the first place of ranking. Subsequently the column exhibits that one individual placed technological competence as the first position, one individual placed cost, and another individual placed flexibility in the first place. There was no one who puts delivery in the first rank. The rest of figure's column can be also interpreted in the same manner as previously mentioned.

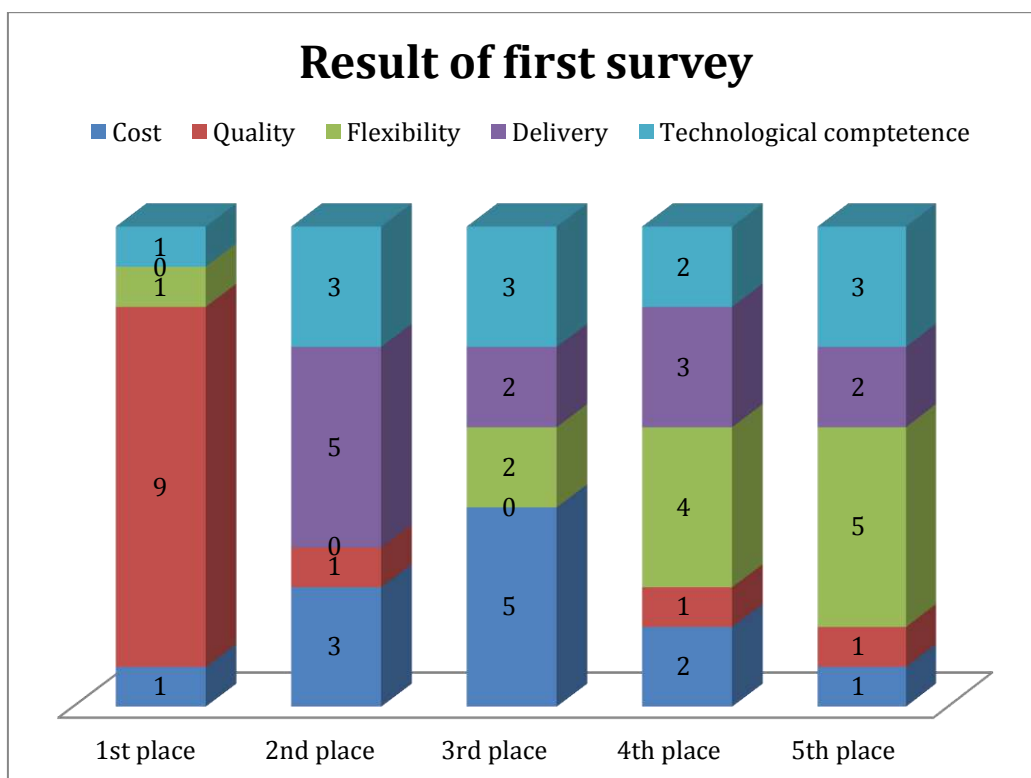


Figure 26-Result of the first survey, aimed at finding the weights of factors

Based on the positions that each factor gained in the first survey, a relative score was calculated for each factor. Each place in the ranking has its own score and this score was dedicated to the factor that has been placed on that rank. After all, the cumulative score of each factor was calculated which has been exhibited in Figure 27.

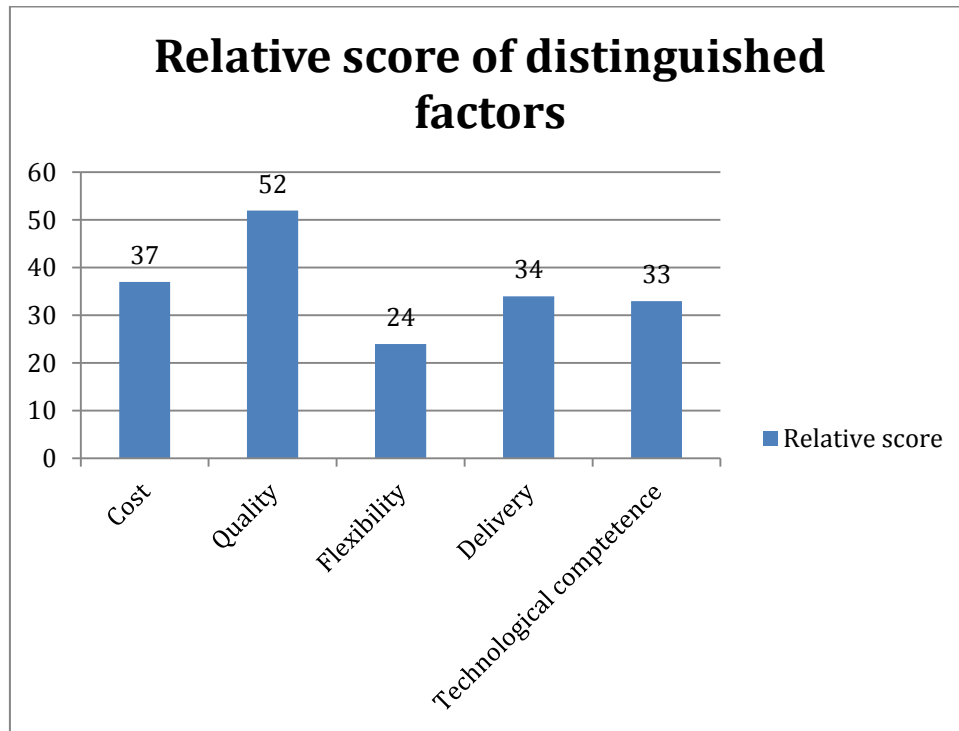


Figure 27- Relative score of distinguished factors

5.2 Procured items categorization

Based on the earned relative score for each factor, the Weight of that factor was calculated. This weight in combination with the results of second and third survey resulted in categorization of procured components. The target respondents of second and the third factor were strategic purchasers. They set the score of each factor for each component. The score of each factor for each component was multiplied with the weight of that factor, and the position on the vertical axis was spotted. For the horizontal axis, the study applied cumulative approach. The scores of each factor for each component were added together, and the position of component on the horizontal axis was spotted. Figure 28 depicts the distribution of components in four categories. 51.8% of 54 components were categorized as strategic, 13% as leverage, 7.4 % as noncritical, 5.6% as bottleneck, and finally no response received from strategic purchasers for 22.2% of components.

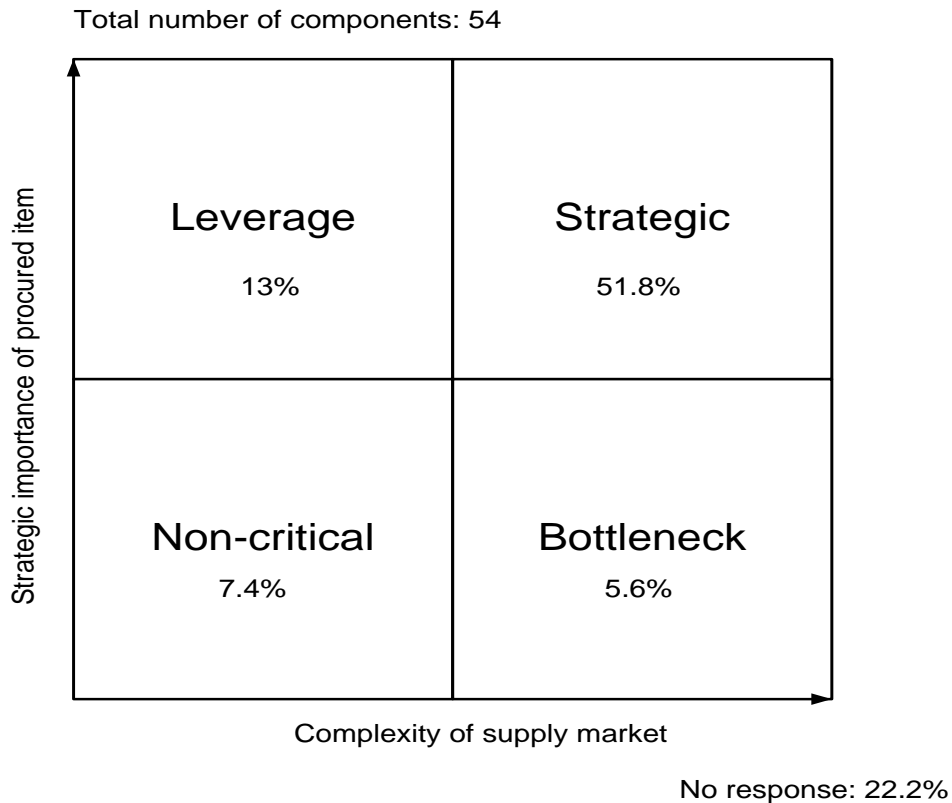


Figure 28-Results of categorization

5.2.1 Strategic components

Strategic components are of immense strategic importance to the company but they also share a highly complex supply market due to low number of suppliers and/or high degree of technological request on suppliers. These items have high strategic importance because they should usually be supplied with strict specifications. For some of these kinds of items, only one or exceeding few sources of supply are available. This supply structure cannot be changed in the short run without incurring considerable cost. Some examples of strategic components includes high-tech and high-volume or price customer-specific products. Purchasing costs of such components are usually high. They contribute to reinforce not only the overall strategy of the company but also to support the core competences of suppliers. Accordingly, the appropriate strategy for strategic components can be to establish partnership with relevant suppliers.

5.2.2 Leverage items

Leverage components enjoy high strategic importance to the company but, on the other hand, they have high market availability and low level of supply market complexity. They may significantly contribute to company growth strategies. The company has the responsibility to ensure the stocks for leverage components to never run out because there would be the case that the consumption rate of leverage components be exceptionally high.

5.2.3 Bottleneck items

Bottleneck components share significant level of vulnerability with respect to their complexity of supply market while they contribute little to profitability and strategic growth of the company. Such components have a tendency to have high purchasing cost because there may be devilishly few available suppliers in the market. Also, it can be the case that customers may put extremely strict requests regarding those components that make their supply market immensely complex. The crucial strategy for bottleneck components would be to avoid delivery shortages. These shortages may jeopardize the production which may result to losses of sales and reputation.

5.2.4 Noncritical items

Noncritical components have a low level of strategic significant to the company. In addition, they are widely available in the market and have very low level of complexity in their supply market. The strategic aim for noncritical components can include; reducing the number of components in this category, focusing on other factors such as a cost rather than main strategic factor for the company, eliminating small volumes spending, rationalize the number of units in order to control cost.

5.2.5 Placement of selected samples

One sample component from each category was selected for further investigations. Table 8 summarizes the characteristics of the selected components.

Article \ Characteristics	Speed Sensors	Low Inductive Busbar	Connectors	Power Semiconductor (IGBT)
Purchasing cost	Low	Moderate	Low	High
Impact of article quality on the quality of final product	Moderate	Moderate	Moderate	High
Length of leadtime	8-10 weeks initially then 2-4 weeks	10-18 weeks	10-14 weeks (depends on customization)	12-26 weeks (depends on supplier)
Impact of article on-time delivery on the on-time delivery of final product	Not significant	Moderate	Moderate	Highly significant
Article's level of technological competence	Low	Moderate	Moderate	Moderate
Supplier base	Multiple sourcing(one for each project)	Parallel sourcing for each project	Multiple sourcing	Multiple sourcing

Number of available suppliers	4(many alternatives available in the industry)	3(many alternatives available in the industry)	8	4 (2 are mainly being used)
Supplier's required level of technological competency	Moderate	Fairly high	Fairly high	High
Purchasing region	Europe	Europe, Asia, North America	Europe	Europe, Asia
Level of difficulty to switch supplier	Fairly easy	Moderate	Very difficult	Difficult
Logistics cost and complexity	Low	Fairly low	Low	High
Cost of none on time delivery	Moderate	Fairly low	Moderate	High
Impact of customer request on suppliers selection	Low	Fairly low	Highly influential	Influential

Table 8-Characteristics of selected components

Based on above presented characteristics, following figure exhibits the position of each selected component on the developed purchasing portfolio matrix.

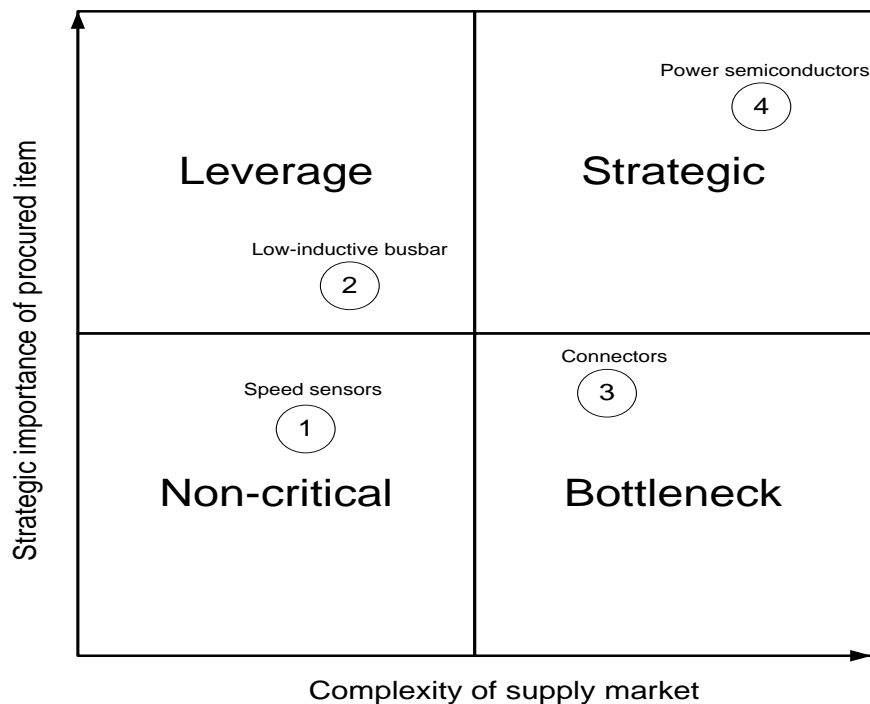


Figure 29-Position of selected components

Section 6 Analysis

In this section, the above presented empirical study is going to be analyzed through step-by-step mapping of how access to flexibility from the suppliers is being influenced, and can be altered. As a starting point in this analysis, it is considered crucial to understand the needs of the sourcing flexibility that exists in the case study. This is the basis for the section 6.2 where the need by the uncertainty in demand from three aspects of volume, delivery date and customization are identified. After that, in Section 6.6, the different types of sourcing strategies have been analyzed where their impact on sourcing flexibility at various levels of strategic and operational has been brought into discussion. It compares the different levels of sourcing flexibility related to different categories of procured items.

6.1 Business unit strategy and flexibility

As it exhibited in the previous section, the first priority in strategic direction of procurement inside Bombardier is to ensure the quality of final products. This is being done by put the concentration of purchases on quality. Suppliers are strictly being evaluated based on the quality of the material they provide. This proves that quality has been well sensed and integrated in purchasing strategic direction.

According to the current request of top management, VAPPC needs to be more responsive towards customer demands. This would highlight the significance of flexibility as indispensable requirements for customer responsiveness. As it can be observed from the results of the first survey (presented in figure 27), flexibility has the lowest relative score. This score would indicate that the strategic importance of flexibility is being highly neglected. Top managements are ranking flexibility as the lowest strategic direction for the procurement function while simultaneously they emphasize the requirement for customer responsiveness.

6.2 The necessity of flexibility

Referring to the theoretical part of the report, three types of uncertainties can be considered as the drivers for the sourcing flexibility. These types of uncertainties are volume, delivery date and mix flexibility (Christopher, 2000). In the case of Bombardier, all of these three types were detected. The observations regarding associated uncertainties will be brought into attention in the followings.

It should be noted that production in the case study is fully customer order driven and procurement forecasts are based on known and unknown demand.

6.2.1 Volume uncertainty

VAPPC was supposed to procure customer with deliverables for 63 number of train sets from February 2011 until April 2012, according to production schedule

released in February 2011. This data are just related to the mere project that this report investigates and does not reflect the whole delivery plan of VAPPC. Figure 30 tracks the changes in the number of TS (train sets) that should be delivered based on different MPS (master production schedule) released by project's customer. The figure exhibits the change in the number of requested TS over time. The initial delivery number of 63 train sets has decreased substantially to 40 in the schedule released in March 2012, a year after. Each train set has 10 deliverables which are being produced in VAPPC (referred to as operation materials) and 11 deliverables which being shipped to the customer directly from the supplier side (referred to as by-pass materials). The resulted 23 difference in the number of requested train sets would indicate 230 difference in the requested number of operation components and subsequently 253 difference in the requested number of by-pass materials. This proves the difficulties associated with forecasting of the materials' volume that should be procured from suppliers.

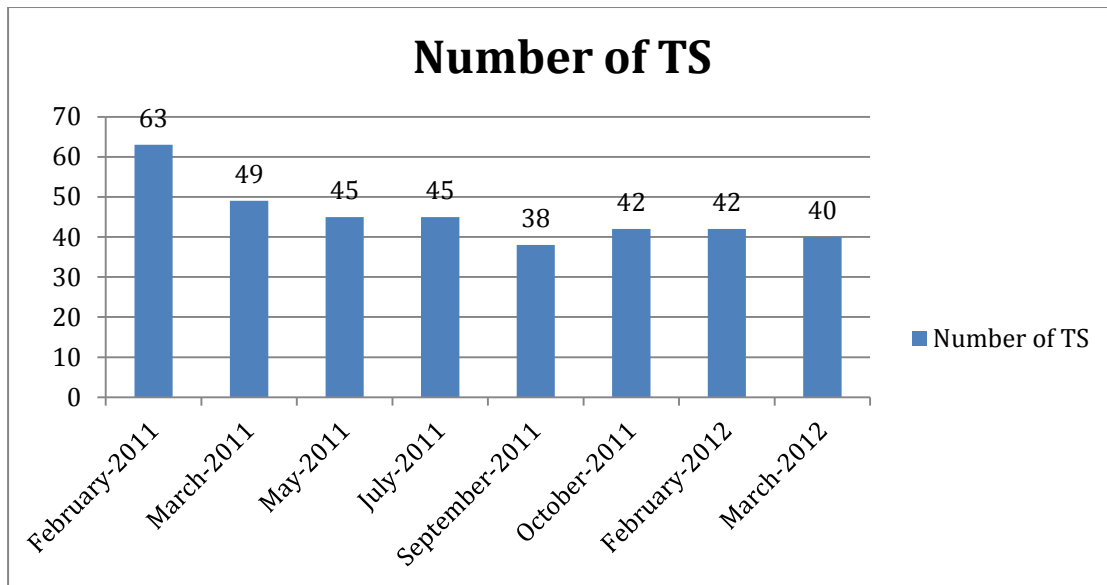


Figure 30-Change in volume

6.2.2 Delivery dates uncertainty

In addition to the volume uncertainties presented above, the studied project was prone to high level of uncertainties associated with products' delivery dates. For efficiency in the analyses, in this report just the changes in delivery date which were over two weeks have been considered as relevant and consequently the changes less than two weeks were ignored. As pointed out previously, each train set has 10 operation deliverables and 11 by-pass deliverables. The assumed delivery number of 63 train sets would indicate total delivery numbers of 630 operation materials and 693 by-pass materials. Figure 31 depicts the number of changes in delivery dates of both operation and bypass materials. Delayed delivery date means that the delivery date for requested item has been postponed to more than two weeks. Successively, accelerated delivery date

means that the delivery date of material has been brought forward in time by more than two weeks. This should be noted that the delivery date of some materials may have changed more than once and that is the reason that numbers of changes exceed the total number of deliverables.

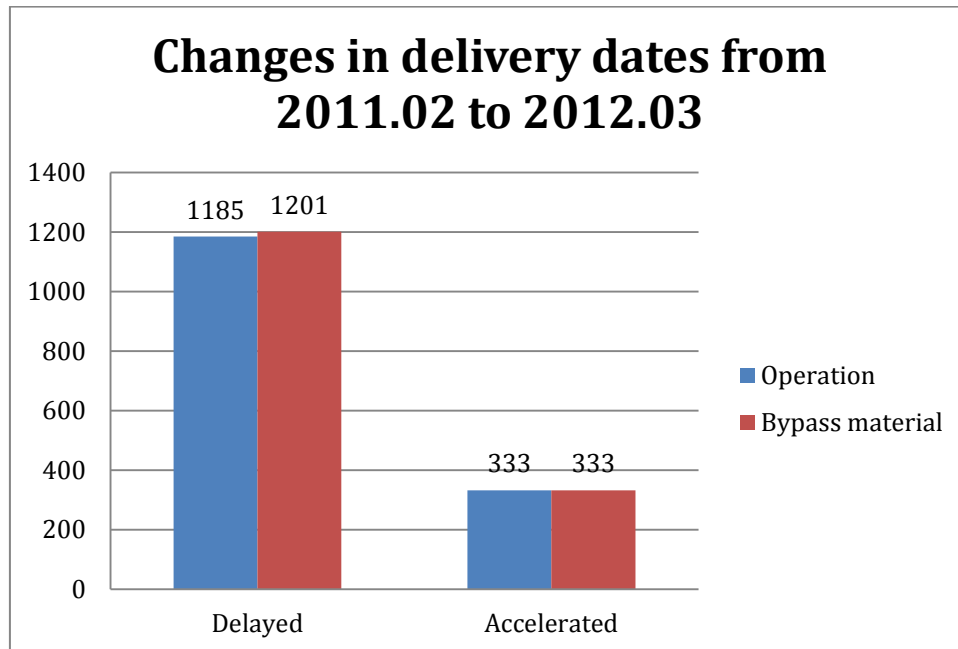


Figure 31-Changes in products' delivery dates

6.2.3 Mix uncertainty

Two interviews took place with current and previous project managers of the under-examined project. Based on those interviews, several occasions have been occurred that the project was forced to be delayed due to required changes in the specifications of components. According to project managers, the threat of changing products' specification is probable event that is expected to happen several times in projects.

6.2.4 Nature of changes

Figure 32 depicts the nature of changes in delivery dates that have been explained previously. As it can be observed in the figure, there is a small portion of changes in delivery dates which have been occurred after the delivery dates of material. Similarly, small portion of changes have been requested within two months of delivery dates of materials. As figure clearly indicates largest portion of requested changes are related to over two months from delivery dates.

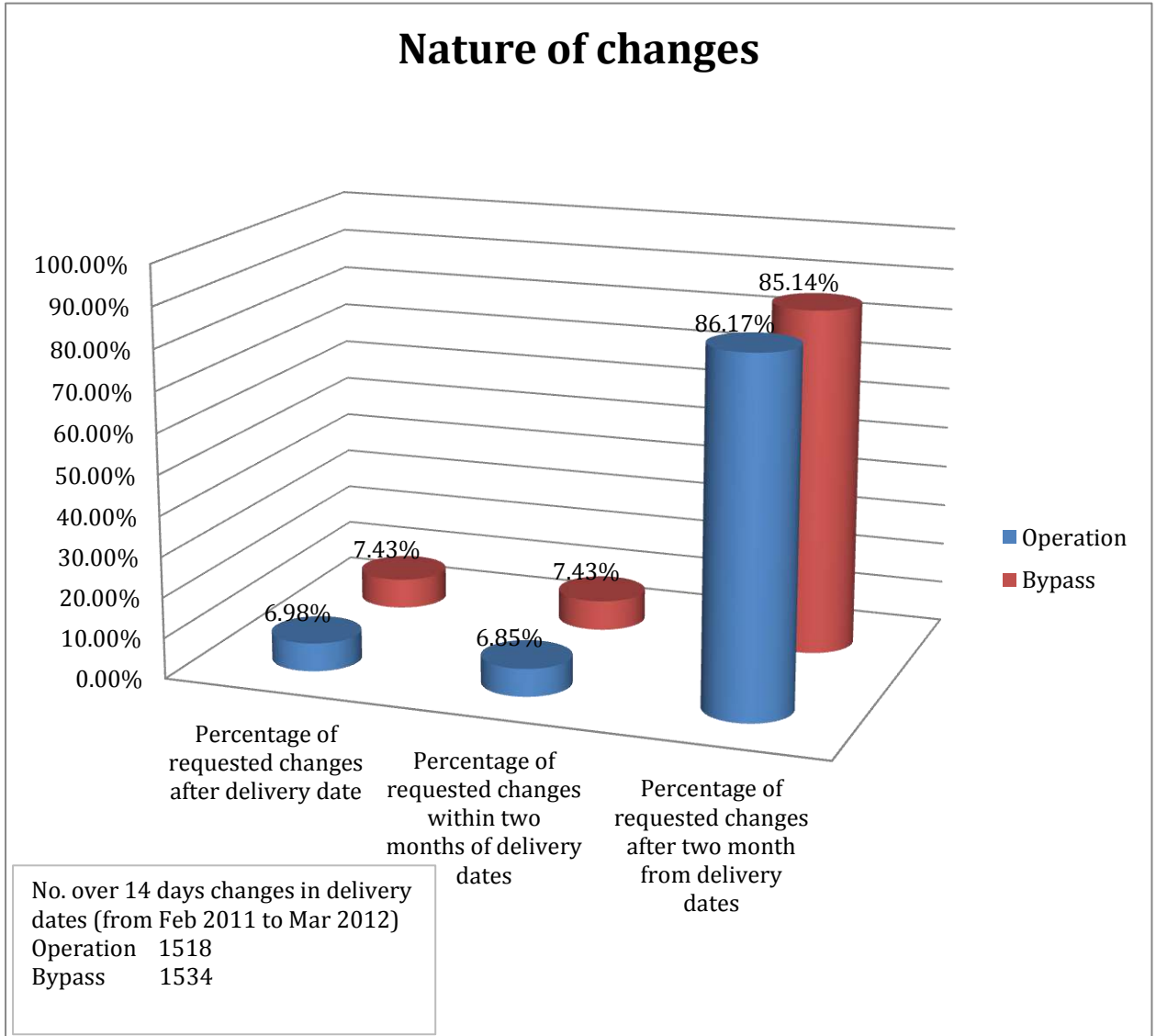


Figure 32-Nature of changes in delivery dates

6.3 Current flexibility level

While it is essential to investigate the changes occurred in delivery dates and volume, it is of the same importance to analyze how the company responded to these requested changes. Figure 33 and 34 present the nature of actual deliveries have taken place from February 2011 to March 2012 from VAPPC related to studied projects. The number of deliveries for operation materials is 395 items and for bypass materials is 435 items. It can be observed that both operation and bypass materials have mainly been delivered before requested delivery dates from customers. This would indicate extra inventory costs. Another notable point is that level of flexibility with respect to bypass materials is lower than the same for operation materials. As the major portion of operation materials has been delivered in one month before the delivery date while bypass materials

have been mainly delivered more than one month before expected delivery dates.

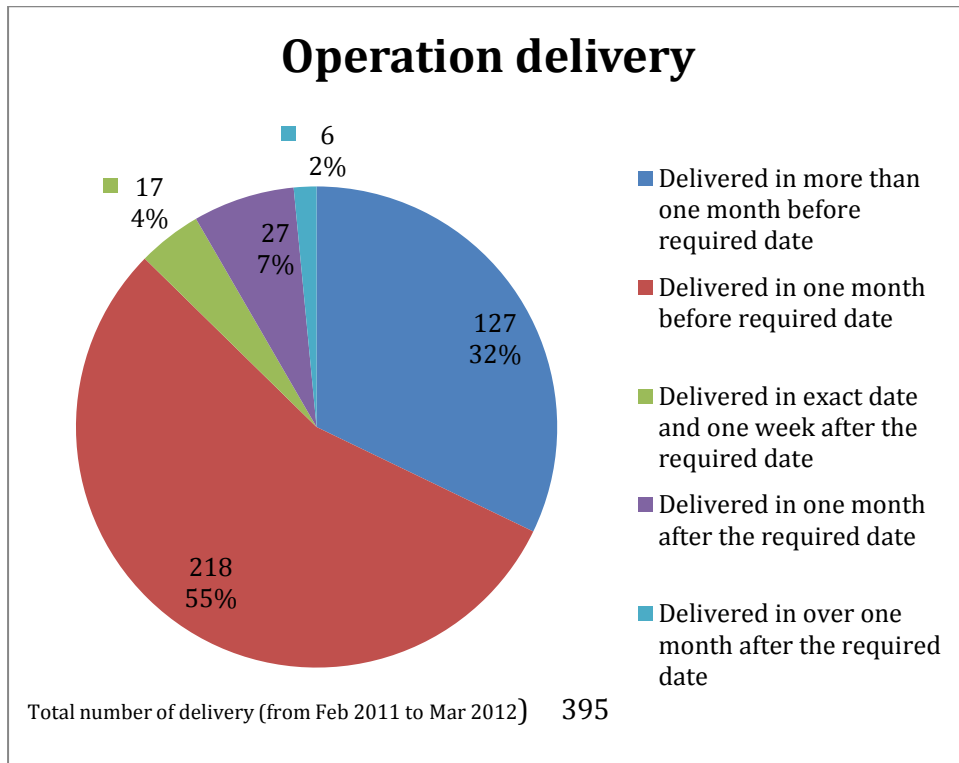


Figure 33-Operation deliveries statue

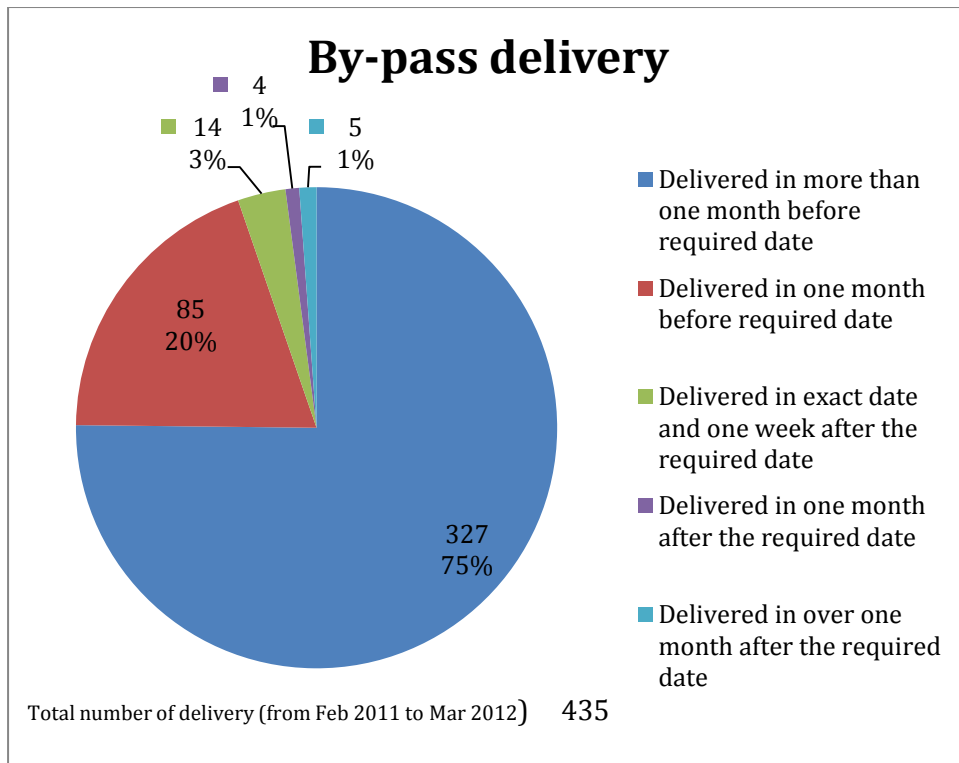


Figure 34-By-pass deliveries statue

6.4 Definition of sourcing flexibility

Sourcing flexibility can be defined from two perspectives. First one refers to the capability of the focal firm to change the structure of its upstream supply chain. Second aspect refers to the ability of company's suppliers to provide it with flexibility in three dimensions of delivery, volume and product.

6.4.1 Influential factors and measurements

The both two above mentioned aspects along with associated dimensions can be measured in three different conditions of required, actual and potential. Making observations over the quality of focal company's reactions to changes happened to regard volume, delivery date and specification of deliveries can be clear indications of the actual level of sourcing flexibility. It should be again highlighted that flexibility is relative element. Flexibility can be measured in evaluation with other factors such as cost and quality. To assess flexibility, it is highly crucial to consider trade-offs.

Considering the existing uncertainties in supply chain, it denotes the level of flexibility needed to mitigate those uncertainties. If the focal firm analyses the existent drivers that necessitate the need for sourcing flexibility, it can gain reliable estimations on the required level of flexibility. Estimating the potential level of sourcing flexibility is a tough task to execute. Considerations such as supplier's production method, suppliers' difficulty to access raw materials, strategic importance of the buyer to supplier, influential power of buyer in relation to suppliers, the experience and skills of purchasing team, and potential

investments to decrease lead time can be some factors that can influence the potential level of sourcing flexibility.

As discussed in the theory section, three elements have been mainly used to define any flexibility dimension in literatures. These elements distinguished as range, mobility, and uniformity (Upton, 1994; Watts et al., 1993; Zhang et al., 2002). In the following table, two aspects of sourcing flexibility along with three dimensions of volume, delivery and product have been analyzed considering those three elements.

		Sourcing flexibility	Elements		
			Range	Mobility	Uniformity
Aggregate level	}	Structure of supply chain	Number of available suppliers	Switching costs or costs and efforts of adding new supplier	Differences in performance considering cost, quality, on-time delivery, leadtime and etc
		Operational level	}	Volume	Flexible options regarding volume in contract with supplier
Delivery	Flexible options regarding delivery date in contract with supplier			Cost and efforts of changing delivery date(may include inventory costs)	different transportation costs, different production cost and quality for different time periods
Product	Flexible options regarding changing the specifications of product in contract with supplier			Cost and efforts of changing products' specifications (new designs, tests,...)	Change in production cost, quality and time as results of changes in product specifications,

Table 9-Definition of sourcing flexibility elements

6.5 Distinguished drivers for sourcing flexibility

6.5.1 Drivers

As it defined previously, a sourcing flexibility driver is a characteristic of supply chain which the purchasing function has little or no control over it and it necessitate the requirement of sourcing flexibility. It also can operate as a determination for the level of required sourcing flexibility (Tachizawa & Thomsen, 2007). Through deep analysis of the particular project and the performed interviews, several drivers have been identified. Some of them are dependent on the characteristics of the focal company and are internal. Additionally some others are related to characteristics of firm's upstream supply

chains (suppliers) and/or downstream supply chains (customers). These are being considered as external drivers. Following, a brief description of each has been gathered together. All these drivers have been analyzed based on their contribution to different levels of sourcing flexibility. At the supply chain level, there exists factor of supply chain structure. At the operational level, there exist three dimensions of volume, delivery and product (more information at 3.1.3.3).

Uncertainties associated with the production plan

This driver was found related to all three dimensions of sourcing delivery, volume and product. In the project under analysis lots of changes in the delivery dates and the volume of delivery, over a specific period, were observed. Product uncertainty was also found affected. The under examined industry is highly customer oriented and requirements of the customer are of high priorities. Furthermore, the speed of development in the technological competence related to components being applied in the transportation industry is remarkably fast. So in the analysis, several incidents of delays due to changes in component specification were observed. Additionally, failure of workers or manufacturing equipment, low performance of suppliers, and problems related to internal communications are other roots of the uncertainties associated with production plan. In a company operates in make-to-order environment and its production is project-based, it is usual that changes in the production schedule related to one project directly affects the production schedule of other ongoing projects.

Customer's demand volatility

As exhibited earlier, the orders of the customer are highly unstable. The stability levels of the orders have been placed by customers, considering their due dates, quantity and specifications, are low. According to Pujawan (2004) this is being considered as one key driver of sourcing flexibility. This driver can make impacts on all three dimensions of sourcing flexibility.

Low accuracy of forecasts

The company under investigation operates in a totally make-to-order environment. This may imply that forecasts are supposed to be mostly valid specially the ones that are based on actual orders. But the high volatility associated with the orders has made the forecasting extremely difficult and inaccurate. The effect of this driver is more highlighted in relation to volume and delivery dimensions.

Customers' requirements disparity

This factor is also among the elements that have been pointed out by Pujawan (2004). According to the performed interviews, different customers require

different speed and service level. Some customers, like the one related to investigated project, may ask for lots of changes in delivery schedules, but some other projects may have steadier flow of deliveries. So this would imply that there exists a high level of disparity between different customer requirement in the under-examined company. The goal is to provide customer responsiveness considering all types of customers. So the sourcing flexibility is one necessity to provide that desired level of customer responsiveness. This driver has been found influential on sourcing flexibility at the aggregate (strategic) level. Due to different requirements of diverse customers, the focal firms may be obliged to change the structure of its supply network to meet customer requirements efficiently and effectively.

Need to switch between suppliers

Each project has its unique characteristics and requires suppliers with diverse capabilities that can match the flexibility requirement of the project. It can be the case that some suppliers cannot follow the deliveries on the required timetables. There are also incidents that some specific suppliers should be chosen due to customer requisite. Customer requirement can make the selection of suppliers exceedingly hard because it can limit the company's options for supplier selection to just one.

Supply uncertainty

The specification of a component along with characteristics of its supply market play a pivotal role on the component's required level of sourcing flexibility. The number of suppliers available for a specific component and level of technological competency that a supplier should have in order to be selected, are other determinants for the component's required level of sourcing flexibility. The drivers associated with supply uncertainties have been found influential on both aggregate and operational level of sourcing flexibility.

Length of leadtime

This report defines lead time as the time period between the moment the focal company places an order to the moment it is delivered. Leadtime is a measure of how long it would take for a product to be delivered from the first point of ordering through delivery. If there do not exist any finished goods or intermediate inventory, leadtime is the time it takes to actually produce the component. Leadtime may sometimes be dependent on the supplier's level of difficulty for accessing required raw materials.

A short leadtime would indicate that either component is the standard item and there exists sufficient amount of inventory for that or the production and

delivery processes are not complex and can be executed in the short period. In this situation, the supplier is able to produce demanded components in more flexible ways considering all three aspects of volume, delivery date, and product. The opposite is also true when the leadtime is long. Hence, the length of leadtime affects the need of those three diagnosed flexibility dimensions.

Following table summarizes the distinguished drivers along with their influence on aggregate and/or operational level of sourcing flexibility.

Drivers	Aggregate level	Operational level		
	Structure of supply chain	Volume	Delivery	Product
Uncertainties associated with the production plan		X	X	X
Customer's demand volatility		X	X	X
Low accuracy of forecasts		X	X	
Customers' requirements disparity	X			
Need to switch between suppliers	X			
Supply uncertainty	X	X	X	X
Length of leadtime		X	X	X

Table 10-summary of sourcing flexibility drivers

6.5.2 Required level of sourcing flexibility at different categories

The degree of strategic importance and the characteristics of the supply market are different for each category of procured components. Analyzing the magnitude of previously mentioned criteria related to each category, can enlighten the required level of sourcing flexibility specified to each category.

Article	Speed Sensors	Low Inductive Busbar	Connectors	Power Semiconductor (IGBT)
Characteristics				
Component Category	Non-critical	Leverage	Bottleneck	Strategic
Length of leadtime	8-10 weeks initially then 2-4 weeks	10-18 weeks	10-14 weeks (depends on customization)	12-26 weeks (depends on supplier)
Impact of article on-time delivery on the on-time delivery of final product	Not significant	Moderate	Moderate	Highly significant
Supplier base	Multiple sourcing(one for each project)	Parallel sourcing for each project	Multiple sourcing	Multiple sourcing
Number of available suppliers	4(many alternatives available in the industry)	3(many alternatives available in the industry)	8	4 (2 are mainly being used)
Supplier's required level of technological competency	Moderate	Fairly high	Fairly high	High
Purchasing region	Europe	Europe, Asia, North America	Europe	Europe, Asia
Level of difficulty to switch supplier	Fairly easy	Moderate	Very difficult	Difficult
Logistics cost and complexity	Low	Fairly low	Low	High
Cost of none on time delivery	Moderate	Fairly low	Moderate	High
Impact of customer request on suppliers selection	Low	Fairly low	Highly influential	Influential
Required level of sourcing flexibility	Low	Medium	High	High

Table 11-Required level of sourcing flexibility at the category level

The required levels of sourcing flexibility were extracted out by making considerations over above presented characteristics.

Non-critical components usually do not have long lead times. Their impact on on-time delivery of the final product is not so significant. Due to low level of complexity associated with non-critical items, there exists several numbers of available suppliers. Also, it is not particularly difficult to switch between suppliers because there are not so much differences between performances of suppliers considering cost and quality as indicating factors. Furthermore, customers do not usually ask for specific requirements which may restrict the

selection of the supplier for non-critical components. Considering these characteristics, it is viable to rate the required level of sourcing flexibility for non-critical category as low.

The lead times of leverage components have been found greater than non-critical components. Also, their influences on on-time delivery of the final product have been diagnosed as more significant in comparison with non-critical components. Based on the observations, suppliers should have a high level technological competency that they can be selected for leverage components. This will make it harder to replace or switch between available suppliers. Furthermore, leverage components encounter higher probability that customers ask for specific requirements which may restrict the selection of the supplier for leverage components. Considering these observations, the required level of sourcing flexibility for leverage category was distinguished as medium.

The length of lead times for bottleneck components has been found approximately equal to the ones related to non-critical components. However, some slight differences were observed. On the other hand, their effects on on-time delivery of final products are more significant than non-critical components and somehow at the same level of leverage items. The required level of supplier technological competence was found high for bottleneck components. One intriguing point was observed regarding bottleneck items. Some of them have quite restricted number of suppliers while for some others, several suppliers found available. The difficulty that has caused some components to place in bottleneck item was the real specific request of customer regarding selection of supplier. It has been observed that for some components, customer may just approve material from only one specific supplier and this would make the selection of supplier remarkably limited. Based on these findings, required level of sourcing flexibility for bottleneck category was distinguished as high.

The average lead times for strategic components have been observed exceptionally long. Their impacts on the on-time delivery of the final product have been found highly significant. The suppliers should possess tremendously high level of technological competency in order to be selected for the major portion of strategic components. Due to this restriction, extremely few numbers of suppliers exist for strategic components. Considering the high complexity of strategic components and their requirement for specialized tests, it is very difficult to change supplier. The switching costs are high for these components. Furthermore, many strategic components have high logistic costs and complexity. This makes their transportation and inventory difficult and slightly costly. Based on these mentioned observations, required level of sourcing flexibility for strategic category was noted as high.

Section 7 Discussion

In this section analysis of the case study, presented in the previous section, is going to be used as a basis of discussions. This section discusses how the availability of sourcing flexibility is controlled and influenced via sourcing strategies.

7.1 Sourcing strategies and sourcing flexibility

As also pointed out by Tachizawa & Thomsen (2007), two main strategies can be observed as influential on sourcing flexibility. This study use the same expression as Tachizawa & Thomsen (2007) and call those strategies as (1) the ones aim at improving supplier responsiveness capabilities and (2) the ones with concentration on flexible sourcing. This point of view is consistent with the view of this report to consider sourcing flexibility from two levels of aggregate (strategic) and operational. The sets of strategies concentrate on increasing supplier responsiveness are the ones that influencing sourcing strategy at the operational level. Consistently, those strategies focus on flexible sourcing are the ones that are influential on sourcing flexibility at the aggregate level and try to constantly reconfigure the supply chain.

7.1.1 Sources

As stated previously a source of sourcing flexibility can be defined as a “practice in the purchasing function that allows an increase in sourcing flexibility” (Tachizawa & Thomsen, 2007). In this analysis, which is based on the empirical data, it has been tried to discover some patterns. Pattern means that the detected sources were checked against existent literature in order to verify the validity and consistency of distinguished patterns. Table 12 summarizes several sourcing strategies as various sources of sourcing flexibility. These sources have been analyzed by their influence on several dimensions of sourcing flexibility. Furthermore, these sourcing strategies have been categorized to two groups of “improve supplier responsiveness” and “flexible sourcing” based on their characteristics of the contribution.

Sources	Sourcing Flexibility				Strategies	
	Structure of supply chain	Product (customization)	Volume	Delivery date	Improve supplier responsiveness	Flexible sourcing
Multiple or single supplier	X					X
Joint product development with supplier	X	X			X	X
Supplier selection based on flexibility	X					X

Long or short-term relationship with suppliers	X	X	X	X	X	X
Supplier switching cost and time reduction practices	X					X
Incentives for investment in leadtime reduction		X	X	X	X	
Sending demand forecasts to supplier			X	X	X	
Active communication		X	X	X	X	
Application of electronic data interchange			X	X	X	
Collective purchase volume at supplier	X		X	X		X
Common production plan			X	X	X	
Engagement of top managements	X				X	X
Collaboration with subsuppliers		X	X	X	X	
Consignment inventory			X	X	X	
Buffer inventory at supplier side			X	X	X	X
Keeping safety stock			X	X		X
Flexible options in contracts	X	X	X	X	X	X
Incentives for leadtime reductions			X	X	X	X
Cooperation with suppliers to eliminate leadtime reduction barriers			X	X		X
Cooperative product development		X			X	
Availability of alternative transportation method				X		X
Integration with logistic provider				X	X	
Standardization of products	X	X				X

Table 12-Sources of sourcing flexibility

It should be noted that the main source of sourcing flexibility is not related to capabilities of a particular supplier's responsiveness, but it is based on the capability of the firm in order to manage the entire supply chain and restructure supply network in an effective and efficient manner.

The classification of sourcing strategies to two categories of "improved supplier responsiveness" and "flexible sourcing" is aligned with segmentation of procured components to four categories of strategic, leverage, bottleneck, and noncritical. Considering different characteristics of each category and dissimilar level of required flexibility for each category, two implications can be made. First, strategies focus on improving responsiveness of suppliers would better suit for the procurement of strategic and bottleneck components. Second, strategies concentrate on flexible sourcing are more appropriate for procurement of leverage and noncritical components.

Additionally, some results may seem counter-intuitive. For example, one component can be noncritical while the company has long term oriented relationship with a multiple sourcing strategy and low level of cooperation with suppliers related to that component. This situation observed in the case company. The explanation here can be that long term relationship with the suppliers does not always indicate establishment of cooperation. There are companies that have a long term relationship with the buyer but do not necessarily cooperate with each other.

Form another perspective, the total availability of sourcing flexibility includes the opportunities that exist to access both existing and added flexibility of the resources. Several literatures applied in this study signify the placement of procured components in purchasing portfolio matrix depending on different characteristics and establishment of relationships with suppliers. The impact of power and the relationships on the availability of sourcing flexibility becomes clear when components with different prerequisites to establish advantageous priority were studied. Thus, the availability of sourcing flexibility besides internal capabilities of suppliers to exercise flexibility also depends on the distribution of power and the relationship with the suppliers. For example, leverage components represent a significant portion of the total purchase spending for the purchaser company, and their market conditions empower the buyers more. So the purchaser has the possibility to adopt coercive strategies when they need suppliers to be more flexible. Coercive strategies can be interpreted as high-pressure efforts to impact suppliers to and provoke a desired response.

This perspective becomes most evident for volume dimension of sourcing flexibility where flexibility depends on the way that supplier priorities purchaser. If the buyer purchase large portion of production capacity of

suppliers and highly contribute to profitability of the supplier, there is a high chance that company's order being highly prioritized by supplier. Otherwise, if the purchase volume is small there would be risk that the order be prioritized as low priority from the supplier. In these cases, usage of multiple providers cannot be expected to generate more volume flexibility as the company risks becoming a less preferred customer for the respective suppliers. The way that suppliers prioritize purchaser's order influences a varying degree of access to the volume, product, and delivery dimensions of sourcing flexibility. The influence of power and dependence for making improvement in sourcing flexibility is higher for leverage and noncritical components where buyer usually has greater bargaining power.

Two dimensions of sourcing flexibility, namely product and structure of supply chain, are more dependent on the complexity of the article. For articles that are categorized as strategic and bottleneck articles, it takes long time and high cost to make development in components' characteristics or change the structure of their supply chain. This can be due to the costly quality control tests which are also highly time-consuming. In addition, it can be the case that but the manufacturing technology used by the supplier is generally complex and, therefore, difficult to change the supplier. For this dimension is thus the complexity of the product, rather than the power relations, which govern the sourcing flexibility.

Strategic sourcing decisions must not be merely based on operational metrics such as cost, quality, and delivery. It is beneficial to also incorporate strategic dimensions and capabilities of suppliers into decision making process. The capabilities of the supplier may include prominence of quality management practices, process capabilities, management practices, design and development capabilities, and cost reduction capabilities (Talluri & Narasimhan, 2004). These supplier attributes can be interpreted as key features for long-term strategic relationship. Operational factors are imperative and vital in making evaluations over suppliers but it is the strategic evaluation of suppliers that can lead to a long-term relationship. The establishment of long-term relationship with the supplier asks for making deep considerations on supplier capabilities. Suppliers with high potential capabilities are more expected in the long run to have the infrastructure and organizational competences in place to effectively meet the volatile demands of the purchasing firms.

Section 8 Conclusions

Based on the above presented analysis and discussion, here conclusions have been summed. This section tries to clarify the answers to the initial questions. Finally, the generalizations of the results and suggestions for further studies have been discussed.

8.1 Fulfillment of research questions

Obviously, this study is just an exploratory study, and all conclusions should be regarded cautiously. Especially if this fact brought into consideration that this report was just generated based on one case study. The objective with this report was to formulate some suggestions that can be further tested in future confirmatory studies. Following the initial research questions have been brought into attention along with brief and summarized answers to them.

Research question 1: What is the definition of sourcing flexibility?

This study conducted a comprehensive search and analysis on the relevant literatures to map the four constituent flexibility dimensions that pertain to the sourcing function. Based on the investigations and nature of the presented problem, this report will consider the definition of sourcing flexibility from an integrative, customer-oriented perspective. Sourcing flexibility can be defined from two perspectives. First one refers to the capability of the focal firm to change the structure of its upstream supply chain. Second aspect refers to the ability of company's suppliers to provide it with flexibility in three dimensions of delivery, volume and product.

The both two above mentioned aspects along with associated dimensions can be measured in three different conditions of required, actual and potential. It should be again highlighted that flexibility is relative element. Flexibility can be measured in evaluation with other factors such as cost and quality. Three elements have been mainly used to define any flexibility dimension in literatures. These elements distinguished as range, mobility, and uniformity. The definitions of these elements with respect to different dimensions of sourcing flexibility have been presented in Table 9.

Research question 2: How is sourcing flexibility connected to strategic procurement?

A sourcing flexibility driver is a characteristic of supply chain which the purchasing function has little or no control over it and it necessitate the requirement of sourcing flexibility. Through deep analysis of the particular project and the performed interviews, several drivers have been identified for sourcing flexibility. Some of them are dependent on the characteristics of the focal company and are internal. Additionally some others are related to

characteristics of firm's upstream supply chains (suppliers) and/or downstream supply chains (customers). These are being considered as external drivers. The distinguished drivers are uncertainties associated with the production plan, customer's demand volatility, low accuracy of forecasts, customers' requirements disparity, need to switch between suppliers, supply uncertainty, and length of leadtime.

Due to differences in characteristics of above mentioned drivers with respect to each category, the required level of sourcing flexibility varies between different categories of procured components. Observations over the characteristics of non-critical category resulted in low level of required sourcing flexibility. This is while, this level for leverage category distinguished as medium and for strategic and bottleneck categories determined as high.

Two main strategies can be observed as influential on sourcing flexibility. (1) The ones aim at improving supplier responsiveness capabilities and (2) the ones with concentration on flexible sourcing. This point of view is consistent with the view of this report to consider sourcing flexibility from two levels of aggregate (strategic) and operational. The sets of strategies concentrate on increasing supplier responsiveness are the ones that influencing sourcing strategy at the operational level. Consistently, those strategies focus on flexible sourcing are the ones that are influential on sourcing flexibility at the aggregate level and try to constantly reconfigure the supply chain.

It got concluded that for leverage and noncritical products, the flexible sourcing strategies are more appropriate and company can gain better benefits regarding improvements in the level of sourcing flexibility. Cohesively, for bottleneck and strategic items those strategies that focus on improving supplier responsiveness are more suitable. This is while company should always seek strategies to find more flexible sources for even strategic and specially bottleneck products.

Finally, improvements in level of sourcing flexibility were analyzed from another perspective too. The influence of power and dependence for making improvement in sourcing flexibility is higher for leverage and noncritical components where buyer usually has greater bargaining power. For product and structure of supply chain dimensions is the complexity of the product, rather than the power relations, which govern the sourcing flexibility.

8.2 Managerial implications

The results of this study provide essential information for procurement practitioners who are involved in the process of managing sourcing flexibility. A customer-oriented manufacturer should develop the capability to affect sourcing flexibility in order to match dynamic customer demands.

8.3 Future research

There are some points in the study that can form the basis for further studies. Firstly, it should be noted that most of the sourcing flexibility sources can be also applied to achieve other competitive priorities such as cost or quality differentiation. However, due to the requirement of restraining the scope of this report merely the practices applied to increase sourcing flexibility were analyzed. Nevertheless, in further studies it would be beneficial to recognize the degree that those sourcing practices can influence a mix of competitive priorities.

Furthermore, a good compliment for this study can be verifying the results of this report in other companies and more beneficially other types of industries.

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Section 10 Appendices

Appendix 1

Strategic direction of procurement department

Following are the criteria for analyzing the strategic importance of procured items (i.e components that are being purchased by PPC). These have been defined by using four competitive priorities of *cost, flexibility, quality and delivery*. Please rank these criteria based on their preference according to your point of view. **Where 1 is the most important one in compare to others and 5 is less.** For example if you think purchasing cost is the most important factor, assign number 1 to it and then the rest based on your view in numerical order.

Your answer to the question is of high significance since it is going to be applied as a basis of further analysis.

	1	2	3	4	5
Cost of procured item (purchasing cost)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Required level of Flexibility	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Delivery(effect on ,on time delivery of final product)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Technological competence	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Appendix 2

Strategic Importance of procured categories

Dear Strategic purchaser,

A list of categories of components which you are responsible for purchasing have been gathered up together. **Our request from you is to evaluate each category based on the criteria mentioned below.** For example if you think that the purchasing cost of one component category constitutes a high portion of the final product's cost, assign number 5 (high) to its purchasing cost. The answers can also be repetitive. For example, for one category both of its purchasing cost and quality can be highly influential on the cost and quality of final product then number 5 will be assigned to both criteria.

Your answers are of very high significance for us because they are going to be used in our further analysis.

Thanks for your time in advance!

(Name of component group)

Please rate the product category based on following criteria.

	1 (low)	2 (fairly low)	3 (moderate)	4 (fairly high)	5 (high)
Purchasing cost (How big share of the final product cost refers to the cost of this component category?)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality (In what degree does the component category's quality influence the final product's quality?)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lead time (How long is the lead time for this component category)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Delivery (How important is on-time-delivery for this	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

1 (low) 2 (fairly low) 3 (moderate) 4 (fairly high) 5 (high)

**component category to
get the final product
on time?)**

**Required level of
technological
competence (Where 1
is very standard
component and 5 is
very customized)**



Appendix 3

Complexity of supply market

Dear Strategic purchaser,

A list of categories of components which you are responsible for purchasing have been gathered up together. **Our request from you is to evaluate each category based on the criteria mentioned below.** For example if you think that the supply market of one component group is highly scarce, assign number 5(high) to the first criteria. The answers can be also repetitive.

Your answers are of very high significance for us because they are going to be used in our further analysis.

Thanks for your time in advance!

(Name of component group)

Please rate the product category based on following criteria.

	1 (low)	2 (fairly low)	3 (moderate)	4 (fairly high)	5 (high)
Availability of alternative suppliers (Is this component category single sourced or does it exist multiple sources?)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Technological request on suppliers (In what degree should the supplier be technological competent in order to supply this component category?)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Difficulty/ease to switch supplier (How difficult is it to change supplier? Considering switching costs, cost of qualifying new supplier, degree of specific investments, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	1 (low)	2 (fairly low)	3 (moderate)	4 (fairly high)	5 (high)
Logistics costs and complexity (In what degree is the component costly and complex from logistic perspective? Considering transportation cost, inventory cost, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cost of non on time delivery by the supplier	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How big effect has the customer request while you selecting supplier for this component category?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Appendix 4

Interview questions

- What is the function of the article?
 - Please tell us generally about the article.

 - Component uniqueness. Is there any other article with same function?

- **Production method**
 - Specific, standard, customized? Complexity of manufacturing.

 - Customer order, make-to-order or regular order?

 - Common productions plan with supplier? (About sharing info)

 - What is the production capacity of the supplier for the article?

- **Supplier selection criteria**
 - No of available suppliers

 - Difficulty in changing supplier

 - Why is it easy or hard? What are the limitations?

 - What are the factors containing in switching cost?

 - Are there any activities to reduce the switching cost?

 - Any need of specific investment in terms of education, money or (tech) knowledge exchange... (for development)

 - Do they or do we invest in an own production line?

 - Any incentives for investments?

- How do the options in the contract look like? How are these defined? Any flexibility options?
-

- **Transportation**

- Method and why? Train, air, ship...

 - Any alternatives? Multi choices? Trade-offs?
-

- Is it a third party logistic provider?
-

- Interval and volume
-

- How is urgent deliveries handled?
-

- **Inventory**

- Do you or supplier keep inventory for these articles?
-

- Supplier: In what inventory form – material, component or final product?
-

- Is the supplier holding safety stock? Are we? Buffert?
-

- **Lead time**

- What factors are making the lead time?
-

- How can it be reduced? What have been done?
-

- Any trade-offs? Flexibility-cost-quality-time.
-

- How is the access of material resources for supplier?
-

- How are the choices of material resources for supplier?
-

- How is the quality assurance and tests being done in terms of duration and importance?
-

- How is the forecast being done? (2 aspect - customer and supplier)
-

- Is the order-cycle-time regular or irregular? Ordering the same quantity? Q-limitation?

- **Relations**
 - How important is the relationship with BT for the supplier? Does BT cover a big share of their business?

 - What is the level of manufacturing flexibility at supplier site?

 - What are the success factors for the long relationship? If non, what are the reasons why? What can be improved?

 - How are conflicts resolved?

 - How is the information sharing? Any change? Previous-, today or future plan.

 - What are the methods of sharing information? (ERP, weekly meeting, follow-up emails, EDI)

 - Distribution of power, who is holding bargaining-power?

 - How is the usage of power influence, persuasion or force in achieving requirements?

 - Can you influence the short-term capacity of supplier?

 - What is the outlook for future relationship? Short-, mid-, long-term

 - Any connections to sub suppliers? E.g any contracts with them?

- Change in sourcing flexibility dimension (customization, volume, delivery)
 - How is the process when a change within each dimension occurs?

 - What is the limitation and restrictions?

 - In case of defects of article, how is it handled?

- What are the possibilities of postponement?

- Is there any cost for changes? Other penalties?

- What activities have take place for improving flexibility?

- Which activities are you working with today to improve flexibility?
