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**Single versus Multiple Sourcing: Investigating the most profitable scenario  
for OEMs**

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# **Single versus Multiple Sourcing: Investigating the most profitable scenario for OEMs**

By  
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## Abstract

This thesis aims to explain how a specific Truck OEM chooses how many suppliers to source from. The main purpose of the study was to investigate the benefits and disadvantages of single and multiple sourcing in a specific Truck OEM.

A case study has been used in order to conduct the research, with semi-structured interviews to collect the data. The empirical data show that a buyer-supplier relationship and collaboration in regards to common product development and progress is stronger in the single sourcing strategy since the amount of time spent is huge. The main focus of buyers should be cost reduction in a long-term perspective. Further, the empirical data show that volumes, investments and manufacturing locations do not make shifting easy from one supplier to another. Securing budgets and resources for multiple investments can be challenging. With the global markets expanding more and more, it is critical that each organization keeps track of all changes in the purchasing world, and how different scenarios in the supply chain are realized. In fact, many factors determine whether a buyer follows the single or the multiple sourcing strategy. A checklist that could be consulted to buyers when making sourcing decisions, can better prepare them for choosing between the two strategies.

**Keywords:** single sourcing strategy, multiple sourcing strategy, supplier selection procedure, supplier relationship management, total cost of ownership.

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## List of Abbreviations

ABC:	Activity Based Costing
APQP:	Advanced Product Quality Planning
DEA:	Data Envelopment Analysis
EDI:	Electronic Data Interchange
ERP:	Enterprise Resource Planning
JIT:	Just in Time
OEM:	Original Equipment Manufacturer
KG:	Kilogram
PSL:	Potential Supplier List
QDCF:	Quality Delivery Cost Features
RFI:	Request for Information
RFQ:	Request for Quotation
ROI:	Return on Investment
RTS:	Review of Technical Specifications
R&D:	Research and Development
SCM:	Supplier Choice Meeting
SOP:	Start of Production
SRM:	Supplier Relationships Management
SSEM:	Short Supplier Evaluation Method
SWOT:	Strengths Weaknesses Opportunities Threats
TAR:	Target Evaluation Request
TCO:	Total Cost of Ownership
TOPSIS:	Technique for Order Preference by Similarity to Ideal Solution

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# 1. Introduction

Firms need to produce quality products at reasonable prices in order to remain competitive in global markets. The purchasing departments of multinational organizations select suppliers based on their capabilities and they must be carefully analyzed and evaluated in order companies to meet high standards. The managers of purchasing departments have gained more power over time because organizations begin to realize the importance of defect-free components and the value-added capabilities of suppliers. Moreover, they come up against supply chain disruptions. Disruptions occur for different reasons and can be in many cases harmful to production.

This chapter introduces the main concepts that are looked into in this thesis. The author starts with explaining purchasing, and its importance to the company. The main area of investigation in this thesis is how a company chooses how many suppliers to source from. Since sourcing is a function of the purchasing department, it is appropriate to describe what purchasing entails, so that a more holistic view is formed. A more detailed understanding of the role of purchasing is important to a buyer, since it can provide the tools to more effective sourcing and to deciding whether sourcing from one or more suppliers is appropriate in each case. Basic terms are explained, followed by the background and the purpose of the study. Finally, the outline and the delimitations of the study will be presented. This thesis is written in collaboration with a Truck OEM. A confidentiality agreement signed by the author prohibits him from mentioning the Truck OEM's name and the commodity's name under investigation. By the term commodity, the author refers to a family group in which there is a variety of different components. When relating to truck parts, OEM relates to the manufacturer of the original equipment, which means the parts assembled and installed during the construction of a new truck. The assumptions made by the author were that single sourcing means one component is being delivered by one supplier and multiple or dual sourcing means one component is being delivered by more than one supplier.

## 1.1 Purchasing

To purchase something means to buy it; to obtain something by paying the price or its equivalent, set by a seller. Depending on what type of purchase one is making, different processes take place concerning the different purchase types. Consumer purchasing is done for personal consumption and is influenced by a range of different factors, including product availability, disposable income, brand image and advertising. Industrial purchasing takes place when a company is the buyer. The aim is buying to convert material into finished products, such as raw materials, components, tools and equipment. Between the two purchase types, the industrial purchasing process is typically much more complex and large-scale. The focus here is on industrial purchasing, when a company obtains items and services towards achieving a production goal.

Once a company has identified the components required to manufacture the items that it disposes to the market, it needs to source them. The purchasing process and function includes a number of steps, which once identified and specified, can be documented and repeated. It involves managing the resources that a company needs in order to be able to secure services, capabilities and a smooth supply of goods that are required for running, maintaining and managing a company's primary and support activities (Van Weele, 2014, p 3). Direct purchasing applies to procuring the materials needed to manufacture the final product, and indirect purchasing refers to activities not directly related to production, such as office

equipment, staff catering, cleaning materials and housekeeping (Van Weele, 2014, p 6). The focus in this thesis is on direct purchasing.

The decision-making process starts with identifying alternatives and ends with choosing between these. Deciding between suppliers to source products and services requires time and meticulous work. Products must be of the required quality and at the right price. Decisions depend on production specifications and the capacity of the facilities among others. The economic factor obviously plays a big role in buying decisions.

The person who takes decisions on acquiring materials and services for the employer is called a 'buyer' (Cheverton & van der Velde, 2011, p 1). Tasks include specifying, sourcing, negotiating, contracting and evaluating. For example, in the case of standardized items that are needed regularly, the buyer is authorized to place orders with the suppliers according to production needs.

Purchasing and logistics are two separate but complementary actions. In a simplified model, there is inbound logistics related to transporting items and materials towards the premises of the manufacturer where they are typically stored. Outbound logistics is related to transporting the ready production out of the premises. Therefore, purchasing and logistics play an integral role in establishing and managing the supply chain. Their cooperation assures a smooth product and information flow, as logistics assist purchasing in achieving improved coordination of transportation and warehousing. In this way, their cooperation accommodates the expansion of the company's relationships with other firms, if those functions are outsourced (Cooper and Ellram, 1993).

Procurement is the action of locating and subsequently obtaining something (e.g., equipment or supplies). The relationship of procurement with purchasing is that the purchasing department specifies what needs to be bought, and the procurement department makes sure that what is needed is actually sourced. Ideally, the purchasing and procurement departments should work closely together and be mutually complementary. Procurement is a related operation to purchasing and includes actions like planning, making, administration and control. Depending on how the company is organized, both functions can be under the responsibilities of a single department, or they can be separated, as recommended by Cheverton and van der Velde (2011, p 1). Procurement is a firm's organization unit accountable for all strategic and purchasing-relevant planning, activities and procedures. Purchasing is a subset of procurement. It is based on transactions and is accountable for the provision of goods and services required within the company at the right time, price, and quality (Münch, 2015, pp 42-43).

Working with purchasing or procurement means working as part of the supply chain. The functions described above could be met in different job descriptions in the field. Sourcing is another piece of the chain, directly related to purchasing, since once a supplier is chosen, it is then time to purchase.

### **1.1.1 The role of purchasing in an organization**

Purchasing, as part of a company's activities, can have a significant effect on its robustness and prosperity. These activities can be influenced by lack of services or materials, among others; therefore, the role of the buyer in the company is a central and essential one. The

majority of companies today spend more than half of their sales turnover on purchasing, whether this is services or parts (Van Weele, 2014, p 3). It is therefore of paramount importance that careful consideration is put on what to purchase, how, at which price and from whom. Since most purchased items and services serve to a company's continuous needs, they become key components of production cost. This does not only create the need for establishing standardized processes, but also optimized ones. Companies are similar to living organisms that can be affected by both internal and external factors, and processes must therefore be under constant evaluation. As businesses become increasingly competitive, purchasing, consequently, attracts growing attention.

In an organization, a number of value creating activities take place, all of which together constitute the value chain. Effective management of this value chain can give the organization a competitive advantage. The two main categories are 'primary' and 'support' activities, each of which includes subcategories (Porter 1985, pp 39-40) (Figure 1). All are separate but related functions.

<u>'primary' activities</u>	<u>'support' activities</u>
<b>Inbound Logistics:</b> Receiving, storing, vehicle scheduling, warehousing, inventory control etc.	<b>Procurement:</b> Referring to the function of purchasing.
<b>Operations:</b> All functions related to transforming inputs to outputs, namely the final product.	<b>Technology Development:</b> Technologies related with the effort to improve the product and the process.
<b>Outbound Logistics:</b> Finished goods logistics, like order processing, delivering etc.	<b>Human Resource Management:</b> Recruiting personnel, training, compensating etc.
<b>Marketing and Sales:</b> Advertising, promotion, pricing, quoting etc.	<b>Firm Infrastructure:</b> Activities related to management, planning, finance, accounting, legal, facilities management etc.
<b>Service:</b> Services related to enhancing and maintaining the value of the product.	

**Figure 1:** Overview of value creating primary and support activities in a company (based on Porter, 1985)

Purchasing, as part of the support activities, can have a significant impact on the overall cost, which is why optimized purchase execution should be pursued (Porter, 1985, p 41). That is not only because of the cost of the purchased items, but also of their effect on the total quality of the output. Therefore, purchasing can be decisive in cost positioning.

Understanding the economic role of purchasing in an organization is vital, because sourcing strategies are directly related to costs. As Van Weele (2014, p 13) puts it: 'a euro saved in purchasing is a euro added to the bottom line', meaning generally savings from the whole purchasing procedure. He goes on to argue that improved logistics related to purchasing processes, like refined planning and scheduling, can bring about working capital reductions, and save cost in this area as well. Finally, he mentions that the suppliers can positively influence the company's innovation processes, if this message is communicated to them properly.

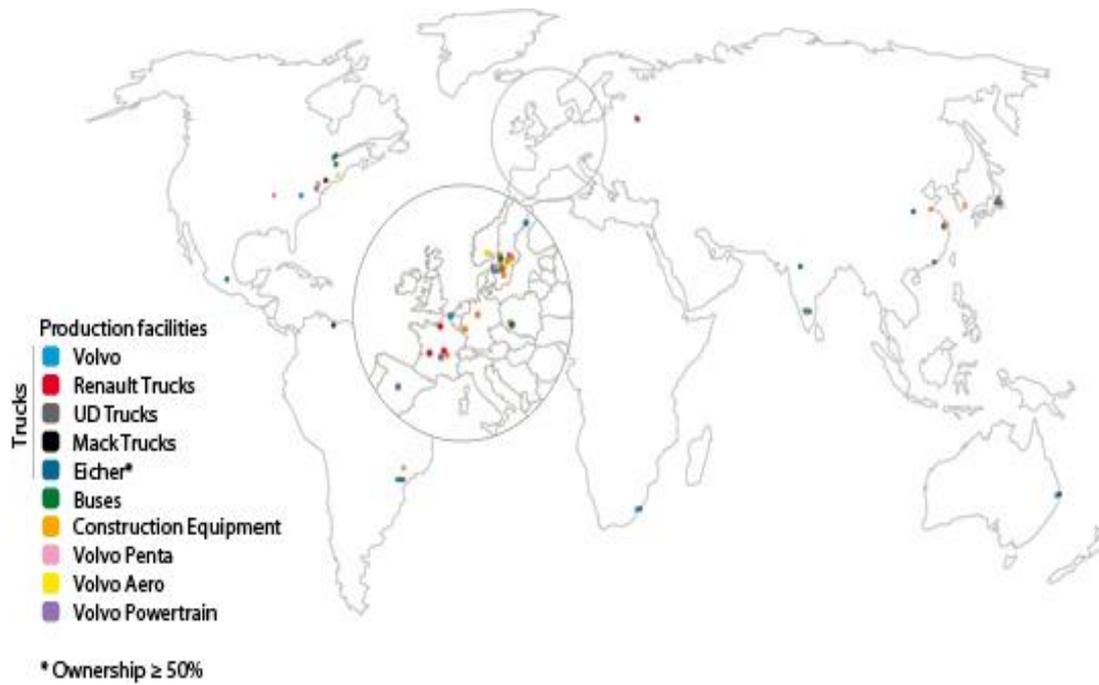
The purchasing process can relate to a large variety of goods and services. These can be grouped into many categories such as: raw materials, supplementary materials, semi-manufactured products, components, finished products among others (Van Weele, 2014, p 15). This thesis deals with many components under one specific commodity category. A confidentiality agreement signed by the author prohibits him from mentioning also all the components' names under investigation. However, these components are divided into three main categories. Some components are raw materials which are machined in-house, others are semi-finished products which are machined also in-house and others are completely ready from a supplier's part. These components consist of different characteristics, the analysis of which is not the scope of this thesis.

An improvement in the skills of the employees sitting behind purchasing functions could lead to a progression from a simple supplies ordering model, to a managed supply chain model (Rozemeijer, Van Weele and Weggeman, 2003). That would mean to not only just order supplies at designated quantities and delivery times, but also to see past that simple function. It would mean to be able to recognize important patterns in suppliers and compare them to the company's requirements, maintain the company's standards, manage and try to reduce risks, planning and controlling. The higher this level of maturity is, the higher the chances of reducing cost. Through audits performed by Schiele (2007), it was concluded that purchasing maturity is positively correlated to cost reductions. The more developed the organization is, the larger are the saving potentials.

The objective for manufacturing companies is to maximize profit. This is achieved via sales increase or cost decrease. Sales increase is a marketing issue mainly, but cost decrease can occur on many levels, and through purchasing, significant cost savings can occur. Effective purchasing management can contribute to the general growth of a company. The proposition that a company's sustainability performance may hinge on cost savings in the purchasing process was accepted by Krause, Vachon and Klassen (2009), who observed that, 'a company is no more sustainable than its supply chain'.

## **1.2 Background of the study**

Among the world's largest truck manufacturers are Daimler Trucks, Isuzu Motors, MAN Truck & Bus, Mitsubishi Fuso Truck & Bus, Renault Trucks, Volvo Trucks & Buses, Scania and others (Automotive World, 2016). All these manufacturers have extended brand portfolios and their production facilities are spread all over the world. One example is Volvo Trucks & Buses, which has production facilities in 18 countries and sell their products in 190 markets worldwide (Volvo Group, 2017). Daimler is also an example of a company with production facilities located throughout most continents (Figures 2 and 3).



**Figure 2:** Worldwide distribution of Volvo production facilities (Volvo Group, 2011).

## DAIMLER

### International presence: ... Daimler Trucks



**Figure 3:** Worldwide distribution of Daimler production facilities (Daimler, 2010).

The distribution maps in Figure 2 and 3 indicate the potential complexity of sourcing in companies operating on six or seven different continents. Decisions on whether to use one or more suppliers can be challenging to begin with. It can become even more complicated when the production facilities are spread around the world, since the same dilemma can be regarding each facility, country, region or continent. While each facility generally, has autonomy regarding indirect purchasing, decisions regarding direct purchasing are usually performed centrally in the company. The reason is that companies might spread out global tenders to their suppliers of choice. Attending to all the facilities' needs can be more challenging for the buyer making this decision on a global basis.

Manufacturers are dependent on their suppliers in order to produce their products. The suppliers are likewise dependent on their own suppliers. Any disruptions at any part of the chain can lead to problems ranging from minor delays to production stoppage. If the supplier is unable to provide the manufacturer with the needed items, it is imperative that an alternative strategy is in place. Manufacturers must always be prepared for this and take precautions to prevent a potential production stop.

Several of the companies mentioned at the beginning of this section manufacture cars and trucks. The production of each type of vehicle requires a long range of different parts. Since generally cars are produced in larger numbers and sell more than trucks, it would be reasonable to assume that car components are easier to obtain. For a truck manufacturer, there might be only a handful of suppliers available, which produce some of the specialized parts needed.

Since purchasing represents a significant amount of yearly spend, it is important that there is a balance between how much money is used and how much money is earned. With markets continuously expanding, it is crucial that the company keeps track of changes in the purchasing world, and that different scenarios in the supply chain are perceived as effectively as possible. In addition, it is imperative that the company is prepared against possible disruptions of the supply chain, with multiple sourcing options and at the same time with optimized logistics cost.

Following a single sourcing strategy has both its advantages and disadvantages, as does a multiple sourcing strategy. It was exactly the dilemma of choosing a single or a multiple sourcing strategy, which led the specific Truck OEM to commence this investigation. All manufacturers face a similar dilemma. The literature is full of examples of supply chain disruptions caused from companies not having alternative suppliers. Attempting to find a potential choice for the Truck OEM investigated here may possibly have practical implications to their operations and increase their improvement potentials. Interest for this analysis could extend beyond this single Truck OEM, since it potentially has a wider application to other OEMs. Terms 'component' and 'item', 'manufacturer' and 'buyer', 'strategy' and 'approach' will be treated as synonyms in this thesis.

### **1.3 Purpose statement**

The purpose of this thesis is to investigate the advantages and disadvantages of single and multiple sourcing in a specific Truck OEM. Moreover, the drivers for decision making during sourcing need to be researched. Based on them, a checklist is prepared in the conclusion chapter in order buyers to make better sourcing decisions. Some generalization could be

possible to OEMs in the car industry because some rules apply as well in regards to sourcing strategies.

#### **1.4 Research questions**

The main research questions in this thesis are:

**RQ1:** What are the benefits and disadvantages of single and multiple sourcing in a specific Truck OEM?

An aim is to formulate a checklist on how to better prepare for choosing between the two strategies, by compiling and formulating an index of checkpoints that could be consulted to buyers when making sourcing decisions. For that to be possible, the motives behind each decision must be identified. Therefore, a related research question is:

**RQ2:** Which are the drivers for decision-making in a specific Truck OEM during sourcing?

It is expected that looking into how Car OEMs take this decision will provide an improved understanding of the issue. This is reflected in the third research question:

**RQ3:** What lessons can be learned from Car OEMs in regards to the same dilemma?

Following this introductory part, a literature review and the main theories in regards to sourcing will be presented, followed by the methodology chapter which describes the motivation for the application of the author's approach used to identify, select, and analyze information applied to understanding the research problem. The empirical data will summarize the main results gathered during this investigation and the analysis part will provide an answer to the research questions. The discussion part will sum up the convergent and divergent aspects between the results of the literature review and the outcome of the empirical data. The thesis will be concluded with suggestions to the company and description of limitations to the analysis and the results.

#### **1.5 Delimitations of the study**

As mentioned in the beginning of this chapter, only decisions in regards to direct purchasing are investigated in this thesis. Moreover, the companies looked into, are strictly manufacturing. Since it is a manufacturing company that initiated this project it would not add any value to the company if sourcing strategies from a wider industry were investigated. As much information as possible was gathered from vehicle manufacturers, since is the closest market to the Truck OEM.

Decisions on acquiring materials are investigated in this thesis. Some services in regards to these materials are integral to operations, such as sourcing the transport provider or renting warehouse facilities. Parts' requisition necessitates consideration of transportation costs. Logistics operations and costs are key factors, which should not be omitted from the investigation of any purchasing case.

To investigate all commodity types included in truck building, each of which consists of categories of specific items, is deemed too ambitious for a single research study. In addition,

the results would be questionable, as each commodity is characterized by its own specific features. Therefore, the main body of interview data regards one specific commodity.

## **2. Literature Review and Theoretical Framework**

This chapter serves the purpose of reviewing the most relevant theories related to this study, as found in published literature. In the first part, the theoretical foundation is developed from theories on the single sourcing approach, followed by the same in regards to the multiple sourcing approach. The sourcing strategies are then compared, taking into consideration both their advantages and disadvantages. Following these, the industrial buying behavior is explained, as both the variables affecting it, and the actual supplier selection procedure, can have a weight on sourcing decisions. Supplier relationship management and assessment come after, as integral parts in any sourcing case, since the number of suppliers employed can be affected by the buyer-supplier relationship. Finally, the concept of the total cost of ownership is considered, as all costs related to hiring a supplier need to be taken into consideration, before any decisions are taken. Many academic articles were looked into and the relevant information was utilized to compile this chapter.

### **2.1 The single sourcing approach**

Single sourcing means that the buyer is using a single supplier for specific items and for a specific period. The goods or services sourced are linked to one supplier who is chosen to enhance the collaboration between the buyer and the supplier (Skjøtt-Larsen et al., 2007).

During the 1990's, there was a trend for Japanese manufacturers to single source from suppliers. Particularly Toyota adopted a perspective that focused on long-term relationships with a single supplier per item sourced, with the aim of improving the performance of their supply chain. The Japanese manufacturers chose to accept the risk of dependency on one supplier, by significantly increasing the purchase volumes, and by committing to invest in those suppliers through their development programs. The single sourcing strategy has the advantage for the suppliers to benefit from the economies of scale (as the volumes increase the cost per unit decreases). Specifically, it helped the Japanese manufacturers not only to obtain lower prices, but also to lower other underlying supply chain costs. Furthermore, dealing with single sourcing and keeping a smaller total number of suppliers reduces the costs of negotiation with managing a larger supply base; thus, reducing the transaction costs (Johnsen, Howard, Miemczyk, 2014, pp 96-101). In addition, single sourcing can have the advantage of reducing the duplication of operations, such as setup, if that is needed, when sourcing from another supplier (Benton, 2010, p 176).

For the sake of clarification, single sourcing is different from sole sourcing. Single sourcing means a buyer chooses to work with one supplier, even though there are other comparable suppliers in the market. Sole sourcing refers to the relationship between parties, when there is only one supplier in the supply base (Yu, Zeng and Zhao, 2009). For the purpose of this thesis, they are considered within the same category even though in reality of purchasing they have different risks and benefits.

Sourcing from a single supplier and signing a long-term contract decreases the supplier's uncertainty, since business will not be lost over the competition. Because of this, the supplier is more willing to invest in new equipment or modify some of its operations in order to supply the buyer more effectively (Benton, 2010, p176). There is better responsiveness between the buyer and the supplier since the buyer has to worry only about communication with one party, something that saves time. Moreover, there is better quality of products when dealing with single sourcing and the product design is much faster. In other words, with one supplier, the

buying company does not have to worry about suppliers having different ideas about what the product should be and what it should be made of. The inspection costs are also reduced, since the buying firm has only one company to inspect (Mathusek, 2010).

Burke, Carrillo and Vakharia (2007) and Yu et al. (2009) agree on the fact that single sourcing allows a more streamlined supply chain network to be established between the parties, via successful JIT inventory initiatives. In the same spirit, the benefits of single sourcing also include that suppliers are linked to higher levels of buyer-supplier cooperation, and total order lead-times and logistics costs are reduced as a result of decreasing the supply base (Larson and Kulchitsky, 1998).

There is empirical support that experience makes firms better at doing something. That means that they are constantly learning by doing. This phenomenon of learning has been observed at many different levels such as firms, individuals, groups, factories and industries. Single sourcing enhances this learning, which is experienced by the active supplier, and for that reason, it reduces the supplier's costs. This strategy, however, increases the buyer's dependency on this supplier, as alternative supply sources become less and less competitive comparatively. Because of this, the buyer might not be able to extract much of the benefits derived from the supplier's cost reductions, as its outside options might be limited. This is a trade-off for the buyer, but for a powerful one with strong bargaining capabilities, single sourcing can be proven a better option. In addition, single sourcing maximizes system profitability, which means the aggregate surplus of the buyer and the supplier (Heese, 2015).

Generally, single sourcing is preferred from buyers when they are interested in building partnerships with the suppliers. The reason why this might be imperative could be related with the nature of the sourced items and what kind of technical support the buyers might need in the future. For complex products with high tooling cost or for highly specialized components, it is important that the supplier's technological knowledge is available. Support should be at the buyer's disposal, if the buyer intends on concentrating the orders with one supplier in the long run. The advantage with that strategy is that the quality of the final product could be improved with time (Owens Swift, 1995).

## **2.2 The multiple sourcing approach**

Multiple sourcing is the use of more than one supplier for buying the same or similar product or service and because of that, the buyer can switch between them if needed. This can be beneficial for the buying companies because they can maintain alternative supply options. By having several suppliers, the company avoids dependency on one supplier, and any potential risk that dependency brings is spread. Companies can stimulate competition among suppliers, for example by forcing them to reduce prices. Even though the multiple sourcing approach could create an adversarial atmosphere within the buyer-supplier relationships, this view has changed over time as companies demand more collaborative relationships with their suppliers (Johnsen, Howard, Miemczyk, 2014, p 97).

Two suppliers might be able to achieve economies of scale, by spreading volume over fixed costs. This means that the per-unit savings are subject to diminishing returns. If the volumes are large enough though, the two firms might get the returns diminished enough to be comparable with that of one firm (Benton, 2010, p 176). Diminishing returns, in production for example, occur when the amount of a variable factor is incrementally increased, and as a result, the incremental output of the production decreases (CFA Institute, 2011a, p 138). Moreover, the buying firm has more opportunities to learn from multiple suppliers instead of

having just one (Mathusek, 2010). In avoiding supply bottleneck or supply congestions, the recommendation according to Schuh et al., (2012, p 66) is to use dual sourcing; using at least two suppliers in parallel for critical components. With dual sourcing, there is one main supplier, which gets the biggest amount of business from the buyer, and another, to create competition, but also to be a back-up in case of problems with the main one. The percentages of the shared business between the suppliers are not necessarily fixed. Depending on the situation and the contracts, they might change (Yu, Zeng and Zhao, 2009).

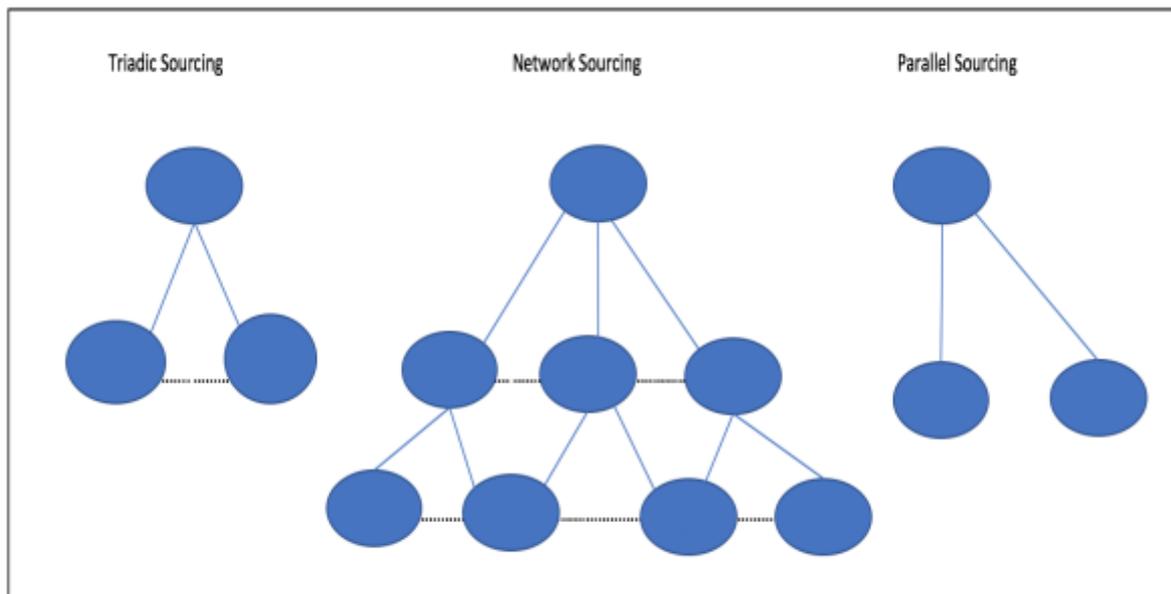
Furthermore, multiple sourcing can provide improved market intelligence. That means that if the buying firm has contact with many suppliers, it can allow the firm to be aware of new developments or new technologies, gain knowledge and expertise, and potentially introduce faster its products to the market. Supplier appraisal effectiveness is also another advantage of multiple sourcing, which occurs when the buying firm has greater contact with many suppliers. That will increase the effectiveness of evaluating a supplier's ability by comparing production data and cost from one supplier to another (Benton, 2010, p 176).

According to Ramasesh et al. (1991), multiple sourcing provides greater assurance of delivery on time and greater flexibility in volume because of the diversification of the firm's total requirements. Many managers have recognized that their firms need to develop a close collaboration relationship with their suppliers. For that reason, multiple sourcing is considered the most suitable approach in order to maintain balance among them and reinforce the partnerships (Kirytopoulos et al., 2010).

One type of multiple sourcing according to Hines (1995) is the network sourcing, which involves using many suppliers for the same type of components. This type considers not only the direct suppliers and their relationships with the buying firm, but also the indirect ones, and how they collaborate among themselves. Indirect suppliers are the suppliers of the buying firm's suppliers. Thus, competition is maintained both between direct and indirect suppliers. Japanese car manufacturers followed this unique subcontracting system. Their cooperation with their suppliers include a tiered supply structure, risk sharing, staff cross-exchange between buyer and supplier, trust relationships and supplier coordination and development (Skjøtt-Larsen et al., 2007, p 237).

Dubois and Fredriksson (2008) recommended another form of multiple sourcing, the triadic sourcing. Under this form, the buyer creates interdependencies between two suppliers. For example, based on observation from practices from Volvo Cars, they described how Volvo Cars makes two suppliers to be responsible at the same time for developing interdependent components. In addition to that, Volvo Cars would allow one supplier to produce what the other has already developed.

Another form of the multiple sourcing is the parallel sourcing. According to Richardson (1993), under parallel sourcing the buyer wants to have its options open, by exploring other sources and thus putting a lot of pressure on the single supplier. There is intense competition between the suppliers, who have similar competences and deliver the same type of components to the buying firm. In parallel sourcing one supplier supplies one component for one plant, and another supplier supplies the same component to another plant. This type of sourcing ensures that similar suppliers act as single suppliers of the same component. The manufacturer can compare their performance and maintain a competitive pressure between them, encouraging them indirectly for continuous improvement (Skjøtt-Larsen et al., 2007, p 235).



**Figure 4:** Triadic, Networking and Parallel Sourcing (Johnsen, Howard, Miemczyk, 2014, p 99)

Gadde, Håkansson and Persson (2010) concluded that the advantages of multiple sourcing include reductions in the transactions' uncertainties, avoidance to lock into one technology, and opportunities to pressure more the components' price. By having many suppliers, the risks for transactions' uncertainties are minimized, because the risk of delivery failure is reduced. The other suppliers can pitch in, in case one does not manage to fulfill the obligations (Tullous and Utrecht, 1992). Moreover, many suppliers ensure that the buying firm will not depend exclusively on a specific technology and in that way, they will ensure to introduce a product on time to the market. Several suppliers can put some extra pressure to the price of components and that is beneficial for the buying firms. A computational analysis performed from Sawik (2014) concluded that multiple sourcing better mitigates the risks related to increased cost for the buyer, stemming from disruption risk, and to decreased service levels for its customers, referring to fulfilling orders after the due date. In a similar spirit, Meena, Sarmah and Sarkar (2011) had claimed that a reduced supply base increases the risks of supply disruptions, because failure of a single supplier to produce and deliver the needed items to the buying company, will negatively affect the performance of the whole supply chain.

According to Gadde, Håkansson and Persson (2010), the advantages of multiple sourcing described above, do not ensure that they occur at the same time and apply to every situation. For example, the fact that the suppliers are competing against each other, is not a guarantee that the buying firm can source at a lower price. Nevertheless, there are a lot of authors who advocate in favor of the individual benefits of multiple sourcing for the buyer.

The selection of a sourcing strategy is a complex issue for every organization and there is no right or wrong answer. The challenges in regards to both strategies that are described below can give a more holistic view and might be helpful for professional buyers to decide which strategy is more suitable. Each firm needs to weigh all the factors of single and multiple sourcing before making a decision.

### 2.3 Challenges related to single sourcing

Single sourcing has advantages, because it creates close collaboration between the manufacturer and the supplier. However, dependency on a single source pressures the buying firm towards a greater risk of supply chain disruption (Chopra and Sodhi, 2004).

One example of a manufacturer failing to produce its items, because the supplier failed to deliver parts, is that of 'Ericsson', the mobile telephone manufacturer. In 2000, lightning hit a power line in New Mexico. This affected the electricity in the whole area, and started a fire at a local 'Philips Electronics' plant, which was producing microchips for mobile telephones, Ericsson included, destroying millions of them. As a result, the plant had to close down for an extended period. Even after started production again, it took time to produce enough microchips to supply the market once again. Ericsson was forced to stop their mobile telephone production for months, as they had adopted a single sourcing strategy at the time. The results were detrimental and ended up in a \$400 million loss in sales. 'Nokia' on the other hand, a competing mobile telephone manufacturer, who was also sourcing from the same plant in New Mexico, started sourcing immediately after the incident from other Philips plants and other suppliers in Japan and USA. It was because of Nokia's multiple supplier strategy that the company did not suffer as much as Ericsson did. Ericsson since then has followed Nokia's example (Chopra and Sodhi, 2004).

Toyota's brake valve crisis in 1997, which started when the supplier failed to deliver the components when it was supposed to, is another example. The single sourcing strategy that Toyota had followed in that case, to achieve JIT deliveries, did not work in favor of the company. The supply chain was disrupted as a result (Yu, Zeng and Zhao, 2009). An earthquake in Taiwan in 1999 caused many plants to stop their production, which affected all companies sourcing anything from that area. Supply chain disruptions due to supplier problems, can also cause a price increase of the final product. A flu vaccine shortage in the USA in 2004, because of one of the two suppliers not delivering due to batch contamination, caused a significant price increase in most states. These examples show that supply chains can be vulnerable. Dependency on a single supplier could during adverse circumstances cause a company to eat into their stock and thus lose the inventory buffer that allows it to continue production relatively undisturbed (Yu, Zeng and Zhao, 2009). It follows from this that sourcing from several suppliers becomes an insurance for buying firms against supplier failures caused by fire, strikes, quality or delivery problems etc. (Skjøtt-Larsen et al., 2007, p 236)

Working with one supplier might have the advantage of JIT deliveries to the buyer, but there are other aspects that should be considered, apart from the potential production stoppage risk. Coordination and operations alignment bears some extra cost that the buyer would not have otherwise. This could be stemming from potential need for extra personnel and from potential longer reaction times, since more functions need to be coordinated, increasing this way the administration cost. In other words, there is less flexibility and adaptability with this integration, which could impede coordination (Horwitch and Thietart, 1987). Das, Narasimhan and Talluri (2006) suggested that continuous investments in integration might not yield equal performance improvements. Apart from employees, investments can be technology initiatives, such as electronic data interchange (EDI) or similar systems or software like enterprise resource planning (ERP). Like any investment, they are subject to diminishing returns and may eventually decline to negative returns.

The cost incurred from close collaboration with one supplier is not always measurable. According to Sorenson (2003), interdependency between two parties can have a long-term

negative effect, because it could result in both companies reducing their learning capabilities through limited contacts with their external environment. The economies of experience that companies enjoy via a 'learning-by-doing' process might not have the result that they were initially aiming for.

Lewi, Hayward and Kasi (2013) quote the above authors in their article describing the hazards of single sourcing. They also add that the sense of stability and reliability that a buyer gets from doing exclusive business with one supplier might prove to be false, since the supplier can decide to stop collaborating with the buyer. Changes in the relationship might occur if strategic goals change. The innovation-based changes that the buyer might want to invest into, to become more competitive, might not be included in the supplier's immediate plans. This conflict could result in reduced autonomy, competences and identity for the buyer. Reduced autonomy means that the buyer can be dependent on the supplier's goals. Reduced competences are related to the fact that when the buyer purchases an item that the supplier is not willing to change, it might end up having to purchase other items or activities related to the initial item, thus reducing the firm's possibilities to increase its competences. Finally, a feeling of reduced identity might occur since the buying firm will not be able to proceed with what it had set its mind to, if its only supplier is not willing to follow.

According to Bhote (1987), the relationship management costs for single sourcing, in terms of capital and time, might excel the performance benefits of this sourcing strategy. The logic behind this argument is that the single sourcing strategy requires the buying firm to develop a relationship with the supplier, which will be based on trust. Trust in the sense that a contractual agreement in certain cases can be "by-passed" by informal arrangements. Of course, trust should ideally be built also in the case of collaborating with multiple suppliers for sourcing the same items. In the case of single sourcing though, this becomes more important, especially when something unpredictable happens, that might not be covered by the contract. However, trust is difficult to gauge accurately since it cannot be measured on specific factors (Burke, Carrillo and Vakharia, 2006).

When there is high involvement relationship, both the buying firm and the supplier must make considerable investments in terms of time, so that they adjust to each other's functions smoothly. For their processes to be coordinated, significant handling time is required from both parties, so that their relationship to be developed (Gadde, Håkansson and Persson 2010). Kirytopoulos et al., (2010) observe that there is high risk for the buyer, if the supplier knows that it is the only company supplying a specific item. The supplier will be aware of the buying company's hesitance in switching to another supplier due to the resulting costs. The supplier might take advantage of such a situation and overcharge the buyer.

## **2.4 Challenges related to multiple sourcing**

Some of the challenges associated with single sourcing can be mitigated if the buyer chooses to collaborate with more than one supplier. However, multiple sourcing has its own set of challenges, some of which are mentioned here below.

Managing several suppliers can present challenges to the buyer in regards to choosing transportation mode. The general dilemma is whether to choose short lead times with high transportation costs, like airfreight, or opt for longer lead times and lower transportation costs, such as sea freight, or a combination of both (Minner, 2002). For items, whose dimensions are too large to fit in an airplane, transport by container would be the obvious choice. Apart from obvious cases where the mode of transportation is non-optional, the dilemma pertains to both

single and multiple sourcing. However, coordinating shipments from several suppliers can be more time and resource consuming for the buyer, which is why choosing the right transportation mode bears greater weight.

Although sourcing from more than one supplier can reduce the stock out risks, it is imperative that the buyer considers carefully the order splitting, so that a balanced inventory is kept. A typical challenge facing a company is on one hand balancing how much inventory should be kept to prevent a production stop, and on the other hand making sure that too much working capital is not tied up in inventory (Glock and Ries, 2013). While relying on multiple suppliers could prevent a potential production stop, the complexity and challenges in dealing with several partners must be carefully addressed, all the way down to inventory replenishment processes.

The buyer/manufacturer faces uncertainties in regards to predicting the demand, which would provide a lead as to how much to order from the suppliers. Once a prediction is made on how many items to manufacture, there should be standard operating procedures dictating how many pieces of each commodity to order. In the case of multiple suppliers though, the risk increases for the manufacturer, because apart from demand uncertainties, also exchange rates uncertainties could be of relevance when you purchase overseas. Combining purchasing and selling uncertainties in regards to when an order should be placed and at what quantity, was investigated by Hu and Motwani (2014), who analyzed how to minimize the risks of multiple supply candidates from different countries.

The more suppliers the company has to deal with, the less the involvement between the parties. Because there is lower involvement with the suppliers, commitment and loyalty are not easy to be achieved since the buying firm can switch between them easily. Suppliers can be reluctant to invest in new technology and enter new markets and in that way, buying firms are not able to access the suppliers' capabilities. A buyer's awareness of existing competition could hamper any extra effort and commitment put towards improving their products and developing the relationship with the buyer (Constantino and Pellegrino, 2010). The buying firm's low level of involvement with the supplier decreases the possibility of a more effective cooperation between them. When the buyer and the supplier do not have a close relationship, the buyer cannot necessarily assess the products' quality, since information on the supplier (and its products) might be insufficient (Skjøtt-Larsen et al., 2007, p 236).

Another negative aspect of multiple sourcing is the increased administration cost that it can bring upon the buyer. This includes both the initial cost of choosing the supplier and the ongoing cost of collaboration, throughout the duration of the buyer-supplier relationship. The latter would depend on how many employees are dedicated to each supplier, how many telephone calls need to be made, how much record needs to be kept and so on. It is therefore related to the managerial effort required by the buyer. This cost can be incremental, until it reaches a plateau, something that actually happens with all the suppliers, no matter how many the buyer collaborates with (Costantino and Pellegrino, 2010). Nevertheless, the more suppliers, the higher the administration cost can be expected. For better multiple source management, Burke, Carrillo and Vakharia (2007) suggest investments in web-based supply chain management applications.

When looking into following a multiple sourcing strategy, the buyer should consider the ideal number of suppliers for the same or similar products. In other words, to examine how many suppliers might be too many. This decision might not be relevant in the case of specialized parts, where the buyer might not have many sourcing options anyway. When there are options, though, also in regards to the practicalities around the logistics, this is a decision that

needs to be taken. Berger, Gerstenfeld and Zeng (2004) proposed an analysis approach based on the technique of decision-flow diagrams and probability modeling, to tackle this issue. The probability refers to the likelihood of events happening that may affect the suppliers. Ruiz-Torres and Mahmoodi (2007) suggest a similar method of deciding, based on a model that considers the suppliers' failure probability and reliability. If using advanced modeling is not an option for the purchasing manager, deciding can be challenging.

Sawik (2013) summarizes the main issues that purchasing managers need to consider in regards to multiple sourcing that were also analyzed by most of the aforementioned authors. These include: a) from which supplier to purchase parts, b) how many suppliers to use, c) order quantity allocation and d) order scheduling.

## **2.5 Comparison of the two approaches**

During the last two decades, there has been a debate about the merits and the demerits of single and multiple sourcing (Skjøtt-Larsen et al., 2007, p 234). This subsection compares the two approaches and overviews some of their advantages and disadvantages, as mentioned in published literature.

Slack, Chambers and Johnston (2004, p 453) summarized the advantages and disadvantages of single and multiple sourcing. The advantages of single sourcing include among others higher confidentiality between the buyer and the supplier and stronger buyer-supplier relationships, which can last over time. Furthermore, it is easier for the buying firm to cooperate with one supplier on product and service development instead of having many. On the other hand, if there is only one supplier, the potential order volume fluctuations from the buyer will have a negative effect on the supplier's functions. The reason why this would be more apparent to the single supplier is that all the orders are supposed to be fulfilled by this single company. If they were to be fulfilled by more, the individual suppliers would feel the fluctuations less, since the total quantity bought by the buyer would be divided.

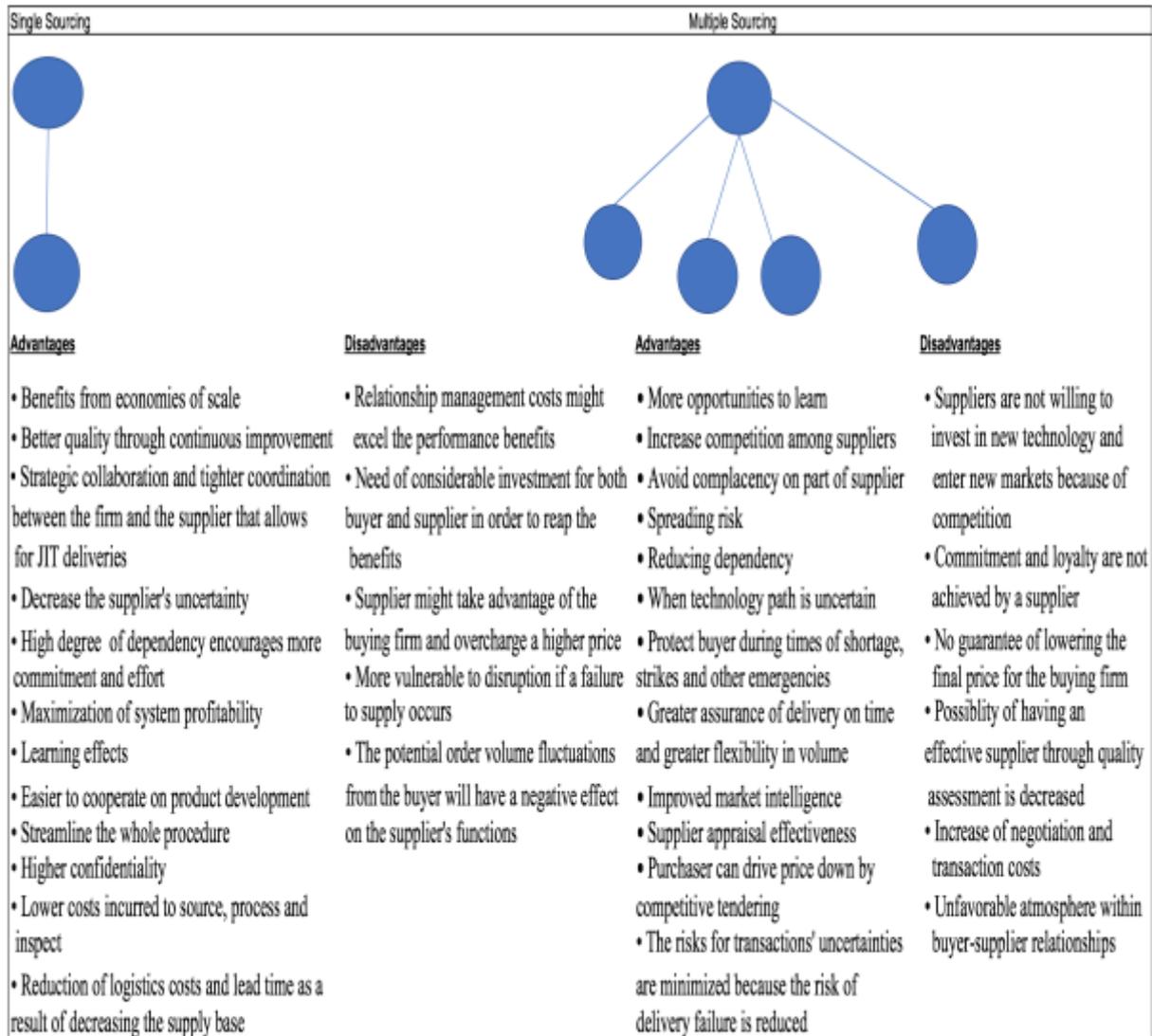
The advantages of multiple sourcing include that the purchaser can drive down prices by competitive tendering. Tendering is an approach for decreasing costs and an effective way to obtain transparency regarding the prices on the supplier market. Successful use of tendering requires expertise in the various steps of the process. These include identification of potential suppliers, preparation and mailing of the tender documents, analysis of bids and negotiations with suitable suppliers etc (Schuh et al., 2012, pp 24-26). More effort is needed though in regards to communication, when a buyer is cooperating with many suppliers. It is also less easy to develop supplier quality assurance because there are many suppliers who might not be willing to invest in new technologies for the specific buyer. The reason is that there is low involvement between the buyer and the supplier, which makes it difficult to develop trust between each other. Therefore, the buyer is not able to access the supplier's capabilities. In addition to this, it is much more difficult for a buying firm to obtain economies of scale; in other words, to be able to potentially buy more quantity at a lower price per unit, when the orders are divided between many suppliers (Slack, Chambers and Johnston, 2004, p 453).

According to Liker and Choi (2004), Toyota and Honda do not depend on a single source but develop two to three suppliers for every component or raw material they buy. Starting with product development, these two companies encourage competition between suppliers. The selected supplier receives contracts for the life of a model, but in case the performance is not good enough, the next contract will be given to a competitor. The performance is measured by the standards of the car manufacturers. Toyota and Honda follow six distinct steps in order to

build up relationships with their suppliers under the multiple sourcing approach. Those are: 1) understand how their suppliers work and respect their capabilities, 2) turn supplier rivalry into opportunity by sourcing each component from two or three suppliers and setting up joint ventures with existing suppliers to transfer knowledge, 3) supervise their suppliers and provide feedback, 4) develop supplier's technical and innovation capabilities, 5) share information in a structured format and 6) conduct joint improvement activities such as set up supplier study groups, initiate kaizen projects (continuous improvement) (Jacobs and Chase, 2010, p 461) at suppliers facilities.

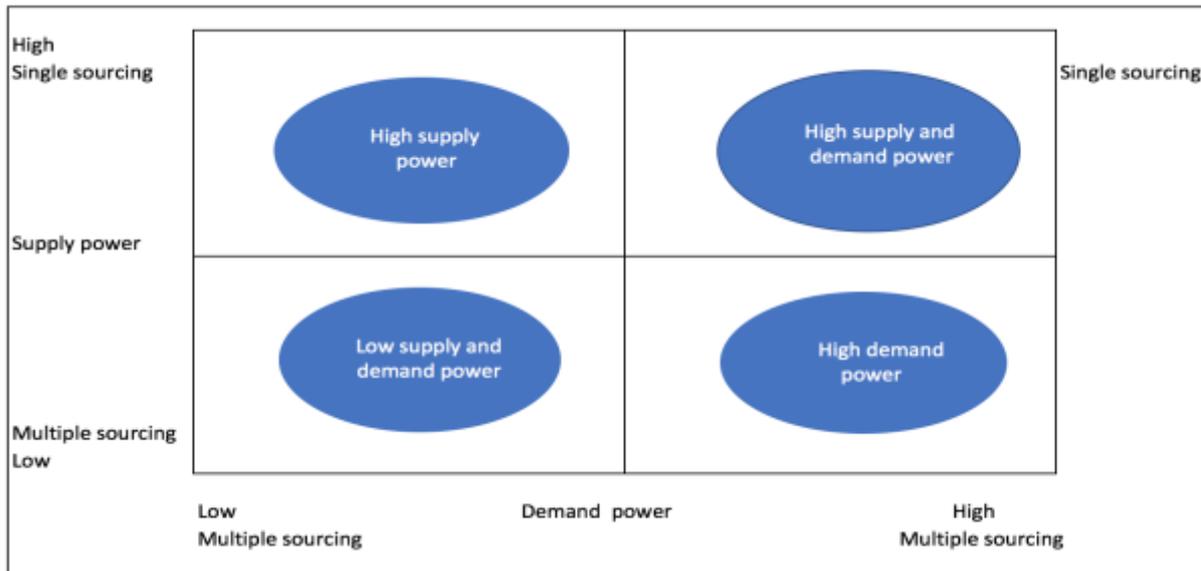
Wagner and Friedl (2007) used the concept of switching costs, meaning the buying firm's cost from switching suppliers, in a principal agent framework. Principal agent framework means one person, the agent, is able to make decisions on behalf of another person or entity, the principal (CFA Institute, 2011a, p 108). They examined the circumstances under which one firm switches the entire or partial quantity to an alternative supplier. The factor that was taken into consideration was how the firms make decisions in transactions, when the two parties, meaning the buyer and the seller, have the same information, or when one party has more information than the other. The first case is called symmetric information and the second asymmetric information (CFA Institute, 2011a, p 54). The authors claim that choosing between single or multiple sourcing depends mainly on the buying firm's belief on unit cost as well as the switching between suppliers cost.

There are studies according to Horowitz (1986) that mention that uncertainty in supply price and aversion in risks from the buyer's view, prompts the buying firm to place orders from the high cost seller. The table below shows an overview that has been discussed so far of the advantages and disadvantages of the two approaches.



**Figure 5:** Single or multiple? Pros and cons (based on Johnsen, Howard, Miemczyk, 2014, p 99; Slack, Chambers and Johnston, 2004, p 453)

According to Schuh et al. (2012, p 12), looking into the supply and demand, can assist in deciding between the two sourcing approaches. The following table shows that when there is high power in demand from the buying firm, then this company can exploit competition to their own advantage, since there are many available suppliers, many of which will be able to meet the requirements of the buying firm. Therefore, multiple sourcing is the appropriate option for the buying firm. On the other hand, when there is high power in supply, in other words, when there is supplier's monopoly or oligopoly, the buying firm does not have a high degree of control. In this case, the single sourcing approach is more suitable for the buying firm, for the additional reason that there are not many options available. The monopolistic or oligopolistic situation that the supplier manages to establish has to do with technical knowledge or other capabilities that the supplier possesses. The buying firm should then consider changing these technical specifications, so that freedom of choice is gained again. That can be achieved by innovation breakthrough, technical data mining, re-specification and risk management.



**Figure 6:** Supply and demand in purchasing (based on Schuh et al., 2012, p 12)

When there is both high demand and supply power, then the buying firm and the supplier are dependent on each other, and securing joint long-term advantages is without a doubt, the best option for both firms, leading to single sourcing to some extent. However, when there is low demand from the buyer's side, as well as low supply from the suppliers' side, then the buying firm can choose between which costs can be avoided. For example, the buyer can choose to omit a visit to a supplier, because since the demand is low, this is not urgent. In other words, the buying firm can manipulate its own demand (Schuh et al., 2012, pp 13-14).

Partnerships with strategic suppliers are without a doubt essential, but it is not only a matter of "either or" choice (Johnsen, Howard, Miemczyk, 2014, p 101). The advantages and disadvantages of both approaches require careful consideration.

## 2.6 Industrial buying behavior

Selecting suppliers can be a long procedure because of the many steps that it includes and decisions that need to be taken throughout every step. Apart from the money involved in buying parts for manufacturing, it is also the man-hours that need to be invested, from the employee or employees sitting behind buying decisions. It is important to look into what kind of variables affect the buying process and decisions, as well as the individual supplier selection steps. That is because decisions on sourcing from one or more suppliers can be based on the time and resources that the company is willing to spend.

### 2.6.1 Variables affecting the buying process

According to Van Weele (2014, p 24) there is a number of variables that affect the buying process, which need to be taken into consideration before the whole purchasing process, and consecutively the supplier selection procedure, starts. One of the most obvious is the

characteristics of the product. When building a truck for example, all parts are of equal importance, since nothing can be omitted from the original design of the vehicle. The difference though is in the financial importance of each part, namely, how each part affects the price of the final product. This financial importance could furthermore be influenced by the technical complexity of the part. Manufacturers might need to purchase raw materials as well. The variables that affect the buying decision and process in regards to raw materials are: 1) their changing prices, 2) the availability of new materials, 3) materials that might need to be replaced due to discontinuation and 4) potential changes in the attributes of the final product (Muteki & MacGregor, 2008).

Other variables include the sums of money involved in the purchases, the role of the purchasing department in the organization, which has to do with how big or small the company is, and the degree of risk related to the purchase. Specifically regarding the risk, it decreases as the decision process becomes shorter, when the organization has more experience with one specific part or supplier. Therefore, the risk related to purchasing process time is less with one supplier and increases with every new supplier added. Finally, the characteristics of the purchasing market can affect the approach towards the suppliers. For example, in a monopolistic market there is no dilemma whether to buy from one or more suppliers. However, in an oligopolistic market, negotiations will be more complex than in markets characterized by free competition (Van Weele, 2014, p 25).

## 2.6.2 Supplier selection procedure

The purchasing process includes a number of specific and interrelated steps. Drawing upon Van Weele's book on purchasing (2014, pp 32-42), as a staple cornerstone for this thesis, we accept as the basic steps being: 1) the specification phase, which includes clarifying the functional and technical specifications of the items that need to be sourced, 2) supplier selection and supplier assessment. After the supplier/s have been chosen the following steps are: 3) negotiation and contracting, which includes clarifying the commercial and legal terms and conditions between the parties, 4) ordering process and expediting, and finally, 5) follow-up and evaluation of the buying process.



**Figure 7:** The purchasing process (inspired by Van Weele, 2014, pp 32-42)

All the above steps can be related to choosing a buying strategy. The specification phase will clarify whether there are many suppliers available to choose from, or not, depending on the part characteristics. The negotiating and contracting phase can have a weight on the future cooperation between the parties. As this phase includes terms of payment, penalty clauses and warranty conditions (Van Weele, 2014, p 37), it could be decisive in future collaboration between the companies, if any of them does not honor any part of the agreement. During the ordering and expediting phase, the buyer and seller relationship might be affected, if everything is not as agreed. If for example after the delivered products have been checked,

they do not meet the specified requirements. The follow-up and evaluation phase are related with the supplier assessment procedure, as the supplier is evaluated before and after the delivery. If during any of these steps something does not go as planned, the buying company might have to consider stopping the collaboration with the specific supplier, thus reducing the supply base.

The traditional supplier selection model is described by Van Weele (2014, p 34). The first step includes determining the method of subcontracting. If the company wants to buy a complete product, that is ready for immediate use, or if the company wants to buy parts to assemble the final needed part. In the first case one supplier is needed to fulfill the assignment, and in the second more than one. Therefore, that solves the dilemma of using one or more suppliers. The second step includes compiling the bidders' long list, which are the supplier candidates. For the list to become shorter, request for information (RFI) needs to be sent, and possibly some visits or audits should be conducted. The next stage is to decide who from the long list will receive a request for quotation (RFQ), a tender, and send it to them. The candidates now constitute the suppliers' short list. Price is a decisive factor in selecting a supplier; nevertheless, it is advisable that the total cost of ownership (TCO) is taken into consideration, which will be explained in detail later. After all these steps have taken place, a supplier is selected.

As mentioned earlier, the longer the supplier decision process, the higher the risk. It is advisable then that if the buying company has established good relationships with a supplier, not to expand further. For a manufacturer though to be competitive, it is important that the whole supply chain is considered, not just an individual supplier at a time, like the simplified supplier selection model implies. For this to happen, Chen (2011) proposes that the company establishes its own supply chain, starting by performing a SWOT analysis (strengths, weaknesses, opportunities, threats) of each potential supplier. When the most important selection indicators are identified, the potential suppliers can be screened through a data envelopment analysis (DEA). For more precise supplier evaluation, the 'technique for order preference by similarity to ideal solution' (TOPSIS) is recommended. This method would require that the buyer has the relevant training. Nevertheless, a basic SWOT analysis can be performed by most of the personnel. Houshyar and Lyth (1992) also suggested a computational selection method, based on defining critical, objective and subjective supplier performance factors. Supplier selection problems have been suggested to be solved via other alternative methods such as mathematical programming methods, cost based methods, statistical methods, multiple attributes decision methods, combined methodologies etc (Önüt, Kara and Isik, 2009).

Using tools like the above to support the supplier selection procedure could decrease the uncertainty that human judgment can bring to the process, which could also be reason for conflicts within a company (Matawale, Datta and Mahaparta, 2016). Whether it is software, that assists the decision or not, a supplier selection procedure can claim a lot of time and resources from a company.

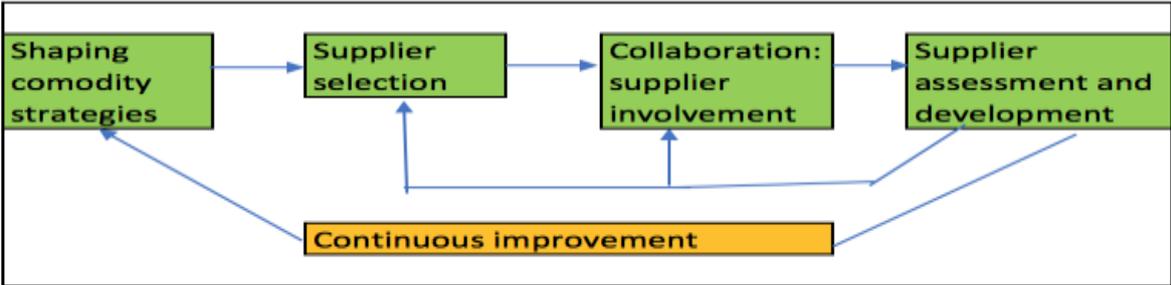
## **2.7 Suppliers relationships management and suppliers' assessment**

At the center of successful purchasing is managing the relationships with the suppliers, where extensive information and knowledge are shared. In the past, purchasers were advised to source from many different suppliers, in order to avoid any form of dependency on one

supplier, and minimize risk exposure. However, this has changed over time, as companies outsource more and more, they become increasingly dependent on suppliers. The higher the manufacturer’s dependency on their suppliers, the more imperative it becomes to effectively manage them (Kannan and Tan, 2002). Many companies use “partnership sourcing” which is a model that focuses on close long term supplier relationships based on single sourcing (Johnsen, Howard, Miemczyk, 2014, p 129). This subsection focuses on suppliers’ relationships management and supplier assessment, in order for the buying firms to access the suppliers’ capabilities that will allow them to offer new products to the market. Assessing the suppliers means assessing the collaboration with them, which could be decisive in concluding which strategy to follow, single or multiple sourcing.

**2.7.1 Supplier relationships management (SRM)**

After a contract has been signed between a buyer and a supplier for a particular commodity, it needs to be implemented as well. Many contracts are never implemented fully due to lack of business support and leadership from the buyer’s side with the new suppliers. It is critical to manage the contract agreement, so that the procurement process generates value (Harrison, van Hoek and Skipworth, 2014, p 368). According to Park et al. (2010), supplier relationship management aims for collaboration with suppliers, so that the buying firm can develop new products competitively and produce goods efficiently. The basic steps to supplier relationship management are: 1) reduce the supply base, 2) segment the supply base, 3) establish policies per segment, 4) implement vendor rating and improvement planning, 5) assign executive ownership to most important suppliers to foster relationship potential and 6) manage towards ‘customer of choice’ status. The supplier relationship framework below describes the process of continuous improvement, which is made possible by the alignment of commodity strategies, supplier selection and long-term supplier collaboration, supported by assessment and development (Park et al., 2010).



**Figure 8:** A proposed integrative SRM framework (Park et al., 2010)

Every firm needs to establish contact with each supplier so that the relationship among the two can be managed suitably. Relationships with strategic suppliers need to be always monitored and evaluated. One way to keep up with all the different suppliers is to compose their individual profiles. These can include: 1) a company overview, 2) key management contacts, 3) a SWOT analysis (strengths, weaknesses, opportunities, threats), 4) key financial figures, 5) an organizational chart, 6) information on current contracts and 7) the names of the suppliers within the firm. The content of these profiles could be made available to other related departments in the company, so that knowledge is shared. In addition, the company needs to establish expectations from all the suppliers and discuss further about future product

and supplier development plans. Finally, the company needs to give constructive feedback to each supplier separately. A suggestion to do this is to firstly ask the supplier to self-assess its performance, and to combine this with a rating from their side (the buyer). Many firms use some kind of reward and punishment system in order to trigger improved supplier performance. Ideally, the supplier profiles, the expectations from them and the feedback, should be compiled on an annual basis (Benton, 2010, pp 167-172). Despite the fact that this procedure would be time consuming and costly in regards to administration, it might be proven useful to the company. The supplier base needs to be kept clean, by for example removing inactive suppliers regularly, so that administration time is reduced. Regular supplier assessments can assist with that.

### **2.7.2 Supplier assessment**

Supplier assessment is critical for companies since they face the challenge to identify reliable suppliers from domestic and overseas markets. In the past, supplier assessment was based only on the suppliers who could offer favorable conditions on price. However, firms have started over time to demand high quality products. As a result, firms select suppliers who obtain quality certifications such as ISO9001 or ISO9002. Even though price and quality are important factors, supplier assessment is a multi-criteria evaluation process (Kwong, Ip and Chan, 2002).

Schorr (1992) concluded that an ideal supplier profile should be based on nine factors. Those are 1) delivery, 2) quality and reliability, 3) price, 4) responsiveness, 5) lead time, 6) location, 7) technical capabilities, 8) R&D (research and development) investment plan and 9) financial and business stability. Based on these factors, potential questions can be made to all the potential suppliers, where answers can be presented as 'yes' or 'no'. All the answers can then be summarized in a report.

On the other hand, Feldman (1994) developed a supplier-rating scheme, which consisted of three assessments. Those were 1) the full business assessment, 2) the quality system survey and 3) the quarterly assessment for quality and delivery. The full business assessment evaluates the suppliers' business views such as cost, quality, delivery, leadership and technology. The quality system survey assesses the supplier quality system whereas the quarterly assessment for quality and delivery serves as an interconnected system that complements all relevant supplier information. All these assessments are rated in a scale from one to four where four is excellent, three is satisfactory, two is minor deficiencies and one is major deficiencies or unacceptable. Then, the total score is simply the summation of the total counts of each set of answers multiplied by a weight. Weight is the degree of significance which each buyer assigns for each factor in terms of percentage, i.e. for cost is 20%, quality 18%, delivery 10% etc.

Although the scoring method is a very common method for assessing domestic and international suppliers, it is not easy to apply. The reason is that it can yield inconsistencies in scores from different respondents. For example, if the following question is asked: "How good is the supplier delivery system?", one respondent may give eight out of 10 and the other may give seven out of 10 although both of them might have the same answer in mind (Kwong, Ip, Chan, 2002).

Assessing a supplier has to do both with hard, quantifiable criteria, as well as soft, non-quantifiable. Ellram (1990) made the differentiation between 'hard' and 'soft' criteria. Hard are those that companies have regularly been relying on in regards to assessing a supplier, like

price, delivery time, quality and service (Hahn, Watts and Kim, 1990). Soft criteria include management compatibility and strategic direction of the supplier (or strategic commitment), qualities that can make the difference between strategic partnership, and just doing business together. Kannan and Tan (2002) proved that supplier management could influence a buying firm's business performance, and that actually soft criteria can have a greater impact on performance than hard. In addition, the buying firm can stimulate an improved supplier performance, by visiting regularly the suppliers' premises, by organizing training sessions with them, or by using alternative suppliers (Krause, 1997).

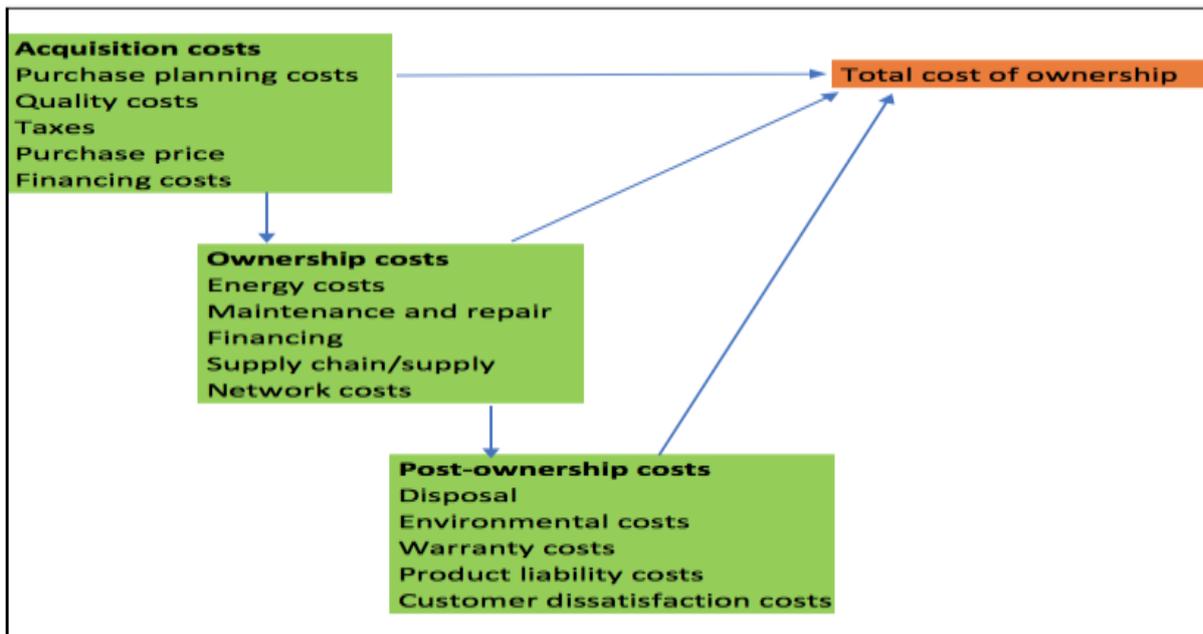
### **2.7.3 Challenges with SRM**

The major potential barriers to the SRM could be 1) lack of common goals and communication, 2) lack of common tools, 3) lack of commitment and trust and 4) inflexibility between the manufacturer and its supplier. These obstacles can be overcome through the establishment of the mechanism that gives the supplier the sense of belonging to a bigger 'industrial family'. By having this perception, the supplier will presumably align its goals and objectives with the manufacturer's. As a result, the supplier will also presumably commit to the operations and trust the manufacturer more. However, in order for this to happen, the manufacturer needs to prove its consideration of its suppliers. For this purpose, the manufacturer is recommended to provide the supplier with incentives such as financial incentives, technology and knowledge transfer, information sharing, in order to earn its trust. The manufacturer needs to follow up supplier selection and accurate performance measurement in order to overcome all the challenges that can become apparent (Oghazi et al., 2016).

### **2.8 Total cost of ownership**

Negotiating lower prices has always been the main center of attention for buyers, because savings are the traditional focus of procurement. Even though price is a very critical aspect of the value exchange with the supplier, it might only be a restricted focus. In many markets, delivery speed, reliability, product quality and innovation are in fact more important than price (Harrison, A., van Hoek, R. and Skipworth, 2014, p 365). Therefore, it is very important for buyers to analyze the total cost of ownership (TCO) in order to decide whether they will follow a single or a multiple sourcing approach.

According to Jacobs and Chase (2010, p 423) TCO is an estimate of the cost of an item, which includes all the costs that are related to its procurement and use, including any costs of throwing it away after it is no longer useful. The costs can be categorized in three main categories: 1) acquisition, 2) ownership and 3) post-ownership costs. Acquisition costs are all the short-term costs and include the initial costs, which are associated with the purchase of materials and products. These costs represent an immediate cash outflow. Ownership costs are the costs, which are associated with the use of materials or products. These costs can often be higher than the initial purchase price and have an impact on cash flow, profitability, productivity and employee morality, because of potential temporary production stoppages. Post-ownership costs are the costs, which include salvage value and disposal costs (Jacobs and Chase, 2010, p 424). The table below shows an overview of the total cost of ownership.



**Figure 9:** Total Cost of Ownership (Jacobs and Chase, 2010)

The theory of the TCO identifies that price might only be the edge of the iceberg of cost drivers. When buying a truck for example, price matters. However, so do all the maintenance costs, how quickly a buyer can take the delivery, the durability of the truck and so on. Moreover, there are costs that occur over time during the lifecycle of the product, such as warranty. The aim of the TCO is to get below the purchase price and recognize all the other costs that the buying firm needs to pay over the product's lifecycle. One product can have lower product price but higher maintenance costs, packaging and delivery costs compared to another product. That means over time that the item, which costed less originally is actually much more expensive than the one, which did not. It would therefore be advisable for a buyer to buy the one with the higher price (Harrison, A., van Hoek, R. and Skipworth, 2014, pp 365-367). The image below shows a graphical depiction of all the cost drivers of equipment. ROI means 'Return on Investment' and it is a group of profitability ratios that measure the ability of a company to generate profits from revenues and assets (CFA Institute, 2011b, p 362).



**Figure 10:** The iceberg of costs (Clark, 2015)

Professional buyers need to take into consideration both value and price in making sourcing decisions. Activities that are part of TCO occur not only in the purchasing department but also in other departments as well. Cost drivers can be at various levels such as 1) unit level, 2) batch level, 3) supplier sustaining level and 4) product or part sustaining level. Unit level refers to the purchase price and quality control cost when each item must be inspected. Batch level refers to the costs of creating a purchase order. Supplier sustaining level refers to the cost of identification and certification of a supplier, and product or part sustaining level to the cost of maintaining technical product information (Wouters, Anderson and Wynstra, 2005).

The more suppliers one buyer examines, the more the total cost that needs to be captured at a greater level of detail, both by supplier and by item purchased (Wouters, Anderson and Wynstra, 2005). The costs can be structured into key components such as direct labor, material, manufacturing overhead and administrative costs. Many times, one type of cost might be more important for a buyer than other types depending on the component that needs to be sourced. The table below describes a framework about cost drivers. Four major categories have been identified, which are design, facility, geography and operations. The costs in any one of these categories might outweigh the costs of the others and buyers need to take into consideration all the different cost drivers in order to make the right choice (Ask and Laseter, 1998).

Category	Description	Examples
<b>Design</b>	Cost attributable to product design tradeoffs	Material specifications Product line complexity
<b>Facility</b>	Costs related to the size of the facility equipment and process technology employed	Facility scale Degree of vertical integration Use of automation
<b>Geography</b>	Cost associated with the location of the facility relative to the customer	Location-related wage rate difference Transportation cost to customer
<b>Operations</b>	Cost that differentiate a well run facility from a poorly run facility	Labor productivity Facility utilization Rejection rates

**Figure 11:** A Framework for thinking about cost drivers (Ask and Laseter, 1998)

Anderson, Thomson and Wynstra (2000) mention that purchasing managers seem to depend more on price information than on TCO information, in making their sourcing decisions. Buying firms though need to aim not only to the reduction of costs, but also to the design of products and services that provide the lowest TCO to customers (Jacobs and Chase, 2010, p 425). Taking into consideration the TCO should become a norm for buyers, if they want to understand all relevant costs, when they are doing business with suppliers. TCO could assist buyers to discover which suppliers are more expensive something that could result in stopping the cooperation with a number of them, thus reducing the suppliers' base, which would mean to move closer to a more exclusive collaboration with a limited number of suppliers. Looking at the TCO should also be applied in regards to the relationship with a supplier. If for example one supplier is not performing good enough during the ordering and expediting process (look at the supplier selection procedure above), it might end up to be too expensive working with the specific company. The time spent on administration by employees should also be considered, in deciding which supplier to work with. Decisions on whether to use one or more suppliers should also be taken with the TCO in mind.

## 2.9 Chapter conclusion

The dilemma of choosing to collaborate with one supplier or more for one specific item can be challenging for manufacturers. This chapter summarized some of the advantages and disadvantages of single and multiple sourcing, as recorded in published literature. Some of them can be more obvious to the reader and others can create more questions. For example, some authors claim that single sourcing can lower the acquisition cost for buyers, because of the economies of scale that they can achieve from ordering increased quantities. The same though is claimed in the case of multiple sourcing, if there are enough volumes to be spread out over fixed costs. JIT deliveries are claimed to be advantages both for the single sourcing approach, as well as for the multiple sourcing, formulated as 'greater assurance of delivery on time'. Reduction in the transaction activities and better responsiveness seems to be able to be achieved with either a single sourcing or a multiple sourcing approach.

In regards to their disadvantages, both strategies seem to be sharing some as well. For example, it is mentioned that both a single strategy approach can increase the administration cost, in the form of cost for coordination and cooperation alignment, as well as a multiple strategy approach, since there are more suppliers to deal with. These concurring advantages and disadvantages can be confusing for a buyer. For that reason, a comparison between the two approaches was added. At this part, the reader can see that for example it is less easy to achieve economies of scale with multiple sourcing, or that nevertheless car manufacturers seem to prefer this approach.

Better clarifications on how companies choose their sourcing strategies are achieved in the supplier selection procedure part of this chapter. The nature of the products sought to be bought and the market characteristics can provide a direction of an answer towards the dilemma. In addition, the relationship with the chosen supplier and how this is managed, the hard and soft criteria in supplier assessment, can all point towards a direction as well. The TCO can determine whether a supplier is worth collaborating with and consecutively how many should the company employ. Information attained from professional buyers, at chapter four of this thesis, can validate whether what has been mentioned on the literature, also applies in the real world.

### **3. Methodology**

The purpose of this chapter is to provide the reader with an overview of the methods that the author used to tackle the research issue of this thesis. First, the research design is explained and the four different phases of the project. The research methodology is identified afterwards, and the paradigm under which it is conducted. An overview of the data collection methods follows combined with the data analysis method. Finally, a short discussion is presented on the reliability and validity of the project, as well as the potential generalizability.

#### **3.1 Research design**

The issue of investigation in this thesis is the choice between a single and a multiple sourcing strategy. As this is not simply a matter of choosing either the one strategy or the other, a more thorough investigation is deemed appropriate. The project was initiated by a Truck OEM, in an effort to get as close to an answer to the above dilemma as possible. For that reason, the researcher and author of this thesis, who was chosen to look into it, has been in close collaboration with the experts working for the specific company, in regards to purchasing matters. The case was chosen by the author since it deals with issues that were covered during his study periods at the University of Gothenburg.

Because a specific company created this project, it fits the methodology of a case study. A case study investigates a contemporary phenomenon in depth from the angle of a real-life context, which reflects exactly the nature of this project. Multiple sources of evidence need to be researched combined with prior theoretical declarations (Yin, 2009, p 18). A case study is separated from the other research designs because the focus is on a specific situation. Even though some of the findings might represent the OEM industry in general, this project is aimed at providing answers only to the specific Truck OEM. The emphasis is on intensive examination of a specific setting (Bryman and Bell, 2011, p 60). The goal with this thesis is to provide an as much as possible comprehensive examination of sourcing strategies.

There are different types of case studies. Several of them have been looked into to categorize this specific research conducted in this thesis. An 'evaluation case study' aims at determining the value of the case and at reporting findings to a range of stakeholders in ways that they can use (Leavy, 2014). As with this research, the author hopes to provide tools to the Truck OEM on deciding between sourcing strategies, this case study can belong to this category. If we were to accept Yin's categorization (2003), then this research would belong to the 'representative or typical case study' category, as it seeks to explore a case that demonstrates an everyday situation. Finally, we can say that this case could also belong to the 'opportunistic case study' category, because the opportunity to study the sourcing issue arose to the researcher because of access he had to the specific business (Otley and Berry, 1994).

The main stages in a case study are: 1) selecting the case, 2) preliminary investigations, 3) data collection, 4) data analysis, 5) writing the report (Collis and Hussey, 2013, p 69). Inspired by that, the author followed four main phases to execute the work in this study. The first phase was about comprehending the dilemma and defining the scope of the research. The research questions were formed and at the second phase the relevant theories were identified in order to understand the main issue in regards to sourcing strategies. In the same phase, the researchers also identified all the people who needed to be interviewed in order for the relevant data to be collected. In the third phase, the empirical data were analyzed and

evaluated and the research questions were answered. Finally, recommendations were given to the Truck OEM. The Table below summarizes the four phases of this project.

Phase 1	Phase 2	Phase 3	Phase 4
Research purpose	Data collection	Data analysis	Conclusion
<ul style="list-style-type: none"> <li>• Comprehend the dilemma</li> <li>• Define the scope of the research</li> </ul>	<ul style="list-style-type: none"> <li>• Theoretical framework and literature review</li> <li>• Interview data</li> </ul>	<ul style="list-style-type: none"> <li>• Data evaluation</li> <li>• Answers to the research questions</li> </ul>	<ul style="list-style-type: none"> <li>• Tools suggestion</li> <li>• Further recommendations</li> </ul>

**Figure 12:** The phases of the project

Case studies have typically been linked to qualitative methods of analysis (Gerring, 2006, p 10). In the same spirit, in order to reply the research questions of this thesis, a qualitative analysis has been chosen, under the interpretivism paradigm. This meets better the needs of this thesis, as it is qualitative data that were gathered, rather than quantitative. Qualitative data are transitory, are understood only within context and are in a non-numerical form (Collis and Hussey, 2013, p 130). A qualitative research is an appropriate approach to business research, when no quantitative data are selected or generated (Bryman and Bell, 2011, p 386), hence rendering it the most suitable approach to this thesis. The main steps in qualitative research are: 1) formulating the research questions, 2) selecting the organizations to be studied, 3) collecting the data, 4) interpreting the data, 5) specifying tighter the research questions and collecting further data, 6) writing up findings and conclusions (Bryman and Bell, p 390). The author of this thesis had the also above steps in mind when conducting the research.

The interpretivism research paradigm is the philosophical framework that guided how the research for this thesis was conducted. The general aim of the research is to provide a better understanding of sourcing strategies within a particular context, namely the Truck OEM. Since interpretivism supports that reality is highly subjective, rather than objective, and it aims at gaining interpretive understanding of the examined phenomenon, it is the most appropriate paradigm to follow (Collis and Hussey, 2013, p 44-45).

## **3.2 Data collection**

The researcher collected secondary and primary data in order to answer the three research questions. Secondary data were collected through published literature and primary through semi-structured interviews.

### **3.2.1 Published literature**

The three stated research questions could not have been answered only with primary data. Secondary data needed to be included as well. The secondary data were gathered by the researcher with the purpose of identifying what has already been known about the topic of interest and which were the relevant concepts and theories already stated about this specific field of study (Bryman and Bell, 2011, p 92).

A literature research relies on collecting the appropriate information from articles, books, reports and journals (Collis and Hussey, 2013, p 76). First, the researcher identified important keywords that helped to define some boundaries in the searching process. The most obvious keywords that were used are 'single sourcing' and 'multiple sourcing'. In relation to those, words like 'advantages', 'gains', 'disadvantages', 'perils', 'challenges' were also used, including other synonyms that were helpful. Other simple search keywords that were used are 'industrial buying behavior', 'supplier/vendor selection procedure', 'supplier/vendor relationships management', 'supplier/vendor assessment', 'total cost of ownership' and so on. The electronic version of the library of the University of Gothenburg was the main search engine platform that was used, along with the suggested literature from courses studied during the authors' studies. This platform led to other databases that were used, like Scopus, Elsevier, Science Direct and Emerald Insight among others.

The theories discussed in the literature review helped in devising the questions that were used in the interviews. The data collected from the interviews were also connected to the same theories, and helped to formulate the analysis chapter of this thesis.

### **3.2.2 Interview data**

Semi-structured interviews were chosen for this thesis. The researcher began the investigation having specific issues in mind to be addressed. Interviewing in qualitative research is less structured than in quantitative research and the emphasis is on the interviewee's own perspectives (Bryman and Bell, 2011, p 472), which is what the interviewer wanted to catch. For that reason, this type of interviews was chosen. In qualitative interviewing, there is greater interest in the interviewee's point of view and reaction. The researcher can depart considerably from any guide that is being used during the interviews. In that way, the interviewer can extract rich and detailed answers that will be of help during the analysis stage. Follow up questions can also be asked after the initial interviews, which is the case with some of the interviews conducted for this thesis (Bryman and Bell, 2011, pp 466-467). All of the questions used were prepared in advance and they were open in nature, allowing the respondent to provide longer and developed answers (Collis and Hussey, 2013, p 133). They were also sent in advance by e-mail to the respondents to allow them some time to prepare them but to also introduce them in more detail to the topic. The researcher believes that this did not affect the results.

The interview guide that was prepared by the interviewer, namely the list of specific topics to be covered (Bryman and Bell, 2011, p 473), was designed to allow the respondents to reply the way they wanted. For the same reason, leading questions were avoided. In addition, it was constructed in a way that it allowed some flexibility in regards to asking questions. The effort was to make the language used understandable and relevant to everyone who was interviewed (Bryman and Bell, 2011, p 475). All the questions were asked in the same wording, apart from those that arose during the interview and were not included at the interview guide. That is because during a semi-structured interview, the interviewer often pick up things said by interviewees, which can give the lead to further conversation (Bryman and Bell, 2011, p 467). Depending on the time limits set by the interviewees, this was the case with all the interviews.

Eight interviews were conducted in total; approximate time of duration was one hour each. Four of them were face-to-face and the rest were conducted via Skype. As some of the respondents were spread out globally, it was impossible for the researcher to visit their premises, both for time constraint and financial reasons. The interviews had to be recorded so that all the vital information was caught on tape and allow this way the researcher to listen to them again, if he had to. All the recording took place after the respondents' permission to do so was given.

In order for the researcher to generate more data from the interviews, he occasionally referred to particular events, to encourage more detailed narratives. In other words, the respondents were asked to recall examples of specific events, an approach referred to as 'critical incident technique' (Bryman and Bell, 2011, 472). One characteristic occasion when this happened, was when the researcher used the example of 'Ericsson' and 'Toyota' stated on chapter two, to guide the respondents to potentially recall similar incidents. However, since the researcher's knowledge of the phenomenon under study was evolving the time the interviews took place, he did not know on all occasions what constitutes a critical incident; therefore, the technique was used with caution (Collis and Hussey, 2013, p 141).

The author decided to organize the conducted interviews as a text which is typical to the case study method. Further, the author included subtitles, in that way he divided the answers in major blocks. This gives the reader a better feeling of the case and helps to drive comparisons between different viewpoints. Content analysis was used as the main method of data analysis and all the questions of the interview guide were written in the appendix of this thesis. Coding would have been useful if the researcher had transcribed the interviews word-by-word. However, the researcher decided not to use coding in the semi-structured interviews. Coding is a process where the data is broken down into component parts, and names are given to categorize them according to their attributes (Bryman and Bell, 2011, p 577). The reason why the researcher decided not to do so was that a word-by-word transcription is a time-consuming process that requires meticulous work (Bryman and Bell, 2011, p 583). For about every hour of an interview, it is required five to six hours for transcription (Bryman and Bell, 2011, p 483). Moreover, there was the possibility of losing important information and the context in general (Bryman and Bell, 2011, p 588) and the researcher did not want that to happen.

### **3.3 Data analysis**

In analyzing the data gathered during this thesis work, the researcher used an inductive approach. This means that the theory was developed from the empirical reality, or in other words, the researcher moved from observations to statements (Collis and Hussey, 2013, p 7). This means in practice that the researcher could analyze the data after the interviews took place and after he had attained some knowledge from real-life occasions. The researcher did not try to test the theories, but rather with their help, reach a conclusion and advise the Truck OEM that initiated this thesis work accordingly. Generally, the inductive approach to analyzing data is associated with the interpretivism paradigm (Collis and Hussey, 2013, p 44) and a qualitative research approach (Bryman and Bell, 2011, p 13). In addition, a case study tends to take an inductive approach as well, in regards to the relationship between theory and research (Bryman and Bell, 2011, p 60). Nevertheless, since the researcher had already studied a significant amount of existing theory and literature on the researched topic by the time the interviews took place, an initial approach on data collection had been formed beforehand. The SWOT analyses for the two groups (buyers within the Truck OEM as well as Car OEMs) increased the credibility of this study.

### **3.4 Reliability and validity**

Reliability and validity are important criteria for estimating the quality of a business research (Bryman and Bell, 2011, p 40). Reliability refers to whether a study can be replicable, producing the same results if it was to be repeated (Bryman and Bell, 2011, p 41). If the investigation of how companies choose between single or multiple sourcing strategies were to be repeated, it would most likely not produce the exact same results as this one did. The reason is that this thesis looked into the specific setting of the Truck OEM.

Validity assesses the integrity of the conclusions from a research (Bryman and Bell, 2011, p 42) and tests whether the results reflect the phenomenon under study (Collis and Hussey, 2013, p 53). Validity is usually separated into internal and external. Internal validity refers to validity that is internal to the sample (Gerring, 2006, p 43) and to whether the researcher achieved a match between the theoretical ideas he reviewed and his observations (Bryman and Bell, 2011, p 395). In this thesis, there was an identification between concepts and observations, therefore the internal validity is high. External validity refers to the extent that the empirical data can be generalized to other settings or business cases (Bryman and Bell, 2011, p 395) or can be applied to a broader population (Gerring, 2006, p 43). Even though the empirical data refer to the truck industry, some generalization is possible to other OEMs, as some rules in regards to sourcing strategies could be applicable to more than one industry.

## 4. Empirical Data

The purpose of this chapter is to present all the data that the author gathered from interviews. The first five interviews were conducted with buyers within the Truck OEM that initiated this investigation. All these buyers are responsible for sourcing a specific commodity, but each one of them is an expert within a specific portfolio of components under the same commodity category. They are sitting in different offices around the world and they are responsible for their respective portfolios globally. The other three interviews, were taken from buyers from Car OEMs, so that knowledge from other companies to be attained as well. Confidentiality was asked by the respondents of the Car OEMs interviewed as well, therefore no names are mentioned in this chapter.

### 4.1 Respondents within the Truck OEM

The different buyers within the same company have provided their own angles on how they deal with sourcing issues. The main reason for that is that the items each of them is responsible for have different characteristics. The supplier selection procedure they follow though is the same. Average duration is 16 week, according to Buyer A, who provided the details.

#### Supplier selection procedure

A typical supplier selection procedure within the Truck OEM is divided into seven steps. The first step is called ‘Market Survey’. After the marketing department has identified a new market the company should expand to, it informs the engineering department to determine the needed parts. The buyer is then informed and a market research begins, during which the potential suppliers, who can supply the items the engineers asked for, are listed. The second step is divided into two phases. Phase one deals with the ‘Short Supplier Evaluation Method’ (SSEM), during which the potential suppliers are audited from a distance from the buyers. Issues like the supplier’s financials, qualities and deliveries are checked, at the same time as phase two, which is a RFI. During the third step, the list of suppliers becomes shorter and a presentation to the interested stakeholders is made (engineering, quality, logistics, manufacturing, purchasing, after-market departments), justifying the reasons why those that qualified did so. The list is now called ‘Potential Supplier List’, PSL. During the fourth step, a RFQ is sent as well as a ‘Review of Technical Specifications’ (RTS) form to the short-listed suppliers, to confirm that they understand the technical requirements. Another presentation is held during step five to the stakeholders, justifying the buyers’ final choice. Step six deals with the final negotiation, if everyone approves the supplier and finally, the contract is signed at step seven.



**Figure 13:** Supplier Selection Procedure (Truck OEM)

This procedure can be a considerable investment for both the buying company and the suppliers, mainly because of the many man-hours required from both sides, of highly skilled and educated personnel. If a competitive supplier is to be procured though, this investment is worth it for a buying firm.

#### **4.1.1 Interview findings Buyer A**

The next three subsections helped to create the SWOT analysis and the table of drivers for decision making during sourcing which are developed in the analysis chapter.

##### **The single sourcing approach**

Buyer's A department is mainly following a single sourcing strategy, representing around 70%-80% of the products he buys. That is because the availability of substitution for the specific segment he is responsible for is low. The parts he sources are very particular and the supplier he works with is restricting technically everyone else, since it is the only company globally, that manufactures most of them. That is also the reason why it is a big investment for the buying company in terms of time. The supplier has to make everything new, according to the buyer's requirements for the needed parts. This includes additional cost for tooling and development that the buyer has to pay to the supplier.

The single sourcing strategy has its advantages, in regards to monitoring, tracking and managing the supplier. The plant experiences JIT deliveries and the general administration cost is lower, since there are no designated employees working only with the specific supplier. However, there have been occasions when the supplier was facing financial or quality issues, that production had to stop. That is a severe issue, where the buying company has to wait until the supplier's problems are solved, since immediate substitution is practically impossible.

##### **The multiple sourcing approach**

The remainder 30%-20% is sourced from multiple suppliers, because the technology is not completely owned by one company. If geography allows, items are delivered locally, thus export duties and taxes are avoided, otherwise sourced from within the same continent where the plants are. Decision time increases accordingly to the number of suppliers the company collaborates with. Sourcing from many suppliers though, so that intercontinental transportation is avoided, is worth it. With multiple sourcing, there is always a back-up solution, as it is considered a risk mitigation activity, and the buyer is commercially a bit stronger, because the suppliers know they have competition. Market intelligence is also increased because the buyer can get information on what other suppliers do.

##### **Supplier relationship management and supplier assessment**

For Buyer A, the supplier that won over the other candidates is the one that can present better commercials than the rest, meaning the best financial situation. This is checked through its turnover, its latest investments, what other companies it supplies and its audited financial reports among others. It is very important that the supplier holds quality certifications, specifically the ISO TS and the ISO 9001, which are mandatory in the automotive industry. The chosen supplier has received the highest financial rating score of all the candidates, and meets the technical, quality, delivery and logistics requirements.

## **Total cost of ownership**

When choosing to work with a supplier, the TCO is considered, which includes apart from the buying price, the exchange rates, the logistics cost, the quality and delivery among others. The suppliers are evaluated and whether a new contract will be signed with them is considered already one year before the existing one expires. Nevertheless, these issues do not affect the number of suppliers employed. Buyer A concludes by adding that ‘the life of a purchaser is much easier when there are a lot of suppliers’, since there is always a back-up solution. This subsection helped to create the checklist in the conclusion chapter.

### **4.1.2 Interview findings Buyer B**

As a senior sourcing Buyer, Respondent B can ascertain that the purchasing department plays a big role in an OEM, as it relates to large amounts of money spent. In regards to the characteristics that the ideal supplier should be based on, it is quality of the items that plays the most important role. A competitive price is always considered, the suppliers’ certifications, but also the local content requirements for each country. The local content requirements refer to governmental regulations that need to be fulfilled by an OEM in regards to the minimum amount of locally produced items that they need to use in a truck. There is therefore governmental pressure to source a minimum percentage of items locally to where the production facilities are situated. There is a strong need within the Truck OEM to meet those requirements, therefore the suppliers employed and their number is affected by that factor. This subsection helped to create the flow chart in the analysis chapter and the next three subsections helped to create the SWOT analysis and the table of drivers for decision making during sourcing which are developed also in the analysis chapter.

### **The single sourcing approach**

Single sourcing is not preferred because there is a considerably high risk involved. Buyer B actually argues that throughout his career as a buyer, the single sourcing approach was never supported, as there are barely any advantages with it. Administrative cost is definitely reduced; nevertheless, it becomes difficult to manage a supplier that is employed only for one specific item, unless the buyer has always new business to offer to it, which also results in reduced leverage power from the buyer’s side. He goes on to argue that it is the nature and the characteristics of the specific segment he is responsible for that does not allow single sourcing. That is because items are big and heavy pieces of equipment, the logistics of which could be very expensive, if the company had to transport them from one continent to another.

### **The multiple sourcing approach**

In regards to the sourcing strategy chosen from Respondent’s B department, it is exclusively a multiple sourcing approach. Sourcing from many suppliers is a superior solution than sourcing from one supplier. By sourcing the same part from multiple locations, the supply risk decreases, because if something prevents one supplier from delivering, the other or others will. Multiple sourcing is therefore a risk mitigation activity, since back-up options are in place. This also increases a healthy competition between the suppliers and can improve the market intelligence, since the buyer has access to their technologies. Finally, the buyer can take advantage of currency exchange rates when dealing with many suppliers, depending on which one is cheaper at the time when exchange rates fluctuate. In regards to administration though, it becomes more expensive to deal with more than one supplier. In addition, the initial

tooling cost is higher, and if there are differences in the machineries of the facilities, maintenance cost can occur, which would not happen when sourcing from one supplier.

### **Supplier relationship management and supplier assessment**

Despite the fact there are many suppliers to deal with, the level of involvement is high. Feedback is sent once a year on issues like quality, cost and delivery. Some adjustment period is allowed if a supplier is not performing the utmost and if there is room for improvement. This is necessary, as high tooling cost does not allow shifting from one supplier to another easily. Nevertheless, this level of collaboration achieved between the two parties allows common product development and progress. The Truck OEM can rely on the supplier's knowledge and still have the intellectual property rights.

### **Total cost of ownership**

In the end, the number of suppliers that the company employs depends on all the factors mentioned in this section. From the initial tooling and development cost, the logistics and transportation cost, the quality and delivery, the inventory cost to the final production. This subsection helped to create the checklist in the conclusion chapter.

#### **4.1.3 Interview findings Buyer C**

For Buyer C, the most important attributes of a supplier are that it can supply quality products that meet the technical requirements and that it has a healthy financial status. In regards to the department's sourcing strategy, it is 40%-45% single sourcing while 55%-60% is multiple. Sourcing decisions are taken depending on the project's requirements. The next two subsections helped to create the SWOT analysis and the table of drivers for decision making during sourcing which are developed in the analysis chapter.

### **The single sourcing approach**

If the project's investment is considerable, then it is cheaper for the Truck OEM to use one supplier, and not invest in more, since the cost will increase accordingly. Generally, the ideal scenario for single sourcing is when smaller parts are needed, but in large volumes, because the buyer can get advantage of the economies of scale, and get a better price from one supplier. The lower administration cost, accurate deliveries and increased leverage power were mentioned again as advantages from single sourcing. Buyer C added the advantage of being able to standardize the items more, which means easier operations. The disadvantages mentioned were the same as the other buyers did, with increased supply risk and dependency on one supplier being the most prominent. For these reasons, the OEM is always in the lookout for new suppliers who could produce the same items, but who can also fulfill the least of the Truck OEM's expectations. Despite the fact that it takes time for a new supplier to develop the tools to produce the items needed from the Truck OEM, it is worth waiting, because in that way, it becomes also easier to spot innovations coming to the market.

### **The multiple sourcing approach**

If the tooling investment is low, then multiple sourcing is preferred. In addition, when big items are needed it is preferable to have multiple suppliers around the world, to avoid excess transportation and logistics cost. The healthy competition between the suppliers that develops with multiple sourcing, leads to the buyer ending up with the best price in the market. The

sense of security that multiple sourcing brings to the buyer, because there is a back-up option in case of delivery failure by one of the suppliers, was mentioned from Buyer C as well. Also, the fact that there is product benchmarking with many suppliers since knowledge is shared, leading to improved market intelligence. The main disadvantage that was mentioned is that since volumes are being distributed between the suppliers, the leverage goes down, unless the buyer has good volumes to offer. In addition, that requires more work, in regards to volume allocation decisions. The buyer suggests how to split the business between the suppliers, and a cross-functional committee consisting of different stakeholders (see Buyer A), takes the final decision. Apart from that though, administration cost is not higher, because the same items would have been sourced anyway, whether from one supplier or more. No matter the additional administration in regards to volume allocation, it is advisable to always have at least one supplier situated in the same continent as the production facilities, which refers to multiple sourcing.

### **Supplier relationship management and supplier assessment**

Changing suppliers for some parts is easier than others, depending on the tooling development cost and the quality. Therefore, the chosen strategy depends on the specific item. The same applies for the level of involvement of the Truck OEM with the supplier. If the investment is big then the relationship is closer, and the opposite. In addition, the more complicated a part is, the higher the engagement with the supplier. All of the suppliers though participate once a year in a meeting with the Truck OEM's top management, and the buyer pays visits to the suppliers as deemed necessary. Regular audits also take place, to confirm whether the supplier still qualify to do business with the Truck OEM. In the end, this affects how many suppliers the Truck OEM employs, depending not only on the scores of the audits but also on the strategy of the respective segment.

### **Total cost of ownership**

Buyer C concludes that the TCO is the ultimate factor in deciding how many suppliers to collaborate with. Every part of the cost of any items that is being bought is important in the decision-making procedure, from the buying price, to the ongoing relationship with the supplier, the product quality and the proximity of the supplier to the plant. The last two subsections helped to create the flow chart in the analysis chapter and the checklist in the conclusion chapter.

#### **4.1.4 Interview findings Buyer D**

The fourth buyer acknowledges the role that the purchasing department plays in the Truck OEM, since it includes sourcing as well as project, operations and quality assurance functions, and it employees around 1000 staff members. Especially the parts that its department is responsible for, is the biggest spend area in Europe, supplying the biggest plant in Europe. Therefore, it is of utmost importance that careful purchasing decisions are taken. The next three subsections helped to create the SWOT analysis, the table of drivers for decision making during sourcing and the flow chart which are developed in the analysis chapter.

### **The single sourcing approach**

Single sourcing is the main strategy followed by the department, of around 80% of the total items bought. The main driver for this strategy is the characteristics of the items themselves. They are small items, dimension wise, making logistics not challenging, and while substituting them can be relatively easy, it takes significant amount of time, since its engineering department needs to validate everything first. Standing by a single sourcing strategy has its advantages; volume concentration can increase the leverage in the Truck OEM's negotiating power, the relationship/partnership with the supplier becomes closer, the two parties can rely more on each other, there is higher level of cooperation and trust and as always, JIT deliveries. In addition, there is administrative cost advantage with single sourcing, since fewer employees are required, especially with the specific department's case where there are no account managers. The disadvantages are that for monopolistic markets, it becomes hard to have some control over the supplier, since the Truck OEM is completely dependent on it. No matter the market, with single sourcing there is always the risk of production stoppage in the case of delivery failure. Poor delivery performance is a reason to stop collaboration with a specific supplier.

### **The multiple sourcing approach**

If the needed items are classified of strategic importance and high priority, then multiple sourcing is preferred (for the remainder 20%). The reason is that the company always needs to have a backup. Buyer D attests to the fact that by collaborating with more than one supplier, you can potentially introduce faster the product to the market, since you can gain access to the supplier's capabilities and increase your knowledge on the product. Moreover, the Truck OEM can use the market share to leverage the suppliers, something that leads to a healthy competition between them. As a drawback though, dealing with more than one supplier can be associated to additional workload, since the items need to be tested from each supplier separately. That could have an effect on manufacturing cost, since competing companies might produce different batches with different standards and cost. In regards to volume allocations, it depends on the item and on how many players are in the market. For less strategic items for example, volumes are split equally between the suppliers. For more strategic items, the biggest and most reliable supplier takes the highest percentage and the smaller companies a lower percentage.

### **Supplier relationship management and supplier assessment**

The suppliers' performance is assessed regularly and every buyer visits every supplier twice a year, regardless of the amount of business it does with a supplier. In regards to the specific items, that Buyer D is responsible for, assessing thoroughly the supplier is particularly important, since the supplier is involved in the product development, as it does some final additions to the released finished machine parts. For that reason, it takes time to change suppliers, since every potential new one has to go through a test period of six months, during which is evaluated whether it can meet the Truck OEM's engineering constraints. Generally, existing suppliers are evaluated according to their so-called 'QDCF', quality, delivery, cost and features (for example durability, lifetime, various characteristics etc). How many suppliers will be employed for every item, is affected by the supplier assessment procedure, since the OEM will eventually stop collaborating with those suppliers that do not score very

well in the QDCF. Before that though, the Truck OEM makes sure that they are properly informed by sending them notices, in the form of alert letters.

### **Total cost of ownership**

The general conclusion from the interview with Buyer D is that only the price of the items bought is not enough to decide on which supplier to collaborate with. Everything related to logistics is taken into consideration, but also the governmental regulations for each country where the facilities are located, as Buyer B also mentioned. If the Truck OEM achieves a specific percentage of locally produced items to use in a truck, then the Truck OEM can get some tax refund, while if not, a fine needs to be paid. That can influence the sourcing strategy accordingly. Finally, the Buyer adds that despite the fact that the majority of items are sourced from one supplier, there is always a consideration for back-up suppliers, to be prepared for unpleasant situations. The last subsection helped to create the checklist in the conclusion chapter.

### **4.1.5 Interview findings Buyer E**

For Buyer E, the most important characteristics of a supplier are that it can supply quality products, possesses engineering capabilities, has a healthy financial status and performs on time deliveries. An oligopolistic price is considered thus it is important for Buyer E to maintain a healthy relationship with a supplier. Moreover, a supplier must hold ISO/TS certifications as mentioned also from Buyer A. The role of the purchasing department is big since it includes global sourcing. This subsection helped to create the flow chart in the analysis chapter and the next three subsections helped to create the SWOT analysis and the table of drivers for decision making during sourcing which are developed also in the analysis chapter.

### **The single sourcing approach**

As a senior sourcing Buyer, Respondent E claims to dictate the business with a supplier. Single sourcing strategy is mainly followed in the department, representing 98% of the products he buys. That is because the volumes are not big enough to split the business between two or more suppliers. The ideal threshold of volumes in order to use another source for the same item is 30000 units per item otherwise there is no leverage for a buyer. Some of the parts Buyer E sources are quite big but others are not. The main advantage of having one supplier for items with low volumes is the development and evaluation of one set of tooling. Furthermore, the negotiation power increases and it is cheaper in terms of administration and communication. On the other hand, there is dependency on a single supplier and if something does not turn out as expected, the production might stop. Buyer's E department monitors suppliers on a regular basis. However, it is hard to make a decision whether a supplier would go bankrupt. Nevertheless, in some cases there are hints. Following the single sourcing approach, it is necessary for Buyer's E department to keep more inventories but that depends also on where the supplier is situated.

### **The multiple sourcing approach**

If the volumes of an item are high, another supplier could be developed. Identifying new suppliers in an oligopolistic market is an advantage. Other advantages include back up options, independency and a buyer feels more secure knowing that has more than one supplier to deal with. Many times, a cost increase is unrealistic from a supplier's part. A buyer could

face a challenge of securing budget and resources for multiple investments. If Buyer E has to develop another supplier, he needs to secure resources and initial costs to study the supplier first and then to invest on the tooling requirements.

### **Supplier relationship management and supplier assessment**

The ideal case is to provide fair chances to the existing suppliers to meet the Truck OEM's expectations. Based on the four elements which are quality, cost, delivery, features, moreover the relationship with a supplier affects the number of suppliers the company will employ. Many parameters affect the quality of a component. Those are the dimensions of a component, audits that need to be done and technology required among others.

### **Total cost of ownership**

When choosing to work with a supplier, the TCO is considered, which includes apart from the buying price, logistics cost, taxes and special duties and packaging cost. Maintenance cost is also included since inventories are kept for 8-10 weeks; thus, that is a considerable cost for the company. This subsection helped to create the checklist in the conclusion chapter.

## **4.2 Respondents from Car OEMs**

The buyers from Car OEMs have provided also their own angles on how they deal with sourcing issues. The main reason for that is that the items each of them is responsible for have different characteristics. The supplier selection procedure they follow is not the same and for that reason it is described separately in each subsection.

### **4.2.1 Interview findings Buyer I**

As a project Buyer, Respondent I is responsible for many commodities and ensures that the project gets the prototypes of the components on time. The purchasing department is responsible for nominating suppliers and works closely with other departments. A competitive price is considered for all the commodities and the objective is to minimize cost as much as possible.

### **Supplier selection procedure**

The supplier selection procedure within the Car OEM is divided into five steps. The first step is called 'TAR' which means target evaluation request which is set by the project. The buyers meet up to decide the costs of an item, the quality and other specifications. The next step is the actual design which includes research and development. It is the start of development the concept. The third step, the buyers present the strategy of the intended suppliers to the management team in a meeting called sourcing approach and send a RFQ. The fourth step is the global alliance which includes support, guidance and negotiation with suppliers. Finally, it is the supplier choice meeting where the top management needs to approve a supplier. In the SCM, there is only one or two suppliers involved since a buyer has already decided. If there are two suppliers in the SCM, a buyer is in better position to negotiate. In that way, a supplier does not feel comfortable. The supplier selection procedure can take up to one year and many teams are involved in this process.



**Figure 14:** Supplier Selection Procedure (Car OEM)

The characteristics that an ideal supplier should have are technical specifications, quality assurance, cost estimators and savings plans per year which refer to the long-term agreements. Moreover, experience and knowledge that one supplier possesses are important elements. The next three subsections helped to create the SWOT analysis and the table of drivers for decision making during sourcing which are developed in the analysis chapter.

### **The single sourcing approach**

In regards to the sourcing strategy chosen from Respondent's I department, it is single sourcing around 90% of the components he buys. That is because the availability of substitution for the specific components he is responsible for depends on the technology behind. Those components are of high technology and a supplier has a take rate 100% which means that it gets the whole business and has global volumes.

Standing by the single sourcing strategy has its advantages as it is cheaper for a high technology component to have one supplier in regards to administration, communication and handling. Buyer I needs to keep the collaboration with a supplier for a long-term and improve the technology. However, it needs to work harder and pressure a supplier more in order to make a profitable situation for the Car OEM. Buyer I has not experienced so far any production stoppage since the Car OEM conducts risk assessment for every project it undertakes and takes into consideration many parameters before sourcing such as geographic position, political safety and financial stability. Dun and Bradstreet is a company which helps out the Car OEM with the risk assessment and provides commercial data on credit history, counterparty risk exposure and supply chain management.

### **The multiple sourcing approach**

The remainder 10% is sourced from many suppliers, because of high competition especially in the low technology components. There are no more than two suppliers for each component, so the highest Buyer I uses is dual sourcing. The volumes of an item among two suppliers are divided 60%-40%. A supplier who offers the lowest price gets the 60% otherwise the Car OEM loses money. Depending on the component, other suppliers share knowledge with buyers and others do not.

### **Supplier relationship management and supplier assessment**

Buyer I treats all suppliers the same way and it is up to his judgement when he will meet up with them. Buyer I proactively works with a supplier and gives continuously feedback. It is not easy to change suppliers because it is a complex process and includes a lot of moving costs such as the tooling costs which are situated to a supplier's location specifically designed for one component. If Buyer I wants to change a supplier, he needs to go all over again the supplier selection procedure. There are monthly audits in order to manage product quality with many suppliers. Advanced Product Quality Planning is a process for all new parts or new

processes covering suppliers. A supplier has to work one year in advance in order to be chosen by the Car OEM.

**Total cost of ownership**

When choosing to work with a supplier, the total business case is considered, which includes not only the buying price but also the FCA requirements. These requirements refer to the logistics cost when products are transferred from one location to another. Inventory is part of the FCA requirements also since Buyer’s I department does not want to keep much inventory because that will affect the lean. The total business case is considered at a late stage before buyers attend the global counsel. Buyer I concludes that he cannot evaluate technology for components he has not worked with in the past. The risk with single sourcing is that a buyer does not know if a supplier could give what it has promised for. The best way to eliminate that risk is to run prototype tests. That means, a buyer is doing outside work making sure that the technology is updated for example test trials. However, it is not easy to allocate resources for running these tests. On the other hand, the risk with multiple sourcing is that there are lots of administration costs and one way to eliminate that risk is to employ more people.

**4.2.2 Interview findings Buyer II**

For Buyer II, the most important characteristics of an ideal supplier are that it can supply quality products at the lowest cost for the regions needed. He uses exclusively the single sourcing strategy considering the amount of volumes.

**Supplier selection procedure**

The supplier selection procedure is short in general about 7-8 weeks within the Car OEM and it is divided into five steps. The first step is a RFI which is the design stage and includes all technical information. RFI is sent to potential 5-6 suppliers which are already preapproved because they have been working with the company. The suppliers know what is actually going to come as a RFQ since they are prepared to get the business. The RFQ is sent to 3-4 suppliers and it is the second step. The next step is the final negotiation which includes fewer suppliers than in the previous two steps. The sourcing meeting with the supplier committee follows as the next step. That is the only step which approval is needed. Many teams have to sign a sheet in order a supplier to get approved. If it gets approved, this sheet goes back to the regional management and then the purchase order is made to a supplier. The last step is the nominating which normally includes only one supplier. The supplier selection procedure is not considered a high investment especially for a face lift. However, depending on project to project if it is for a complete new car, then it is a high investment.



**Figure 15:** Supplier Selection Procedure (Car OEM)

The next two subsections helped to create the SWOT analysis and the table of drivers for decision making during sourcing which are developed in the analysis chapter.

### **The single sourcing approach**

The main driver for choosing the single sourcing strategy is cost savings. When Buyer II negotiates on large volumes of business with a supplier, it is easier to manage since there are a lot of cost leverages and benefits. However, if there is any crisis or quality issues, the production line has to stop. The parts are delivered 20 minutes before, even though suppliers have stock in a plant of 2-3 days. This is the epitome of JIT deliveries. Having many suppliers for a single component in the car industry is a large amount of workload for a buyer. Depending on the technology of a component, a supplier gets the business either based on preexisting relations with a buyer or based on its financial situation.

### **The multiple sourcing approach**

For a low technology component, multiple sourcing is preferred because it is easy for a buyer to spot many available suppliers in the market. But, for a high technology component, it is much more complicated for a buyer to find many available suppliers since customization is needed and there is no easy substitution. For this reason, single sourcing is preferred. The biggest advantage of multiple sourcing is to stimulate a healthy competition among the suppliers, negotiate and have better commercials with them. However, it is more difficult to deal with many suppliers at the same time.

### **Supplier relationship management and supplier assessment**

The relationship with suppliers is extremely strong because the amount of business in the car industry is huge. There is collaboration with suppliers in regards to product development because of the big number of items they produce. One model keeps changing frequently. A supplier wants to get the business not only today but also tomorrow. So, when a supplier is close to a buyer, it is aware of any changes that might occur in the future. Buyer's II department provides feedback to the biggest supplier who is the one in terms of money, having quarterly review meetings with it. He proactively works with a supplier otherwise the cost of developing a product when choosing another supplier is high. All suppliers can log into the company's system every week to find out all necessary information regarding their performance. This procedure does not affect the number of suppliers that will be employed by the company since there are already long term relationships with them.

### **Total cost of ownership**

When choosing to work with a supplier, the TCO is considered which includes apart from the buying price, the early savings. That refers to the long-term agreements between a buyer and a supplier in which the price decreases as time goes by. That happens because the efficiency improves. Technology is considered also a major part of TCO. Moreover, transportation and logistics cost are taken into consideration.

The general conclusion from the interview with Buyer II is that it is not easy to move from single sourcing to multiple sourcing because the frequency of changes in design is huge in the car industry. Buyers within the Car OEM have been following the single sourcing approach for a long time, so that plays apparently, a big role since that has worked in the past and no one has challenged it before. The last subsection helped to create the SWOT analysis in the analysis chapter and the checklist in the conclusion chapter.

### 4.2.3 Interview findings Buyer III

As a senior engineering Buyer, Respondent III can ascertain that the purchasing department plays a big role in the Car OEM, as it relates to large amounts of money spent yearly. A competitive price is considered for some components and a monopolistic one for others. In regards to the Respondent's III sourcing strategy, it is 90% single sourcing while 10% is multiple. The main factor that Respondent III looks for an ideal supplier is transparency. Transparency means a supplier should be transparent about which aspects of the business it can meet and which it cannot. Furthermore, it has to be transparent in its books of account and all its costs. The Car OEM embodies the concept of kaizen event which means continuous improvement.

#### **Supplier selection procedure**

The supplier selection procedure is a laborious and lengthy one for the Car OEM and is divided into six steps. The first step is about receiving technical information from the mother company. The second step is called 'Market Research' which includes also a RFI which is sent to potential suppliers. During the next step, a RFQ is sent to fewer potential suppliers. In the next step, technical information and cost are received and all technical interviews are conducted. During this step, the cross functional teams which consist of quality, production, product development, testing, logistics and purchasing, will review all information and send it to the mother company in order to approve the price. Thereafter, the best suppliers are decided. The next step is to get quotes and all technical information need to get validated by the best suppliers. A final decision for the supplier then has to be made. At the quotation and validation stage, the teams which are involved are purchasing, costing and project. Including the final negotiation and nomination step which is the last one, the entire process takes up to one year. The supplier who is chosen has four years in its disposition with respect to cost, quality, delivery and process to make sure that the part is developed properly.



**Figure 16:** Supplier Selection Procedure (Car OEM)

The next two subsections helped to create the SWOT analysis and the table of drivers for decision making during sourcing which are developed in the analysis chapter.

#### **The single sourcing approach**

The Car OEM concentrates all its energy and time to develop only one supplier. In that way, it scrutinizes the whole process with a supplier. The relationship among the mother company and a supplier is really strong since the updates could be transferred faster to a supplier compared to a buyer within the Car OEM. That makes sure that a supplier is actually a part of the company.

The main driver for following the single sourcing approach, is cost savings. A buyer should concentrate only on cost savings in order to get the lowest possible price. The 'should be cost'

is the cost that a buyer is interested to pay. That is partly built on experience and partly on a buyer's own research. If a price is logical, then a buyer should accept that price, otherwise it should not. The strong need for JIT deliveries, and that it is cheaper to have one supplier in regards to administration, communication and handling were mentioned again as advantages from single sourcing. A buyer gets risk triggers when using one supplier. A risk trigger consists of an issue and a risk. Issue is what has already happened, and risk is something before happening (issue). When a buyer has to develop one supplier instead of two, the initial fixed cost investment and the coaching for developing a supplier are reduced by half. On the other hand, the main disadvantage of the single sourcing strategy is that if single sourcing is not managed properly, the OEM is leading towards catastrophe. Properly means a buyer needs to know whether a supplier is transparent, otherwise it is risky to follow the single sourcing strategy. Furthermore, it takes a long time to work with a supplier.

### **The multiple sourcing approach**

The main driver for following the multiple sourcing approach is to de-risk one buyer's business fast. That means if one supplier goes bankrupt, then there is other or others to source a component from. In addition, a buyer could turn one supplier against the others, negotiate and try to decrease further the price. The advantages for selecting this strategy are that a buyer is always on the commanding seat; in other words, it can dictate the business as Buyer E has also mentioned. Moreover, there is high level of independency as a buyer can spot many available suppliers. On the other hand, the main disadvantage is that a buyer-supplier relationship is not strong. For that reason, a buyer might not get information from a supplier with respect to cost, technology and new innovations. In addition, there are a lot of fixed cost investments that need to be made, testing and validating. Therefore, the cost for a buyer using many sources is high.

### **Supplier relationship management and supplier assessment**

When there are many available suppliers in a market for sourcing an item, a buyer allocates volumes to suppliers by making sure that all suppliers are on the same 'field' and choosing the one with the less cost. If a part is customized, then volumes are not high. Generally, OEMs feel customization is not a really good option. The reason is that this entails operational issues in order to make multiple parts such as huge amounts of inventories and supplies. The negotiation between two suppliers would never be at the level of 50%-50% pricewise because in that way a buyer has done the wrong negotiation. It should always be at least at the level of 60%-40%. If it is 50%-50%, a buyer then has to introduce a new supplier in order to be able to reduce the price further. However, that would take more time for a buyer to make a final decision.

If suppliers are far away from a price, then a buyer needs to stop working with them and move on. A method of assessing a supplier is the 'ABC method', which means activity based costing method. It is a cost analysis tool and each company has its own way of estimating the costs. Buyer's III department uses a method named 'machine hour rate' which is the cost of running a machine per hour. This method absorbs factory expenses to production. The ABC method can be applied to both single and multiple sourcing but there are different ways of executing it.

### **Total cost of ownership**

When a buyer chooses to work with a supplier, the complete cost of ownership is considered both in attaining a supplier and throughout the relationship with it. TCO includes apart from

the buying price, the tooling cost, depreciation, the logistics cost, the defect cost and the warranty cost.

A major risk of the single sourcing approach is the technical issues that could occur in an OEM's premises. Then, that OEM could be in bad shape for a long time. One way to eliminate that kind of risk would be to have a backup source or a parallel source. If a buyer feels a supplier is a critical one, then it needs to store a larger quantity at the warehouse. Buyer III concludes that it is better to follow the multiple sourcing strategy for low technology components where a buyer can reduce costs. That is because there are plenty of suppliers in the market. The single sourcing strategy on the other hand, is preferred for high technology components where there are limited suppliers available. For a high technology component, a buyer needs to make sure that the technology is coming in for longer lead time. When there are many available suppliers, a market defines a price for one component whereas when there is a limited number of suppliers, a market does not define it but a supplier does. The investment on new testing and validation is quite exponentially high on high technology components when it is compared with low technology components. When the technology is leading, it is better for a buyer to follow the single sourcing strategy whereas when a buyer is designing a part, it is better for a buyer to follow the multiple sourcing strategy. The conclusion from Buyer III helped to create the flow chart in the analysis chapter and the checklist in the conclusion chapter.

## **5. Analysis**

The purpose of this chapter is to evaluate all the data that the author gathered from interviews. Moreover, answers to the three research questions are given. In the first part, two modified SWOT analyses are developed; one for buyers within the Truck OEM and one for buyers from Car OEMs. Strengths, weaknesses and challenges are analyzed based on the findings during this study. Following, two Tables of drivers during sourcing are analyzed and compared; one for buyers within the Truck OEM and one for buyers from Car OEMs. Finally, a flow chart of a low, a medium and a high technology component for buyers from Car OEMs helped investigate how other manufacturing companies deal with the main dilemma of single versus multiple sourcing.

### **5.1 Comparison of the two approaches**

Three out of five respondents within the Truck OEM use single sourcing as their main strategy, one out of five uses multiple sourcing and one out of five uses a mixed approach. In this subsection, the first research question is answered which is: What are the benefits and disadvantages of single and multiple sourcing in a specific Truck OEM?

#### **5.1.1 Benefits of single and multiple sourcing for Buyers within the Truck OEM**

The buyers who follow single sourcing as their main strategy agree that it is much easier to monitor, track and manage one supplier. A buyer spends all its energy developing one supplier and for that reason a buyer-supplier relationship becomes stronger. Moreover, as a buyer increases the volumes of orders, the cost per unit decreases which means that the Truck OEM benefits from the economies of scale. Based on this finding, I would argue that economies of scale could be achieved with multiple sourcing as well by spreading volumes over fixed costs. When a buyer concentrates volumes, this increases the leverage in the OEM's negotiating power. As a consequence, a buyer feels commercially stronger which means financially stronger and it is in a position to diminish further component prices. The operations are easier since there is more standardization of one component and the JIT concept is applied when dealing with only one source.

On the other hand, one buyer within the Truck OEM follows the multiple sourcing approach as his main strategy. He argues that there is less dependency on a single supplier which is necessary especially when sourcing critical items. In case of any crisis, there is always a backup option and a buyer feels more secure knowing that it has more than one supplier to deal with. Based on this finding, I believe this makes the life of a buyer less stressful since the supply risk decreases substantially. For big items, which cannot be transported easily from one continent to another, using multiple sourcing within the same continent makes the intercontinental transportation to be avoided. Furthermore, a buyer can stimulate competition among suppliers by turning one against the other. As a result of this, minimization of cost is accomplished for a buyer.

Benefits from currency exchange rates can be achieved for a buyer when it is dealing with many suppliers. However, it needs to know in advance how to deal with that situation. Depending on the fluctuations of the respective currency exchange rates, a buyer could use a hedging strategy such as a currency forward contract. That would enable a buyer to lock in the rate at which it would pay a currency at a fixed price to a supplier at a specific date in the future.

Common product development and progress can be shared among a buyer and a supplier in both single and multiple sourcing strategy. This implies that market intelligence is improved for a buyer and a product can be introduced faster to a market since a buyer has access to suppliers' technologies, capabilities and new innovations. Nevertheless, I would doubt that trust is the same when a buyer collaborates with many suppliers as it is when it collaborates with one.

### **5.1.2 Disadvantages of single and multiple sourcing for Buyers within the Truck OEM**

The major drawback for those buyers who follow the single sourcing approach is that the possibility of a production stoppage increases because there is dependency on a single supplier. A buyer debated that keeping a supplier constantly motivated is difficult unless a buyer has new business to offer. I would argue that since a buyer-supplier relationship is strong as this has been tested over time, it is not difficult to manage a supplier even though there is not new business to offer.

Logistics costs can be expensive for transportation of big items. This shows that a buyer cannot rely on one source because there are budget restrictions for each project and it might be necessary to split the cost between two or more suppliers. When the volume is low however, it is difficult to split the business.

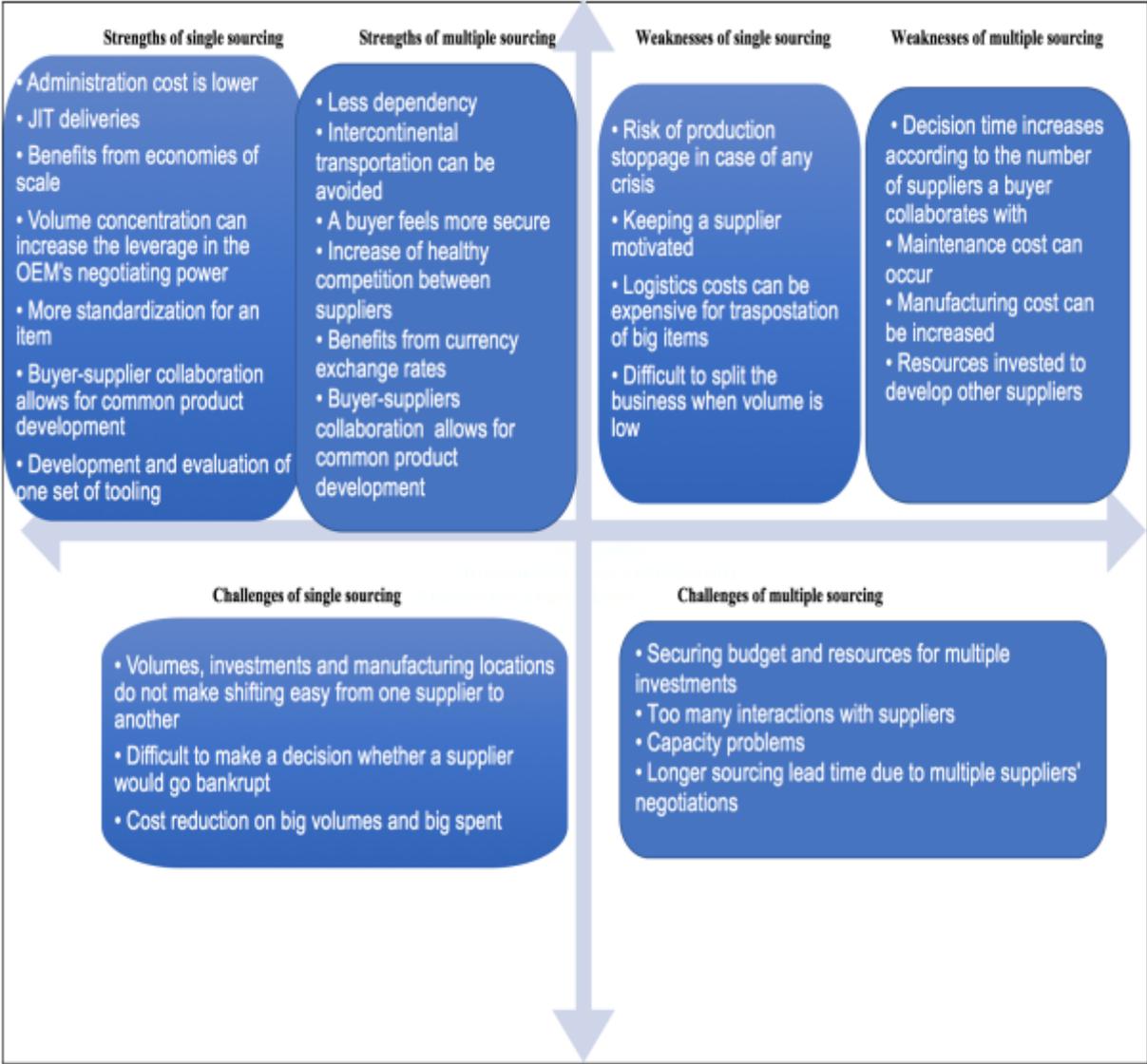
When volumes are distributed among many suppliers, I would debate that this could create more work and stress for a buyer in terms of volume allocation. The more suppliers a buyer collaborates with, the more time it takes for a buyer to make a final decision. Maintenance cost can occur in case there are some differences in the machineries of facilities and when inventories are kept for a long time. I believe this could be a major issue for a buyer who follows the multiple sourcing strategy because many problems could be increased in plants as well. Moreover, the manufacturing cost can be proliferated when competing companies are producing different batches with different costs.

### **5.1.3 Challenges of single and multiple sourcing for Buyers within the Truck OEM**

The major challenge of single sourcing for buyers within the Truck OEM is that volumes, investments and manufacturing locations do not make shifting easy from one supplier to another. It is difficult for a buyer to make a decision whether a supplier would go bankrupt. However, a buyer needs to do its own research, evaluate annual and other financial reports and be close to a supplier in order to get hints. Another challenge for a buyer when it cooperates with only one supplier is to reduce the cost on big volumes. Because the cost per unit decreases as the volumes increase, I would argue that it is up to a buyer's negotiation ability to accomplish a further decrease in a component's price.

The major challenge of multiple sourcing for buyers within the Truck OEM is securing budget and resources for multiple investments. There might be some potential capacity issues in a plant that a buyer needs to solve. Furthermore, the interactions with suppliers are many and as result of this, the negotiations can be increased as well. Another challenge of multiple sourcing that buyers face, is that the sourcing lead time is longer due to multiple suppliers' negotiations. As a consequence, a buyer might not achieve a price reduction if it negotiates with many suppliers more than once. This implies that a buyer might not be able to achieve the annual targets in regards to cost reductions for its purchasing portfolio and that would

have a negative impact for its department. The figure below shows a modified SWOT analysis of strengths, weaknesses and challenges for the buyers within the Truck OEM.



**Figure 17:** Modified SWOT Analysis for Single versus Multiple Sourcing for Buyers within the Truck OEM (Own developed model)

**5.1.4 Benefits of single and multiple sourcing for Buyers from Car OEMs**

All three buyers outside the OEM belong to the car industry and use single sourcing as their main strategy. A long-term buyer-supplier collaboration in regards to product development was mentioned again as the major benefit of single sourcing. Other benefits include that it is cheaper to have one supplier in regards to administration and that there are cost leverages as result of negotiating on large volumes of business with a supplier. In single sourcing, a buyer will get risk triggers. This means an event that causes a risk to occur. Risk triggers consist of two phases: an issue and a risk. For example, a buyer recognizes an operational issue which is an event that occurred. As a repercussion, a production line might stop. A risk of stopping a production line is something that happened before an operational issue took place.

The negotiation power is increased in the multiple sourcing strategy by stimulating a healthy competition among suppliers. A buyer is always on the commanding seat when dealing with many suppliers since it dictates the level of business and it is able to get always whatever component it wants. I would argue that this would make the life of a buyer less stressful since it knows there are a lot of available suppliers in the market. Additionally, multiple sourcing is considered to be a risk mitigation activity because the supply risk decreases.

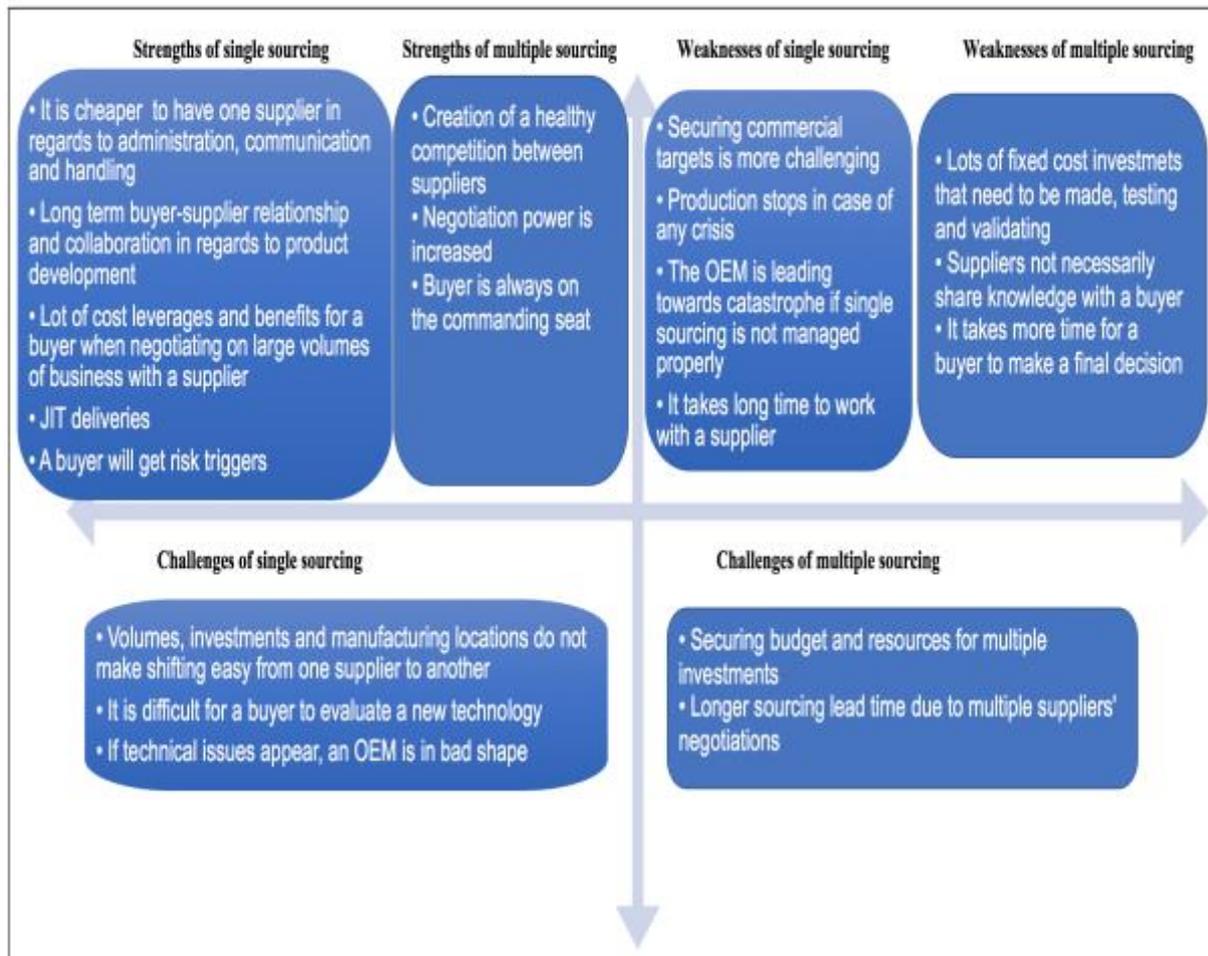
### **5.1.5 Disadvantages of single and multiple sourcing for Buyers from Car OEMs**

The risk of a production stoppage in case of any crisis is considered as the major demerit of single sourcing for the buyers from Car OEMs. Another disadvantage they agreed upon is securing commercial targets. This means a buyer needs to work harder in order to make a lucrative situation for an OEM. Based on this finding, I would argue that this is true when a buyer is dealing with only new suppliers since for the established ones it could take less time to work with. The reason is that these suppliers have been already working and have pre-established a good relationship with an OEM. Additionally, another drawback of single sourcing is that it takes a long time for a buyer to work with a supplier and develop one set of tooling. If single sourcing is not managed well, an OEM could have significant losses. This means a buyer would not minimize the cost spent for items that need to be sourced and this would have a negative impact for its purchasing portfolio.

As far as the drawbacks of multiple sourcing, all buyers from Car OEMs agreed that it takes more time for a buyer in order to make a final decision since there are many suppliers that need to be dealt with. Further, the fixed cost investments that need to be made are considerably higher than the investments in the single sourcing approach since there are many suppliers that need to be developed instead of one. Additionally, a supplier might not share knowledge with a buyer because it has not developed a close relationship and knows that there are other competitors available.

### **5.1.6 Challenges of single and multiple sourcing for Buyers from Car OEMs**

The biggest challenge of single sourcing for all buyers from Car OEMs is that volumes, investments and manufacturing locations do not make shifting easy from one supplier to another. This is the case for buyers within the Truck OEM as well though. Because the dependency on a single source is increased, an OEM could be in bad shape for a long time if technical issues appear. For a consistent part, the quality would always be consistent. But for an inconsistent part, the results would be wrong until a buyer finds out. Most of the times, this does not happen right away but it takes time for a buyer to realize a situation. Moreover, it is difficult for a buyer to evaluate a new technology if it does not possess the necessary knowledge. Securing budgets and resources for multiple investments and that the sourcing lead time is longer due to multiple suppliers' negotiations are also the challenges for buyers from Car OEMs. The figure below shows a modified SWOT analysis of strengths, weaknesses and challenges for the buyers from Car OEMs.



**Figure 18:** Modified SWOT Analysis for Single versus Multiple Sourcing for Buyers from Car OEMs (Own developed model)

In this subsection, the author exhibited all the benefits, weaknesses and challenges of both single and multiple sourcing strategies as gathered from interviews. Figures 17 and 18 helped compiling and formulating the checklist which is described in the conclusion part. Common product development and progress is shared on both strategies for the buyers within the Truck OEM. However, this is not the case for the buyers from Car OEMs. The single sourcing approach is preferred for most buyers within the Truck OEM and for all those from Car OEMs. The most important benefits include a long-term buyer-supplier relationship, cost leverages when negotiating on large volumes of business with a supplier, JIT deliveries and benefits from economies of scale. Moreover, it is cheaper to have one supplier in regards to administration. On the other hand, the disadvantages that all buyers shared for the single sourcing approach encompass more chances of stopping a production line since there is dependency on a single source and there are no further back up plans. The multiple sourcing approach is least preferred for buyers within the Truck OEM and not preferred at all for buyers from Car OEMs. The major benefit of following the multiple sourcing approach is the stimulation of a healthy competition among suppliers and as result a further reduction in components' prices. On the other hand, the major disadvantages of multiple sourcing are that it takes more time for a buyer to make a final decision since it needs to evaluate all suppliers a company collaborates with and the fixed costs and resources to develop other suppliers are

significantly increased. A challenge that all buyers shared for the single sourcing approach is that volumes, investments and manufacturing locations do not make shifting easy from one supplier to another. Two challenges that all buyers shared for the multiple sourcing approach are securing budget and resources for multiple investments and that the sourcing lead time is longer due to multiple suppliers' negotiations.

## **5.2 Drivers for decision-making during sourcing**

In this subsection, the motives behind each sourcing decision are analyzed. Moreover, the second research question is answered which is: Which are the drivers for decision-making in a specific Truck OEM during sourcing?

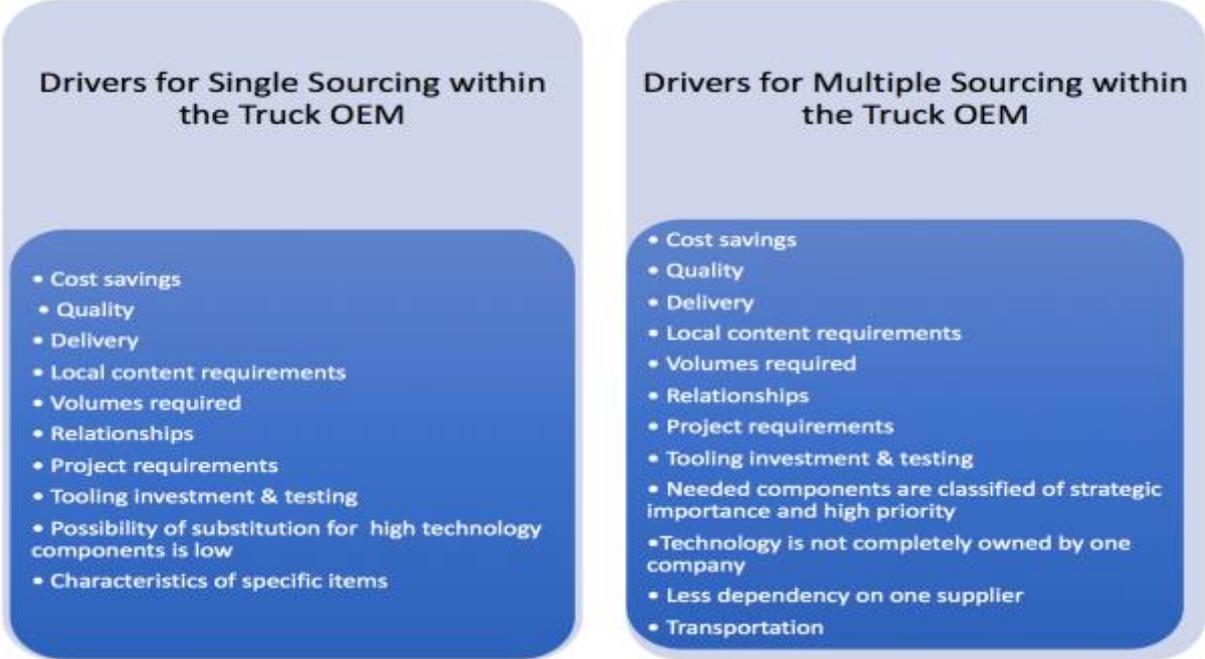
### **5.2.1 Drivers for single and multiple sourcing for Buyers within the Truck OEM**

The buyers within the Truck OEM shared some drivers for both approaches. Cost savings for all buyers is of utmost importance. Moreover, quality certifications, volumes and delivery requirements are significant attributes for each supplier in order to get selected by the Truck OEM. The local content requirements are additionally a significant driver regardless of the component that needs to be sourced. Every country has its own regulations that need to be fulfilled by the Truck OEM in regards to the minimum amount of locally produced items. A lot of money should be involved in this process which would pressure a buyer and its purchasing department. The project requirements are moreover a common driver for both approaches. All these drivers are taken into consideration based on a specific component that needs to be sourced in a real case scenario. For example, volumes are a common driver for both strategies but the requirement level changes from one strategy to another. That means a buyer follows the single sourcing strategy for 30000 units per component but the multiple sourcing strategy for 50000 units per component. Thus, the driver is the same (volumes) but the requirement level changes.

Relationships with a supplier is further an important driver of decision-making during sourcing which determines whether a buyer will pursue the single or the multiple sourcing approach. If a supplier does not reveal its way of working or its technologies, capabilities and new innovations, then it is a strong sign of not wanting to do business with an OEM. However, I would argue that a buyer should always try to detect new potential suppliers in the market so that the current supplier is challenged.

The buyers within the Truck OEM have also motives which are not the same for the two strategies. When a buyer sources high technology components, the possibility of substitution is low. These components have specific characteristics themselves and customization is needed. That means the market to a large extent is oligopolistic or monopolistic. Furthermore, the tooling investment for these components is expensive. In that case, it would be better to let a supplier improve the technology if that would be necessary instead of starting over again from scratch the process of selecting a new one. The costs involved would be tremendous. For these reasons, it would be a good strategy for a buyer to follow the single sourcing approach and maintain a close relationship with a supplier. On the other hand, if a tooling investment is not expensive, then a component is of a low technology and a lot of suppliers are available in the market. A buyer could switch among them easily. This implies that a buyer should pursue the multiple sourcing approach.

Some components needed are classified of strategic importance and high priority. The transportation of these components is not easy from one continent to another since these are quite big and heavy. A buyer cannot use only one supplier because it is more than a necessity to have always a backup plan. Having multiple locations making the same exact component indicates that the intercontinental transportation could be avoided. The figure below shows the drivers for both approaches for buyers within the Truck OEM.



**Figure 19:** Table of Drivers for Single versus Multiple Sourcing for Buyers within the Truck OEM

**5.2.2 Drivers for single and multiple sourcing for Buyers from Car OEMs**

The buyers from Car OEMs argue also that cost savings is the most critical driver for the single sourcing strategy. Further, the possibility of substitution for high technology components is low. If a buyer wants to change a supplier, it is not feasible since this includes many issues which would make operations more difficult. This implies change of the tooling involved, the design and the test modules. Moreover, there is a tool called ‘long term contract agreements’ and with this tool a buyer could pressure a supplier in order to not feel comfortable.

The buyers from Car OEMs support the view that the less dependency on a single source is the most important driver for the multiple sourcing strategy. Another driver is to de-risk one buyer’s business fast. This means if one supplier goes bankrupt, then there is other or others available to source a component from. But, a buyer might not know this in advance. For example, in case of an earthquake in Sweden, there are two suppliers, a local one in Sweden and another one in Switzerland. The local one will be closed but there is still the other one in Switzerland to fulfill a buyer’s requirements. Thus, the risk is spread by using two suppliers. Moreover, another driver for multiple sourcing is the creation of a healthy competition between suppliers for low technology components. This means that a buyer can substitute these components easily since the market is competitive and there are many available

suppliers. The figure below, shows the drivers for both approaches for buyers from Car OEMs.



**Figure 20:** Table of Drivers for Single versus Multiple Sourcing for Buyers from Car OEMs

This subsection assessed all the drivers for the single and the multiple sourcing strategy. Figures 19 and 20 helped compiling and formulating the checklist which is described in the conclusion part. The buyers within the Truck OEM shared many drivers for both strategies such as cost savings, local content and project requirements, quality assurance, delivery and volumes requirements, tooling investment and relationships with a supplier. Even though these drivers are the same for both strategies, they are taken into consideration based on a specific component that needs to be sourced in a real case scenario. On the other hand, the buyers from Car OEMs did not share the same drivers for both strategies. The most important driver for following the single sourcing approach is cost savings and for the multiple sourcing approach is the less dependency on a single source.

**5.3 Lessons learned from Buyers from Car OEMs**

In this subsection, the third research question is answered which is: What lessons can be learned from Car OEMs in regards to the same dilemma?

All buyers outside the OEM belong to the car industry and it would be useful to distinguish some basic differences between the car and the truck industry. The truck industry contains of more variance compared to the car industry. The reason is that the same car could be sold for example all over Europe but this could not happen with a truck because every country has its own specific regulations and requirements. This implies that the customization for a truck is much higher when compared with a car. Moreover, the volumes for trucks are lower than those for cars. Four lessons learned from buyers from Car OEMs. The author of this thesis believes that three out of four lessons are of high importance and one out of four is of low importance.

The lesson learned which is ranked of paramount importance, is that a buyer can follow three different scenarios as are described below in the figure 21 when sourcing a component in terms of technology. The assumption that was made by the author was that a buyer in a monopolistic market has 1-5 suppliers to choose from, in an oligopolistic market has 5-10 suppliers to choose from and in a competitive market has more than 10 suppliers to choose from. When a component is of a low technology, then a buyer can go to any supplier in the market and buy it anywhere since the component is ready for use. The market is competitive. All costs spent are controlled by an OEM and there is no major investment made by it. The best strategy for an OEM in this scenario is to follow the multiple sourcing approach. The drivers are the volumes of a component which are high in most cases and the manufacturing locations that a component can be made. When a component is of a medium technology, then it is designed by an OEM which controls also all costs. The investment made by an OEM is considered to be medium or high. The market is either competitive to a large extent or oligopolistic. That means there are few global suppliers in the market and also many other suppliers who are not global. For this scenario, an OEM can follow either the multiple sourcing or the single sourcing approach. The drivers are the volumes of a component, the investments made by an OEM and the manufacturing locations that a component can be made. On the other hand, when a component is of a high technology, then it is designed by a supplier who controls also all the costs involved. The investment made is high from an OEM's part. The market is pure monopolistic. That means most of the times there are one or two global suppliers who own completely the technology. The most appropriate strategy for an OEM in this scenario, is to follow exclusively the single sourcing approach since the technology is leading and it is the only driver. The substitution is easy for the first two scenarios but for the last one it is not feasible. The figure below shows a flow chart of three different scenarios for buyers from Car OEMs. This flow chart helped compiling and formulating the checklist which is described in the conclusion part.



**Figure 21:** Flow chart for Buyers from Car OEMs (Own developed model)

Another lesson learned is that Dun and Bradstreet is a company which helps out OEMs on doing risk assessment by printing out audits from suppliers. The company entails a huge database, helps out reduce credit risk and provides all information for suppliers worldwide. An OEM before sourcing, is performing an extensive risk assessment for every project it undertakes. This implies that it examines all the parameters from the actual design and RFQ, to receiving all costs, the political outlook of a specific region that a component is going to be sourced, the closeness of a supplier to a plant, the financial stability of a supplier. The possibility that something will turn out to be too wrong is relatively low since the research has been conducted in advance of the supplier selection procedure.

Further, another lesson learned is that the longer the supplier decision process is, the more considerable the investment required by an OEM's part and potentially the higher the risk involved. Even though the supplier selection procedure for the Truck OEM lasts about 16 weeks, for two of the three OEMs it lasts about one year and there are many teams involved in the process. This implies that it should be a considerable investment for the OEMs. For the third OEM, the supplier selection procedure is really short in duration since the potential suppliers have already worked with the company and are prepared to get the business. That denotes it is not a considerable investment. Further, there are no presentations during the process. The supplier selection phase of all three OEMs consists of fewer steps and less potential suppliers involved, compared with the phase of the Truck OEM.

The last lesson learned which is ranked of low importance is the use of the activity based costing method named 'ABC method'. This is a cost analysis tool in order to assess suppliers

and it can be used for both single and multiple sourcing strategy. Every OEM has its own method of cost analysis and there are different ways of performing it. Many teams are involved in this analysis and this procedure affects the number of suppliers a company will employ. Another requirement for suppliers is to use the Advanced Product Quality Planning process for all new parts. This process is related to production purchasing; however, it covers suppliers mostly in the automotive industry.

In conclusion, it would be pivotal for a buyer to identify the level of technology and volumes of a component that needs to be sourced. Further, a buyer needs to perform its own research in order to find out all the necessary information about a component before it enters the supplier selection process. The buyers outside the Truck OEM that have been interviewed, prefer to develop a close relationship with their suppliers in terms of product development and for that reason they follow exclusively the single sourcing approach.

## **6. Discussion**

This chapter serves the purpose of connecting the outcome of the empirical data with the results of the literature review of this study. Convergent and divergent aspects of single sourcing, multiple sourcing, supplier selection procedure, supplier relationship management and total cost of ownership are discussed.

### **6.1 The convergent aspects of single sourcing approach**

The decision of choosing the single or the multiple sourcing approach for one specific component can be challenging for manufacturers. A strategic buyer-supplier collaboration which allows for common product development and JIT deliveries are strongly supported by both the results of the literature review and the outcome of the empirical data. Moreover, as the volumes of orders increase, the cost per unit decreases. As a consequence, benefits from economies of scale are achieved as a buyer is willing to increase its orders. The administration costs are lower when following the single sourcing approach and because the dependency on a single source is high, this encourages more commitment and effort from both a buyer and a supplier.

In regards to the disadvantages of single sourcing, the published literature is full of examples of supply chain disruptions because a supplier failed to deliver a component when it was supposed to. Two such examples are the Toyota's brake valve crisis in 1997 and the Nokia-Ericsson example in 2000 which have been described in the literature review. The risk of a production stoppage is high when a company depends on a single source and this argument is supported also by the examples which have been narrated by the buyers during the collection data phase. One such example is a buyer from the Truck OEM who faced a production stoppage because of bankruptcy of a supplier who had failed to deliver a component on time.

#### **6.1.1 The divergent aspects of single sourcing approach**

The literature review of this study does not take into consideration that in order to develop a strategic buyer-supplier collaboration, a component needs to be of high complexity and technology as the results of the findings point out. These results indicate that following the single sourcing approach, an OEM develops and evaluates only one set of tooling. The results of the theoretical framework however do not support clearly this argument but they point out that there is a reduction of duplication of operations such as setup if that is needed when sourcing from another supplier. Additionally, signing a long-term contract with a supplier, decreases the supplier's uncertainty. Nonetheless, the outcome of the empirical data does not take into consideration a supplier's perspective perhaps because only sourcing buyers were interviewed during this study. It indicates further that the long-term buyer-supplier agreement constantly pressure the supplier.

The results of theoretical framework denote that a buyer might be dependent on a supplier's goals which is a consequence of doing exclusive business with one supplier. On the other hand, the outcome of the empirical data supports the view that a buyer is difficult to manage a supplier unless a buyer has constantly new business to offer. The author of this thesis argues that it is up to a buyer's ability to not be dependent on a supplier's goals by stating to a supplier what is important each time a component needs to be sourced and developed. Additionally, if a buyer-supplier relationship is tested over time, then it is not difficult to maintain a healthy relationship. Another argument that is supported by the results of the

literature review is that a supplier might take advantage of a buying firm and overcharge a higher price. On the contrary, the outcome of the empirical data supports the view that a buyer should do its own research first before it enters the supplier selection procedure. As an aftermath, it will not satisfy a supplier's demand pricewise.

The potential order volume fluctuations from a buyer's part will have a negative effect on a supplier's functions according to a conclusion from the literature review. The outcome of the empirical data does not take into consideration a supplier's point of view let alone a supplier's functions since all buyers who had been interviewed, expressed their own personal opinions and experiences. The buyers argued that it is difficult to split the business between two or more suppliers when the volumes are low. Further, they supported that for transportation of big and heavy items, the logistics cost could be really expensive. However, the results of the literature review do not distinguish the size and the technologies of items and indicate that logistics cost are reduced as a result of decreasing the supply base. In some real case scenarios of OEMs however, this is not true.

The results of the literature review support the argument that changes in a buyer-supplier relationship might occur as a result of change of strategic goals. The stability that a buyer gets from using one supplier might prove to be false in the long-term since a supplier could decide to stop collaborating with a buyer. However, this argument is refuted clearly in the outcome of the empirical data as a supplier tries to be welded to an OEM. For that reason, a supplier wants to align its goals with a manufacturer's goals so that there is no further conflict among them.

## **6.2 The convergent aspects of multiple sourcing approach**

Four arguments are supported by the results of the theoretical framework and the outcome of the empirical data. The most important is stimulating competition among suppliers which means a company depends less on a single source. In case of any crisis, a buyer is protected since there are always available suppliers to source a component from. Moreover, multiple sourcing ensures greater assurance of delivery on time and greater flexibility in volume orders.

Further, an argument that is supported by both the results of the theoretical framework and the outcome of the empirical data is that decision time for a buyer increases according to suppliers an OEM collaborates with. The buyer-supplier relationship is not as strong as it is in the single sourcing approach and in order a buyer to develop other suppliers, it needs to invest resources, time and energy. Additionally, commitment and loyalty might not be achieved by a supplier because of this low buyer-supplier involvement. As a consequence, suppliers are not willing to invest in new innovations. Moreover, another convergent aspect is that multiple sourcing can be used for critical components.

Both the results of the literature review and the outcome of the empirical data patronize that in a monopolistic market a buying firm has a low degree of control since a supplier possesses expertise regarding technology that is unique. However, in a competitive market a buying firm retains a high degree of control since there are a lot of suppliers with similar capabilities to choose from.

### **6.2.1 The divergent aspects of multiple sourcing approach**

The theoretical framework distinguishes three different forms of multiple sourcing which are triadic, network and parallel sourcing. However, these forms are considered as one in the outcome of the empirical data. It is argued in the literature review that because there are many suppliers available who are competing against each other, it is not a guarantee for a buying firm that it could source a component at a lower price. However, this argument is refuted clearly in the outcome of the empirical data because the major advantage of following the multiple sourcing approach for a buyer is to include all suppliers in the same 'platform', stimulate competition and forcing them to reduce further prices. When a low technology component is sourced, it is preferred for a buyer to follow the multiple sourcing strategy because there are many suppliers who can deliver at any time. Nevertheless, the results of the literature review do not distinguish the level of technology when a buyer sources a component. These results point out that it is preferred for a buyer to follow the multiple sourcing strategy when the technology path is uncertain.

Further, the results of the literature review indicate that Toyota develops two to three suppliers for every component or raw material it buys. Moreover, it encourages competition between suppliers. This argument is opposed by the examples which have been narrated by the buyers during the collection data phase. They mentioned that Toyota follows exclusively the single sourcing approach. The company spends all its energy and time developing only one supplier and for that reason the company-supplier relationship is extremely close.

The academic articles do not refer extensively on benefits from currency exchange rates since this is subjective to every OEM how to manage its expenses. However, this is an important issue when OEMs source high and low technology components in real case scenarios. As a buyer backed it up, an OEM could make a lot of money when sourcing low technology components since it is capable of reducing costs by stimulating competition among suppliers.

### **6.3 The convergent aspects of supplier selection procedure**

Both the results of theoretical framework and the outcome of the empirical data support that in the first steps of a supplier selection process an OEM has a list of suppliers to choose from which becomes shorter as the process advances. In the beginning, a market survey is conducted in order a buyer to find out the characteristics of an item and the number of available suppliers. Following, the request for information firstly and request for quotation secondly need to be sent out to potential suppliers in order a list of suppliers to become shorter. Price is the most important factor when a buyer chooses a supplier. However, a buyer needs to take into consideration not only the buying price but also other underlying costs which are referred as the total cost of ownership and they are discussed later in this chapter. Besides the phases of RFI and RFQ, the negotiation phase is also common.

After an OEM acquires some experience in the supplier selection procedure, the risk for not choosing the most competent supplier decreases as all the necessary steps are performed in a more automated way. Using different statistical software programs to back up the supplier selection process can reduce the possibility of a failure. However, it takes knowledge and experience from a buyer's part in order to minimize the uncertainty and the potential conflicts within a purchasing department of an organization.

### **6.3.1 The divergent aspects of supplier selection procedure**

The literature review describes a supplier selection procedure in general and it is not clear whether it can be applied to a specific group of companies or industries. Moreover, it is not explicit in the arguments of the literature review of this study whether presentations are included during the steps of a procedure and whether a buyer seeks for approval as the procedure advances. This happens in real case scenarios however, with the procedures of OEMs. The conclusions from the empirical data support that for the Truck OEM, the steps of request for quotation and final negotiation are of paramount importance during the supplier selection procedure. For that reason, these are the most time-consuming steps of the process. Other OEMs have the negotiation phase in the middle of the process and others at the end which includes also the nomination of normally one supplier.

Academic articles support that supplier selection problems are solved via different methods such as mathematical programming and cost based methods. Based on the outcome of the empirical data, OEMs include collaboration among many teams such as quality, production, product development, testing, logistics, purchasing and costing in order to solve any uncertainties during a process.

### **6.4 The convergent aspects of supplier relationships management and assessment**

It is important for an OEM to update its supplier base periodically and remove suppliers that are not active anymore. This saves time, money and energy for a buyer and its purchasing department. After an OEM selects a supplier, it needs to establish contact so that the relationship is managed appropriately. Every OEM needs to treat suppliers equally, be strict with them in terms of meetings and performance regardless the sourcing strategy it follows.

When an OEM follows the multiple sourcing strategy, potential barriers might occur. These are raised because a supplier will not reveal its capabilities to a buyer if it knows that there are other competitors in the market that a buyer cooperates with. In that case, there might be a lack of common tools, commitment and trust between a buyer and a supplier. It will be then a matter of time this buyer-supplier relationship to halt. When an OEM follows the single sourcing strategy, that gives a supplier a sense of belonging to a bigger family. An OEM which has been in cooperation with a supplier for a long time, could literally 'own' that supplier. This is achieved by the increased trust that is developed between the two parties. As a consequence, a complete alignment of goals and objectives is succeeded among a supplier and a buyer. These two main arguments are supported by both the results of the theoretical framework and the outcome of the empirical data.

#### **6.4.1 The divergent aspects of supplier relationships management and assessment**

Some firms according to the literature review of this study use a reward and punishment system in order to trigger improved supplier performance. Academic articles support different methods for companies in order to assess their suppliers. These methods are scoring methods which are not easy to apply in real case scenarios because the scores are based due to buyers' subjective judgements. Other firms prefer to have standard factors to evaluate such as delivery, quality, financial stability and technical capabilities among others. On the other hand, the outcome of the empirical data indicates that a purchasing and a quality department of an OEM cooperate closely and perform large audits in order to assess a supplier's

performance. Moreover, the Truck OEM assesses its suppliers based on five distinct factors which are quality, delivery, cost, features and relationships. Even though all suppliers need to be treated the same way, the biggest ones in terms of money draw more attention by a buyer. If an OEM follows the single sourcing strategy, a buyer provides feedback to a supplier continuously and allows a period for improvements if that is necessary. The reason is that the cost of changing a supplier is high; thus, it is not feasible because that would include a lot of operational issues that need to be aligned. The higher the dependency of an OEM to a supplier, the more critical is for an OEM to be able to manage a healthy relationship.

## **6.5 The convergent aspects of total cost of ownership**

The total cost of ownership consists of all short and long term costs besides the buying price that are related to an estimate of the cost of an item. These costs include logistics, inventory and maintenance. Moreover, taxes and special duties, depreciation, transportation, defect and warranty cost cannot be underestimated as they could increase significantly the total cost from a buyer's part. The total cost of ownership could assist buyers to find out which suppliers are more expensive. As an aftermath, the collaboration would be stopped with a number of them; therefore, decreasing the suppliers' base which means to move closer to a more exclusive cooperation with a limited number of suppliers.

### **6.5.1 The divergent aspects of total cost of ownership**

The results from the theoretical framework indicate that the costs are grouped into three categories which are acquisition, ownership and post-ownership costs. Some costs are identified as hidden such as labor, waste, repair costs, installation, and redeployment costs among others. This distinction is refuted by the outcome of the empirical data. In many cases, all costs incurred by a buying firm's part are referred as the total business case instead of the total cost of ownership. In conclusion, this discussion among the results of the literature review and the outcome of the empirical data, can provide a more holistic view to the reader in order to understand better the sourcing strategies.

## 7. Conclusion

The purpose of this chapter is to make final conclusions for the dilemma of choosing to collaborate with one supplier or more for one specific component. In the first part, concluding remarks and tools suggestion to the Truck OEM are given by formulating a checklist that could be consulted to every buyer when sourcing a component. In the second part, limitations to the analysis and the results are provided and in the last part guidance for further research is given in regards to the same dilemma.

### 7.1 Recommendations for the Truck OEM

Following, they are the concluding remarks of this thesis to the Truck OEM:

- The main focus of a buyer should always be the cost reduction/savings in a long-term perspective. Every buyer should maintain the same mentality whether it collaborates with one supplier or more.
- A buyer-supplier relationship and collaboration in regards to common product development and progress is stronger in the single sourcing strategy since the amount of time and energy spent is huge.
- Volumes and technology of a component are of utmost importance when making a sourcing decision. The higher the volumes, the more leverage a buyer has. If the volumes are low, then a buyer should follow the single sourcing approach. If the volumes are high, then a buyer could split the business between two or more suppliers. However, this depends on a case to case basis. For a low technology component, the market defines the price of that component and it is better for a buyer to follow the multiple sourcing approach since there are many available suppliers. For a high technology component, the market does not define the price of that component but a supplier does and it is better for a buyer to follow the single sourcing approach since the technology is the only driver. For a high technology component, a buyer needs to make sure that the technology is coming for longer lead time.
- A buyer is on the commanding seat when it sources one component from many suppliers. The reason is that it has more options to negotiate (more suppliers).
- If single sourcing is not managed well, an OEM could have significant losses.
- The more suppliers a buyer collaborates with, the more time it takes for a buyer to make a final decision.
- Fixed cost investments and resources invested to develop other suppliers are significantly increased in the multiple sourcing strategy.
- The main challenge of the single sourcing strategy is that volumes, investments and manufacturing locations do not make shifting easy from one supplier to another.
- The main challenges of the multiple sourcing strategy are securing budgets and resources for multiple investments and that the sourcing lead time is longer due to multiple suppliers' negotiations.
- The longer the supplier decision process is, the more considerable the investment required by an OEM's part and potentially the higher the risk involved.

- The higher the dependency of an OEM to a supplier, the more critical is for an OEM to be able to manage a healthy relationship.
- A buyer should try to preserve a balance between cost and relationship with a supplier in order to achieve a better overall pricing.

The checklist of the figure 22 has been created by the author as the main outcome of this thesis. Many factors need to be taken into consideration in order a buyer to make the best available sourcing decision. Buyers of the Truck OEM need to explore three scenarios when sourcing a component which are the single sourcing, the mixed sourcing and the multiple sourcing scenario. The following checklist consists of 25 checkpoints and is divided into three main categories which are: project requirements, potential supplier list (PSL) requirements and sourcing requirements.

This checklist is a supporting tool in order buyers to make better sourcing decisions. The author of this thesis defined the value of checkpoints in order to make the checklist workable. If the volumes of a component are less than 10000 units then a buyer follows single sourcing. If the volumes of a component are 10000-20000 units then a buyer follows mixed sourcing and if the volumes are more than 20000 units then a buyer follows multiple sourcing. For a high technology component, a buyer follows single sourcing. For a medium technology component, a buyer follows mixed sourcing and for a low technology component a buyer follows multiple sourcing. Knowledge and experience of a supplier and initial tooling development cost, apply to the same principle as the technology of a component.

If the lead time is less than 6 months, then a buyer uses multiple sourcing. If the lead time is 6 months-1 year, then a buyer uses mixed sourcing and if the lead time is more than 1 year, then a buyer uses single sourcing. As far as the weight of a component, if it is up to 5 kg, then a buyer uses multiple sourcing. If the weight of a component is 5-25 kg, then a buyer uses mixed sourcing and if the weight is more than 25 kg, then a buyer uses single sourcing. As far as the local content requirements, delivery to single region means that a buyer uses single sourcing. Delivery up to 3 regions means that a buyer uses mixed sourcing and delivery to more than 3 regions means that a buyer uses multiple sourcing. For the testing requirements, if the lead time is more than 1 year, then a buyer uses single sourcing. If the lead time is 6 months-1 year, then a buyer uses mixed sourcing and if it is less than 6 months, then a buyer uses multiple sourcing.

If there are up to 5 available suppliers in the market, then a buyer follows single sourcing. If the available suppliers are 5-10, then a buyer follows mixed sourcing and if the available suppliers are more than 10, then a buyer follows multiple sourcing. Suppliers and OEM's manufacturing locations and proximity of a supplier to a plant apply to the same principle as the one for suppliers available in the market.

For standard materials, a buyer uses multiple sourcing. For specific materials, which are available in all regions, a buyer uses mixed sourcing. If a supplier owns the materials that need to be used, then a buyer uses single sourcing. For a supplier, which is meeting the Truck OEM's targets, a buyer follows single sourcing and it does not look for alternate options. If a supplier is not meeting the Truck OEM's targets, then a buyer follows multiple sourcing. The same principle applies to delivery requirements and suppliers' competitiveness. If the relationships with a supplier are good, then a buyer follows single sourcing and if the relationships are bad, then a buyer follows multiple sourcing since it is a necessity to have a

backup option. If the relationships with a supplier are neither good nor bad, then a buyer follows mixed sourcing.

As far as the logistics, transportation, inventory costs and taxes and special duties, if these costs are high, then a buyer follows multiple sourcing. If these costs are low, then a buyer follows single sourcing and if these costs are neither high nor low, then a buyer follows mixed sourcing. The same principle applies to the last three checkpoints which are quality risk, maintenance and depreciation and currency exchange rates risk.

As it can be seen from the figure 22, the multiple sourcing scenario is supported under the sourcing requirements but the single sourcing scenario is supported under the project requirements. In this example, the component is technology driven with high initial tooling cost and long lead time. These reasons are restricting the buyer from following the multiple or the mixed sourcing strategy. In this example, a buyer follows the single sourcing strategy as its main strategy. Every buyer needs to make a careful decision which approach to follow, justify that decision by explaining which factors outweigh the others and for what reasons. It completely depends on component to component whether the Truck OEM can switch from the single sourcing to the multiple sourcing approach. The author of this thesis believes that every buyer would like to challenge the current supplier but sometimes this cannot be applied in a real case scenario. It should be an increased amount of work for a buyer if it uses more than one supplier for every component needed. Following, it is an example of a checklist for a buyer when sourcing a component.

<b>Checklist for every Buyer when sourcing a component</b>				
Categories	Checkpoints	Single Sourcing Scenario	Mixed Sourcing Scenario	Multiple Sourcing Scenario
1 Project	Volumes of a component		✓	
2 Project	Technology of a component	✓		
3 Project	SOP(LONG LEAD TIME/SHORT)	✓		
4 Project	Weight of a component		✓	
5 Project	Local content requirements		✓	
6 Project	Testing requirements if any	✓		
7 PSL	Suppliers available in the market	✓		
8 PSL	Suppliers manufacturing locations	✓		
9 PSL	OEM's manufacturing locations			✓
10 PSL	Availability of materials		✓	
11 PSL	Knowledge of a supplier	✓		
12 PSL	Experience of a supplier	✓		
13 PSL	Long term agreements with a supplier	✓		
14 PSL	Delivery requirements			✓
15 PSL	Relationships with a supplier		✓	
16 PSL	Proximity of a supplier to a plant			✓
17 Sourcing	Initial tooling and development cost	✓		
18 Sourcing	Logistics cost			✓
19 Sourcing	Transportation cost			✓
20 Sourcing	Inventory cost			✓
21 Sourcing	Taxes and special duties			✓
22 Sourcing	Suppliers competitiveness			✓
23 Sourcing	Quality risk			✓
24 Sourcing	Maintenance and depreciation			✓
25 Sourcing	Currency exchange rates risk			✓

**Figure 22:** An index of checkpoints that could be consulted to all Buyers when sourcing a component (Own developed model)

Based on the outcome of the empirical data of this study, the Truck OEM has been following the single sourcing strategy for a long time so it seems that it is more a habit rather than an order. However, the past should not be a pattern for the future.

In conclusion, the buyers of the purchasing department of the Truck OEM should not decide blindly just because the Truck OEM has been following one approach for many years but they should think that there are always other available options. If the Truck OEM has the cost benefit of selling more trucks by following the multiple sourcing strategy, then why buyers cannot follow that strategy which would make the whole organization more profitable. Both single and multiple sourcing strategies have advantages and disadvantages for an OEM. However, a combination of both approaches is doubtless required in a world of ever increasing competition.

## **7.2 Limitations to the analysis and the results**

All buyers outside the Truck OEM that have been interviewed belong to the car industry. Therefore, a comparison of the analysis has been made among the buyers of the Truck OEM and those of the Car OEMs. That is because it was not feasible due to time restrictions and lack of access to interview buyers from major competitors of the Truck OEM. These buyers could have provided possibly a more holistic view that would be helpful to buyers of the Truck OEM.

All interviews were conducted with buyers who are responsible for sourcing specific components and preserve a purchasing portfolio. However, the results might have been a little different if managers were to be interviewed as they would have given a different insight into the sourcing process. This was not possible however because of their busy daily schedules.

The checklist in the figure 22 is applicable only to all components under one specific commodity category which was investigated in this thesis.

## **7.3 Further research**

The author's suggestion for future research is to choose a quantitative method of analysis for this dilemma of choosing to collaborate with one supplier or more for one specific component. The main focus would be on all cost drivers that affect not only the single sourcing but also the multiple sourcing and the mixed sourcing strategy. An anonymous questionnaire of 25-30 questions could be created based on independent, dependent and control variables. This questionnaire could go internal to all buyers within the purchasing department of the Truck OEM. Single sourcing, multiple sourcing and mixed sourcing strategy could be the three independent variables of this study. The dependent variables could be these costs that are attributable to component design tradeoffs such as for example material specifications, costs related to the size of facilities equipment and process technology employed, costs that differentiate a well-run facility from a poorly-run facility, costs related to currency exchange rates. Moreover, logistics cost, quality risks as other relevant costs could be included in this study. The control variables could be the position of each buyer within the Truck OEM, the specific commodity and component each buyer is dealing with and the geographical location it is situated. The outcome of this study, would be firstly to find out what is the degree of correlation between all the costs and the single sourcing strategy. Secondly, to find out what is the degree of correlation between all the costs and the multiple sourcing strategy. Lastly, to find out what is the degree of correlation between all the costs and the mixed sourcing strategy. Descriptive statistics could also be provided based on all questions formed. The analysis would show whether a buyer needs to focus more on reducing specific costs and in that way, it would be able to make more appropriate sourcing decisions in the future. As a result of this, the purchasing department of the Truck OEM would be able to achieve its annual targets.

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## **Appendix**

### **Interviews Questions**

- 1) What is your job title and your main area of responsibility? How big is the role of the purchasing dptm in an OEM?
- 2) What would you say the market that the specific commodity you are responsible for is? Monopolistic, oligopolistic or free competition?

### **Supplier selection procedure**

- 1) Which are the specific steps in your supplier selection procedure?
- 2) How long is your supplier selection procedure and how much does it cost for the company? Would you say it is a considerable investment?
- 3) Which are the factors that an ideal supplier profile should be based on? What are the main characteristics that you look for in a supplier?

### **The single sourcing approach**

- 1) Which are the main drivers of selecting a single supplier for one item?
- 2) What do you consider as the advantages and disadvantages of having a single supplier?
- 3) Do you experience JIT deliveries when you use a single supplier?
- 4) Have you experienced any production stoppage because you were using one supplier who could not deliver when supposed to?
- 5) Is it cheaper for you to have one supplier in regards to administration, communication, handling etc, or not? Do you have dedicated employees to deal with one supplier (provided that it is a major account for your company)?
- 6) Where there other suppliers in the market that you decided not to collaborate with, because you had exclusive collaboration with one specific?
- 7) What is the availability of substitution products? How easy it is to switch to another product if your one supplier fails to deliver?
- 8) What would be the total % of components you source from single suppliers?

### **The multiple sourcing approach**

- 1) Which are the main drivers of selecting multiple suppliers for one item?
- 2) What do you consider as the advantages and disadvantages of having multiple suppliers?
- 3) Do you think that multiple sourcing can increase a healthy competition between the suppliers?
- 4) Is it more expensive to deal with more than one supplier in regards to administration, or not?
- 5) How do you allocate volumes of the same item when you have more than one supplier?
- 6) Does multiple sourcing provide improved market intelligence? In which way?
- 7) Do you consider multiple sourcing as a risk mitigation activity? Why?
- 8) What would be the total % of components you source from multiple suppliers?

## **Supplier relationship management and supplier assessment**

- 1) How close is your relationship with a supplier (when it is a single supplier and when there are many suppliers)?
- 2) Do you give feedback to your suppliers if they should improve their performance? If they need to do major improvements do you allow them a period to adjust and improve or do you stop using the specific supplier and move on to someone else?
- 3) What is the level of collaboration in regards to product development when you have one supplier and when you have many?
- 4) How do you assess your suppliers? Do you use any specific method? How often do you do that? Does this procedure affect the decision of the number of suppliers you use (for every item)?
- 5) How do you manage product quality when you work with multiple suppliers for the same item? Does this procedure affect the number of suppliers you employ?
- 6) How easy is it for your company to change suppliers?

## **Total cost of ownership**

- 1) What other factors do you take into consideration when you source an item, apart from the buying price? (transport, logistics, warehousing, inventory cost etc)?
- 2) When you choose a supplier, do you consider the TCO both in attaining the supplier and throughout your relationship?

## **Challenges related to the two approaches / comparison**

- 1) What do you see as the major risks/challenges related to single and multiple sourcing?
- 2) What do you think is the best way to eliminate those risks (for each strategy separately)?
- 3) Can you please give an example on which according to you, from your work experience, could be ideal scenario for single or multiple sourcing?
- 4) Which general strategy would you say you use? Single or multiple sourcing?

**Respondent A:** Interviewed 2017/02/22, Gothenburg, Sweden.

**Respondent B:** Interviewed 2017/02/23, via Skype, Gothenburg, Sweden.

**Respondent C:** Interviewed 2017/02/24, via Skype, Gothenburg, Sweden.

**Respondent D:** Interviewed 2017/02/27, via Skype, Gothenburg, Sweden.

**Respondent E:** Interviewed 2017/03/14, via Skype, Gothenburg, Sweden.

**Respondent I:** Interviewed 2017/02/24, Gothenburg, Sweden.

**Respondent II:** Interviewed 2017/03/06, Gothenburg, Sweden.

**Respondent III:** Interviewed 2017/03/17, Gothenburg, Sweden.