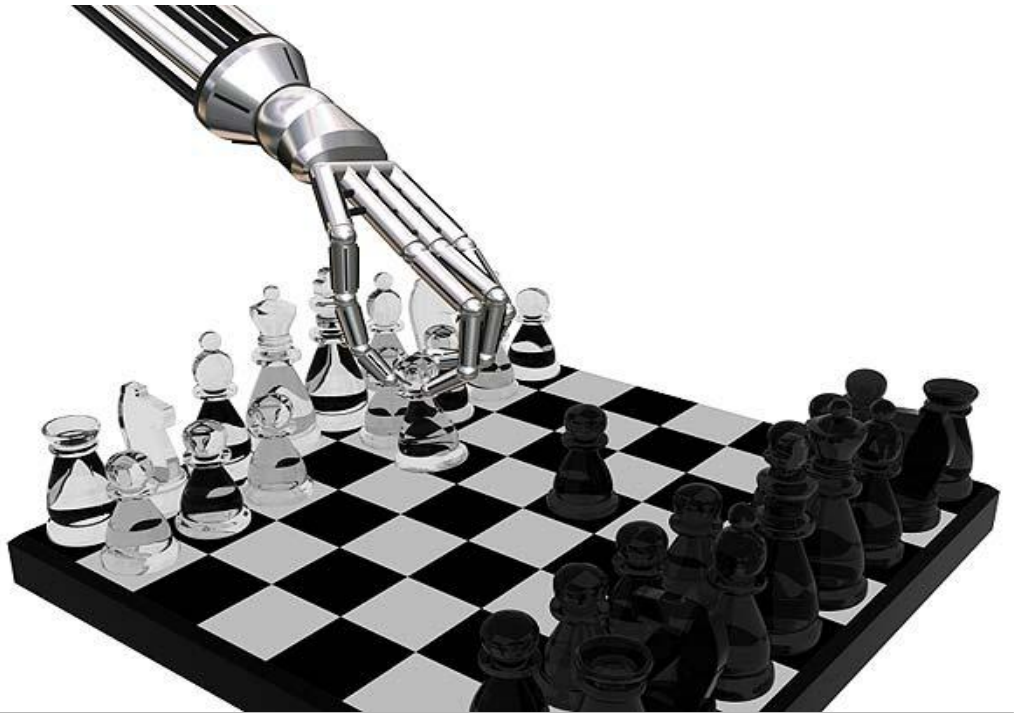

Developing a Sourcing Strategy for Robots

Master of Science Thesis
Supply Chain Management

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Göteborg, Sweden, 2011

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ABSTRACT

The main focus of the thesis is to develop a sourcing strategy for purchase of robots. Though sourcing/purchasing had always been an important part of the company, its relevance and importance has gained drastically during the recent years. Companies have realized the potential cost benefits that can be obtained by streamlining and having an efficient purchasing process. This gives a strategic importance to the sourcing strategy.

The thesis at Swisslog analyzes the current state of purchasing through various theoretical models and gives an overview of the important parameters that have to be considered while developing a sourcing strategy. An overview of current purchase of robots globally across the company was carried out to include the relevant parameters. The broad nature of the topic makes it challenging to consider various parameters under different business environments.

The current state of purchasing process is determined and the possible future is indicated. Based on the maturity of the purchasing process, the thesis presents three different alternatives including the existing situation with analysis of all three alternatives in consideration with the parameters considered. The various advantages and disadvantages for all the alternatives are discussed and summarized. It is with consideration to external business environment and company strategy that a particular sourcing strategy would be relevant for implementation.

Key words: Sourcing strategy, robots, strategic sourcing, purchasing organization, project based organization

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We are thankful to our supervisor at Chalmers, Ingrid Hessel, who constantly kept us motivated. Her constructive and timely feedback helped us develop the thesis and the required purchasing strategy. We would also like to thank our friends who helped us fine tune the thesis through their feedback and comments.

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LIST OF ABBREVIATIONS

AGV	Automatic Guided Vehicles
AM	Automation Manager
EoAT	End of Arm Tool
MG	Material Group
MGM	Material Group Management
OEM	Original Equipment Manufacturer
PLC	Programmable Logic Controller
SIS	Swisslog Interface Standard
SPOC™	Visualization Software
WDS	Warehouse and Distribution Solutions Division
WMS	Warehouse Management Systems
TC	Technology Center

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1. INTRODUCTION

The role of purchasing has evolved from being a clerical job to that of strategic importance. This can be attributed to economic slowdown, globalization, increasing purchase costs, bottom line pressure, as few parameters that needs to be mentioned. Increasing purchasing costs and the need to streamline the purchasing process for robots, has led Swisslog to realize the need for a sourcing strategy.

The thesis develops various options for a suitable sourcing strategy. It considers the underlying challenges of purchasing and its role in an organization. It gives an understanding of various aspects that have to be considered while developing a sourcing strategy for particular commodity, robots in this case. It aims to provide different solutions under different circumstances in order to find a strategic fit within the organization.

This section gives a brief background about importance of purchasing, introduction to the company, Swisslog followed by the purpose and disposition of the thesis. It can be noted that the words purchasing and sourcing have been arbitrarily used and has the same meaning.

1.1 Background

It has been evident from various purchasing literature over past 10 years about the changing role of purchasing and its increasing importance in the company (Van Weele A. J., 2010; Gadde & Håkansson, Supply Network Strategies, 2001; Jennings, 1997; Carter, Carter, Monczka, Blascovich, Slaight, & Markham, 2007). Prevailing dynamic environment, with constant change in technology, global markets, customer needs, there has been increasing need for a greater role of purchasing recently. Many literatures emphasize the need to shift the role of purchasing from operational to strategic, in order to gain greater benefits and adapt to the dynamic environment. From various surveys carried out during the recent years which Gadde and Häkansson (2001) have consolidated, indicate the growing importance of purchasing. It can be attributed to the increased buying from companies which has increased from 28% to 51% of the total costs, with few companies having nearly 70% of the total costs. This emphasizes the increased attention to supply side of the company and place purchasing in a strategic position. Apart from this, there is a growing need for technical adaptations between the supplier and the customer's activities in order to reduce cost. This makes the purchasing to be involved early from the design phase of the product itself (Gadde & Håkansson, 2001).

Furthermore, cost saving opportunity has also opened the long debatable question of whether to make or buy and points to benefits of outsourcing. Though in simple terms, if contractors can make it at a cheaper price than what you can do, then it is better to be outsourced (Hendry, 1995). This is argued with additional parameter of strategic dimension, where the organization tries to find the right size which would be appropriate for the new environment. Consideration is also given to the strategic partnership role with suppliers for long term relationship (Fill & Visser, 2000). This increasing importance in the organizational domain has lead to the change in purchasing role, from being perceived as task oriented and reactive function, now it is considered to be fully proactive in the development of strategies where decisions made can affect and drive the business performance (Moser, 2007). In the past, the main objectives of the purchasing organization were to guarantee the continuity of supply and cost reductions, therefore the activities undertaken by purchasing

professionals were related to management of purchase orders and traditional supplier selection. (CIPS, 2007; Moser, 2007)

Nowadays the expectations of the management of the supply network have drastically changed. Even though supply continuity and cost reductions still remain as important decision factors and deliverables of the purchasing organization, now the supply network is required to have direct contributions to the company with innovation, improvements in assets utilization, increasing focus on sustainability and effective risk management assessments among other aspects (CIPS, 2007). Furthermore, the KPMG survey concludes the way sourcing benefits various organizations based on the approach taken. It emphasis the value of sourcing/purchasing organization in recognizing the needs of customer and service providers in order to increase the effectiveness and efficiency of resources both in terms of money and people. It mentions the need for continuous evolution of sourcing practices in order to remain part of an effective business strategy (KPMG, 2007). Hence, multinational companies are increasingly developing their supply side organizations and focusing seizing the opportunities through the strategic management of their sourcing requirements.

This is the case of Swisslog, which as part of their business strategy is planning to strengthen their approach to the supplier market. Therefore going forward the thesis would deal with the importance of sourcing and developing a sourcing strategy for a particular commodity, which would be in alignment with the business strategy of the company. A general overview of the company and the situation of their purchasing organization will be presented in the next section

1.2 Swisslog Company

Swisslog is a company with global presence providing integrated logistics solutions though a diverse portfolio of products and services. The target of the company is to be the partner of first choice for automated solutions for distribution centers, warehouses and healthcare facilities. With projects developed in more than 50 countries, Swisslog provides solutions for specific industry segments, offering consulting and project management services including general contracting and civil engineering work. In addition, the company also produces different hardware and software products used for the development of the logistics solutions.

The history of the company dates backs to 1898, when it was founded in Aarau, Switzerland. From then, it has grown to become a company with more than 2000 employees and sales of the order of 620 CHF in 2010. Swisslog has a strong and solid position in the market which has been strengthened by a series acquisitions and strategic partnerships during the recent years.

Swisslog is mainly divided in two separate business divisions, the Healthcare Solutions division (HCS) and the Warehouse & Distribution Solutions (WDS). The Warehouse & Distribution Solutions (WDS) represents around 65% of total sales as can be seen on Figure 1-1. It has clear industry focus, targeting the needs of the retail, food and beverage and pharmaceutical companies. Due to nature of the business the WDS division works on project to project basis. Each project has its own deployment of internal resources and teams while at the same time perform the required purchases from external suppliers.

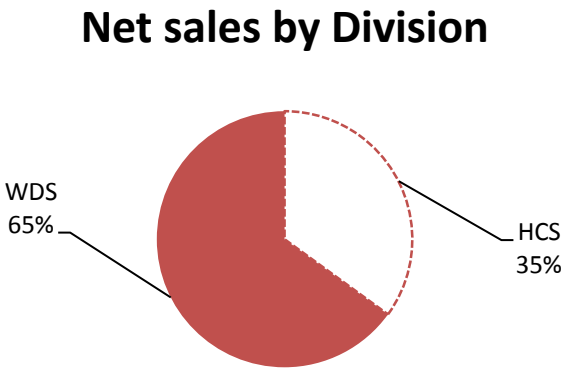

Figure 1-1: Net sales, Segment wise distribution

As part of the interaction with external suppliers, Swisslog purchases different subsystems and components to integrate them in solutions offered to the customers. The purchases were being done by the project managers involved for each project since the company did not have a purchasing/sourcing team until recently. Hence, each region follows its own procedures to purchase the different subsystems required on project to project basis without having a strategy for sourcing the different components or either formal knowledge of the supplier markets. However in the recent years, Swisslog has realized the problems faced in the management of the supply side and started to establish a formal purchasing organization on global basis, bringing the management of the supply network to a higher level of importance for Swisslog's business strategy. With the new purchasing organization, each region has its own Project Purchaser who is responsible for the purchases required for the development of the project.

Due to its role in the business, the robot systems have been determined as one of the important material groups for the company and the Project Purchaser responsible for the material group "robots" is also in charge of the Nordic region. Going forward, Swisslog intends to streamline the purchasing of robots by having a clear strategy on sourcing the robots with consideration to internal and external factors.

The sourcing strategy for robots must be valid globally, while at the same time considering the business requirements of every region and the business characteristics of the industry. As a project based organization, on every project different internal actors are involved during the design, realization and customer support phases, which modifies the relationship requirements for suppliers. The robot system plays a key role during each one of these phases; therefore the sourcing strategy must support the internal requirements for each one of them. Moreover, the sourcing strategy must concentrate on the potential competition from suppliers, development of certain resources in house and management of supplier relations. The sourcing strategy must manage these dimensions and contribute towards the achievement of Swisslog's business goals.

1.3 Purpose

The main purpose of the thesis is to develop global sourcing strategy/strategies for the robots. The development of the strategy should include the views of all Swisslog regions and different

stakeholders within the organization as well as an analysis of the supplier market. In this sense, different alternative strategies will be developed and there implications analyzed.

1.4 Disposition of the thesis

This section outlines the disposition of the thesis for the remaining chapter. Chapter 2 will consider the problem from a theoretical perspective and develop the analytical framework used. The analytical framework will first establish key concepts concerning the role of a sourcing strategy within the company and identify the major decision areas for the sourcing strategy, establishing the strategic sourcing framework used in the thesis. The methodology used for the project will be discussed in chapter 3, defining the research strategy and linking the analysis and data collection to the achievement of the sub purposes. Chapter 4 will present the existing situation of the company in relation to both external and internal aspects. Chapter 5 will build three strategies for the company based on the analysis from the internal aspects and external aspects from the existing situation. These alternatives will be further analyzed individually in chapter 6. This discussion will be made using the findings from the theoretical framework. Finally, chapter 7 will present the conclusion and recommendations of the thesis.

2. THEORETICAL FRAMEWORK

This chapter will establish the analytical basis used to later develop the research questions based on this literature review. The first section will delineate the building blocks of the theoretical framework The Strategic Sourcing Framework will be introduced as means to structure the different factors linked to the development of sourcing strategy. The second section will start by defining the role of the sourcing strategy. The third section will then develop upon the organizational aspects with introduction to sourcing maturity model. The fourth section will develop the decision areas to be included in the sourcing strategy and the important factors to consider on each of them. The fifth section will concern the specific business characteristic in view of the project based nature of Swisslog business, which needs to be part of the analysis of the sourcing strategy. Finally, the sixth section will synthesize the findings of the previous literature and build the sub purposes using the strategy development process as methodology.

2.1 Strategic Sourcing Framework

As already mentioned, it has been evident from various literatures over past 10 years about the changing role of purchasing and its rising importance in the current business environment (Van Weele A. J., 2010; Gadde & Håkansson, Supply Network Strategies, 2001). With dynamic environment prevailing, with constant change in technology, global markets, customer needs, there has been increasing need for a greater role of purchasing recently. Many literatures emphasize the need to shift from purchasing to strategic sourcing to gain greater benefits and adapt to the dynamic environment. However, the shift towards strategic sourcing needs to include several dimensions in order to be effective and be considered as strategic. With this respect, different product categories can have different strategic objectives. For example, for key categories, the focus can be to speed up development process, contribution to new products and how to achieve best prices. The content of the strategy will then be developed in order to achieve the objectives. The development of the sourcing strategy must comprehend several elements as well as be sustained and facilitated by different enablers (Carter, Carter, Monczka, Blascovich, Slaight, & Markham, 2007). For this reason, this section will introduce these dimensions as part of a strategic sourcing framework.

First, it is important to understand the meaning of strategic sourcing and the role it will have as part of the business. Strategic sourcing is defined by CIPS as “satisfying business needs from markets via the proactive and planned analysis of supply markets and the selection of suppliers with the objective of delivering solutions to meet pre-determined and agreed business needs”. It also emphasizes the fact that, it is a core activity in the purchasing and supply management process, requiring great amount of knowledge and competence owing to the complex commercial process. Moreover, it shows that sourcing strategies are fundamental for the achievements of the overall business goals of the organization. In fact, a focus study presented by the Center of Advance Purchasing Studies involving more than 260 worldwide companies clearly reflects how the mission and goals of supply organization had been adjusted in order to fulfill these expectations (Carter, Carter, Monczka, Blascovich, Slaight, & Markham, 2007). The categorization is made on four different areas: innovation, revenue, risk and cost. With this in mind, is clear that the expectations of the sourcing strategies are no longer reduced to cost reductions. Instead, the supply side of the company must be in capabilities to contribute to the company on the revenue side, innovation and risk management for example. For this reason, it is important to clearly understand the implications of

these new expectations, in terms of the roles the sourcing strategy has to fulfill within the organization.

Second, different organizational aspects will influence the role of sourcing strategy. Although specialized sourcing departments exist in many companies, its importance and perception can vary from company to company. In some cases, it can be playing an important strategic role, with sourcing manger being part of the top management making decisions or in other cases, a limited role with many strategic decisions made by other departments (engineering, production, sales etc.) and sourcing department having to follow their needs (Rozemeijer & Wynstra, 2005). Therefore the organization and interaction of its actors plays a key role during the different decision making processes of the company on the supply side. In fact, Monczka et al (2008) reflect upon the different structures of the purchasing organization and recognize that the structure of the purchasing organization should be defined differently in relation to the strategic importance of decisions being made. Thus, is clear that the potential of decisions taken as part of the sourcing strategy can be limited or affected by the perception the company have over the purchasing organization and also by same organizational structure. Hence, the creation of the sourcing strategy must analyze these organizational features and understand interactions as part of larger organization.

Third, once the role of the sourcing strategy, the organization and interactions are understood, it is important to understand decision areas within the context of the sourcing strategy when perceived from a strategic point of view. The decisions taken in the sourcing strategy will depend on whether it is looked upon from a strategic, tactical or operation point of view (Van Weele A. , 2005). As an example, Gadde (1994) identified the boundaries of the firm, supplier base structure and relationships with suppliers as such decision areas where there can be strategic contribution by the purchasing organization. With the sourcing strategy under the scope of the purchasing organization, these decisions areas will provide the grounds for the different alternatives that can be analyzed and will be the core of the sourcing strategy.

Finally, in addition to the above dimensions the analysis of the sourcing strategy must be made in consideration to the specific characteristics of the business as reflected by Monczka et al. (2008), the purchasing organization and decisions will depend on the nature of the business. In consideration to these business characteristics, most literature has addressed the supply side and sourcing decisions in the context of supply chains characterized by the continuity in supply and distribution process. For companies following a project approach to business, there are specific features that will influence their business performance that must be considered when addressing business decisions from strategic to operational levels. With Swisslog following a project based approach, it is important to understand the implication of having a project based approach on the entire company. Therefore, it is relevant to understand the company in terms of its business characteristics and explore the implications on the organization and decision areas of the sourcing strategy. So, in summary, the discussion in this chapter has identified four major aspects to consider when developing a sourcing strategy as can be seen in Figure 2-1. First, the sourcing strategy should contribute to the organization on different roles from a strategic perspective. Second, the potential to have a strategic approach to the sourcing strategy will depend on the perception of the purchasing organization and its interactions. Third, the sourcing strategy will relate to specific decision areas in alignment to its strategic perception and contribution. Finally, the sourcing strategy must be developed in consideration to the specific characteristics of the company as a project based organization. The

remainder of this chapter will elaborate on each of these four aspects to understand their connections and influences on the sourcing strategy.

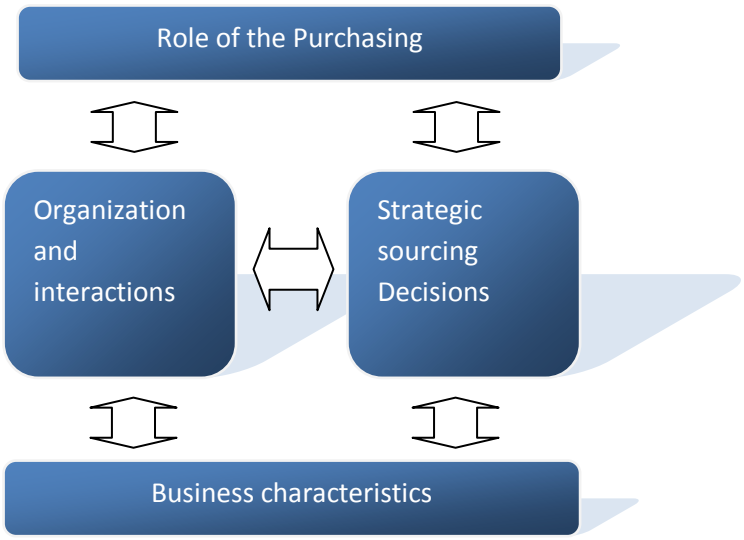

Figure 2-1: Strategic sourcing framework

2.2 The Role of Purchasing

The first block of the strategic sourcing framework relates to the role of the purchasing within the company. In this context, the purchasing organization is responsible for making the decisions on the supply side, whilst the role of the sourcing strategy will be linked to the expectations from the purchasing organization due to the fact that the sourcing strategy must strive to satisfy these expectations. On the other hand, the decision areas will have important implications on the sourcing strategy since they define the scope where different options can be analyzed to the roles of the sourcing strategy. In this respect, as mentioned by Carter et al. (2007) the expectation from the supply side of the company has changed from no longer focusing solely on cost reductions, but rather taking a more strategic perspective where innovation, revenue and risks management are expected. The sourcing strategy must then play a role in the business so as to contribute to these dimensions. In this effect, Axelsson et al. (2005) defines three generic roles of purchasing that can be used in order to frame the role of the sourcing strategy: rationalization, development and structural.

The rationalization role entitles the purchasing function to reduce the various costs involved, thereby contributing to the total cost reduction and competitive advantage of the company. In this respect, the three main costs classifications can be identified. The direct costs are linked to the cost of buying goods and service, which includes for example price in relation to volume, insurance etc. The indirect costs relates to those that arises while purchasing a certain product that may include transactional costs, administrative costs of handling invoices and costs of maintaining the supply base. Finally, internal production cost which refers to the reduction of the internal resources of the company or increasing the value creation through the effective utilization of the resources (Axelsson, Rozemeijer, & Wynstra, 2005). Cost being important, the sourcing strategy should have a role regarding the potential for rationalization.

The development role involves a systematic approach in matching the company's own development and innovation to that of individual suppliers and the overall supplier base. It involves the consideration of various aspects. Firstly, developing, building and maintaining a structure of suppliers in order to provide the company with the required resources. Secondly, leverage the technological capabilities of the suppliers in the internal innovation process of the company. Thirdly, mobilize suppliers in order to develop certain technologies, process and products according to the needs of the buying organization and motivating them to be involved in the innovation process. Fourthly, support of development projects with the collaboration of suppliers and other internal functions (Axelsson, Rozemeijer, & Wynstra, 2005). All these aspects would be important to the company in order to drive revenues and innovation; hence the role of the sourcing strategy should support the achievement of these goals.

Finally, the structural role concentrates on ensuring a right balance between two extremes, dependence and independence on suppliers. On one hand, the company should not be too dependent on the supplier that would become difficult to handle and compromise its position as a buying organization. Whereas on the other hand, dependence on the supplier would be necessary in order to create a unique product, process, procedure etc. This involves various activities ranging from, identification and monitoring the developments in supplier structures, measures to influence the level of standardization in supplier offerings for optimization and maintenance of potential suppliers (Axelsson, Rozemeijer, & Wynstra, 2005). In order to assure this balance, the sourcing strategy must therefore facilitate the management of the different risks as part of its structural role.

The above roles complement each other and help to make a decision from three different perspectives. For example, the rationalization and development role both concentrate on matching the supplier capabilities. But rationalization aims to reduce cost in this process, where as development role aims to have synergies in technology and drive mutual innovations. When considering development and structure, development role for instance may consider having close relation with one key supplier to gain leverage of technology, where as this may not be feasible from structure point of view since it may lead to a monopoly situation for the supplier leading to increase in power. (Axelsson, Rozemeijer, & Wynstra, 2005)

As seen, this section has explored three different roles of the sourcing strategy: rationalization, development and structural roles as shown in Figure 2-2. The purchasing organization must analyze parameters in order to contribute to these roles. Therefore the sourcing alternatives should reflect on how they can support these roles and place the role of the sourcing strategy on a strategic level.

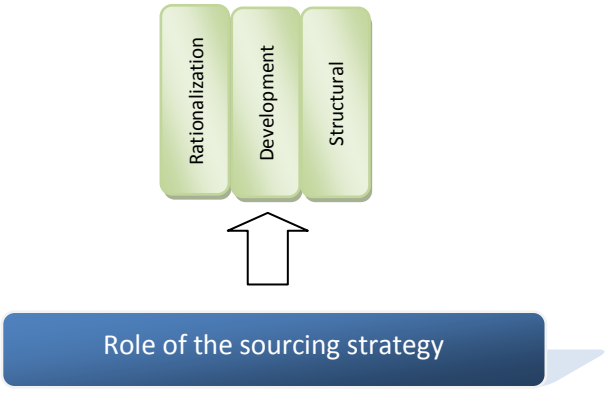

Figure 2-2: Sourcing strategy roles for the Strategic Sourcing Framework

2.3 Organization and Interactions

As mentioned above in section 2.2, the expectations of the purchasing organization can vary to a great extent. On one hand, it can be limited to buying components, according to the needs of various departments, without being considering the departments in the decision making process and only limiting to cost control. On the other hand, the purchasing organization can also be expected to contribute on different dimensions such as innovation and business development. In this case sourcing management would be part of the management team and is involved in the various strategic decisions taken by the company in consensus with other departments. These interactions would determine the extent of the potential contribution of the sourcing strategy to the rationalization, development and structural roles. If the purchasing organization is not structured properly with respect to their strategic expectations, the possibilities of the sourcing strategy to have a strategic impact for the business can be reduced. In this respect, the sourcing maturity model introduced by Van Weele (2010) analyses the relationship between organizational structures of the purchasing organization and its potential impact for the company.

The maturity of the organization is related to the organizational structure and has implications on the contribution of the sourcing strategy to the different roles. For understanding these implications, first it is important to introduce the fundamental building blocks of the organization. Rozemeijer & Wynstra (2005) defined five basic organizational structures based on the activities and various other departments in the organization/company. Accordingly, the basic organizational structures can follow functional, product, geographic, market or process approaches.

Although not directly related to the purchasing organization, these basic organizational structures will have implications for the sourcing strategy since the interactions of the purchasing organization would depend on how the company is structured as whole and how the purchasing organization interacts with other business units that can be market, geographic, product or function oriented. In this respect, the purchasing organization is complemented by additional aspects of organizational design and processes of organizing apart from the general functional or product organizations. They can be mentioned as centralized, decentralized and hybrid structures.

In the centralized structure, the purchasing is done by a central purchasing group. Though the various operating units are consulted, they are not completely responsible for the buying. This process enables collective sourcing and increase the buying power of the company through economy of scale. However, it lacks the ability to be responsive based on the local needs and undermines the position of the corporate purchasing department (Van Weele A. J., 2010).

On the other hand, in the decentralized structure, the purchasing process is carried out individually by each purchasing departments across various business units. Due to this, each purchasing unit have their own way of purchasing methods and very less scope for cross business unit coordination, as it is the case for the first two phases of the maturity model. In case if the coordination exists, it would be voluntary and informal. It emphasizes the local units to take action and have the power of taking decisions, thus decreasing the burden of the corporate purchasing. However, it decreases the ability to take synergies across units, economy of scale and the bargaining power in buying (Rozemeijer & Wynstra, 2005).

Finally as the names indicates, the hybrid structure is neither centralized nor decentralized, but somewhere in between. Depending on the company's needs and external demands, the degree to

which it has to be centralized or decentralized is decided. This ensures having the best of both worlds and trying to decrease the disadvantages of the above two structures. (Rozemeijer & Wynstra, 2005). The coordination of the hybrid structure can take place at different levels and depends on the overall organization structure since it can be at product, market or regional level (Van Weele A. J., 2010, s. 286). In this respect, Rozemeijer & Wynstra (2005) further defines three generic structures for the coordination to take place in the hybrid structure.

First, the Coordinated Purchasing consists of various purchasing units at decentralized level, reporting to a business unit manager combined with other people at a corporate level (Rozemeijer & Wynstra, 2005). This structure can be associated with the third stage in the maturity model where coordination exist allowing the company to have greater consolidation and coordination across decentralized business units. Second, the Centre led action network (CLAN) has all the actual purchasing activity happening in a decentralized manner at a local level, but purchasing accountability and excellence in function is centre led at the corporate level. As shown in the maturity model, this structure can be associated to the higher level of integration across the organization. It allows for corporate purchasing synergies by having cross unit coordination and integrating mechanisms and at the same time enables fast and responsive action at decentralized level (Rozemeijer & Wynstra, 2005). Finally, the Federal Led hybrid consists of small central core, flat in structure, providing support and coordinating across a various independent sourcing units (Rozemeijer & Wynstra, 2005).. As with CLAN structure, this hybrid system can also be associated with higher level of maturity within the purchasing organization since there is in place a professional relationship between federal purchasing unit and central core.

The sourcing maturity model links different organizational structures to the effectiveness of the organization which is a good analogy to the potential contribution of the sourcing strategy to the different roles (rationalization, development and structural). With the combination of purchasing organization structure and the degree of maturity in the purchasing organization, it helps in understanding the current state of the purchasing organization of the company and determines the possible future state. The model indicates the possible maturity level with respect to various industries and mentions the type of organization structure required. These are just possible indications and best possible combination depends up on the combinations of various factors such as the particular company itself, business situation and overall strategy of the company. The following section explains about the various stages in the purchasing maturity process and mentions the corresponding organization structure to be formed.

The model reflects upon how the combination of relationships changes across different industries. The various varying degree is termed as stages or phases indicating that they follow a certain chronological sequence. As shown in the Figure 2-3, the sourcing maturity model indicates six levels of purchasing maturity.

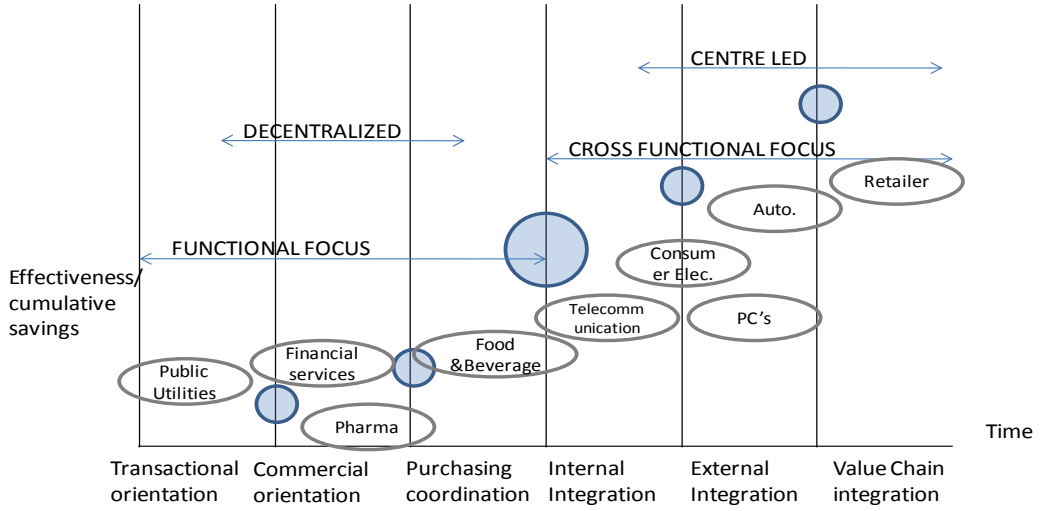

Figure 2-3: Six levels of purchasing maturity (Van Weele, 2010).

When having a Transactional Orientation, it is a reactive purchasing process in which the purchasing professional's role is limited to administering the purchasing tasks. If it moves towards Commercial Orientation, it involves a commercial approach, with the purchasing function requesting for tenders, comparing various bids from suppliers and performing negotiations, operating with pre qualified suppliers. In the third phase as Purchasing Coordination, the buying company has a strong control over the volumes purchased, items purchased and suppliers. It has an advantage to carry out more powerful and coordinated action across various factories, business units and divisions (Van Weele, 2010). In the Internal Integration phase there exists a process oriented approach in the organization handling of purchases and suppliers, taking cross functional teams with relevant competency for decision making in this process. Having cross functional teams opens the possibility to include the views of different stakeholders within the organization and engage on the development programs with suppliers to satisfy the internal requirements. This cross functional approach put demands on the information flows through the use of ERP systems. In the same line, the External Integration adds professionalism by introducing synchronization and optimization of supply chains, involving a systematic approach to coordinate with suppliers at various levels. This approach increases the awareness on where in the supply chain the decisions are taken and calls for the need of active utilization of ICT between the buying firm and suppliers e.g. EDI. Finally, when the organization moves towards Value Chain integration, the purchasing organization is connected and understands their customers. Sourcing here involves synchronized purchasing and supply operations from the previous phases in addition to actively contributing towards customer value creation. It requires an in depth understanding of customer needs and willingness with capability to satisfy them. (Van Weele, 2010).

From the organization structure point of view, in the first three phases the purchasing organization usually follows a functional or decentralized approach in its structure, reflecting upon the lack of coordination across functions of different regions despite the coordination mentioned for the third phase. Moreover, although there is wide evolution from Transactional Orientation to Purchasing Coordination, the role of the purchasing organization is related to the management of cost through consolidation and coordination of purchases in best cases.

In these last three phases, the purchasing organization is in a better situation to increase their importance and potential contribution on different dimensions. By establishing channels of interactions between internal actors beyond purchasing, the business requirements from the company can be better understood as is the case for Internal Integration. Even more, the External and Value Chain Integration expands the scope of interaction of the purchasing organization to external stakeholders as suppliers and the end customer. This places the purchasing organization in the strategic position where it can contribute to different business goals. Therefore, the sourcing strategy is in position not only to contribute on cost dimensions but additionally, through the decisions made on the different decision areas it can have an important impact on long term rationalization, on the different dimensions of the development role and managing the risk of the structural role. However, it is a requirement for the organizational structure to allow interactions between different internal stakeholders as well as with suppliers and end customer. For this reason, as can be seen in Figure 2-3, the purchasing organization should have cross functional focus in its organizational structure for higher levels of maturity

As seen from the various phases, several activities undertaken from the purchasing department ranges from only administering to close coordination involving cross functional teams. In order to achieve a greater degree of maturity, cross functional teams are one of the prerequisites. This is possible by having an effective organization. This implies that organization and organizational design are the key tasks of sourcing management (Axelsson et al., 2005).

This section has explored different organizational features of the overall organization and the purchasing organization and their potential influence on the roles of the sourcing strategy. There are two main aspects to consider when it comes to the organizational aspects of the sourcing strategy. First, it had been discussed that the expectations of the purchasing organization inside the firm has to be reflected on the organizational structure by having in place structures that allow for cross functional collaboration if this is required for the achievement of the business goals. The maturity model indicated that if the company is expecting the sourcing strategy to fully contribute to the rationalization, development and structural roles, the purchasing organization should be more integrated internally and even with suppliers and end customers. In this sense the hybrid structures have shown to be appropriate for this purpose since it permits the information sharing required for the appropriate management of the decision areas of the sourcing strategy. Consequently, as shown in the Figure 2-4 below, as part of the development process of the sourcing strategy the maturity of the purchasing organization should be assessed.

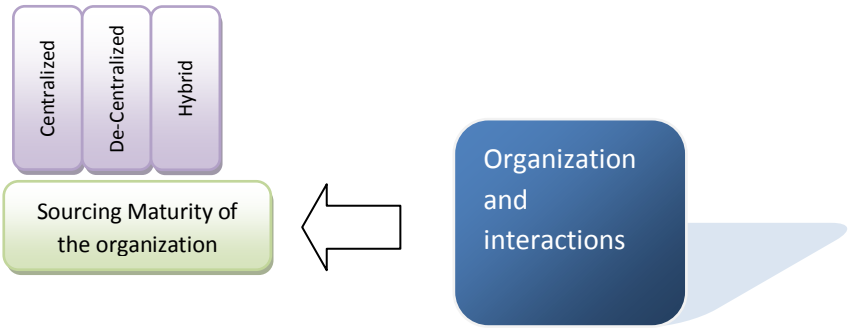

Figure 2-4: Organization and Interactions factors for the Strategic Sourcing Framework

Second, the sourcing strategy can in turn drive organizational changes and in fact, it should be part of sourcing management. However there are limitations to motivate these changes in cases where the analysis is made on a limited part of the sourcing groups. In these cases, the sourcing strategy can be developed considering the current organization but it would be interesting to later analyze the organizational implications of the potential sourcing strategy.

2.4 Strategic Sourcing Decisions

This section focuses on detailed exploration and definition of the main aspects involved in the decision making process and establishment of the sourcing strategy. The first part will be devoted to the definition of those decision areas relevant to the contribution of the sourcing strategy to the different roles of purchasing. Once the decisions are identified, the second part will focus then on an in depth exploration of important aspects concerning the strategic sourcing decision areas. The major decision areas to be explored are: the boundaries of the firm, the supplier base structure and individual relationships with suppliers.

2.4.1 The strategic sourcing decision areas

The rationalization, development and structural roles of the sourcing strategy require addressing decision areas where there can be sufficient contribution to these roles. However, the potential contribution of the sourcing strategy will not only depend on the decision areas themselves since it will also rely on which dimensions and parameters analyzed under these decision areas. For these reason is important to identify clearly those decision areas and explore the different parameters relevant for their analysis.

These decisions are encompassed under purchasing as defined by Gadde (1994) where the decisions are ought to be made under three major decisions areas as can be seen Figure 2-5. Therefore, the following three decision areas can be used applicable for the development of the sourcing strategy. First, is important to determine the scope of the company and establish the boundaries of the firm. For this purpose the main the decision to be taken within the framework of the sourcing strategy will be in consideration to the make or buy question.

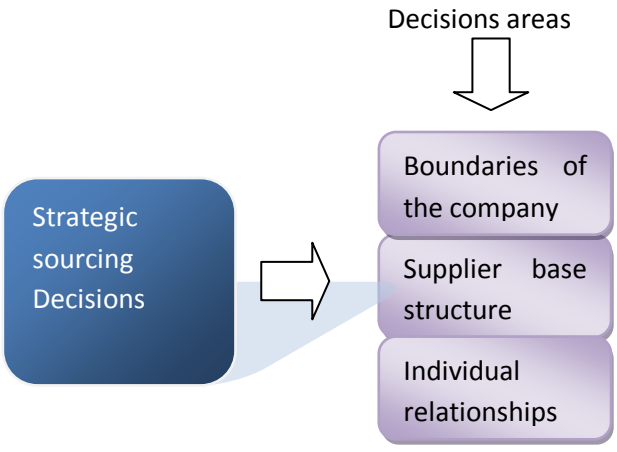

Figure 2-5: Strategic sourcing decisions areas for the Strategic Sourcing Framework

Second, the supplier base must be structured in terms of the number of suppliers considering, as it was suggested by CIPS (2007), and other aspects that could be relevant. Finally, the management of the supplier base must also reflect upon the type of individual relationships to be developed with

suppliers where the major subjects would be related to the level of involvement with suppliers and the continuity of the relationships. Additionally, as it was discussed in section 2.3, the organizational design can be influenced by the sourcing strategy potentially becoming another decision area. However, it was also argued that organizational changes can be limited due to external factors reason why it is not included as explicit decision area in the framework.

These decisions are closely interrelated since the outcome for example of the make or buy decision can in turn affect further the analysis over the supply base structure and individual relationships. In relation to these complexities, Gadde et al (2010) suggests developing the alternatives considering the three decision areas at the same time and then balance the decisions on each area. This approach is valid with regard to the inclusion of the complexities of the supply side of companies. However it is the authors' opinion that for complex situations this approach can provide difficulties to be operationalized due to the vast set of alternatives that could emerge which would require further analysis. In contrast, other authors place as first step the analysis of the boundaries of the firm and to later analyze the supply base structure and individual relationships (Humphreys, Loa, & McIvor, 2000). Disregarding on which approach is used, these decision areas will determine how the sourcing strategy can contribute to the rationalization, development and structural role. At the same time, as it was concluded in section 2.3, the outcome of these decision areas is dependent on the maturity of the organization since it will influence the potential alternatives to be analyzed.

The remainder of this section will be developed upon the three decision areas shown in Figure 2-5

2.4.2 The boundaries of the company

With the focus on a practical approach regarding the supply side, as shown in Figure 2-6 Jennings (1997) has identified five majors dimensions to consider on outsourcing or insourcing decisions complementing the core competence approach and considering supplier relationships and cost aspects as well.

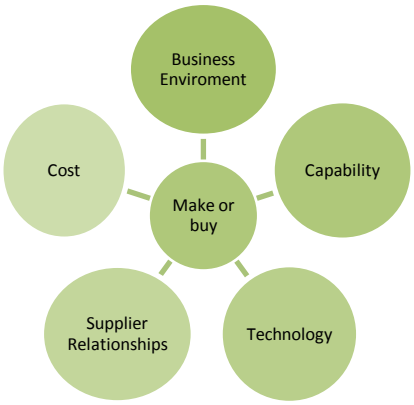

Figure 2-6: Make or Buy on supply side. Adapted from (Jennings, 1997)

The analysis of the business environment emphasizes the competitive position of the company. Since it is a company's reaction to the business environment, it is required to understand thoroughly the business strategy and the potential changes affecting the industry where the company performs. The analysis over the make or buy decision must contribute to the achievement of the goals the company has set from business perspective. Furthermore, Jennings (1997) also points the role of uncertainties

as an important point of consideration when understanding the business environment as it was portrayed from the transaction cost perspective.

On the cost dimension, some aspects must have careful attention. First, it is important to recognize the potential cost savings of the decision and how will they impact profitability and business strategy of the company. Second, it is important to take a total cost approach, considering the effects it will have on internal service performance and the potential net revenue that would be available if resources are released. Finally, the economic scales that might be loss or gain are also an important driver of the make or buy decision and it's recommended to avoid cost penalties for those activities that remain in-house (Jennings, 1997). Additionally, for the cost analysis it is important to reflect upon the possibility of being able to assign real cost to different activities. As identified earlier, most of the make or buy decisions focus on the analysis of outsourcing a process being done inside. Hence, the information about cost and a clearer picture on the cost drivers will be available for decision makers. If this is not available, it does not mean that no consideration should be given to cost but rather that the analysis cannot be made in a detailed level increasing the level of assumptions required and therefore the uncertainties.

For the capabilities dimension, Jennings (1997) also recognizes the problems of using only the core competence concept to drive make or buy decisions. The main reason being, the difficulties to differentiate between core and non-core competences, which is in alignment also with Gadde et al (2010), who critics to the core competence concepts especially regarding its definition. However Jennings recognizes that for a company it is important to protect the core capabilities as well; having activities performed by suppliers is important opportunity for companies to develop further those capabilities that are distinctive of the organization. These capabilities must be attempted to be defined following a bottom up approach (Humphreys, Loa, & McIvor, 2000). Finally, emphasis is made on the possibilities to create potential competitors if outsourcing decisions are not properly managed. The leakage of knowledge regarding the company operations and potential customers' information is another aspect to consider from this perspective.

From the technology perspective based on Welch & Nayak (1992), there are three important aspects to consider. First, the importance of the technology as means of competitive advantage and business performance. Second, is important the status of the technology in the market and its potential development, where consideration shall be given not only to the industry in focus but also a cross industry approach. Finally, it will be relevant to analyze the performance of the company against that on competitors. These aspects emphasize to consider internal importance of the technology and external dimensions as the supplier market and competitors. Jennings (1997) further complements by taking into account that the approach to technology and the business strategy should be fully aligned and there must be a clear understanding of the business environment. Cost will be included since it would be an investment for the development of a given technology. Moreover, in cases with a wide technological gap to be filled, it is unlikely that the company can gain a competitive level and partnerships can contribute to gain performance. Additionally, it must be considered that if a technology is in-house, then company must strive to maintain leadership and innovate, which are costly and effort consuming activities.

Finally, the make or buy decision most also take an outside perspective and the relationships with suppliers should also be analyzed, since identifying supplier relationships as potential source of

competitive advantage (Gadde, Håkansson, & Persson, 2010). However Jennings (1997) recognizes many risks arising from supplier relationships without the appropriate analysis. Therefore the make or buy decision will also relate with suppliers, in terms of the number of suppliers and the type of relationships to be developed, reflecting the interrelation between the decision areas of the sourcing strategy.

Once these aspects are considered and both internal and external situation fully understood, the decision makers should compare different options and evaluate them in terms of the characteristics of the aspects identified. In addition, the appropriate analysis of all these aspects would have organizational requirements since there should be in place interaction channels between the purchasing organization and other business units and departments in order to understand the impact of potential alternatives on different levels.

Besides these aspects, when selecting sourcing options one must also consider the feasibility of the scenarios in relation to the level of interdependencies of activities and resources providing the functionality of the product. As Gadde et al. (2010) reflected, the level of interdependencies between the activities and resources and in general the networks effects, can prove to be an underlying aspect in relation to decisions in the supply base. If one considers the product architecture as the scheme used in order to establish the relationships between product functionality and physical components (Ullrich, 1995) it is clear that for the interdependencies of activities and resources, it will play a key role on the product functionality and therefore needs to be analyzed. Gadde & Jellbo (2002) also points to experience and independencies that will be determined as well not only by physical dimensions but also by the experience of the actors performing the activities. Hence, besides the technical interfaces, the previous experiences would determine the feasible division of labor.

The analysis over the make or buy decision has identified major aspects in consideration to the determination of what the company should perform internally and what should be acquired from the market or outsourced. First, there are some major factors that will determine the convenience and feasibility of internalizing or outsourcing a process when relating to the supply side as can be seen on Figure 2-7. In this respect, the business environment cost, supplier relationships, the technological context and the current capabilities of the company will be structural factors defining the make or buy decision and there would be organizational requirements to allow for interaction. Finally, the interdependencies between activities and resources will also affect the boundaries of the firm. The resources and activities should be understood as a set of aspects providing a required functionality that must be kept or improved in every feasible alternative.

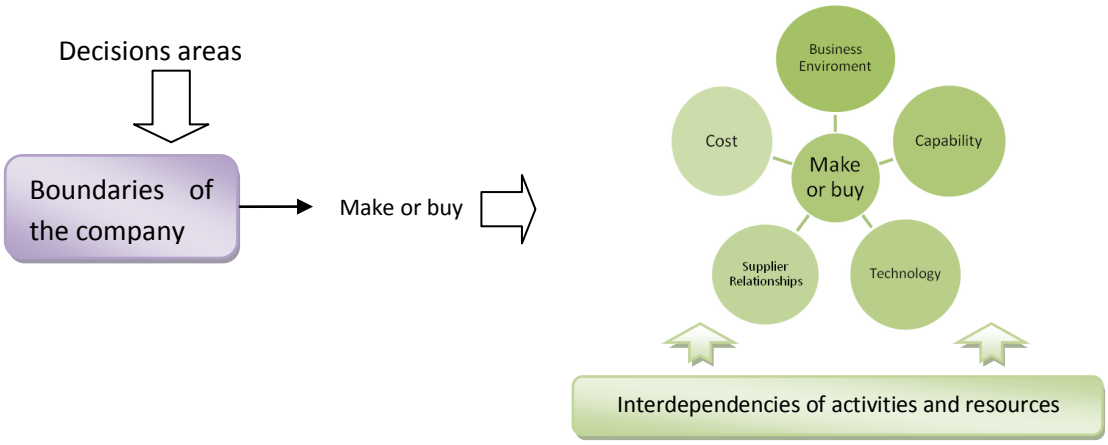

Figure 2-7: Make or buy factors for the Strategic Sourcing Framework

2.4.3 Supplier base structure

The structure of the supplier base has always been recognized as a main decision area to be included in the sourcing strategy. In fact some times, the concept of sourcing strategy used by some authors only relates to the number of suppliers to have relationships with (Gadde, Håkansson, & Persson, 2010). However, when analyzing the structure of the supplier base many considerations can be taken in to account. Van Weele (2005) argues that sourcing strategy should be concerned with several aspects in relation to the supplier base such as global vs. local sourcing, single vs. multiple. It is clearly identified in the context of the sourcing strategy that the management of the supplier base structure will deal with the number of suppliers and its nature in terms of its geographical characteristics. As part of the supplier base structure decision areas, these decision will be of importance for the contribution of the sourcing strategy to the different roles since many rationalization or development opportunities can depend the number of suppliers and their location.

The decision for example of having global or local suppliers must be carefully thought through with previous understanding of the implications this decision will carry for the firm, both in terms of its relationship with suppliers and internal operations. Sourcing from international markets can provide the company with cost advantages, given the scale of operations and labor cost of potential international players. At the same time, it can start penetration into new markets by first developing supplier relationships in the target market, which does not necessarily have to be a geographic market but also other types of niches such as industry segments or embryonic technological markets, which is identified as expectations from sourcing by (Carter, Carter, Monczka, Blascovich, Slaight, & Markham, 2007). When dealing with a global market, besides the potential markets that can be opened, there can be also be potential benefits in terms of gaining control or access to critical resources and technologies that can strengthen the competitive position of the company. This discussion on global markets can be addressed from two different perspectives. First, the term global sourcing can refer to decision of purchasing goods in foreign markets that will be further used in production, other processes or direct selling. On the other hand, global sourcing can also be analyzed considering rather the nature of the supplier rather than location of the same. This implies characterizing and distinguishing between global players and local players.

The cost and benefits in each case is hard to asses and there is not much agreement in literature (Holweg, Reichhart, & Hong, 2011). Defining what would be better for the company should be based on specific features since generalizations can be risky. If one considers only the cost dimension there are more defined guidelines introducing the possible cost effects global sourcing can have. Holweg et al (2011) distinguishes between three different types of costs: static, dynamic and hidden, stressing that companies often only consider the static cost when trading off between local and global sourcing. Figure 2-8 shows the wide range of possible cost effects of global sourcing. However it is focused on the perception of global sourcing as the location of the supplier and not in its nature. Furthermore, it assumes that after an individual transaction is made and accepted between both parties, the responsibility of the supplier in terms of after sales services does not have cost impact on the company. This last aspect can be of major consideration for global sourcing decisions in industries where the products supplied have long life cycle requiring service and after sales support.

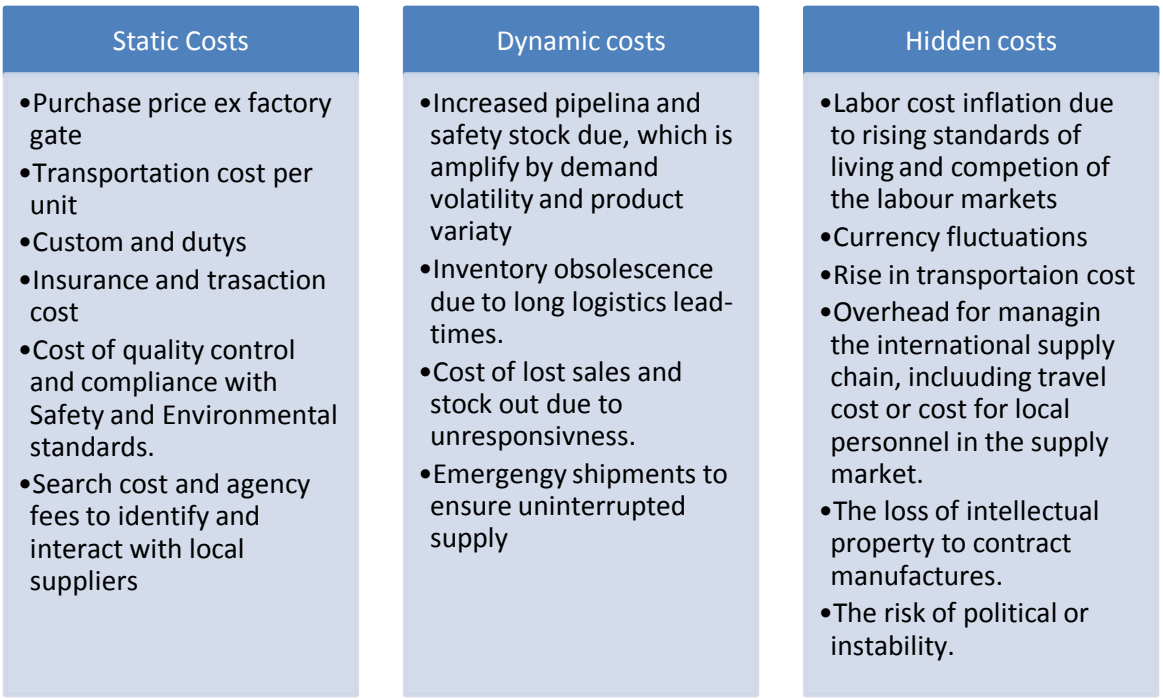

Figure 2-8: Costs of global sourcing decisions. Adapted from (Holweg, Reichhart, & Hong, 2011)

Inherently, for assessing a decision of global or local sourcing besides the consideration given to the different cost arising from the two different possibilities one must first have excellent understanding of the supplier market where the decision is ought to be made. In the case of the cost previously identified they will not only depend on the internal features of the company but also from the characteristics of suppliers performing in a market. The knowledge of this market on global basis is therefore a prerequisite before making a decision of the global versus local.

In similar manner, as part of the supplier base structure it's critical for the company to determine the number of suppliers for the sourcing strategy for an individual product category. Thought it may appear as an intuitive definition, the concepts of single and multiple sourcing has some aspects that need to be explained. As defined by Trevelen & Bergman (1988) single sourcing decision is related to the company goal of having at most one supplier in order to full fill the organization's requirements

of given set of products. Additionally points a key difference existing between the terms of single and sole sourcing, when sole sourcing; the company is buying from only one supplier due to monopoly in the supplier market rather than as selection. On the other hand multiple sourcing can be understood as referring to cases where a company is buying "identical" products from more than one supplier. According to the companies' needs and market situation, a firm should strive to gain as much benefits when defining the number of suppliers for a given product. In this respect Gadde et al (2010) identifies the main differences between the two policies focusing on the potential advantages it can have on cost considerations. The advantages deriving from single sourcing are related to the possibilities of achieving mutual benefits due to the continuity of the relationship. These benefit can be related to cost reductions, efficiency in process, better interaction environment or tied up research for example, but at the expenses of the dependency to suppliers. On the other hand, when having multiple sources Gadde et al. (2010) argues that there can be an increase flexibility and risk reduction of supply failure while at the same time restrain suppliers from becoming complacent or pressure the buyer on price, in this cases at the expenses developing mutual synergies. Moreover, one most consider the position of the selling company, since for the assessment of single and multiple sourcing decisions will provide different advantages and disadvantages from both the supplier and buyer point of view. (Berger & Zeng, 2006). Therefore important tradeoffs will arise and risks to be considered.

From a broader perspective, Trevelen & Bergman (1988) identify some risk categories important for the single vs. multiple sourcing decisions. First, is about the continuity of supply from the supplier base for the commodities categories been analyzed. Second, price escalation understood as the possibility of suppliers taking advantage of the dependability of the buying company and increases the prices. In addition to these to more cited categories, Trevelen & Bergman (1988) also portrait that several tradeoff will be needed to assess in terms of quality performance, inventory/scheduling and the access to technologies.

The main conclusion is that when it comes to single vs. multiple sourcing decisions no generalization can be made about the best strategy to pursuit; it will depend on every specific situation. For this reasons, it is important to consider the supply market, the company business strategy and different requirements of the internal process in order to assess the different tradeoffs especially in concern to the dependency with suppliers and the potential involvement in business relationships on the supply side.

The focus of this section was related to different decision concerning the structure of the supplier's base. The more familiar one relates to the number of suppliers as in single or multiple sourcing, which can have several advantages that company should try to maximize and it will be closely related to the potential involvement in the relationship and dependability to suppliers. However, the involvement of the relationship can be considered to fit better under the umbrella of the individual relationships decision area, reason dependency is most important parameter to consider regarding the number of suppliers. Additionally, the structure of the supplier base will depend on the geographical nature of the suppliers considering their location and their scope of operations. These characteristics can affect the cost performance of the company not only in as static cost, but the analysis of the different sourcing alternatives must asses dynamic and hidden cost. The considerations can be seen in Figure 2-9 below.

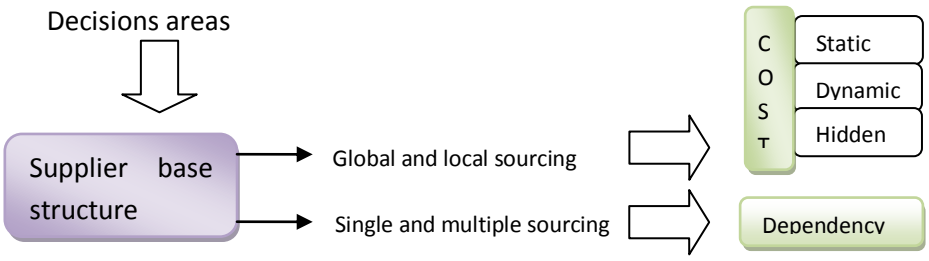

Figure 2-9: Supplier base structure factors for the Strategic Sourcing Framework

2.4.4 Individual relationships

Similar to the make or buy decision and the supplier base structure decision areas, regarding individual relationships there can be found different views in the way the company should act in order to gain and sustain competitive advantage. It is a common issue in purchasing literature that one mainstream suggests arms lengths relationships in order to avoid dependency and exploit the market, reflecting a clear bias on the structural and rationalization roles of the sourcing strategy. While on the other hand, others argue that close relationships with supplier can provide great benefits; some related to the development role as joint innovation or long term rationalization by mutual cost reduction programs. Disregarding which approach is more suitable, it is clear that the individual relationships decision area will play a key role in the contribution of the sourcing strategy of the different roles. For this reason it is important to understand the characteristics of the individual relationships with suppliers and how the level of involvement and continuity of the relationships will determine the benefits that can be gain from supplier relationships

The relationships between the buying company and suppliers is said to take place at different levels e.g individual, business unit, company individual level and the outcome of this relationship would be a result of previous interactions and future expectations. The atmosphere in which these interactions take place is important due to the great deal of uncertainty involving the future of the product, market demands, technology changes, etc. (Gadde & Håkansson, 2001). In this respect, Gadde & Håkansson (2001) suggest that atmosphere of individual relationships will be characterized by "Conflict and cooperation", "power and dependence" and "trust and commitment". Conflict and Cooperation will impact the collaborative efforts in the long term in the relationship and conflict itself should be understood negatively since the lack of conflict can be an indication of the inability of both sides to make effort for collaborative relationship. In the Power and Dependence dimension, the implications is laid on handling dependence from suppliers rather than taking advantage for one's own benefit and the use of power for constructive purposes benefiting buyer and seller. Finally, as far as Trust and Commitment concerns, it is important for the individual to know each other on a personal basis and know about the operations and procedures of the company in order to adapt together to manage effectively the uncertainties of the business environment.

Consequently, the level at which interaction takes place and its atmosphere will have implications on the individual relationships with suppliers impacting the potential benefits that can be gained. These implications arise due to connection between the level of interaction and atmosphere with the level of involvement of the relationship. In this sense, the two extremes of relationships are low involvement and high involvement, with each having its own benefits and costs depending on the

strategy and the position of the firm in order to avoid dependence. Low involvement relationships have many parameters associated with it due to the prevention of being "locked" with one supplier. Firstly, it prevents the buyer from being 'locked in' with one supplier which would lead to reduction in transaction uncertainty where buyer is not certain if the supplier would meet the required obligations. Secondly, it helps the buyer have enhanced technological flexibility by having various suppliers to approach based on the changes in technology. And third, it helps to get price advantage by making various suppliers compete against each other. At the same time, low involvement relationships would also lead having too many suppliers increasing the supply handling costs. Moreover, switching suppliers may increase the transaction cost and due to the possible hidden costs involved and splitting orders among suppliers may influence the potential for consolidation affecting the direct procurement cost negatively. On the other hand, high involvement relationship deals with the fact of having relationship benefits in comparison to low involvement. This would be in terms of resources, increased service levels, increased flexibility, supplier skills and capability to improve quality and increase innovation in products offered. But these come with attached costs in form of increase involvement, interaction, adaptations and relationship handling costs. The approach should be always taken considering both the benefits of having the relation in comparison to the relationship costs (Gadde & Håkansson, 2001)

Another aspect to consider in the involvement of relationship is the continuity aspect. Generally high involvement relationship requires long time to develop and hence high degree of continuity. Low involvement relationships may have low degree of continuity or high degree depending on the need for adaptations by the firm. Based on the relation between degree of involvement and the degree of continuity, Gadde and Håkansson (2001) have come up with a matrix that classifies various suppliers based on the two dimensions as shown in the Figure 2-10 below.

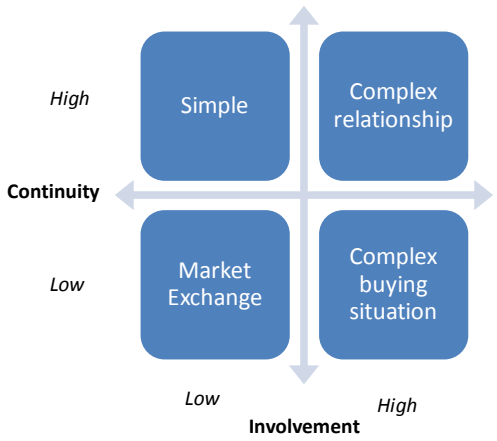

Figure 2-10: Degree of involvement and continuity- Adapted from Gadde & Håkansson (2001)

Even with low involvement relationship, there can be less continuity since the buying firm would like to be flexible in various aspects as discussed above. But sometimes even though there would not be a requirement for great deal of involvement but remain with few selected vendors always in order to save time in searching for new vendors, administrative time since the vendor would know what are the expectations of buying firm and hence the decrease in going through the learning curve my new vendor. On the other hand, with high involvement the buyer would have locked in with the supplier with specific adaptations, investments, which would be ideal to have continuity in relation. But in

cases where product complexity increases and requires high involvement with supplier only for a period of time, project basis then it is possible to have low continuity (Gadde & Håkansson, 2001)

Therefore the different types of relationships in terms of their involvement and continuity will have different benefits and cost that would need to be assessed by the company as part of the individual relationships decision area. As suggested by Gadde & Hakånsson (2001), this implies that the company's overall relationships with suppliers should be characterized by a mix of individual relationships with different levels of involvement and continuity in order the exploit differentiated benefits. At the same, this variety of relationships will also have implications in the structure of the supplier base. Since relationships should be addressed differently depending on the type of supplier, the number and location of suppliers needed to gain those expected benefits will also be affected. This situation reflects a close connection between the supplier base structure and individual relationships decision areas. In fact, some authors tackle this bond by integrating these two decision areas into one, named for example as "strategic supplier portfolio management" (Wagner & Johnson, 2004)

In order to assess the potential benefits to be gained from the different types of relationships to be developed with suppliers Gosling et al. (2010) have formulated various flexibility parameters that would be relative to the level of involvement of the relationship. As shown in the Figure 2-11 below, these flexibility parameters comprises of both internal and external factors that needs to be considered in order to have the required supply chain flexibility.

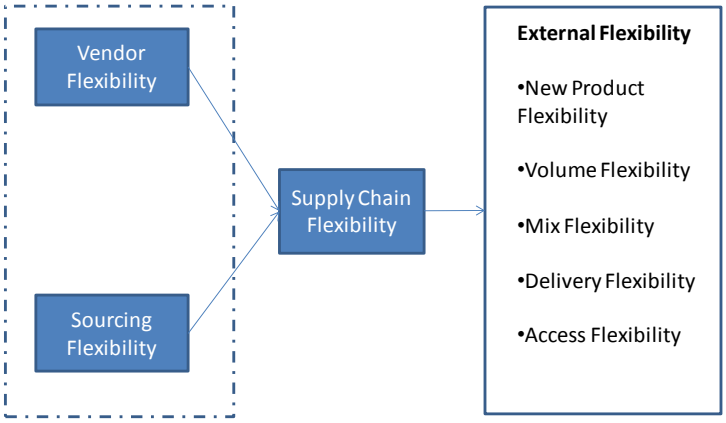

Figure 2-11: Supply Chain Flexibility parameters. Adapted from Gosling et al (2010)

Regarding the internal factors, Vendor Flexibility is in relation to each vendor who supports various activities such as manufacturing, warehousing and transport operations while Sourcing Flexibility is the ability to reconfigure the supply network by selecting or deselecting vendors. The external factors on the other hand, are those viewed by the customer who determines the actual performance of the company. In this respect, Gosling et al. (2010) defines the following parameters.

1. *New Product Flexibility* is the ability to take into consideration to develop new products of wide variety as well.
2. *Mix Flexibility*, is the ability to change various products currently used
3. *Volume Flexibility*, is the ability to accommodate changes in production volumes
4. Delivery Flexibility, is the ability to make changes in delivery dates

5. *Access Flexibility* is the ability to provide access across various regions and geographies for different customers.

The importance of these external flexibility parameters would be dependent on the business environments and the customers since some industries might characterize by demanding a high rate of new product introduction but less of delivery performance. As result of the above mentioned parameters and the level of involvement of the relationships, the Figure 2-12 below shows a matrix showing the required supply chain flexibility outcomes for different categories of supplier based on the type of relationship. The different types of individual relationships with suppliers are segmented in to approved, preferred and framework agreement suppliers as mean to help the sourcing and procurement decisions during various projects.

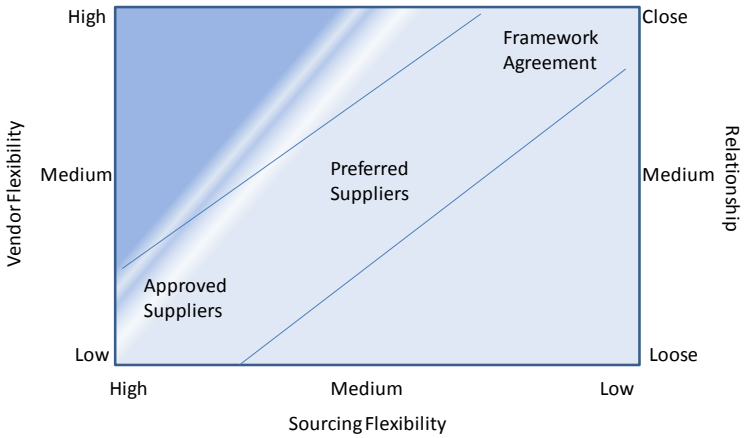

Figure 2-12: Interaction between supply chain flexibility antecedents. Adapted from Gosling et al (2010)

The framework agreements aim to have close relationship with suppliers by integrating systems, investment in development of supplier to have supply chain flexibility. It also aims to increase the vendor flexibility through the above approach. Since it requires great amount of investment, sourcing flexibility is lower due to "lock in" effect since it would not be easy to switch suppliers owing to loss of investment. The preferred suppliers intend to have a view of external flexibility parameters and gauge the suppliers to avoid lock in effect and at same time have good relationship in moderation. Mostly used in high frequency products where there would be a need for the service of the vendor frequently for various projects. Since these vendors would have already been acclimatized with the firm buying patterns and administration activities, there would be less transaction costs.

Finally, as the lower level of involvement, approved suppliers approach is to have high sourcing flexibility and not vendor flexibility. It gives more importance to the external flexibilities in consideration to vendor capabilities with little lock in effect. The relationship is of arm's length with the process of tender being floated to choose the best vendor among a pool of approved suppliers. These may be suitable with standard components with many potential vendors out in the market. The other extremes are top left corner of matrix, with high vendor and sourcing flexibility which results in over compensation for risk and uncertainty, creating unwanted cost for the supply chain. The bottom right corner of matrix, with low vendor and sourcing flexibility, where the supply chain is not prepared for risk and uncertainty (Gosling, Purvis, & Naim, 2010).

As it has been explained in this section, individual relationships with suppliers will be related to the involvement and continuity. However the nature of the relationship is closely linked to the level of interaction and the atmosphere under which it develops, affecting the level of involvement and continuity, and more important, the potential benefits from the relationship. Finally, it was identified that flexibility as an expectation from the relationship with suppliers is appropriate assessment measure in order to define which approach should be taken for individual relationships with different type of suppliers. This due to the fact that it includes both internal and external aspects and it can be put in to operation in terms of the type contract to have with suppliers if any. Therefore, the Strategic Sourcing Framework must include the type of relationships and flexibility for the analysis of the alternatives, as seen in Figure 2-13

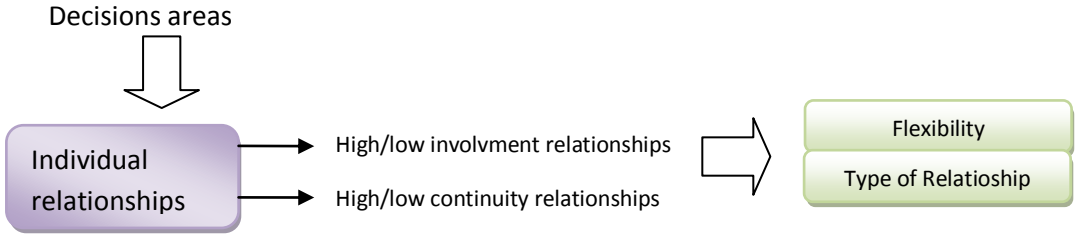

Figure 2-13: Individual relationships factors for the Strategic Sourcing Framework

2.5 Business Characteristics

The final block of the strategic sourcing framework refers to the specific business characteristics of the company. As introduce early, the majority of the literature and business cases regarding strategic sourcing address this subject in consideration to businesses operating in supply chain characterized by the continuity in business relationships. It is also important to understand the business characteristic of the company and understand the nature of supply chain while developing a strategy. There are many industry examples that have supply chains ranging from being agile, flexible and rigid based on the business characteristic the company follows. Based on these supply chains other parameters such as relationship, continuity etc, would follow based on the business characteristic. Similar to the project based approach of Swisslog, some authors refer to the challenges faced by supply chains in the construction industry and blame the one off project based approach as one factor preventing the achievement of excellence in supply chain concerning the construction industry. (Briscoe & Dainty, 2005; Dubois & Gadde, 2000)

For this reason, the project based organization arises as one business characteristic that can have implications for the development of the sourcing strategy. As in the case of the construction industry which is the more representative business characterized by a project based approach, it can be inferred that some of the factors affecting the construction industry can be replicated in other industries. This section brings about the various issues and challenges faced by the construction industry serving as parallel for an industry which works largely on a project basis. These challenges will have to be contextualized in terms of their imaginable significance for the organization and interactions or the different decision areas of the sourcing strategy.

In this respect, Dubois and Gadde (2000) defined some business characteristics for the construction industry inherent to its project based nature. First, it has been observed that contracts tend to have an impact on the degree of standardization and adaptations in project based organizations. This is

due to the fact that customer has to decide the between standardized and adapted (customized) solutions for the project which in turns affect involvement of the relationship with subcontractors. If adaptations are in place, it increases the potential benefits of the relationship in the long term but at the expenses of interdependency from suppliers. On the contrary, the use of standardized components lays emphasis on short term goals, leading to supplier selection based on price basis (Dubois & Gadde, 2000). This characteristic will therefore have consequences on the development of the sourcing strategy by affecting the potential benefits of individual relationships with suppliers.

Second, one other major characteristic of construction industry as a project based organization is the creation of temporary multiple organizations described as temporary multiple organizations within the context of a permanent network (Dubois & Gadde, 2000). The temporary networks arise based on the project, when several actors with various tasks come together and deploy their resources in order to deliver and complete the entire project within a time period as can be seen in Figure 2-14. The organizational requirements that arise from the temporary network are more than that from the permanent network since the coordination and interaction required increases. This brings rise to increased interdependence between the firms when it comes to a project, thus making it a strong project organization which is temporary, but weak interdependence between the firms at the permanent organization level. The figure shows three different firms A, B and C who employ resources A1, B1 and C1 indicated in different colors, for one of the projects as indicated by the blue circle. Simultaneously, these firms A, B and C also have other projects going on for which they have to employ other resources in the form of A2, B2 and C2 as shown.

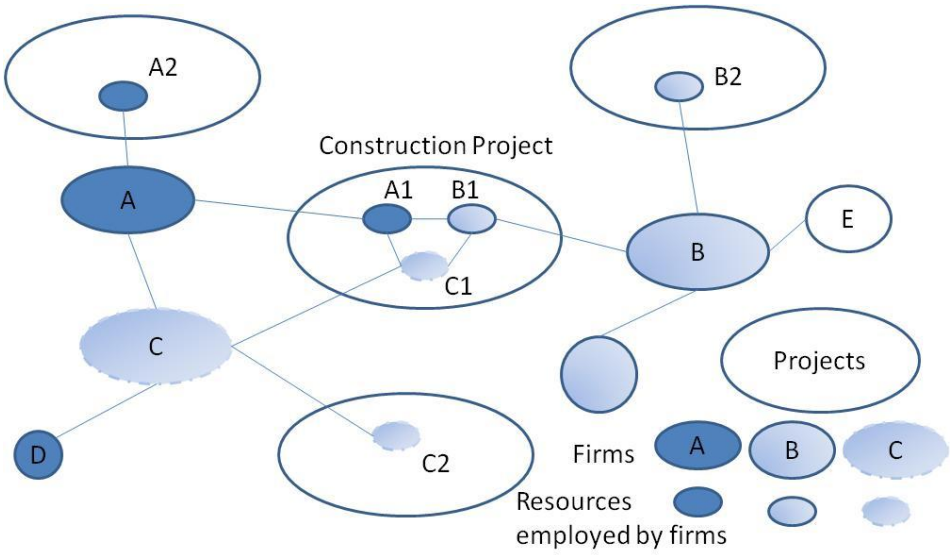

Figure 2-14: Coordination in the permanent and temporary network. Adapted from Dubois & Gadde (2000)

As shown in Figure 2-14, this coordination and interaction takes place at four different levels. Firstly, coordination at the project level between A1, B1 and C1. Secondly, at the firm level to coordinate within the firm the various activity, resources etc., (A1, A2, A3, etc,.). Thirdly, coordination of activity and resources between A, B and C firms at firm level though not at a project level. Finally, coordination is required between subcontractors and their suppliers as shown for example between C and D. Moreover is important to consider that these temporary networks can also change within the same project in adjustment to the different project phases which would therefore change the coordination and interaction patterns. As a result, the characteristic of having temporary network

during the different project phases can impact the sourcing strategy by increasing the interactions in the organizations due to the requirements for coordination.

Finally, Dubois and Gadde (2000) also conclude that transactional exchange is more predominant than relational exchange in construction industry. This prevents the use of same actor all the time and makes it difficult to utilize the experience gained from previous projects. Thus, creating "cost inefficiencies" for the customer since the supplier has to go through the learning curve all the time. This transactional approach can be suitable when there is no interdependency between the components of the solution offered but with due to large amount of interaction and interdependency, relational approaches in terms of higher level of involvement and continuity. Therefore, as in the case of standardization vs. adaptation, this business characteristic of project based organization can determine also influence the development of the sourcing strategy by having implications for the individual relationships decision areas.

From the above discussions, there is a need to find a balance between transactional and relational. Relational approach would increase the development of both temporary and permanent network and increase the adaptations among firms in permanent network. Increased adaptations would lead to increase in efficiency of operations. Having already adapted to each other would also lead to increase in providing customized solutions with increase in innovations from all actors in the network. But if the business situation demands a transactional approach to take leverage of market situation, then trade-offs have to be considered.

The discussion about the specificities that the project based organization brings when relating with suppliers has shown different dimensions to consider in the assessment of sourcing alternatives. First, the dilemma regarding standardization vs customization shows that the adaptations required for standardization are harder to achieve on individual relationships. Second, the temporary network created during the project development demands higher coordination among the actors at different levels and through the project phases influencing the organization and interaction dimensions. And third, there is tendency to transactional exchange, affecting the level of involvements as part of the decision area of individual relationships. Therefore, all these special characteristics of project base organization will be important to be considered during the assessment of the sourcing strategy to understand its true potential and are shown in Figure 2-15.

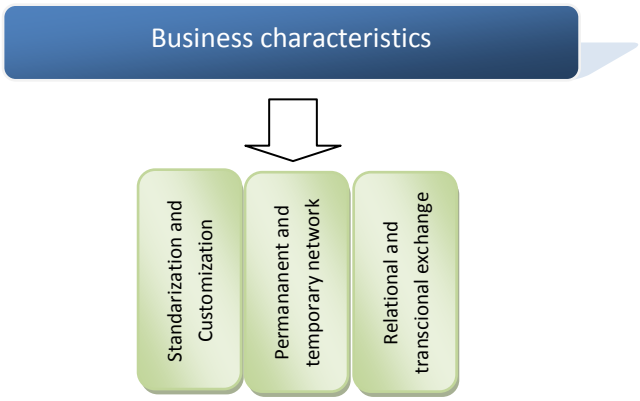

Figure 2-15: Project based organization factors for the Strategic Sourcing Framework

2.6 Research Sub Purposes

The theoretical framework has established the basis for the development of the sourcing strategy. First, the sourcing strategy must contribute to the different roles of purchasing. Second, the organization and interactions will determine the potential for influencing these roles and the sourcing maturity of the organization will be important before developing the sourcing alternatives. Third, the boundaries of the firm, the supply base structure and individual relationships are the major decision areas to be covered by the sourcing strategy. And finally, the business specific characteristics of the company such as a project based organization are required to be considered when analyzing the implications of the strategy alternatives. These dimensions are part of an integrated framework that can be seen in Figure 2-16 below:

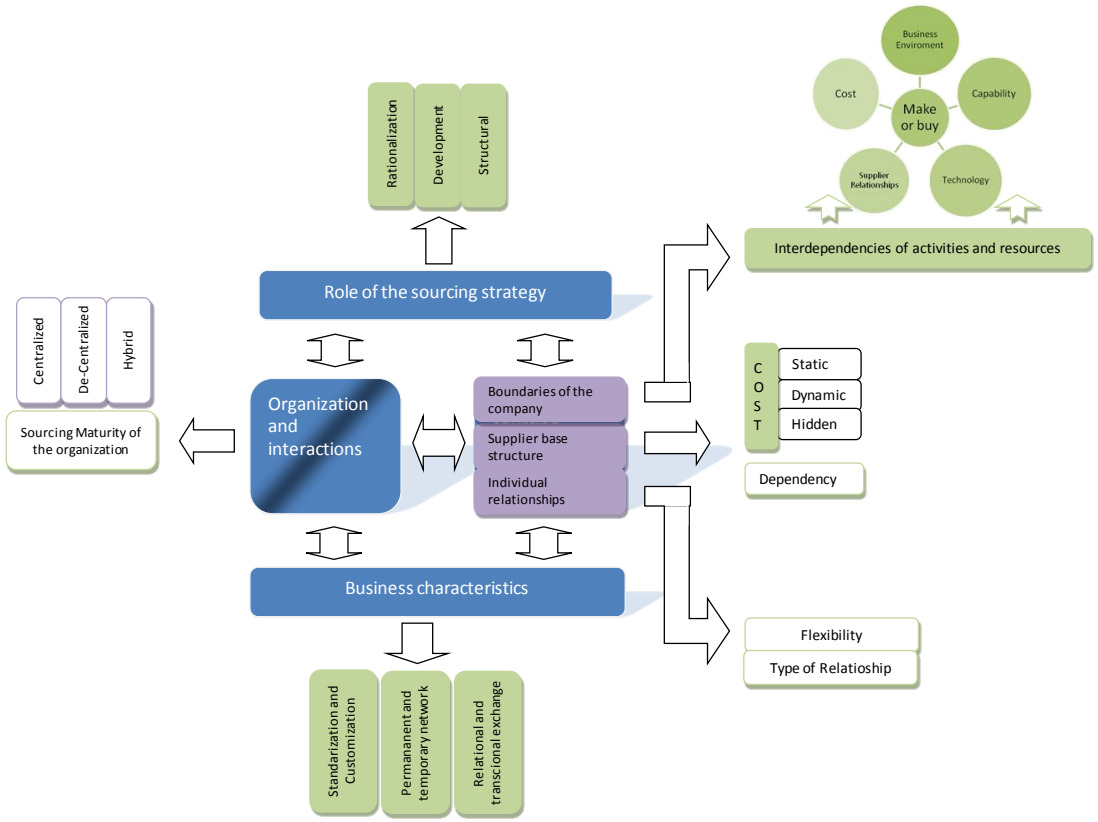

Figure 2-16: Complete Strategic Sourcing Framework

It is clear that the sourcing strategy must include these parameters and the research questions must be built based upon them. However the literature does not offer a clear methodological approach for decision makers to operationalize and integrate all these dimensions and build the sourcing strategy in a structured manner through research questions. For this reason, the rational strategic planning approach, as suggested by Lysons & Farrington (2006), offers a suitable methodological basis in order to approach strategic decisions on the supply side and will be used in this project. As shown in Figure 2-17 below, the rational approach suggests that first there must be an understanding of existing situation considering both internal and external aspects of the company. As a second step, decision makers' needs to engage in a rational process to develop feasible alternatives for the strategy. Finally, these alternatives would require to be evaluated with regard to the company's needs.

Figure 2-17: Strategy development process: Research sub purposes.

Therefore, using the three steps of the strategy development process as general research sub purposes, the remaining of this section will attempt to integrate the Strategic Sourcing Framework by establishing specific research questions in accordance to what has been developed throughout the theoretical framework.

2.6.1 RSP1: Understanding the existing situation:

In order to develop a strategy, it is important to understand the current situation. This understanding has to be gained from both internal and external perspectives.
In the development of the analytical framework many factors have been identified as relevant.

First, it is required to have a complete understanding of the company business in accordance to the business environment. As it was identified by Monczka et al (2008), the contribution to the company is no longer on cost reduction but also on different other dimensions. The roles of purchasing defined in the theoretical framework as rationalization, development and structural require an understanding of the company's business characteristic to have positive effects on the strategy. More specifically, as part of the strategic sourcing decisions, the business environment emerged as one key aspect of the make or buy decisions which would also influence the technology dimension. In addition, decisions on the supply base structure regarding the number of suppliers or their global scope will also be influenced by the business requirements. The benefits to be gained from individual relationships for sourcing robots will also depend on the business and the implications for the robot systems since it can influence the flexibility and type of relationship required. Therefore, as part of the research it is important to understand Swisslog business and importance of the robot system. The research question can be framed as:

- *RSP 1.1: What is Swisslog business and what are the implications for the robot system?*

Second, the robot system itself is complex and it requires many activities and resources for its performance. The boundaries of the firm have revealed technology, capabilities and cost as important factors of the make or buy decision. The activities and resources involved in the robot system and the independencies among them determine to a large extent the requirements on these dimensions. In addition, as mention by Gadde & Jellbo (2002) the interdependencies and previous experience will also determine the division of labor among Swisslog and its suppliers. Therefore, decisions on the supplier base structure and individual relationships would also be influenced. Hence, an analysis is required to clearly understand the activities and resources involved in the robot system before analyzing them to develop sourcing strategy alternatives. Another research question can be established:

- *RSP 1.2: What are the current activities and resources involved in the robot system projects?*

Third, the theoretical framework identified the purchasing organization and its interactions with other business units and its members as important in order to assess the impact of the sourcing strategy. Additionally, the purchasing organization should be set in accordance to its strategic perception (Van Weele A. , 2005), and in fact, organization design can be a key task of sourcing management (Rozemeijer & Wynstra, 2005). Since great emphasis has been made on the strategic conception of the sourcing strategy, it is important to understand the purchasing organization and its interactions in order to assess these strategic expectations in accordance to its maturity. For this purpose, it is necessary to understand the general organization and identify how the purchasing organization interacts with the different business units to gain the perspective of different implications for the robot system. Thus, two additional research questions can be built:

- *RSP 1.3: What are the different business units within Swisslog and their role?*
- *RSP 1.4: How is the purchasing organization structured and how does it fit within the overall organizational structure?*

As fourth step, it has been identified that Swisslog is a project based organization and included in the Strategic Sourcing framework as one part of business characteristic block. The sourcing strategy must therefore be built considering these characteristics since the decisions areas will require to support them during the different project phases. This will not only be with regard to the permanent network, but also to the temporary or project organization, as identified by Dubois & Gadde (2000). This is an inherent characteristic that must be considered when developing relationships with suppliers in project based industries. Consequently, there are two main aspects to understand from this perspective and should be framed as research question:

- *RSP 1.5: What is the involvement of purchasing as part of the project development?*
- *RSP 1.6: What are the characteristics of the project based – temporary organization in the project development?*

The previous research questions have addressed the understanding of the role of the purchasing as a part of the business, the robot system, the organization and interactions and project based characteristics. Furthermore, as established in the theoretical framework the sourcing strategy must address the boundaries of the firm, the supplier base structure and the individual relationship as part of the strategy. Before analyzing these decision areas and develop the alternatives it is important to understand how the company has previously addressed these decision areas by observing their purchasing behavior. This opens another research question for the understanding of the internal situation

- *RSP 1.7: What has been the previous purchasing practices followed by the organization?*

The external part consists of the suppliers who are an integral part of the strategy from whom the purchase is being done. It is a prerequisite to understand the possible availability of resources, activities undertaken by them and value addition created for the buying firm in order to decide the development of relationship. The analytical framework has identified different factors as part of the three decision areas and this will be dependent on the variety of the supply market and also different cost dimensions as identified by Holweg et al. (2011).Hence, the external part will provide the

insights required in the analysis from the different suppliers found in the robotic application industry in terms of their different product offerings, technologies, capabilities and geographical nature. This understanding will serve as input for the analysis of the different decision areas defined in the theoretical framework. Hence, the research question is as follows:

- *RSP 1.8: What are the characteristics and differences between the different actors in the robot market?*

2.6.2 RSP2: Developing Alternatives

The analysis over the different strategic sourcing decisions areas will be related to the expectations of the sourcing strategy. Additionally, the maturity of the organization gives a good reflection of the strategic importance of the organization and the impact it can have on the different purchasing roles. For this reason, before developing the alternatives, it is important to assess the maturity of the organization as it was defined in the analytical framework. In an ideal case, the organization structure would have to be influenced by the sourcing strategy. However, given the scope of the project this will not be part of the organizational analysis. Instead, the organizational assessment will provide the sourcing strategy with a solid foundation in order to develop the alternatives from a strategic perspective. Therefore, the first research question as part of developing the alternatives would be:

- *RSP 2.1: What is the maturity of the purchasing organization as a measure to its strategic importance and its impact on the development of the alternatives?*

The alternatives to be evaluated are ought to address the three strategic sourcing decision areas. However, if as suggested by Gadde at al. (2010), as the alternatives are developed considering the three decision areas at the same time, it would be difficult to define a given set of alternatives to be evaluated. There will be many options for the make or buy decision in terms of which specific components to in source and these will also increase the possible options in the supplier base structure and the individual relationships decision areas. These difficulties would be challenging to overcome, potentially impairing the evaluation process. Therefore it is valid to first address the make or buy decision in accordance to the factors defined in the strategic sourcing model.

In this, respect the theoretical framework has shown that the definition of the boundaries of the firm is a multidimensional complex decision. In fact, the feasibility of the alternatives to be evaluated will not only depend on the five factors defined by (Jennings, 1997), but additionally the functionality of the system must be guaranteed when analyzing the different resources and activities in terms of the independencies among them. Moreover, these will be interdependent and will have implications on the relationships with suppliers as suggested by (Gadde & Jellbo, 2002; Jennings, 1997). Of these, the supplier relationships will be indeed important for the analysis (Jennings, 1997). However, the other strategic sourcing decisions will cover it extensively, reason why this factor is NOT considered as part of this sub purpose as it will be dealt by the remaining decision areas. As research questions, it can be framed in the following way

- *RSP 2.2: What feasible alternatives can be analyzed with regard to the interdependencies between activities and resources of the robot system?*
- *RSP 2.3: What are the implications for the make or buy decision in relation to the business environment, capabilities, technology and cost and how does this impact the alternatives to be further evaluated?*

Once the organization has been appraised and the make or buy decision analyzed, different feasible alternatives can be developed for further scrutiny. This will set the research question as part of this sub purpose as:

- *RSP 2.4: What alternatives can be analyzed in the relationships with supplier as part of the sourcing strategy?*

2.6.3 RSP3: Evaluating the developed alternatives

The development of the alternatives includes the analysis the organization and interaction through the sourcing maturity assessment and the analysis over the boundaries of the firm as part of the development process. Based on these inputs, different alternatives will be established and the remaining blocks of the strategic sourcing framework should be included in their evaluation. For this purpose, the supplier base structure decision area has identified different cost dimensions that must be evaluated in relation to global and local relationships (Holweg, Reichhart, & Hong, 2011). Additionally, the number of suppliers does have important implications on the dependency from suppliers. It will be important then to evaluate the alternatives considering the factors identified in the supplier base structure

Furthermore, the decision area concerning the individual relationships has shown that the relationships with suppliers are linked to the supply chain flexibility as defined by (Gosling, Purvis, & Naim, 2010). Since, the flexibility will also affect the type of relationship. The strategic sourcing framework also reflected upon the importance of the type of relationship in terms of the level of involvement and continuity in order to gain benefits from different relationships (Gadde & Håkansson, 2001). Therefore, as part of the individual relationships decision area, the alternatives would require evaluation in terms of the flexibility and the type of relationship. Finally, the analysis of the specific business characteristics has shown that project based companies have some inherent aspects that the sourcing strategy needs to evaluate since they affect the relationships with supplier as argued by Dubois & Gadde (2000). Consequently, the evaluation of the alternatives shall be made considering firstly the dimensions identified as part of the supplier base structure. Secondly, the individual relationships requires to be evaluated with regard the flexibility of the alternatives and the type of relationships and thirdly, the project based characteristics will also be relevant for the analysis. As a result, the research question is defined as follows.

- *RSP 3.1: What are advantages and disadvantages of the different alternatives in terms the supplier base structure, supply chain flexibility, the type of relationship and business characteristics.*

Finally, the strategic sourcing framework has suggested the interrelations between the decision areas and the purchasing organization and how they are important for contributing to the different roles of the sourcing strategy. The organization maturity was assessed as part of the development process of the alternatives as defined by RSP 2.1. However, as it was defined by Rozemeijer & Wynstra (2005) organizational design is a key task of sourcing management. In this sense, even though organizational changes were not part of the scope of the strategy, it would be interesting to reflect upon the implications of the alternatives to the current organization. In the same line, the approach to the decision areas was to assess first the make or buy decision. Nevertheless, the boundaries of the firm itself would depend on supplier relationships (Jennings, 1997), reflecting the close interrelation of the sourcing strategy decision areas in alignment with Gadde et al. (2010) conclusions. Therefore, it is

important as well to understand the implications of the alternatives for the boundaries of the firm. Finally, this discussion should be made considering the potential contribution of the alternatives to the different roles of the sourcing strategy. Therefore, a research question can be established:

- *RSP 3.2:* What are the implications of the alternatives for the purchasing organization and the outcome of the analysis from the make or buy decision and how do they relate to the roles of the sourcing strategy.

2.6.4 Concluding summary

The discussion of this section has established the different sub purposes for development of sourcing strategy. Furthermore, it has linked each sub purposes with different research questions in order to have a structured analysis and case study. The research questions have been defined in accordance to the strategic sourcing framework constructed in the theoretical framework. The Figure 2-18 below illustrates the integration between the research sub purposes from the strategy development process and the research questions based on the Strategic Sourcing Framework.

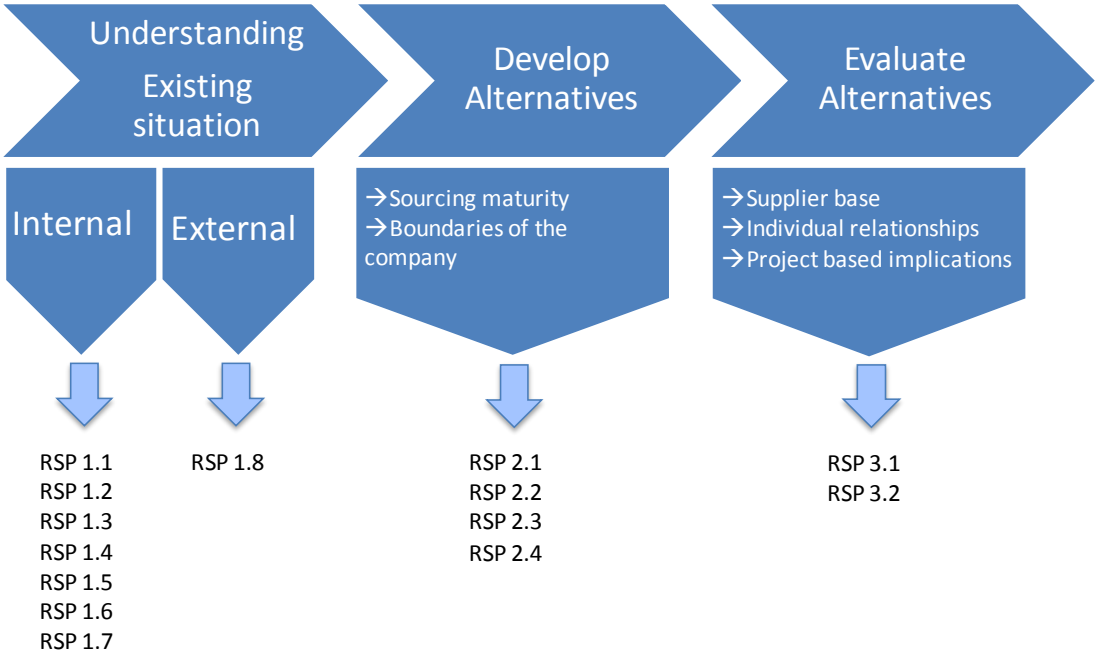

Figure 2-18: Sub purposes achievement and research questions

The thesis will be developed following the approach suggested in Figure 2-18. First, an analytical description will be made of the current situation. Considering the internal aspects defined by the RSP 1.1 to RSP 1.7 and the external aspects as RSP 1.8 suggests, the understanding of the internal and external situation will serve as input for the development of the alternatives and their further evaluation. As second step, the development of the alternatives needs to first assess the maturity of the purchasing organization as defined by RSP 2.1. Moreover, the first decision area for consideration will be the boundaries of the firm with regard to the parameters defined by RSP 2.2 and 2.4. After this initial assessment, the feasible alternatives will be established for further analysis. Finally, this analysis will be made in detail considering the important aspects of the supplier base structure and individual relationships decisions areas as well as the business characteristics as project based organization.

3. METHODOLOGY

This chapter concerns the methodology used for the project. First, the research strategy and design will be described defining the research as qualitative case study. In the second part, a description of the practical work process in relation to the achievement of the research sub purposes will be developed. Third, the data collection phase will be discussed and aspects concerning the interview process will be further explained in order to increase the transparency of the research. Finally, relevant aspect of the quality of the results from the research will be outlined

3.1 Research Strategy and Design

As portrayed in the previous section, the strategic development process consists of three stages. Given the dynamic characteristic of the strategy development process the research strategy and design has been established to address these dynamics. For this purpose, a qualitative case study was selected to be useful, since the characteristics of the case study research are focused on the particular contextual nature of one single complexity as it is defined by Bryman & Bell (2003). Many critics have been found regarding the use of qualitative case study as a research approach, however they are mostly focused on the limitations it can have from a theoretical point of view. In the case of qualitative research, the individual situation of the company has been studied and the findings are ought to be used with caution for generalization since it is based on the company and specific industry characteristics.

In the case study research both inductive and deductive approaches are identified as the main streams for contrasting the realities found in the empirical world and the theory describing the phenomena. Alternatively, Dubois and Gadde (2002) suggest the use of systematic combining as a way to interactively manage theory and empirical work. In this sense, they conclude that by switching within research phases it is possible to gain a better understanding of the both theory and empirical aspects and even, argue that theory itself cannot be understood without empirical data. However, one important drawback of systematic combining, which is based on an abductive approach is that, having the freedom to go back and forth from theory to empirical aspects can result in situations where everything is described, making it difficult to validate findings for the purpose of the research (Dubois & Gadde, 2002). For this reason, the role of sourcing and the implications both in terms of the decisions to be considered and the organizational aspects were clearly defined on early stages of the theoretical development. Moreover, for the empirical work some boundaries were set in early stages regarding the number of suppliers to be evaluated due to the robot market being a vast complex entity with the involvement of many players. At the same time, the empirical and theoretical boundaries were often subject to challenges in order to complement them during the development of case study.

3.2 Work Process

As it was defined in the research design, the master thesis has been conducted following a systematic combination of theoretical and empirical work. As the first introductory interview was conducted, it was possible to establish the main objective of the project, being to develop a sourcing strategy within Swisslog based on the analysis of different alternatives. In this initial stage important aspects to consider were defined to be in consideration to the boundaries of Swisslog WDS operations and the nature of suppliers in terms of global or local scope. However, after an exploratory study of theory, market situation and initial understanding of the company's business requirements it is important to establish the alternative in terms of a strategic perspective. This

would also provide a more transparent basis for further comparison and guidelines for the data collection phase.

Therefore, before defining the research sub purposes it was required to develop further the main purpose of the thesis after the initial exploratory study as can be seen on Figure 3-1 below.

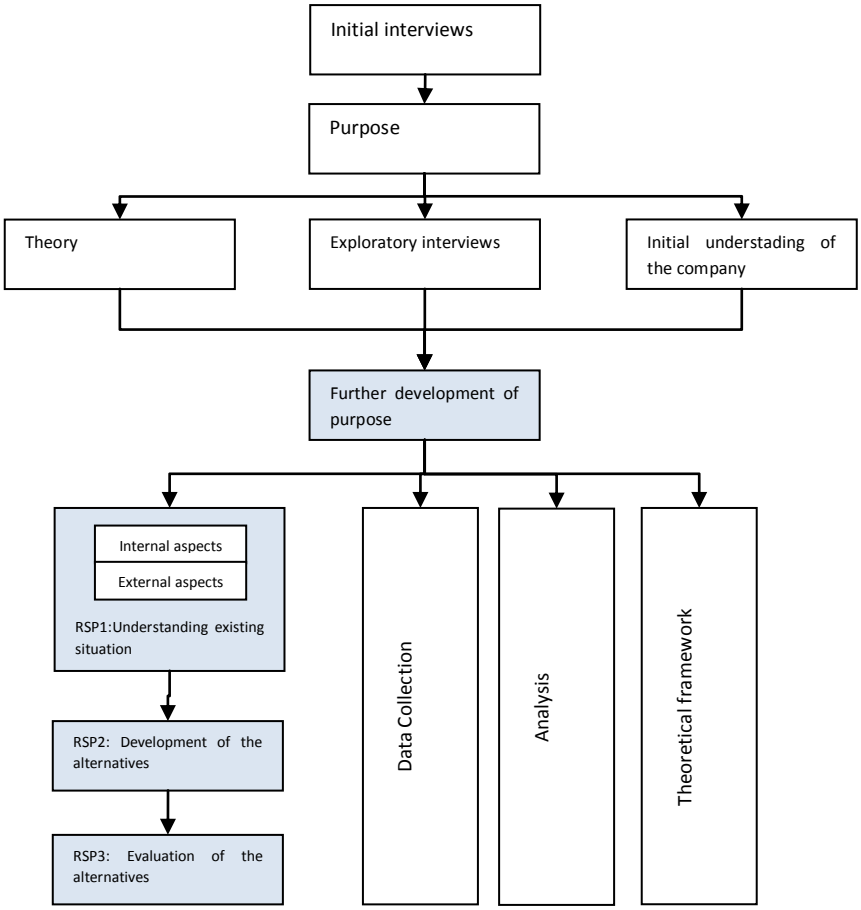

Figure 3-1: Work process for the thesis

It is important to remark that during the working process, the development of the theoretical framework, data collection, and analysis were conducted as different activities as seen in Figure 3-1 above. However, due to the abductive nature of the case study it is hard to split them sequentially and differentiate them during the research cycle. For this reason, during the research process there was continuous overlapping between them and performed as parallel activities. This is an expected practical situation that researchers have to manage (Cepeda & Martin, 2005).

3.3 Data Collection

The main data collection method used for the understanding of the internal situation for research sub purpose, RSP1 was primary sources, conducting interviews with different stakeholders within the organization. The use of interviews as data collection method in qualitative research and participant observations are a common process (Bryman & Bell, 2003). However, given the nature of the case study, it provided to be more convenient to use interviews as a data collection method. As mentioned by Byrman & Bell (2003), interviews have advantages in terms of its capacity to find out

issues resistant to observation, reconstruct events and the greater breadth of scope it can provide. In addition, interviews are less intrusive and have more ethical considerations. Nevertheless, when using interviews as data collection method, there are some critical aspects that must be carefully managed. First, the interview is subject of being influenced by the quality of the questions, affecting in this sense the quality of the responses. Second, the answers can be filtered and interpreted by the interviewer, adding degrees of subjectivity. And finally, the interviewee can have reflexivity over the questions, answering only what he believes is expected from him (Yin, 1994). Therefore, the interviews must be performed and interpreted considering these aspects. Secondary sources were also used with the purpose of understanding the internal aspects. During the interviews itself, interviewees were asked to provide the researchers with documentation regarding the different projects developed across regions since there was no integrated information system to share the information or the consolidated data about robot projects. The interpretation of the documents considered the nature of the documents as personal or official, analyzing who was the producer of the document and what was the context of its production as suggested by Byrman & Bell (2003). Also, it was sometimes difficult to gain access to specific documentation, which is main drawback of using documents to collect data (Bryman & Bell, 2003).

The main information gathered for the understanding of the external aspects as research sub purpose, RSP 1, was based on secondary sources but also supported with some of the inputs from the interviews. The secondary sources used were supplier's web sites, industry organization web sites, advertisement and brochures from suppliers among others. From the interviews conducted with people from Swisslog WDS, the information about suppliers was based on their perceptions about the market rather than actual facts. However, some of the interviewees contributed with valuable and reliable information about the robot market due to their previous experience in the robotic automation industry.

Finally, once the alternatives were developed, the data collection activity change to some extent. The previous information from suppliers from secondary sources was complemented by conducting face to face interviews and telephonic interviews with the critical suppliers identified as important for the three alternatives to be assessed. Moreover, a second round of internal interviews was conducted with internal personnel in order to gain their views on the implications of the different alternatives.

3.4 Interview Process

The design of the interviews was based on a semi structured approach. Since the research strategy was qualitative, using semi structured interviews as primary research method provides several advantages (Bryman & Bell, 2003). Firstly, the topic of the research had a clear focus. Second, since one of the main purposes of the internal situation were to gather information about the specific projects developed in WDS, defining a set of main subjects is useful to guide interviews to recall the specific events in the past and relate them to the main subjects. Finally, since the empirical work was conducted by more than one person, it is important to provide some structure to interviews in order to avoid comparability problems due to different interview styles.

A questionnaire serving as a guideline for the interviews was prepared but it was subject to refinements once each and every interview was conducted. It can be argued that as the research process was moving in time and sub purposes achieved, the level of structure in the interviews was increasing but remained within the boundaries of semi structured interviews. The main reason for

this situation is that as far as the number of alternatives was derived, the topics for the interviews were more directly related to the specific points concerning to the alternatives. The main questions for the interviews can be found in more detail in Appendix A

For preparing and conducting the interviews several aspects were taken into consideration as suggested by Byrman & Bell (2003). First, the interviews were conducted in a quiet private environment to avoid concerns of the interviewee of being overheard. Second, there was a conscious preparation from the interviewers in order to adjust as far as possible within the criteria of a successful interviewer. Being knowledgeable about the subject, framing the interview into a strategic purpose, having clarity in the questions were main aspects during the interviews. Moreover, the interviews were conducted in a gentle, open and sensitive environment, being critical and interpreting the interviewees' responses. Finally, the interviews were attempted to be conducted neutrally in order to avoid any intrusions of interviewer's opinion.

As already mentioned, using interviews within the context of a qualitative research is likely to be the most used method. However, researchers have to be as clear as possible on motivation behind the selection of people to be interviewed since, as identified by Bryman & Bell (2003), this aspect is closely related to the lack of transparency that can be found on qualitative research. Moreover, it will impact the understanding of the analysis made and the process to arrive to conclusions in the study.

In this respect, the definition of the people to be interviewed can be divided into three different categories. First, it was about understanding the current situation for the purchasing organization in relation to the robot projects currently being developed as well as gaining the regional perspectives from the purchasing point of view. In this category, most of the members of purchasing organization worldwide were selected for the interview process. This category was of key importance for the project since it will provide the basis for the definition of the current purchasing situation. One questionnaire was prepared for the interviews with the project purchaser and for the interview with the head of the purchasing organization a different set of questions was prepared. The total of eight interviews conducted is detailed in Table I and these were on its majority conducted via phone.

Table I: Interviews in the purchasing organization

Role	Region
Project Purchaser	North America
Project Purchaser	Europe Central
Project Purchaser	Europe Central
Project Purchaser	Europe Central
Project Purchaser	Europe North-South
Project Purchaser	Asia pacific
Project Purchaser	Asia pacific
Head of Purchasing	Worldwide

The second category relates to people from different organizational units within Swisslog WDS which are shown in Table II below. The purpose of these interviews was to provide the knowledge functional areas, organizational aspects, the working processes, the business strategy, and unveil the complexities of the robot systems. Additionally, in contrast with the previous category, the definition

of the people to be interviewed was not set from the beginning of the project. But, rather during the initial interviews some key generic areas were identified as relevant for the project: sales and design, project management and software realization. As interviews were conducted, more clear definition of the people to be interviewed was made as the project progressed. For each different profile within the organization, a separate interview questionnaire was prepared in order to be aligned with their involvement in the different project phases and their role within the organization. For this category, most of the interviews were conducted within the Nordic region in order to have face to face interaction.

Table II: Interviews in other organizational units

Role	Functional Area
Sales Manager	Sales and design
System Design	Sales and design
Project manager	Project Management
Project manager	Project Management
Head of realization	Project Management
Control Realization	Software and Control
Project Manager Software	Software and Control
Software Manager	Software and Control
Software Support Manager	Customer Service
Service manager SE	Customer Service
Head of region	Top Management
Innovation Manager	Technology Center

Finally, Table III shows the interviews conducted for the last category concerning the primary information from the market. The selection of the sample in this case was limited by the interaction the company has with current suppliers and by geographical aspects. As mentioned earlier, interviews for understanding the external situation in relation to suppliers were used once the alternatives were more delimited, mostly during the assessment of the developed alternatives. In this case, meetings with three different robot/OEM suppliers and one integrator were conducted both face to face and by phone.

Table III: Interviews with suppliers

Role	Type of supplier
Supplier 1	Robot/OEM supplier
Supplier 2	Robot/OEM supplier
Supplier 3	Robot/OEM supplier
Supplier 4	Integrator

3.5 Quality of the Results

The validity and reliability of the results from qualitative research has been a subject of discussion among authors, with some proposing adaptations from the parameters used to assess the quality of the results in quantitative research. However, Bryman (2003) propose alternative criteria specifically

applied to qualitative research. In this sense, the suggested criterion is trustworthiness, which in turns consists of credibility, transferability, dependability and conformability.

The credibility of the results presented was a main concern for the research. Credibility means the quality of being trustworthy or believable. For this reason, during the thesis work there were some instances of respondent validation; interim findings were presented to the Material Group Manager as well as to some of the interviewees in order to validate the results which as suggested by Bryman & Bell (2003) can add to the credibility of the results. Additionally, the interviews were designed in order to gain perspective from different organizational functions to avoid biased views and subjective interpretations. This design permitted to have triangulation of the results by contrasting different views about the same issue, being able to draw conclusions with more credibility. Finally, triangulation of the results was also done with theory and internal documentation as secondary data.

Transferability was also an important factor regarding the quality of the results. Since transferability refers the context where the outcome of the research can be used, it was important for the research to gain the worldwide perspective across the organization to contribute to the transferability of the results among Swisslog's regions. For this purpose, the information about the projects across regions was complemented with interviews with each one of the regions in order to understand their specificity and make the results transferable. From another perspective, the transferability of the results to contexts outside Swisslog organization were not a main concern of the project, the reason why the results from the thesis should be looked carefully when being applied to other organizational contexts. However, some aspects from the theoretical framework can still hold valid to in some strategic sourcing context. For example, the inclusion of the maturity of the organization and the analysis of the business characteristics as individual blocks in the strategic sourcing process can be relevant for other researchers

For assuring the dependability of the results, Bryman & Bell (2003) suggest the requirement of having a complete track of all phases of the research process. Since dependability, which is a quality of being dependable or reliable, would be ensured with this process. However, they also recognize the difficulties in doing so since qualitative research can involve a large amount of data, demanding a lot of work and effort. Nevertheless, during the research process, besides the proper documentation of every interview and findings from the analysis of documentation, the outcomes of the discussions of the research with the respective dates was saved on independent files in order to have track of the analysis. This contributed immensely to the traceability of results.

Finally, conformability is about not allowing personal values or theoretical inclinations to influence the research and its results (Bryman & Bell, 2003). The methodology used to track the analytical discussion for the dependability of the results did also contribute to the conformability of the same since, as suggested by Bryman & Bell (2003), this can be used in order to audit the findings and identify possible subjectivity from the researchers.

4. UNDERSTANDING THE EXISTING SITUATION

Following the structure of the research sub purpose 1, a clear picture of the WDS existing situation will be described. The first part will concern about the internal situation considering the nature of WDS business and the characteristics of robot projects, organizational aspects and the current purchasing practices. The second part will then take upon the different external aspects and describing the variety present in supplier market for robotic applications and its characteristics.

4.1 Internal

This section will explore different internal aspects that have emerged from the theoretical framework to be relevant for the development of the sourcing strategy. The business nature and the business environment will be the focus of the first part and later on describe the different activities and resources required for robot systems and the implications for the project development. The different organizational features of the company and the purchasing organization will be explained. Moreover, the purchasing process will be described in consideration to the different phases involved in a project and generalization of a typical temporary network formed in project will be exemplified. Finally, analytical description of the current purchasing practices across regions will be made.

4.1.1 WDS Business as a provider of integrated logistics solutions

During the last years, the warehouse distribution service, WDS division has gone through a series of strategic changes. In this respect, it has expanded its services and solutions portfolio by becoming a producer of different automated subsystems such as pallet cranes and pallet conveyor. This section will explain the features of these changes as part of the company's business strategy in the context of the role of Swisslog as integrator.

To deliver an automated/manual warehouse Swisslog starts with consultancy work and the design of the solutions including the layout of the warehouse and the logistics features of the offering to the customers Furthermore, Swisslog can be also responsible for the civil engineering work and the implementation of the project as it's shown on the top layer of Figure 4-1. For fulfilling the logistics functions required by the customer, it is needed to define a number of subsystems and integrate them into a fully operational solution with the use of their Software Suite Warehouse Manager and controls. The different subsystems inside the solution are the cranes, conveyors, robots, AGV and so forth that can be supplied by Swisslog as part of their material handling products or through the use of external suppliers.

The strategic changes mentioned, has affected mostly the material handling products. As it was introduced earlier and as shown in Figure 4-1, now Swisslog is also acting as a producer of some of these subsystems, increasing their value addition into the development of a project. The access to these key products has been structured following different strategies. Some of them are being manufactured entirely by Swisslog. For others, the company has developed joint ventures including share capital or developed partnerships to become exclusive distributor for some projects. The effects of this strategy have also been translated to the IT Hardware/Software & Controls. Since Swisslog is more involved in the production of the subsystems, it is also expanding the scope of the PLC controls required for the conveyors and cranes for example. The robot systems have not been considered into these strategies and are included as an additional subsystem. But, due to the changing business environment, it is also possible to consider such an alternative as a feasible

possibility to strengthen the competitive position of the Swisslog both in terms of being more involved in the production of robot hardware as well as the PLC control related activities.

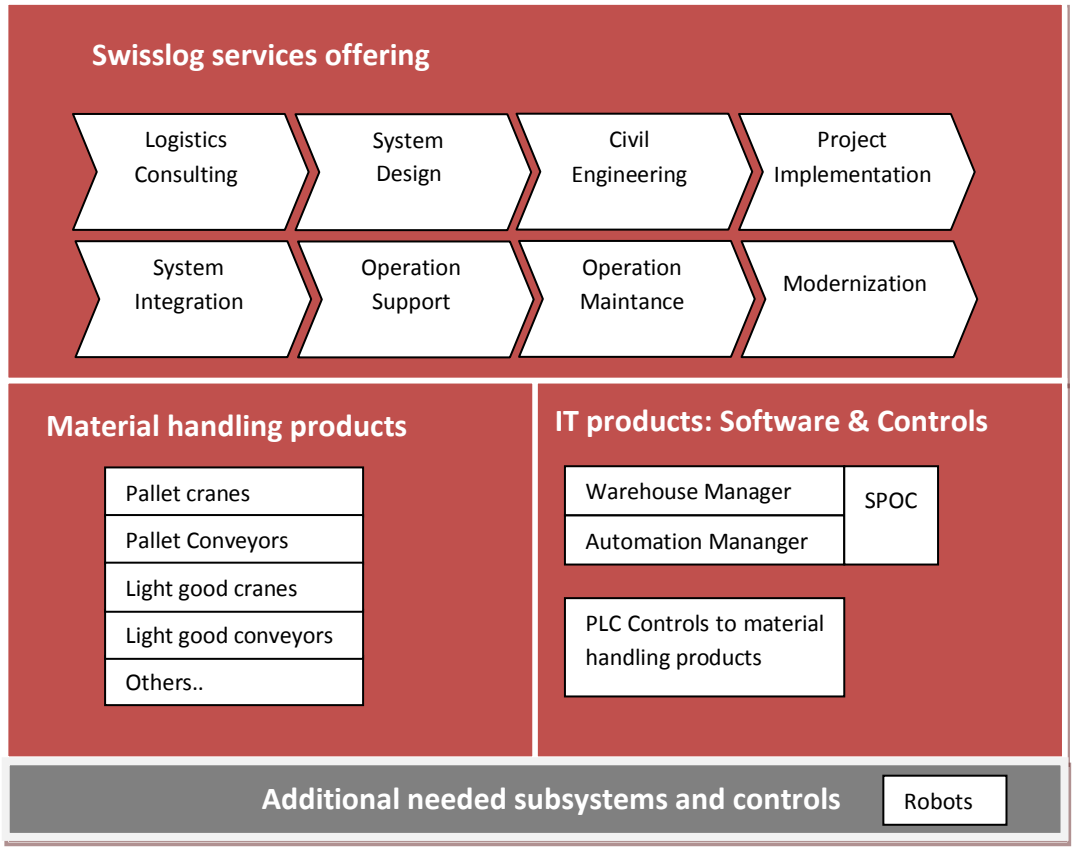

Figure 4-1: Swisslog's offering to customers

One of the main drivers for this strategy was the ever increasing competition faced from the hardware suppliers in the market. The hardware suppliers who have become logistics system integrators, engaging with customers and delivering integrated solutions, not solely hardware. This issue has also been considered for the purpose of the sourcing strategy.

Nevertheless, the role of Swisslog within the activities shown in the top layer of Figure 4-1 has not changed since these have been the core business of the company historically. From this perspective, it is important to understand the scope of Swisslog activities from as a system integrator and the interaction between the different subsystems. In general the structure of a project is defined by three different levels of action that Swisslog must manage and deliver.

The below Figure 4-2 describes a generic architecture in a project for the communication between software and the different subsystems. The level 1 defines the subsystems that are required in order to comply with the customer logistics requirements. The specification of the subsystem will depend on several factors such as the load unit, the logistics flow, expected performance, working conditions and also the budget of the customer.

In this level, projects do not always require the utilization of automated subsystems. But rather, both manual and automated operations can be included in a given project. The subsystems included in the solution will depend therefore on the specific characteristics of every project. It is Swisslog's responsibility to use their knowhow and understand the logistics requirements of their customers,

defining the different sub systems' requirements for the logistic solution and coordinate the internal and external suppliers who will be used in order to accomplish the project.

Once the subsystems needed are specified, it is required to synchronize them and make them "talk" between each other in order to perform their automated functions. For this purpose Swisslog uses the Automation Manager (AM), software that coordinates the activities between the different automated subsystems. Additionally, the automated subsystems are also linked to the Visualization Manager. The AM is responsible for assigning the different transport orders to the different subsystems and control their undertaking. As can be seen in Figure 4-2, the communication between the subsystems is managed mostly through the AM, implying that there is seldom direct communication between the subsystems. There exists a process of communication protocol, called the Swisslog Interface Standard (SIS) and is defined by Swisslog to the different external suppliers used in a project. However, there are cases where the system architecture is built with direct communication between the subsystems as is shown by the red line in the figure above and the manual subsystems do not communicate with the AM. This last aspect holds true for the robot systems and will be detailed in section 4.1.2

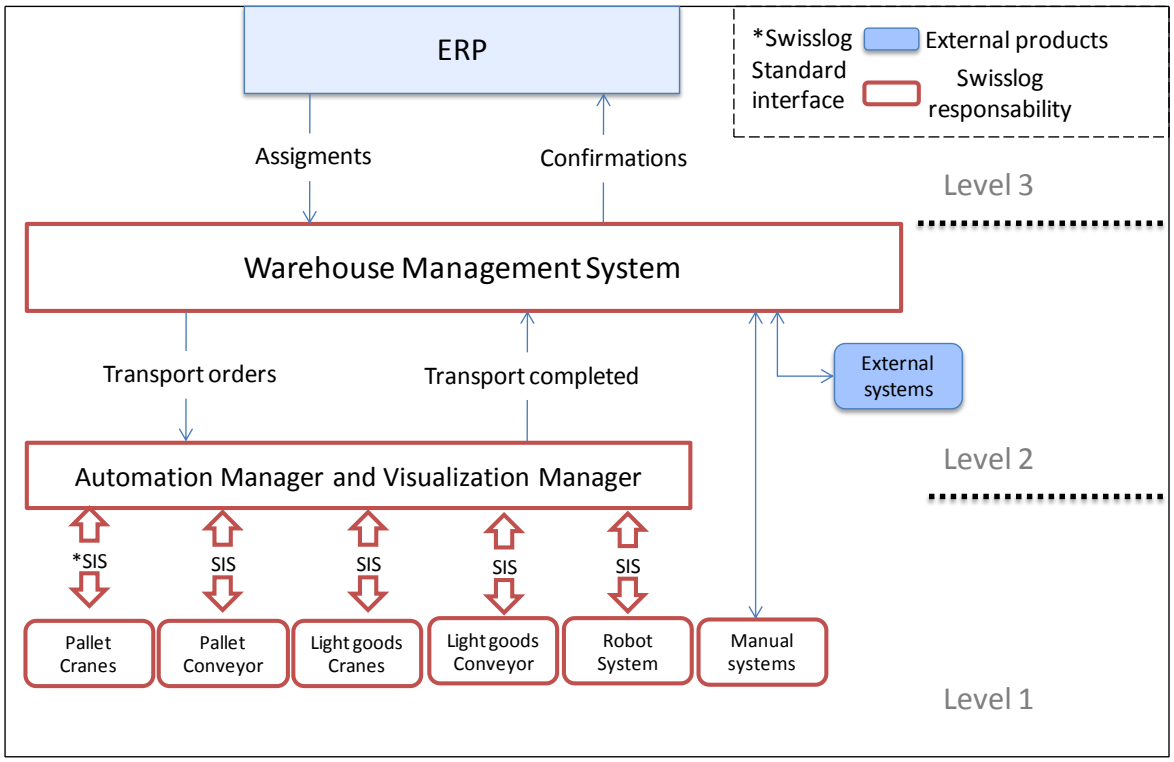

Figure 4-2: Generic system architecture for a project.

The Warehouse Management System (WMS) is the link between the AM and manual subsystems and the ERP of the company. This system receives assignments from the ERP and divide it accordingly into different transport orders that would be sent to the AM and the manual systems. In this level, there can also be cases where the WM is required to communicate with external systems as part of the integration responsibilities. Swisslog is then also responsible for the proper communication between their WMS and the external ERP which constitutes the level 3.

As can be seen in Figure 4-2, the scope of supply varies on project basis and can vary extensively based on the customer requirements. The type of subsystems that will be included in a given project cannot be defined as a standard solution since it will vary with respect to the customer's needs. These requirements are not only related to the logistics functionality and design but also to the software specifications, implying that subsystems-software integration scenarios will vary accordingly. For example, considering the level two in Figure 4-2, even though Swisslog Warehouse Management Systems (WMS) is well recognized in the market, it is not used in every project due to customer specific requirements. The company has the capabilities to be flexible for these scenarios and manag the project accordingly. This variation in the customer requirements reflects the need for the sourcing strategy to consider the mix of products as one main aspect behind the analysis of possible alternatives

4.1.2 The Robot Subsystem: Activities and Resources

The previous section introduced the nature of the business in which Swisslog is involved as Logistic integrators. In this section a typical example of the application of the robots subsystems which are the main concern on this thesis will be briefly described. The main purpose is to identify the different resources and activities required for the production of the robot system in the context of the project in order to unveil the interfaces and dependencies among them. Furthermore, the requirements for the Customer Support phase of the robot system will be explained.

As mentioned, Swisslog is an integrator of several subsystems in order to provide a complete "integrated" solution to the customer. The focus of the thesis is one of the subsystems being bought by Swisslog from various other suppliers in several different ways. This subsystem is called the "Robot system". As a typical example Figure 4-3 shows the various parts of this system. One of its applications is as palletizing cell, where the robotic arm arranges several layers of crates over a pallet.

Once the entire logistic solution is decided by Swisslog, the specifications for the robot subsystem are decided accordingly and an OEM supplier/integrator chosen. For Swisslog, this entire subsystem is a black box and expects the integrator to supply a subsystem with the functionality and performance required by the overall solution. A typical scope of supply for the integrators for the projects includes the following:

- Construction of the robotic cell
- Selection of the robots and purchase
- EoAT- End of Arm Tooling, design and integration with robot
- Robot Programming
- PLC[1] programming
- Vision system (based on the application)
- Site installation, testing and commissioning

[1] Programmable logic controller

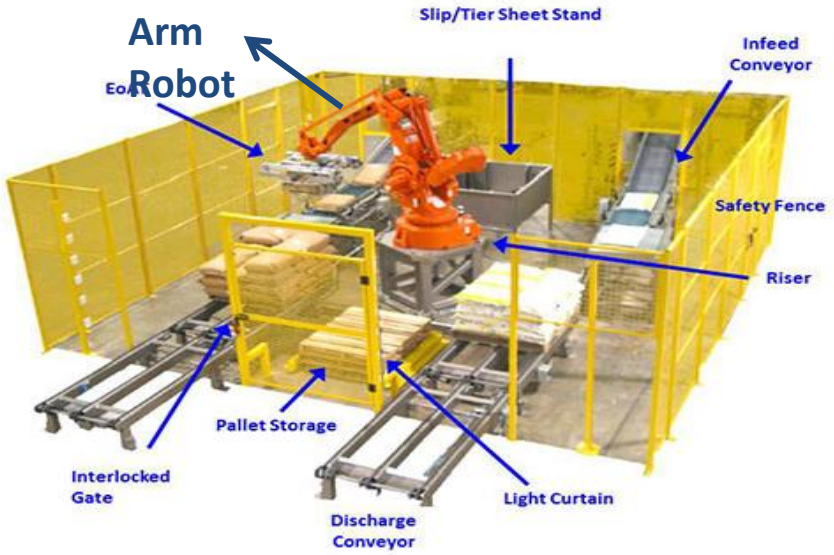

Figure 4-3: Display of palletizing cell

Considering the above, information from various interviews across regions has unanimously indicated the complexity and importance of the EoAT. The robot itself can be bought from various different OEM suppliers, but the EoAT is mostly customized and has to be designed according to the project. It is the EoAT which is the most complex and critical part of the system that differentiates the solution offered to the customer. The design and movement of the tooling have an effect on the cycle time which as mentioned is an important parameter. The design of the EoAT varies to a large extent from being carried out by integrators themselves or outsourced to another supplier who is specialized in tooling design. Considering the interdependency or resources, the tool specifications, for example the weight of the tool, EoAT needs to be considered for the selection of the robot. It needs to be ensured that the robot together with the tool performs the desired function. But currently Swisslog has no knowledge of the tool design what so ever and is dependent on the integrators in this respect.

The robot programming is an activity where different algorithms are used to define the movements of the robots and is done by the integrators. There are different methods to program the robot. The algorithms can be typed directly on using a given programming language. The programming language is different for each robot brand but still the logic behind it is similar. Additionally, other methods can be used, as offline programming where the robot is modeled virtually and movements defined, or lead by nose, where the movements are defined by guiding the robot manually to the different positions and recording the sequences. The robot programming is done on the robot system itself using the robot controller which defines the language to be used.

Another activity which is mainly done by the integrators is the PLC programming. The PLC device serves as link between orders given by the Warehouse Management System (WMS) software and the robot subsystem. The programming will depend on the type of PLC used but in most cases, this has been standardized for most projects. In all the projects this activity has been carried out by the integrators or the robot suppliers itself depending on the region and the supplier. This activity requires great amount of interaction with the software team in Swisslog in order to adhere to the Swisslog Interface Standards (SIS) and make sure each and every system is adapted to each other. It

has been seen in most projects that the interface with various systems are the challenging part with several issues observed during the project implementation phase.

The level of interdependencies between the different subsystems on the PLC programming activity will depend on the architecture for the PLC controls. Although the PLC programming is generally done individually for every subsystem as in case a) in Figure 4-4 , there have been cases where the same PLC is used to control both robot subsystem and the PLC conveyor as shown in case b). This has been due to the fact, that controls for conveyors and the robots was done by the same supplier. The implications of using case b) as PLC architecture is that there is no direct SIS individual communication between the robot subsystem and the Automation Manager, affecting the potential control of what is happening inside the robot system as well as the visualization in the visualization manager.

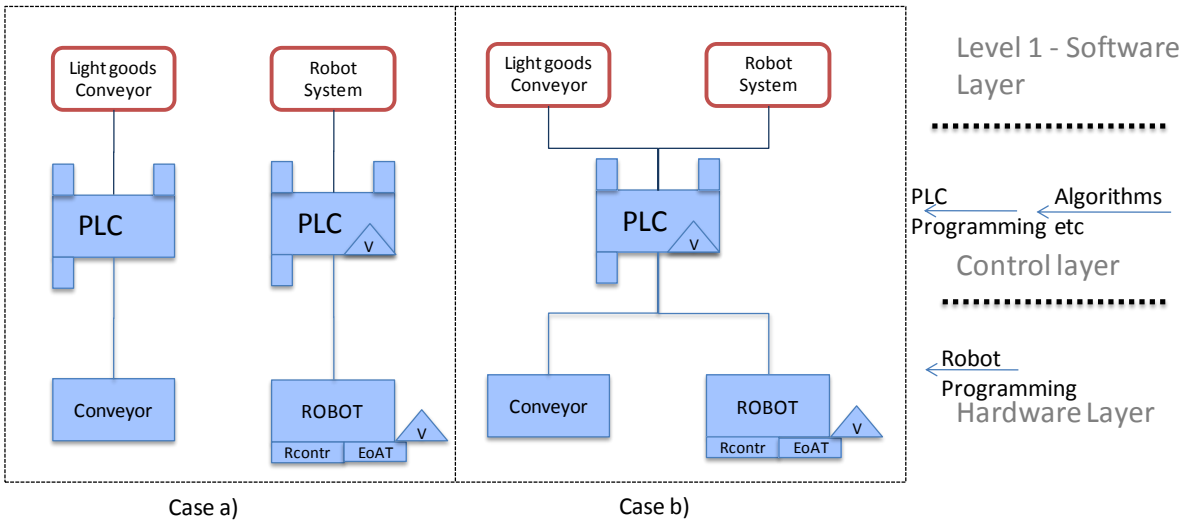

Figure 4-4: PLC Control scenarios for the robot system

The vision systems are additional peripherals used as part of the robot system dependent on the requirements for the applications. These can be used to guide the movements of the robots in real time or to recognize different characteristics of the environment and provide the robot system with such information. The logic and programs required to integrate vision devices to the robot system can be made either at the PLC level or directly on the robot controller and will be dependent on the requirements of the application. There are seldom any projects using vision systems, but it is seen as a potential business opportunity for Swisslog, if the appropriate applications are developed.

The onsite commissioning, installation and testing requires the need for great amount of work on the site. This calls for the need to have integrators with local presence in order to avoid the various travel costs from having integrators on the site from other regions. This activity is best performed by the integrators with local presence and Swisslog is dependent on them in this respect. Even on the site, based on the project organization, a site leader from Swisslog oversees the testing, commissioning and various other aspects, by closely monitoring the situation and making sure all the standards and norms are adhered to by the integrators.

As part of the testing protocols, there are in place different tests performed during the project realization. The tests address both the mechanical functionality of the subsystems as well as the controls and integration among them. For this purpose, the integrators are required to perform tests

on the robot system before the delivery on site in order asses the functionality of the subsystems to make the appropriate adjustments before entering to the installation and commissioning phase. Once the robot system is installed on site, another testing procedure takes place with the involvement of the integrators in order to access the communication and functionality of the subsystem. After the requirements of testing procedures are fulfilled, the subsystem is tested as part of the entire integrated system, requiring less or no involvement from integrators.

Considering the entire robot system, it is the value addition and critical part of the entire solution offered to the end customer by Swisslog. Apart from adding value, the uniqueness of the solution itself differentiates the project. Since the robot subsystem is only one of the sub systems of the entire solution, it is very important to ensure the proper functioning and reliability of the system. The connection and interdependencies to the other subsystem will be dependent on the application for what the robot is used for. For some applications, the robots are only handling empty pallets therefore; the interrelation to the other subsystems is limited to those managing pallets. In the more common applications, the robots are part of the Light Goods modules which are those managing smaller unit loads such as cases or boxes. For this reason, the independencies between the light good conveyors and robot system needs will increase and needs to be managed. For example, during the specification requirements sent to suppliers for the robot systems, there are specifications about the tolerances of the light good conveyors when delivering the unit loads to the robot systems. Therefore, in addition to the internal performance parameters such as the cycle time[2], the design of the robot system must take into account these deviations of interaction between light good conveyors and robot systems.

When it comes to after sales support, customer support aspects, the integrators are required to give a list of critical spare parts that have to be made available in order to prevent the shutdown of the system. Depending on the project, there are agreements with regard to spare parts directly between Swisslog and the robot supplier or in some cases through the integrators. Integrators are completely responsible for the EoAT, maintenance and proper functioning of the system. In some cases Swisslog emphasizes the need to have a spare EoAT made readily available in order to prevent downtime. Integrator is also responsible to provide training, preventive maintenance schedules, training documents, service manuals etc to name a few.

Swisslog with round the clock customer care is the single point contact for the customers. The customers call Swisslog customer care support, who in turn determine the nature of the problem and try to fix the minor problems themselves, which is mainly limited to software issues. In case of complex problems, Swisslog gets in touch with the corresponding supplier responsible for the system. Swisslog in the Nordic region has a spare part warehouse which stores the required spare parts and offers customer support round the clock, based on the nature of the support agreement signed with the end customer. It has been observed from various projects that there is seldom any problem with the robot hardware as such and main issues are the interface and software aspects.

[2] The cycle time indicates the time taken to perform an activity

4.1.3 WDS organization: Regional and central business units

The purpose of this section is to describe the overall organization of the Warehouse & Distribution division (WDS) as well as the characteristics of its different units. First, the organization will be contextualized to its global presence and recent organizational changes. Further on, the WDS organization will be introduced including the technology center and the regional organizations

The WDS Division is constituted by which four different types of organizations/units as seen in Figure 4-5. First, the corporate units are managed centrally directly by headquarters e.g. human resources and administration & finance. Second, the technology center has become an important function within the organization which previously was based in regional business units. Third, there are regional business units, which are responsible for the development of the business and project development. Finally, marketing, process & quality, information systems and strategic purchasing serve as horizontal functions supporting the regional operations as well as the technology center. The creation of the Strategic Purchasing function was an outcome of recent organizational changes, in order to support the regional operations. It is with the inclusion of the Strategic Purchasing organization that the development of worldwide strategy for the Material Group Robots emerged as a priority to support not only the different process taking place regionally, but also to provide inputs to the technology center processes when applicable. Besides, the strategic purchasing organization, which will be explained in more detail in section 4.1.4, it is important to elaborate more in to the details of the technology center function as well as the regional units, since they are of utmost importance for the robot system strategy.

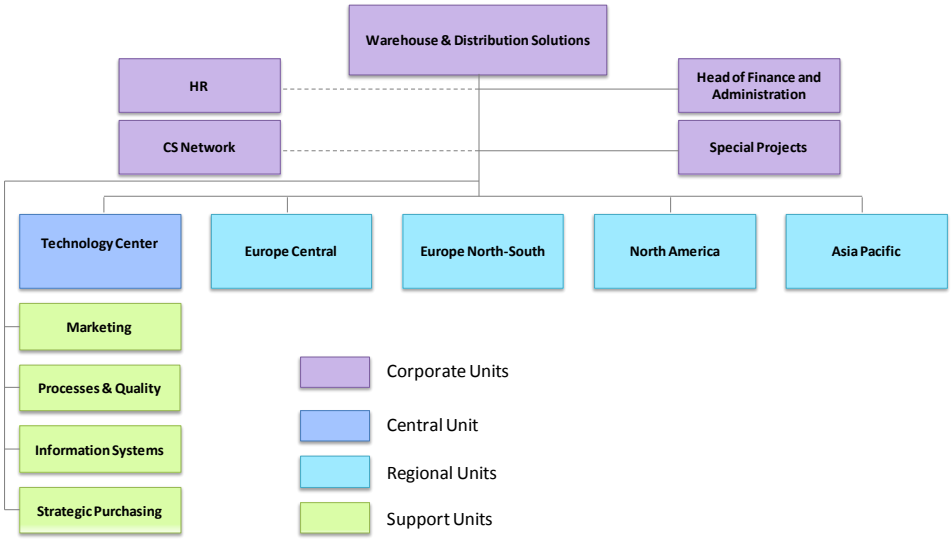

Figure 4-5: Swisslog's WDS organizational structure

The technology center (TC) is responsible for the development and production of Swisslog's own product portfolio and solutions. For this purpose, as can be seen in Figure 4-6, it is divided into the pallet technology center which produces the pallet cranes and pallet conveyors at its locations in Boxholm (Sweden) and Kunshang (China) respectively. The Light Goods Technology center drives the development of solutions for light goods material handling systems and at the same time produces the miniload cranes on Sipbachzell (Austria). Finally, the technology center is also in charge for management of the software and control solutions. It is important to remark that the Innovation

Management is part of the technology center, because besides its production management purposes, the TC is also expected to drive innovation in alignment with the business.

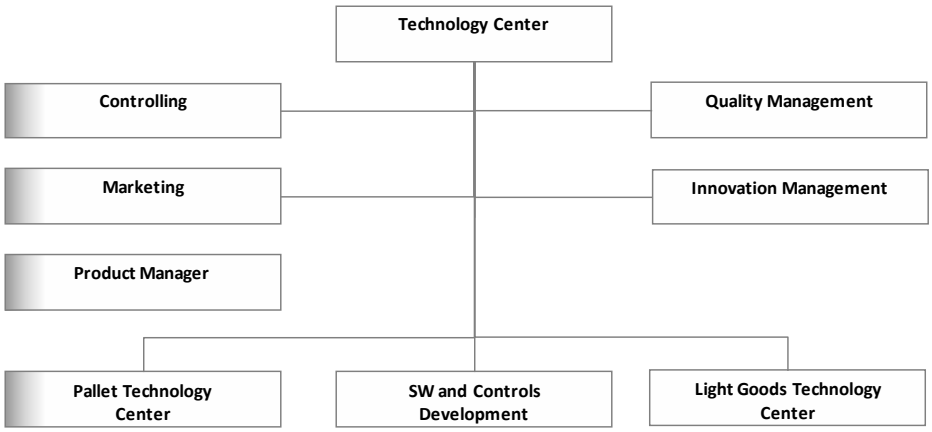

Figure 4-6: Technology center organization

The role of the Technology Center with regard to robot systems has two main dimensions. First, the SW (SoftWare) and Controls Development center is the organization responsible for the strategy of control systems. This is especially important with consideration to the possibilities of Swisslog doing the PLC control internally since this decision must be encompassed and aligned with the central approach to controls for the different subsystems. Although the PLC programming implementation for individual projects is still done on regional basis and their capabilities for control implementation varies from region to region, it is the SW and Controls Development who should deploy the resources required from the central organization in order to achieve a worldwide implementation of the strategy. Second, the Innovation Management center is responsible for developing new industry solutions to satisfy the market segments where Swisslog is operating. For the design and implementation of these solutions, there exists several Innovation Management process aimed towards the creation of solutions with market potential. As an outcome, the different ideas generated can be a combination of different subsystems from Swisslog's own product portfolio e.g Light Goods cranes, Pallet Conveyor. However, the solutions being developed can also put requirements on the robot systems which are being acquired from external suppliers. Therefore, the sourcing strategy must be able to support these innovation processes by taking leverage of the resources from the supplier base required for the new product developments.

The organization used by the different regions follows a process structure in alignment with the different project development phases: Sales & Consulting, Project Realization and Customer Support as seen in Figure 4-7. In each of these functions, the regions must possess the capabilities to satisfy the requirements demanded by the specific conditions of their markets. However, there exist different communication and information sharing channels to collaborate and support themselves on the core process.

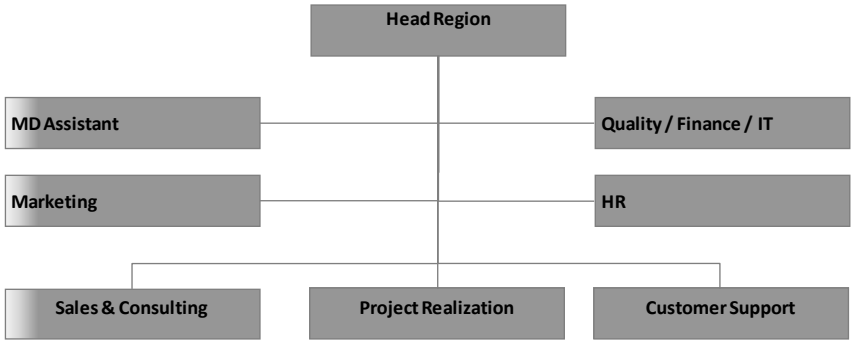

Figure 4-7: Generic regional organization

Moreover, although WDS develops a business strategy on central basis, this process is built based on the inputs from different regions and tries to create competitive advantage for Swisslog with these considerations in mind. Although the business strategy is created, the regional management is able to make the required adjustments and changes in order to adapt the central business strategy to the specifics on every market and in accordance to the current situation of every regional business unit. This situation emphasizes the fact that the sourcing strategy should provide the support for these regional specificities while considering the central business strategy. For this purpose, the understanding of the purchasing organization and how does it fit within responsibilities of the regional business units as part of the project development process systems will be further explained in the following two sections.

4.1.4 The purchasing organization and its role in the organization

It is important to understand the existing purchasing process of Swisslog before developing a strategy. As mentioned earlier, Swisslog can be termed as a project based organization, where key stakeholders are identified and a project organization created. This "project organization", of temporary nature, is responsible to deliver the final solution to the customer. To understand the current situation, a brief description of the global purchasing organization is taken as a starting point, followed by the purchasing process followed and brief about the project organization and the stakeholders involved.

The below Figure 4-8 shows the global purchasing organization which is quite new for Swisslog, having a mix of professional purchasers and part time purchasers. Part time purchasers have other responsibilities like engineering, project management etc. The purchasing organization is now formally established within the overall WDS organization as support to the different core processes for project development. At same time, as mentioned in the previous section, it is also connected to activities taking place in the Technology Center both for production purposes as well as providing inputs for the innovation management processes.

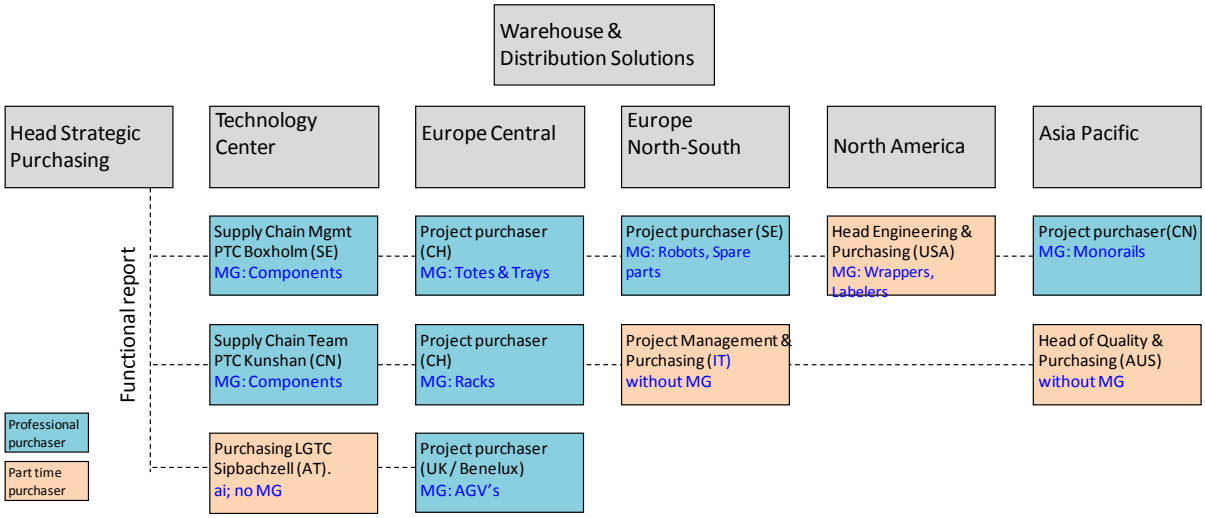

Figure 4-8: Swisslog Purchasing Organization

The purchasing head is part of the top management team of the WDS division, being active in the strategic management decisions. Based on this, he coordinates the activities of the regional Project Purchasers. As part of their responsibilities, the Project Purchasers interact with each other for various issues, varying from material group regional purchasing to taking the opinion of other regions. This will help to decide a global framework for the material group strategy based on the local situations as well. Regular meetings with the Head of Strategic Purchasing also takes place in order to decide the way forward for the department as well as strategies for various material groups in question. This situation shows that the purchasing organization is perceived as strategic and is actively involved in strategic management, with cross functional channels to increase its understanding about different strategic business aspects such as competition, technology and innovation processes on a global level.

The recent change in the organization has changed the purchasing structure where, each region has a project purchaser who is responsible for a particular material group (MG). The definition of the Material Groups was based on different factors, not only the yearly expenses. The robot as material group cannot be said to be at top when it comes to yearly cost, but it becomes of high importance considering the share of cost in the projects where robot systems are used as well as its contribution to the overall solution portfolio of the company. The role of the project purchaser includes the purchase of various materials required for the projects in the particular region and additionally has a global framework for his/her material group that other regions would follow. Details about the role of the project purchaser as part of the project development process are as shown in Figure 4-9.

As shown in the Figure 4-9 the purchasing department is associated with all the phases of the project as shown. Every project follows the above three phases; Sales, Project and Customer Support.

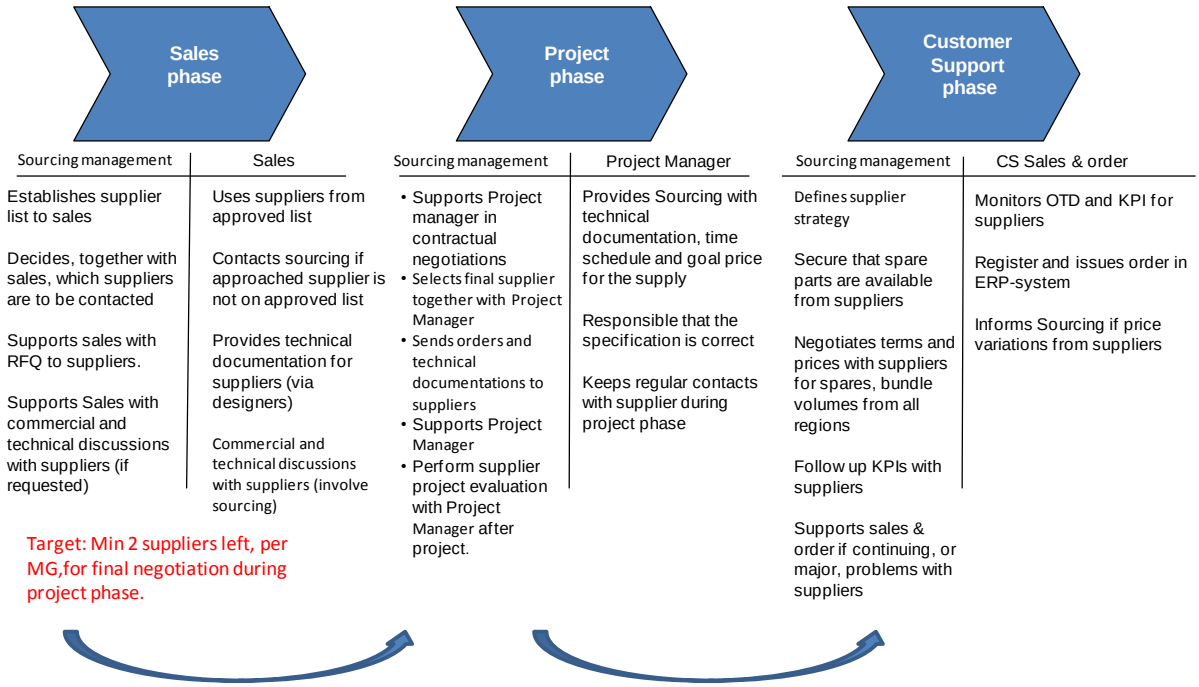

Figure 4-9: The role of the sourcing management on a project

Sales Phase: Here the sales is in charge of the getting the order from the customer by creating an initial design of the solution to the customers problem. During the sales phase the sales team would get in touch with the software and the design team in order to give an initial estimate of the project to the customer. Even the integrator would get associated at this phase in order to decide the final solution in order to avoid conflicts at a later stage. In this phase, the technical details and specifications of the project are not covered in a very detailed manner. Since majority of the projects are engineering driven, the purchaser follows the needs of the engineering department with the need for a new supplier if the project demands.

The role of the project purchaser is to have a consolidated list of “ideal suppliers” given to the sales team based on the specific requirements given by the sales. These suppliers can be chosen based on the past interaction with Swisslog or due to project know how and capabilities. The main idea is to have the RFQ (Request for Quotation) sent to these suppliers in order to decide the way forward for the project. Since detailed specifications of the project are not done in this phase, it is important to have few possible supplier choices during this phase and not select them straight away. The sourcing strategy must therefore, consider the flexibility to switch supplier in case of increased cost or supplier not able to adhere to project specifics at a later stage, reflecting on the dependency from suppliers and an appropriate structure of the supplier base. The Project Purchaser then takes over the commercial and administration activities of the project to decide the potential suppliers for the project together with the sales team.

Project Phase: Once the initial groundwork for the project is done and the order obtained from the customer, the project is handed over to the project realization team. This team would take from where the sales has left, going in to the specification and technical details of the project. Every project would have a Project manager who would be the contact person between Swisslog and the customer. A project organization is formed where people from various departments including the integrators are involved to ensure the delivery of solution to the customer.

The Project Purchaser together with the project manager take a final decision based on various parameters in order to select the supplier. Cost and quality being the key parameters, decision is not based on low cost or low quote by a particular supplier, but a larger dimension is taken in to consideration. Once the supplier is decided, the final specification and document of order is sent to the supplier with consideration to terms and conditions for the project. Once the project is completed, supplier evaluation is carried out in collaboration with the project manager in order to evaluate the progress and work of the supplier, which would be beneficial for the future projects. Hence, the sourcing strategy should consider the requirements for project realization such as cost and quality and how they can be affect by the local or global interactions needed for this phase.

Customer Support: After the project is realized and implemented, it moves to the customer support phase, where support to various systems in the project is given to the customer through Swisslog. It is Swisslog which remains the first point of contact to the customer. Depending on the nature of the problem and the system involved, Swisslog in turn gets in touch with the integrator/supplier. Customer support phase is related to both hardware and software support and it represents a profitable business for the company.

The Project Purchaser plays an important role by ensuring the availability of the spare parts for various resources used in the project as well as software support. Depending on the product, the support may not be directly provided by the integrator, but rather a sub supplier. Increased negotiations are required depending on the volume of spare parts purchase, delivery time and the cost of having inventory. He would be the contact for various issues that would arise during the projects which are supplier related, and ensure continuous support during this phase. Hence, it becomes important for the sourcing strategy to ensure that costs are under control and provide flexibility and reliability for the delivery of spare parts and software support.

4.1.5 Project Organization: the temporary network

A typical project organization is shown in Figure 4-10. Here the various stakeholders required based on the resources involved for the project, right from internal customers to external suppliers are all considered to ensure smooth coordination and communication during the project phase to meet the deadlines and customer demands.

As seen from Figure 4-10 below, the end customer is the head of the project, with single point contact with Swisslog project leader and other people from the end customer organization itself. The various suppliers are only in contact with the project team from Swisslog and do not have any contact with the end customer directly. This so called project organization is a temporary organization which involves both internal stakeholders (Swisslog-sales, software, project design) and external stakeholder; various suppliers who in turn have a nominate project leader for the coordination activity. Since for a given project there would be requirement from other departments such as sales, software (WM and AM), customer support people who take care of after sales, project design personnel who look in to the details of the project and many others based on the need of the project. The presence of all these people is required who are part of Swisslog and interact with the particular supplier as and when required. For example, the software people would interact with supplier 2 with regard to Swisslog Interface Standards, SIS to ensure proper functionality of the entire system.

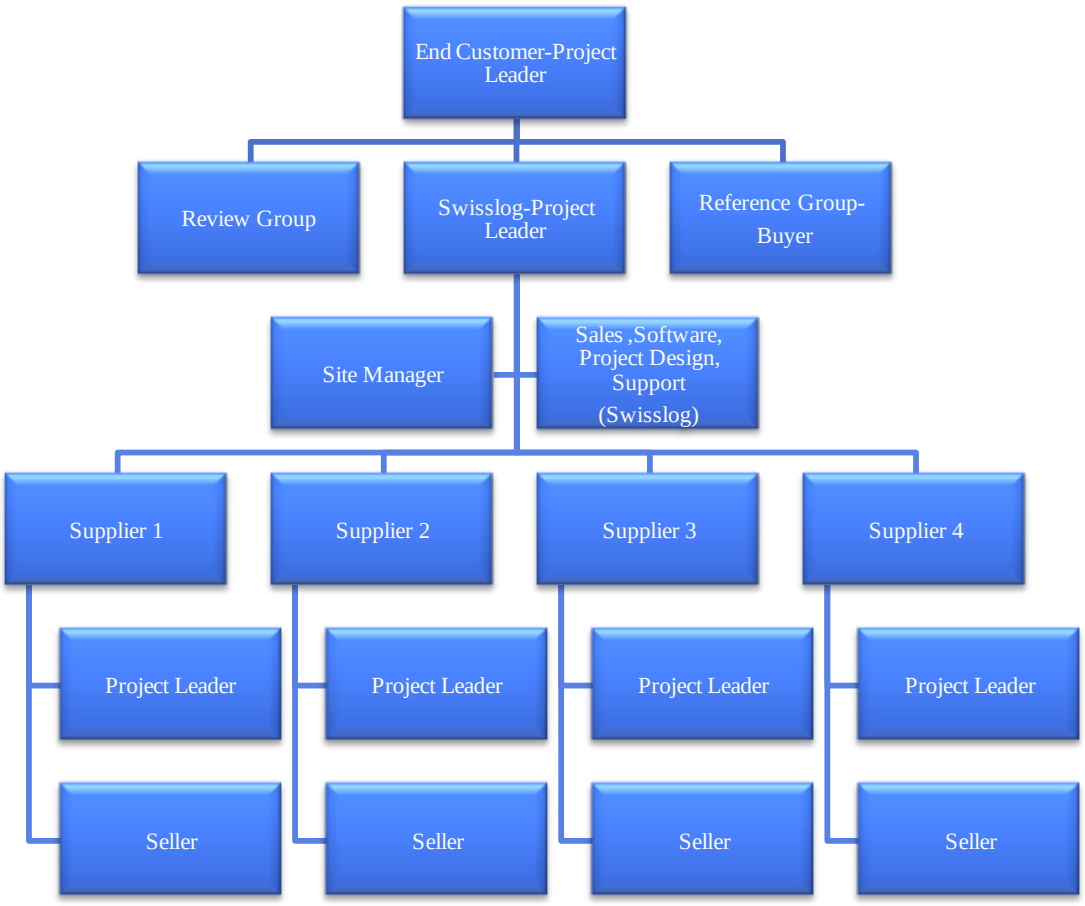

Figure 4-10: Project Organization Example

Following a timeline during the project development, the involvement of the different stakeholders from both Swisslog and the suppliers will also change. For example, during the sales phase, the Sales and Design team from Swisslog can be highly involved with the seller and designers from the robot suppliers since there is often the need to have close interaction in order to deliver the required functionality expected by the end customer. Since this involvement takes place before the project is assigned to Swisslog by the end customer, there can be cases when both supplier and Swisslog has to invest resources and share risk without having to secure the project, which produces a lock in effect between the customer and Swisslog on the temporary network. With the new purchasing organization and the increasing role from regional project purchasers they are expected to be also an active part of this temporary network even from the sales phase.

Once the project enters the realization phase, the stakeholders who are more active on the temporary network will change as well, with the project management team taking over from the sales team on Swisslog side, with a similar situation being for the robot supplier. For Swisslog the more important stakeholders during the realization phase are the project manager, detail engineering (controls and hardware) and also the software realization manager. From the supplier's side, it will depend on the scope of supply being provided and their organizational structure but there must be a responsible for the functions expected from the subsystem. However, this can be channeled though the supplier's project leader. This situation shows how the temporary network is dynamic for Swisslog industry and puts different requirements to consider for the sourcing strategy.

4.1.6 Current robot purchasing practices across regions

This section covers the purchasing behavior of Swisslog across various regions. Project information concerning the robots were collected across all regions in order to understand the various different applications of the robot system, robot brand or the robot supplier, integrator who performed the integration activity and the number of robots purchased in each project. Other parameters that were considered were the industry segment which the project was carried out as shown in the below figure. Various issues regarding the project that are not explicitly shown were taken in to account such as the complexity of the project, uniqueness and synergies among the projects.

Owing to the uniqueness of the projects, the supplier changes, hence the use of various different integrators and suppliers. The type of robot, arm robot, gantry robot also determines the selection of the supplier.

As shown from the Table IV, Swisslog worldwide has used six different robot suppliers or brands in order to deliver solutions to end customers. Seven different integrators were used in order to perform the integration activities including, commissioning, installation, testing and other component supplies based on the integrator and the project. It can also be seen that suppliers themselves have performed all the integration activities in few regions (US for example) and hence not requiring the need of integrators. Supplier 2 has been the widely preferred supplier across all regions both in terms of volume of robots purchased as well as the number of projects involved. Supplier 4 follows next with projects concerning the use of gantry robots. Supplier has been used by Swisslog since long time through the integrator 1.

Supplier 2 is the most preferred choice of supplier at least in the Nordic region, due to close relationship with the sales engineer from Swisslog and the sales engineer from Supplier 1. The relationship had developed since many years which helped Swisslog, since the sales engineer at supplier 1 knew the needs and preferences of Swisslog and offered appropriate solutions. This increased the value of the final solution to the end customer. Supplier 4 in this case had been owned by Swisslog previously and continues to purchase gantry robot according to the project needs. Hence, it can be seen that there is no uniform purchasing process followed between regions and various parameters determine the final choice of the supplier.

The purchasing process carried out follows the process mentioned in section The purchasing organization and its role in the organization4.1.4, where the tender process is followed with request for quotations being asked by different integrators or suppliers from the already assessed pool of suppliers. The final decision is taken based on both price and performance. However, there are exceptions when the project uniqueness requires the search for new suppliers. In this case various internal contacts have been used in order to select the required supplier and quotation sent followed by supplier assessment in order to take the final decision. At times, the end customer would decide the choice of supplier for robots in case the customer is purchasing other products from a supplier and existence of agreements. In such cases, Swisslog is forced to use the particular supplier who is the preferred choice of the end customer. The end customer is also possible to bear the increase in price in these cases. However, there is a strong preference towards the use of the same supplier for a new project owing to various benefits. With Swisslog having certain interface standards, SIS as mentioned in section 4.1.1, it becomes easier and time saving for both Swisslog and the supplier. The

supplier would have already learnt the Swisslog way of doing things and issues with various interface sorted out in the previous project that would help in the new project.

Table IV: Purchasing behavior for projects across regions

Sl No.	Customer	Industry Segment	Region	Type of Robot	Integrator	Robot Supplier	Application	#Robots
1	Customer 1	Retail	Nordic	Arm-Star Robot	Integrator 1	Supplier 1	Star robot	8
	Customer 1	Retail	Nordic	Gantry	Supplier 4	Supplier 4	Multi Pick	4
2	Customer 2	Retail	Nordic	Arm-Star Robot		Supplier 2	Star robot	4
3	Customer 3	Retail	DE - CH	Arm	Integrator 2	Supplier 2	Pallet Handling	1
4	Customer 4	Food FDC 1	US	Arm	Supplier 2	Supplier 2	Layer Picker-Receiving Cooler& Freezer Induction	2
5	Customer 5	Retail	DE- CH	Arm	Integrator 2	Supplier 2	Pallet Handling , Depalletizing	5
6	Customer 4	Food-FDC 2	US	Non Articulated; Arm	Supplier 2	Supplier 2	Layer Picker-Receiving Cooler& Freezer Induction	2
7	Customer 6	Food	Nordic	Arm-Star Robot	Integrator 1	Supplier 1	Star robot	4
8	Customer 7	Retail	DE - CH	Gantry	Integrator 3	Supplier 3	Depalletizing	3
9	Customer 8	Logistcs	Nordic	Arm-Star Robot	Integrator 1	Supplier 2	Star robot-Depalletizing, Order Picking (totes)	6
10	Customer 9	Food	DE - CH	Gantry	Integrator 4	Supplier 6	Depalletizing	2
11	Customer 10	Food	US	Gantry	Integrator 5	Supplier 6	Layer Picking	1
12	Customer 11	Food	Aus	Arm	Integrator 6	Supplier 5	Star Robot-one type tote handling	2
13	Customer 12	consumer	China	Multi axis	Integrator 7	Supplier 2	Cleaning	2*
14	Customer 12	consumer	China	Gantry	Integrator 7	Supplier 2	palletizing	2*
15	Customer 12	consumer	China	Gantry	Integrator 7	Supplier 2	palletizing	2*
16	Customer 13	Other	UK/Benelux	Gantry	Supplier 4	Supplier 4	Multi Pick	2*
17	Customer 14	Port	Uk/Benelux	Gantry	Supplier 4	Supplier 4	Multi Pick	2
18	Customer 15	Food	UK/Benelux	Gantry	Supplier 4	Supplier 4	Multi Pick	No longer installed

From all these projects it has also been observed that Nordic region takes the lead in implementing a number of robot projects compared to other regions. Comparing the robot projects over the past few years there have been around 50 robots purchased in total from various different suppliers over the past 5 years approximately. This volume is less in comparison to the volumes the integrators buy from the robot suppliers. Moreover, the projects that have taken place in Nordic regions have been quite complex and *"the entire robot system was pushed to its limits"* to quote from one of the interviews. There have also been cases where a particular project was very unique and one off nature with a typical solution that was not witnessed earlier. In this case it was difficult to find the required supplier/integrator with specific skills with only one integrator having the capability to provide that particular solution. Since then there has not been another project of similar kind. In the Nordic region, there are few projects which are similar for example the "Star Robot" which has been offered

to various different customers. Though the application and concept remains the same, there was still the requirement of customization which makes it different. In these cases, they have been certain learning from the previous projects that had been used for new projects which are of similar nature. For instance, a similar “Star Robot” project had been executed in Australia in which great amount of knowledge was utilized from the teams in Nordic for the implementation of the project. But yet the projects differ in terms of the EoAT, increased optimization of the robot movements, cycle times etc., to name a few which makes them different from each other.

From the projects carried out, it was seen that the cost of the robot system itself constitutes to 40-50% of the total cost of the project. Thus, making it an integral part of the solution offering by Swisslog. In many projects there have repetition of the concept thus enabling Swisslog to learn for the possible issues and mistakes committed over previous projects in order to add value for the current project. However, this has seldom been the case every year making it difficult to reserve the resources. Moreover, the projects carried out in the Nordic region were complex in comparison to other region where the projects where not very complex, standard and possibility for the solution to be delivered with capabilities of various suppliers/integrators in the market.

4.2 External

This section will highlight the most important characteristics of the actors present in the supplier market: OEM, integrators, vision and gripper suppliers. Although, they all belong to the same industry and are part of the same network, in accordance to our findings, each one of these actors is characterized by a different set of capabilities and technologies, resulting in heterogeneous product offering. Moreover, they also have a different nature in relation to their geographical scope. The presentation of the external findings therefore attempt, to present those differences among the actors in the supplier market.

4.2.1 OEM market review

A review of the market brought into picture various global players who are specialized in few applications with good global presence. However, the scope of the thesis is limited to only three major suppliers who Swisslog intends to get associated with more deeply. These are supplier 1, supplier 2 and supplier 3. In general, there exist various players in manufacturing of robots. But they are handful of them with huge global presence across all regions. These can be limited to five global players in the market with few global players specialized in particular industry and particular type of robots.

Supplier 1

Supplier 1 has been indirectly associated with Swisslog through the integrators for various projects across different regions. Supplier 1 has a large global presence with larger network of system partners in the form of integrators. It has presence in all Swisslog regions with an added advantage of having their largest service unit close to Swisslog in the Nordic region. Supplier 1 is a major supplier worldwide with manufacturing of various other components apart from the robots making it one of the leading players in the industry. Robot segment itself is a small part of the entire business in terms of revenue. However, it sees a great potential in automation with the use of robots in various industries.

With regard to the robot system, supplier 1 has a wide product portfolio with activities spread in various industries, including food and beverage, retail industries which are also the main focus segments of Swisslog. Supplier 1 offers robots for automotive industry, EoAT specially designed for the automotive industry. It has recently launched an entire product range related to palletizing application with the company itself providing a complete standard module ranging from robot, two types of EoAT, software in order to control the movement of the robots. It also offers its own PLC for the robot. Supplier 1 also has partnership with vision companies in order to provide robots with vision in various applications according to the customer requirement.

Apart from having the specific modules for the palletizing application, any customization can be done through their integrator partner network with a wide spread globally. They also have a very good service set up with the possibility to avail 24x7 customer care support and monitoring to address issues.

Supplier 2

Supplier 2 has been the widely used supplier by Swisslog as mentioned earlier, due to close contact with the sales engineer from both companies, at least in the Nordic region. Supplier 2 is known for the solutions in food and beverage industry, automotive, metal, foundry and wood furniture industry. It has great knowledge and expertise in various applications across industries and customer segments. It also has a global presence with sales office in all Swisslog present countries. Industrial robots and automation is the main focus area for this supplier.

It offers a range of industrial robots, including gantry robots, off line PC based programming, software for various applications and PLC controllers. From providing solutions directly to the customer to providing solutions through its system partners, varies across the globe. In Nordic region for example, it has approved system partners through which it offers solutions to the end customer. This holds valid in other regions too. In case of US, the supplier itself provides the entire solution without the help of system partners or acts as a single point of contact for Swisslog. In most cases the EoAT is done by system partners who would be specialized in particular industry and specific application.

It also offers various customer services for the end customer. They have 24x7 customer care support offering solutions to various problems regarding the robot system. They also have spare parts service, maintenance, servicing of the robots and upgrade of the robots in order to ensure quality and reliability of the system for the customer. These services are offered directly to the end customer or through system partner depending on the type of agreement between the companies.

Supplier 3

Similar to supplier 1 and 2, supplier 3 also has global presence in all Swisslog regions. It caters to diverse industries ranging from aerospace, automotive, life science, construction, consumer industry, pharmaceuticals to mention a few. It is the leader in providing arc welding solutions and has a wide product portfolio of robots for various different applications. It commands a market share of 20% as mentioned by the supplier. Apart from these, it also caters to the palletizing and de-palletizing applications with successful implementation of projects for various customers.

The supplier offers a wide range of robot system products varying from robot, vision systems, software, EoAT and choice of complete integrated solution. It provides a complete solution to the end customer in arc welding applications and other areas, thus being the single point contact for the end customer. However, when it comes to palletizing related application it takes the help of its system partners to provide solutions. This is mainly due to the uniqueness of the application and large degree of customization needed for these applications. It has partnership with vision, tooling and software companies in order to provide one stop solution. Its main forte being innovation, it lays strong emphasis on creating new innovative solutions through its strong collaboration and partnership network.

Like the above two suppliers, supplier 3 too has round the clock customer support across various regions, with preventive maintenance, servicing, robot training, spare parts availability to ensure great customer service. As the supplier mentioned, they have the presence of warehouse in Sweden and ensure same day delivery to customers in Sweden. This logic holds well in most of the regions across the globe too.

Hence looking at the robot supplier market, it is quite evident that the robot suppliers having a strong system partnership network in the form of integrators would like the end customer to go through them in order to gain the much needed local support. Robot suppliers hold regular training about the various projects to the integrators in order to provide a good customer support. Since the core competence of the robot suppliers is making the robots, they have specialized integrators who provide the much needed customization to the end customer.

4.2.2 Integrator market review

The integrator market is characterized by a great deal of variety across the actors in terms of geographical presence, capabilities, technology as well as the strategy in relation to the market of both the customer and supplier. Regarding the strategy in relation to the market and its relationships with robot suppliers, there are several ways that integrators are working with OEM suppliers. First, as explain in section 4.2.1, integrators can work with robot suppliers by becoming one of their system partners or integration partner. In this approach, there is a contractual close relationship with one or more robot suppliers and it opens the possibility to access to their resources/capabilities and better negotiation conditions for pricing, however there can also be restriction with regard to the number of partnerships developed, since some OEM suppliers demand exclusiveness on this type of agreements.

Second, integrators can work with robot suppliers without being part of their partnerships network. In this case, integrators purchase different robot brands and have the knowledge to perform the integration activities dependant on the application. However, in this approach, integrators can be also specialized on specific robot brand but without having partnership agreements. Between these two different ways of working, there can also be a middle point where integrators do have partnership agreements with OEM suppliers while at the same time they are working with different robot brands.

The integrators are often specialized in one or more robotic applications such as welding, bending or intra-logistics for example. The integrators working in each field will depend on the strategy used by the OEM suppliers since the robot suppliers are using different market strategies for different applications. In this respect, the technologies and capabilities required for each application will vary

among them while still sharing some common features. The capabilities required from integrators for the PLC programming for example, can be said to be similar among different applications but when it comes to mechanical and design aspects in hardware there are significant differences both in terms of capabilities and technology, the reason why the experience of the integrators in certain application is of extreme importance for assuring functionality and reduce risk on their project development phase for the customer.

Focusing solely on the integrator who works within the intra-logistics field, there exist some major differences among them. The different activities, resources and technologies required for a robot system as well as the specificity of the intra-logistics applications themselves create a heterogeneous market as solution suppliers. Once again, the experience on some applications to some extent defines the capabilities of integrators to provide solutions. For example, item picking and palletizing/de-palletizing applications require different knowledge and technologies. On one hand, picking solutions demands that integrators have expertise on the type of robot used for these solutions as well as knowledge of vision systems integrations, thus reducing the number of integrators required. Palletizing/de-palletizing can be said to be the most common application where intra-logistics integrators have capabilities. However, this will depend on the specificity of the solutions, for example, in the case of mix palletizing applications, only a few integrators globally possessing the capability. For instance, one of the OEM suppliers interviewed, revealed that only one of their system partners worldwide was known to be working on mix palletizing. There are few other applications where combination of various technologies leads to a new solution, such as single item picking which no player in industry has knowledge off.

The differences on the capabilities within the intra-logistics field are mostly related to EOAT related activities and resources as mentioned by the integrator interviewed. The PLC programming and integration activities have been found not to be determinant for the development of solutions. The robot programming will vary depending on the different brands but it can be said that integrators can adapt to these changes since the logic behind it will be similar. However, knowledge and experience of programming both at the PLC level and Robot controller level are important from customer end since it can reduce the work required to developed the project and contribute to the efficiency in the customer support.

Finally, their geographical scope is mainly on a local basis, however there are some within the intra-logistics field who can work on projects on regional (Europe, North America) and even on global scale. Among the different regions, it can be found more mature markets with integrators with more experience such as the ones located the European and North American region. While it can be argued that in regions such as Australia or China, the integrator market in terms of its capabilities it is more uncertain and less developed.

4.2.3 EoAT market review

As it has been identified, the EoAT (gripper) is an essential part of the robot system, defining to a large extent its functionality. The EoAT market can be characterized by three different major aspects. First, the gripping technology used for the application and the level of the standardization/customization. Second, there are distinctive types of grippers suppliers in the market and their capabilities and access to technologies will vary accordingly. Finally, it is important to remark the nature of these different types of suppliers in relation the geographical scope

When it comes to the technologies, there are several different types of EoAT's in the market in relation to the type of technology used for gripping purposes within the intra-logistics field. Among the more basic and common gripping techniques used for the development of the EoAT are mechanical, suction or vacuum principles. However, it does not means that EoAT will be based solely one of these principles; there are gripping applications that are designed using a combination of these techniques in order to provide the required functionality of the system. Figure 4-11below shows different types of gripping technologies and how they can be integrated in one EoAT.

a. b. c.

Figure 4-11: Applications of gripping principles: a) Mechanical EoAT/gripper. b) Mechanical and vacuum EoAT/gripper. c) Vacuum or suction EoAT/gripper

Based on the different principles and the purpose for which they are design, the EoATs can be of standard basis or highly customized putting more requirements on the capabilities and knowledge required for their design. For intra-logistic application there are standard EoATs used for layer gripping or for single box picking which can be acquired on "off the shelf". But in the case of applications where there are items of different sizes, single item picking or even in cases where there are only minor variations from standard applications, there are requirements for the customization of the EoAT and the type of technology to be used. The EoAT technology is constantly evolving and cannot be considered as a mature technology.

In relation to the different type of suppliers, a classification can be made in relation to their position in the robotic market network. First, there are EoAT suppliers which are producers of the different components and parts used to develop the EoATs. Additionally, these suppliers in general also provide standard solutions and to a minor extent can work customer specific applications. Second, there are integrators who can interact with the EoAT suppliers by buying the entire gripping solution from them or buying only components and parts to adjust to produce their specific design. Therefore, dependant on the application and their capabilities, integrators can provide highly customized EoATs or standard ones. Finally, robot supplies can act as suppliers of EoAT s which are usually acquired by integrators. For example, one OEM supplier has recently launched a palletizing EoAT/gripper portfolio for standard applications but it has been identified that some of the other OEM suppliers can also provide this type of solutions and even to some degree of standardization.

Some of the interactions between these actors can be seen in Figure 4-12, reflecting the complexities and variety of this market when purchasing gripping solutions and grippers' components. The interaction levels described in Figure 4-12 can be also applicable for the aftermarket but the main flow in this case is the related to parts and components. From the end customer stand point, they

can acquire parts from the integrators, OEM suppliers or directly from the EoAT supplier on the customer support phase.

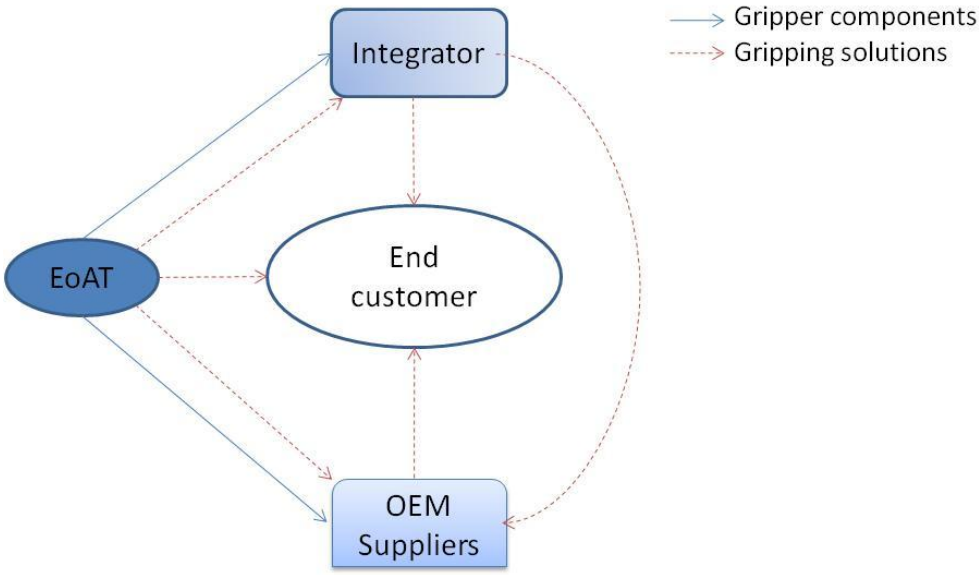

Figure 4-12: Interaction between actors in the Gripper Market

Finally, the geographical scope of operations of these suppliers has already been described in the case of integrators and OEM suppliers. The case of the EoAT suppliers, there are a few major big players with worldwide operation and strong position in the market.

4.2.4 Vision market review

The vision market is characterized by very few global players offering the required products which complement the robot solution. Vision market is growing with great importance by taking the automation to an entirely different level with the capability of sight. With the use of vision systems the robots can have human like eyesight which can be used to detect color of the product, dimensions, position and orientation of the product. Vision systems offers the much needed flexibility in providing cutting edge solutions that gives an entire new dimension to the automation solution offered to the end customer.

The market is divided with three global players having presence across various regions through the partners who also happen to be system integrators. With the help of integrators the company depends on offering solution and combining the robots with vision to make it one system. There have been many applications in the food and beverage industry with the use of vision to identify bottle fill level, tilted bottle, color, cap inspection etc., to name a few to increase the efficiency of the system.

Vision companies are also in direct partnership with many global robot suppliers in order to provide new solutions along with robots. Having partnership enables new product development and innovation together to develop a differentiated solution. Since they are very few global companies the vision companies have partnerships with more than one robot supplier in various regions.

5. DEVELOPMENT OF ALTERNATIVES

As seen from the current situation and the market review of various resources and comparing the resources available with Swisslog, this section introduces three possible alternatives of purchasing the robots considering the various stakeholders involved in the robot project. As part of the development process, first, there will be an assessment of the maturity of Swisslog purchasing organization as it was identified in the block organization and interactions on the strategic sourcing framework. Second, the boundaries of the firm as first decision area will be analyzed looking at the interdependencies of the robot system and the business environment, technology, capabilities and cost implications. Finally, based on these findings and the internal and external situation, the alternatives will be defined for further discussion in the evaluation.

5.1 Sourcing Maturity: Swisslog

Based on the empirical data collected on the purchasing process and the general purchasing organization of Swisslog, it can be inferred that the purchasing organization of Swisslog is similar to Centre led action network (CLAN). This is based on the fact that the project purchaser at each region doubles up as a product purchaser for a particular commodity globally. This is in reference to the nature of process where there is one person in charge globally for a particular commodity group, robot in this case. This person would define the global framework for the purchase of robots applicable across all regions. The guidelines issued by this person are followed at a local level at each region with the option to exercise choice in actual purchasing based on local conditions. Hence, it follows the CLAN approach where actual purchasing activity takes place in a decentralized manner at local level, but purchasing accountability and excellence in function is centre led. The advantage for Swisslog is the local units would have the power in terms of flexibility in choosing a particular supplier based on project uniqueness. Additionally it would enable fast and responsive action with the ability to achieve central purchasing synergies by having coordination across units. Having analyzed the nature of the purchasing organization, the next step is to analyze the purchasing or sourcing maturity of Swisslog based on the purchasing process followed.

The purchasing process follows the three phases which are sales phase, project phase and customer support phase. In all these phases it has been well documented about the role of purchasing and the early inclusion of suppliers right from the initial sales phase to leverage suppliers knowledge and have possible value addition to solution.

It also has a cross functional approach while handling various suppliers for a particular project, being a project based organization. Hence all these factors are similarly echoed in the definition of “Internal Integration” as defined in the sourcing maturity model and seen on Figure 5-1 below. Swisslog follows most of the mentioned parameters, except for the fact that it does not make use of ERP systems, etc for communication with suppliers or across various regions. However, is important to remark that, as been explained in sections 4.1.3 and 4.1.4, the introduction of the strategic purchasing organization with the factors described above has been a recent change. Not long ago, there was no formal strategic purchasing and was considered only with transactional-commercial orientation

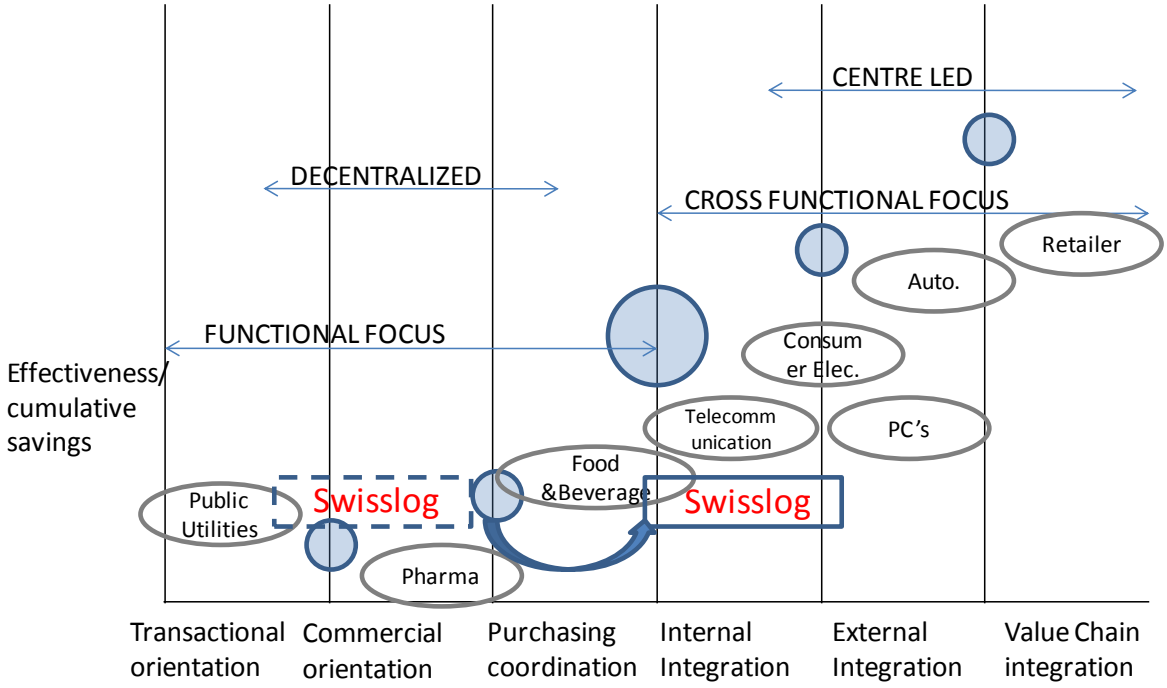

Figure 5-1: Sourcing Maturity of Swisslog

Therefore, it would be appropriate to define the sourcing maturity of Swisslog as that of moving towards Internal Integration as can be seen in Figure 5-1, with the possibility to go towards the achievement of "External Integration" or even further "Value Chain Integration". It is with the consideration of these parameters that the possible sourcing strategies would be developed. These are in consideration with the strategic role of sourcing with the aim of customer value creation. For this reason, the perception of the purchasing organization is far from being considered only as transactional function, reflecting that the development of the sourcing strategy must be made from a strategic perspective, considering its contribution to the different roles. Moreover, the current organizational setup allows for the cross functional work required both during the project phases and at corporate level due to the regional focus and the center led coordination at top management level.

5.2 The boundaries of the firm

The previous section showed the increase importance of the purchasing organization through the assessment of its maturity, implying that the sourcing strategy can be looked upon a strategic perspective and an appropriate organizational is structure is in place for this purpose. However, before assessing the alternatives, is important to analyze the situation in consideration to the make or buy decision as the first decision area. Even though, the make or buy decision will be dependent on the supplier relationships themselves and these changes on each alternative, given the variety of activities and resources involve in a robot system, is important to make an initial approach to the make or buy decision using the parameters in the analytical framework.

As it was developed in the analytical framework, the make or buy decision assessment is of multidimensional nature, considering aspects such as cost, supplier relationships, capabilities, technology and the business environment. Moreover, it should as well attempt to consider the characteristics of each individual component of contributing the functionality of the system as well as

the independencies between them. For this reason, this section will start with a general discussion with regard to the interdependencies between the resources and activities. Once the interdependencies are assessed, the resources and activities feasible to be performed separately will be discussed in consideration to cost, business environments, supplier relationships, technology and capabilities.

5.2.1 Interdependencies

Firstly, it is important to discuss the interdependencies between activities and resources involved in the robot system in order to gain a perspective of the possible network effects that can take place if they are performed by different actors. The EoAT design is closely related to the robot programming since the movements of the robot will be dependent on the type of gripper used as explained on section 4.1.2. Though they can be performed separately, it will require close coordination between actors during the development phase. The actual functionality and performance of the robot will be given, besides than by the specifications of the robot hardware, by the optimization of both the robot programming and the EoAT and how well they interact together. Therefore, it is hardly convenient to separate robot programming and EoT design since the functionality of the robot systems can be negatively affected.

The PLC programming on the other hand, does not define the functionality of the robot system in the same manner as the robot programming and EOAT design. During the design phase, the PLC programming as such does not constitute a major aspect to consider. The role of the PLC programming is relevant during the project realization phase as well as the customer support. As it was described on section 4.1.2, in the project realization phase, there are several tests be conducted both before the delivery to the site and once the system has been installed at the customer location. The testing activities can be performed on different levels. First, the robot system can be tested at the robot programming level without been integrated to the entire system, not requiring PLC programming for the integration. Once this level is tested, the PLC programming can be included and then tested as using the commands given by the PLC. However during the installation and commissioning phase there are seldom projects where everything goes as plan and the robot operates just as it was designed. As mention by one of the integrators “simulation never matches reality”. These aspects demands a lot of interaction between the actors in the temporary network doing robot programming and EoAT design and the PLC programming in order to perform the installation and commissioning. Nevertheless from a strictly technical point of view, it can be concluded that PLC programming can be done in separation to robot programming and EOAT design.

The independencies from doing the PLC programming separately will be transferred to the customer support phase. For software support activities there are cases where it is hard to identify the root cause of the problem, not being able to recognize at first glance if whether the problem is in the hardware, the robot programming or in the PLC program, suggesting interdependencies between the interfaces of these activities, but in accordance to the professionals of the company these could also be manageable.

In conclusion it is technically feasible to separate the PLC programming activity from the rest of the subsystem both in the project realization and customer support phase. However, taking a different perspective, as part of the network effects, it is worth it to give considerations to the possibility of having the PLC programming activities done by one actor on the project realization phase and latter

taking over by Swisslog during the customer support. To provide an effective software support, the software service technicians are highly recommended to be knowledgeable about the programming done in the PLC during the realization phase. It is not probable that software support people are able to provide good support if Swisslog has not being more active during the control implementation in the project realization.

As suggested early, the testing, installation, and commissioning are more closely related to the robot programming than to the PLC programming. So as mean of conclusion, it can be said that it is feasible to have one actor taking care of robot programming, EOAT design, installation and commissioning while other actor can perform the PLC activity and complement the testing and commissioning activity. The testing activities can be divided among them, increasing the interaction among the actors involved in the temporary network as part of the possible effects on the organization.

5.2.2 Business environment

One first step to align the make or buy decision with the business strategy is to understand the nature of the industry where Swisslog is acting. As it has been explained in section 4.1.1, the main business for Swisslog is the utilization of their know-how to integrate different subsystem into a fully functional logistic solution by the use of Swisslog own Software Suite. The robot systems are only one of these subsystems and value addition from Swisslog to meet customer requirements.

Nevertheless, it has also been explained that Swisslog has taken an additional step in the industry, becoming a material handling system producer following acquisitions, joint ventures and partnerships schemes. This has increased the product portfolio of the company as well as their cost base. The decision about which products to have internally, as explained during the interview process, cannot be said to be outcome of planned process. Instead, it was about achieving opportunities that the business environment was offering to Swisslog to strengthen its competitive position.

To enhance the competitive positions, the robot systems can be considered to be the key driver for some of the innovation process, for the development of solutions. In fact, the development of a type of EoAT application for robots would be, as defined during one of the interviews, the “Holy Grial” of the logistics business. With EoAT being the differentiating element for various solutions, there is a great deal of uncertainty for Swisslog whether to make it or buy it, considering the technological changes and economic situation. For other solutions as part of the innovation process, there is a great deal of uncertainty in the market potential since competitors have already taken the lead and it has been defined as a limited market.

On the other hand, as it was identified in section 4.1.6 Swisslog is currently working on different types of robotic solutions. Swisslog is contemplating to develop a standardized solution through a central team. However, these central standard solutions must prove themselves to be attractive for the regional markets so the sales team can include them into their offerings to customers. The regional sales departments do have freedom to decide what to offer to the customer. In fact, in the current applications installed by the company, it is possible to define regional patterns, with each region installing their own robot solutions. Therefore, since the market potential is uncertain and the regions still have independency to decide what to offer to customers, there are a lot of risks involved from a business perspective to go entirely into the robot system development.

From a different perspective, Swisslog is keen on increasing the customer support provided directly to customers since it represents a profitable business for the company. The EoAT and the robot hardware have been identified as having seldom problems during the customer support phase, just occasional maintenance and replacement of spare parts. However, the majority of the customer support occasions arise from the Software part which is one of the major businesses for Swisslog. Therefore, from a business perspective, having in-house the PLC programming for the customer support phase can be an attractive opportunity for Swisslog. Moreover, it is part of their business strategy to increase their scope of PLC control implementations and support.

5.2.3 Capabilities

AS reflected by Jennings (1997) the capabilities dimensions is important for the make or buy decision. Looking at the capabilities required to perform the activities for the robot system activities, one aspect that has emerged as transparent among the different stakeholders in the organization is that the company does not have the capabilities to perform the EoAT design. This is due to the fact that there are plenty of variations from project to project and the demanded technical skills and Swisslog has not been involved in this activity directly in any of the regions. Moreover, the interaction required during the design and project realization phase in the temporary network is high, with different details to be refined on local basis. This implies that the capabilities and knowledge for EoAT design must be interacting directly with the regional sales and design teams and even more with the regional project management; they should be available to provide local support. Therefore, as it was suggested in section 5.2.1, in order to perform the EoAT design the company should developed the required capabilities in addition to those required to do robot programming and installation, commissioning and test the robot. Basically, it will have to build the entire robot system.

The skills required for robot programming activities are less demanding and expensive than those require for EoAT design but at the same time, it is a more mature technology. Even more, OEM suppliers are developing software that facilitates the robot programming activities by end users. However, it is important to recognize that to program the robot movements in a simulated controlled environment than actually installing and commissioning the robot in a real application are not the same activity. In this case it is important also to consider that the use of each robot brand will require slightly different skills that should be transferred, developed and maintained in the customer support phase, increasing the cost involved in an uncertain and infrequent environment. Therefore, it can be more feasible for Swisslog to perform in-house the robot programming but as it was mentioned early this will imply that the company should also perform the tool design given the level of interdependencies among them.

Looking at the PLC programming activities which have a lower level of interdependencies compared to those existing between robot programming and EOAT design, the landscape change slightly. Being a more mature technology, when it comes to the capabilities, the level of skills within the organization is difficult to assess since only in one project Swisslog has been involved in the system integration activities for robots. On the other hand, Swisslog control strategy is increasing their scope. Since it has become in the recent past a hardware supplier, it has also been doing the PLC programming for pallet cranes, pallet conveyors and light good cranes and is the company's short term plans to take care of the PLC controls for the light good conveyors. Therefore, Swisslog do have experience and capabilities of PLC programming for controlling systems and the decision of performing this activity internally would be aligned with the company's business strategy for access

to key technologies. The question then is whether these skills can be considered as similar to those required for robot programming and what would be the cost to develop the required skills.

From the interviews, it can be argued that the PLC programming skills are to large extent similar and Swisslog can take care of the PLC programming for the robot systems or that the gap between the current capabilities and the level required can be filled without having to incur in high cost. Doing the PLC programming internally can provide the company with several advantages since it can increase the level of visualization for the end customer of what is happening internally in the robot system as well as it will imply that Swisslog can also take care of the software support for robots, not having to use integrators for this purpose. This last aspect, though it will represent new business for Swisslog in a profitable area as customer support has to be weighed against two parameters. Firstly, the commitments to provide support during the lifetime of the projects, which do not follow a steady demand and are infrequent. Secondly, on a cost perspective, one needs to consider that the PLC programming only represents around 20% of the time spent by integrators during the realization phase as found during the interview process.

5.2.4 Technology

One another dimension important in accordance to Jennings (1997) is technology and the position of the company from this perspective. With regard to the resources and activities involve in the robot system, the EOAT applications are still developing opening possibilities to exploit this potential, especially for single item picking and mix palletizing solutions. However, Swisslog lags completely on EOAT design capabilities since it has never done it for robotic applications. Even more, it is not Swisslog business area to design robotic tools but rather being able to know how to use them and integrate them into fully functional system.

This opens the question to consider the future changes in the business strategy and how relevant these technologies will become in the future. From this perspective, there are indications that suggest that the use of robot application will be more important in the future for Swisslog's business strategy. For example, in the innovation process taking place in the technology center as part of Swisslog business strategy, there are ideas involving the use of robot systems for different types of applications. It has been recognized by the technology center that the function of the robot system will be critical for the success of the industry solutions being developed reflecting that robot applications will be more important for the success of the business strategy, while at the same time, acknowledging that the company is not in position to develop these capabilities. Therefore, the competitive position of the company can be harmed if it is not able to include the use of robot systems applications as part of the innovation process since it will not be able to compete with competitors and miss market opportunities. However, as reflected by (Jennings, 1997) if a company lags in a technology it can hardly be in competitive position, hence recommends having external suppliers to regain performance.

The EoAT technologies in terms of its maturity across industry are far from being in its early stages. The development of the robots solutions has always required the use of EoAT to have the required functionality. The automotive industry has actually grown using various robot applications for different process. For the case of intralogistics applications, the market review has shown that OEM suppliers, integrators, and EOAT suppliers, have different grippers (EoAT) available, offering a high degree of customization from the integrators. Therefore, even though changes are happening and

new developments are expected, the EOAT can be regarded as mature technology, with the exception of few specific applications, which are the ones that represent the higher potential for competitive advantage and where competitors are not developed.

As it was identified earlier, the PLC programming activities requires interaction on local basis during the project realization phase increasing the level of coordination in the temporary network. So, if Swisslog takes care of the PLC programming, it should be able to provide support to the different regions while being cost efficient. It is Swisslog business strategy to increase the regional control capabilities and most of the regions have a control team, with only one without people working in this area.

These last considerations regarding the use of core libraries for the PLC programming opens once again another possibility for the division of activities between the Swisslog and integrators: Swisslog developing core libraries that the integrators would have to use for the PLC programming and provide the project the application specific PLC requirements identify as option b) on Figure 5-2. Option a) relates to the one previously described where Swisslog makes the entire PLC programming activity.

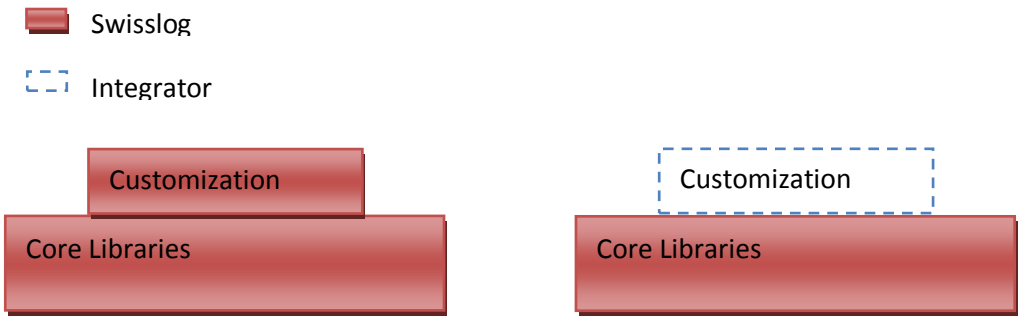

Figure 5-2: Possibilities for PLC programming division of labor. a) Swisslog completely. b) Swisslog core libraries and integrators customization

This decision brings again the role of the technology center but not as owner of the innovation process but rather the software and control divisions, since in the current organization structure of the WDS division, they are the ones who would be responsible for the development of such core libraries and its maintenance.

5.2.5 Cost

Developing the capabilities for EOAT will involve initial cost and more important, once already developed, the volumes will have to be high enough to cover their operating cost. As portrayed by the transaction cost perspective, the high uncertainties and high asset specificity of this transaction will increase the cost for Swisslog of these transactions, while from ROI perspective, the low frequency of robot system will make it difficult to sustain the operating cost and achieve a breakeven point. In addition to these aspects, it is the EOAT design that provides to a large extent the functionality of the system and is a technology that is evolving and changing, especially in the field of picking applications. In this respect, Swisslog will not only have to develop capabilities and cover the operating cost but additionally, it will need to drive the market and keep up with technology changes in order to maintain its competitive position. This commitment is expensive and must be made carefully as it was argued by Jennings (1997). This cost will increase even further since as explained in

section 5.2.1, the interdependencies between the EOAT design, robot programming and installation/commissioning/testing are high, implying that Swisslog most likely will have to invest more in order to guarantee the performance of the robot system. Therefore, the potential for cost savings by producing the EoAT internally are not clear and visible.

In the case of the PLC programming activities, cost is mostly driven by the hours invested and the experience in previous project. In fact, the integrator interviews and some of the internal people interviewed, mentioned that by having core code libraries serving as platform for the development of the remaining PLC program, the hours invested can be reduced from project to project. Moreover, these positive effects can be replicated to the customer support. Since the use of core libraries can serve as means of standardization on the software, which can reduce the customer support hours invested for solving software problems, increasing the operational margin of individual activities.

However since the PLC programming capabilities vary from region to region, the cost involved in its development will depend on the gap to be fulfilled. It can be argued that the PLC programming capabilities can be developed centrally and shared across regions which in fact might help to consolidate volumes centrally. In this case, travelling and coordination cost will also have to be assess and consider well the possible inconvenience caused for the project management team since the PLC programming requires local support.

In the case where the core libraries are considered, the cost involved in this development process is hard to assess since it will depend on the process and the structure itself of such core libraries if developed. In fact, it has been mentioned by in the interviews that if the core libraries for the robot systems can and are developed with similarities to those already in place for the subsystems where Swisslog is currently responsible for the PLC controls, there could be reduced development times and increase standardization.

One additional aspect that deserves attention is that, if Swisslog develops core libraries it needs to incur in development and maintenance cost. Still the integrators will be performing the PLC programming activities but rather using Swisslog libraries, which will still add cost to the scope of supply purchased from the integrators, and given the low continuity of project based relationships, time reductions from learning is difficult to achieve on the project realization phase.

5.2.6 Assessing the make or buy decision

The discussions in this section have focus upon the different dimensions of the make or buy decision. The level of interdependencies between activities and resources has shown that PLC programming can be technically perform separately from the other activities and resources involved. However, the remaining activities do have a high degree of interfaces which are hard to separate without harnessing the functionality of the robot system. This situation is shown in Figure 5-3 where these activities are overlapping to represent their interfaces.

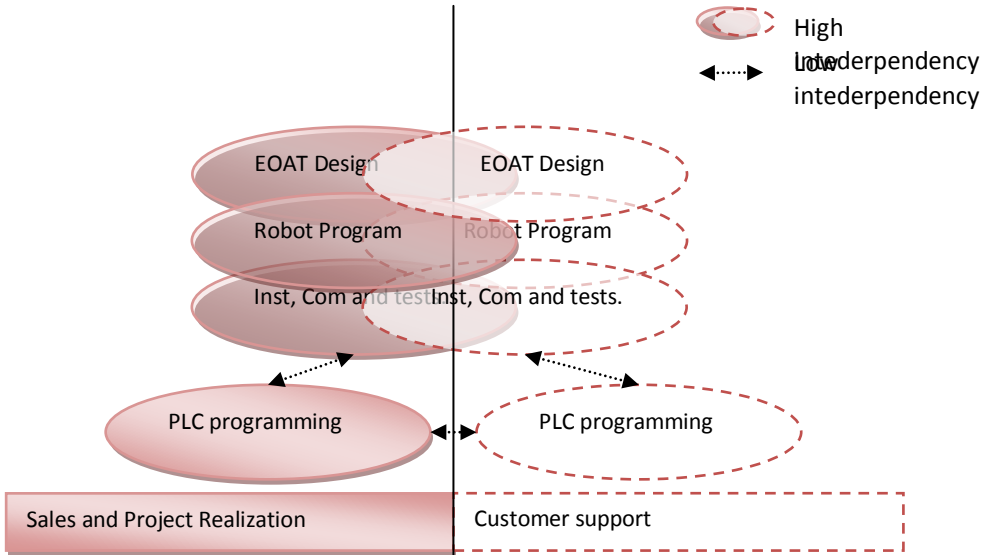

Figure 5-3: Scheme of interdependencies between activities of the robot system during Sales&Project realization and customer support

Moreover, the interdependencies between the activities during the project realization phase and resulting service during the customer support phase, are still in place for EOAT robot programming and "Inst, Com, and tests", implying that if Swisslog takes over one of these activities it is recommended to internalize the other ones, not only during the project realization phase but also for the customer support. On the other hand, it cannot be said that the PLC is completely independent from the other activities, but the interfaces are significantly less. Moreover, it is possible to have only one integrator doing the PLC programming in the project realization and Swisslog taking over the PLC programming in the customer support phase. However, there can be problematic aspects in doing so.

For these reasons, the assessment of the make or buy decision should only be made with respect to EOAT, robot programming and Inst, Com & Tests(from now named "ACT1"), combine as one activity and the PLC programming (from now PLC) as a different alternative to have internally. Additionally, the customer support for ACT1 is closely connected to the project realization phase, while on the PLC programming the links are not that strong. From another perspective, it won't make sense for Swisslog to do PLC on the project realization and outsource its customer support or neither to produce internally ACT1 and outsource PLC. Therefore, there are three activities which Swisslog can have internally:

- ACT1 and PLC both internal completely
- PLC: Project Realization
- PLC: Customer Support

With these in mind and based on the discussion for the different factors of the make or buy decision, being business environment, capabilities, technology and cost, the assessment of these alternatives can be seen on Table V below

Table V: Assessment of the different activities for the make or buy decision

Activities	Business environment	Capabilities	Technology	Cost
ACT1* internally				
PLC: Project realization				?
PLC: Customer support				?

*EOAT + Robot Programming + Installation, Commissioning and testing.

As it can be seen from the table, it would represent a great opportunity for Swisslog from a business environment perspective to increase their in-house capabilities for ACT1 especially regarding EOAT design given its potential to contribute with the company focus on innovation. However, the capabilities required are not within Swisslog and from a technology point of view it will represent an expensive commitment to a mature technology, with a variety of proficient players. In addition, from cost perspective, given the interdependencies, it will imply that Swisslog should take over robot programming and installation, commission and testing, adding cost and complications to the project realization.

For the PLC programming at project realization and customer support, there are indications that Swisslog can have higher benefits on the customer support phase for the PLC given its profitability. Moreover, it is one Swisslog core business to integrate the subsystems and is fully aligned with their business strategy to increase their capabilities and scope for PLC controls. As technology, it can be argue that there is not that much commitment to its maintenance since Swisslog is already skill on these aspect and is not subject to that much changes. However, the drawback is even though there is transferability of PLC controls among subsystems, these skills are not homogenous from region to region and is hard to estimate cost. These unknown costs would have to be maintained by robot projects which are uncertain and infrequent on regional basis.

Therefore one main conclusion of this analysis is that hardly convenient for Swisslog to have in house ACT1 despite the good business environment, but for the PLC programming there are some pros and cons, being difficult to estimate a development cost. For this reason, is important to analyze how the coordination between actors would be affected on different levels. The PLC programming as an in-house complete activity implies that the coordination at project level will increase since it is require more interaction between the project management team and the integrator providing the remaining scope of supply. However, since the robot subsystem often has to communicate with other subsystems, there will be fewer requirements for the integrators to coordinate with other suppliers given that this communication is done at the PLC level. The coordination demanded at this level would depend as well on the architecture use for the project and how the PLC controls are implemented. The coordination in activities perform by Swisslog will also increase, since they will be the ones doing the PLC controls but without affecting to a large extent. At a firm level, the

coordination required between Swisslog and integrators would depend on the approach to relationships in the permanent network. Finally the coordination required from the integrators with their suppliers can be said not to be affected since the PLC programming is mostly an internal activity.

From software project realization, there will no significant differences between the two alternatives for PLC programming, with possibilities to achieve to same benefits as well as subject to the same disadvantages. However, in the alternative b) there will be fewer requirements for interaction since the integrator will be responsible to deliver the entire solution, including PLC controls. In the customer support phase, Swisslog will be gaining possibilities to have more knowledge of the PLC programming used, thus increasing the possibilities of avoiding integrators for the software support without having to commit entirely as with alternative a). This will be due to the fact that now the customer support for software can be backed up with the integrators since they have been highly involve in the PLC programming.

The discussion has reflected that there is potential to internalize the PLC programming, with two different possible alternatives. On the other hand, having in-house the EOAT design offers the company potential especially with regard to the innovation of solutions, but the lack of capabilities, technological requirements and interdependencies can limit Swisslog to reach a competitive position. For this reason, the PLC programming can be internalize but EOAT design and related activities are recommend to remain outside the boundaries of the firm and gain the require resources and capabilities from external actors.

5.3 Definition of the alternatives

The existing purchasing process and market review have bought about interesting facts about the nature of relationships the OEM/robot suppliers have with end customer in partnership with other EoAT suppliers and vision suppliers. Moreover, the analysis of the internal situation and the supplier market globally has identified that globally, many projects have been carried over with different regions possibly ending up purchasing the robot from the same supplier/OEM but mostly through the integrators depending on the applications. However, a transactional approach had been followed, having no relational exchange beyond the temporary network in individual projects and no long term adaptations in the permanent network, verifying the findings of the business characteristics defined in the theoretical framework for project based organizations.

In this projects, there have been a few having similarities, while others being very different and unique. In all these cases it is seen that the EoAT is the critical and most important resource that makes a difference to the application as such. The robot hardware (naked robots) as such can be provided by various OEM's but the EoAT is unique and sometime complex depending on the application. Figure 5-4 shows the various activities and resources carried out by different actors, contributing to the end solution to the customer.

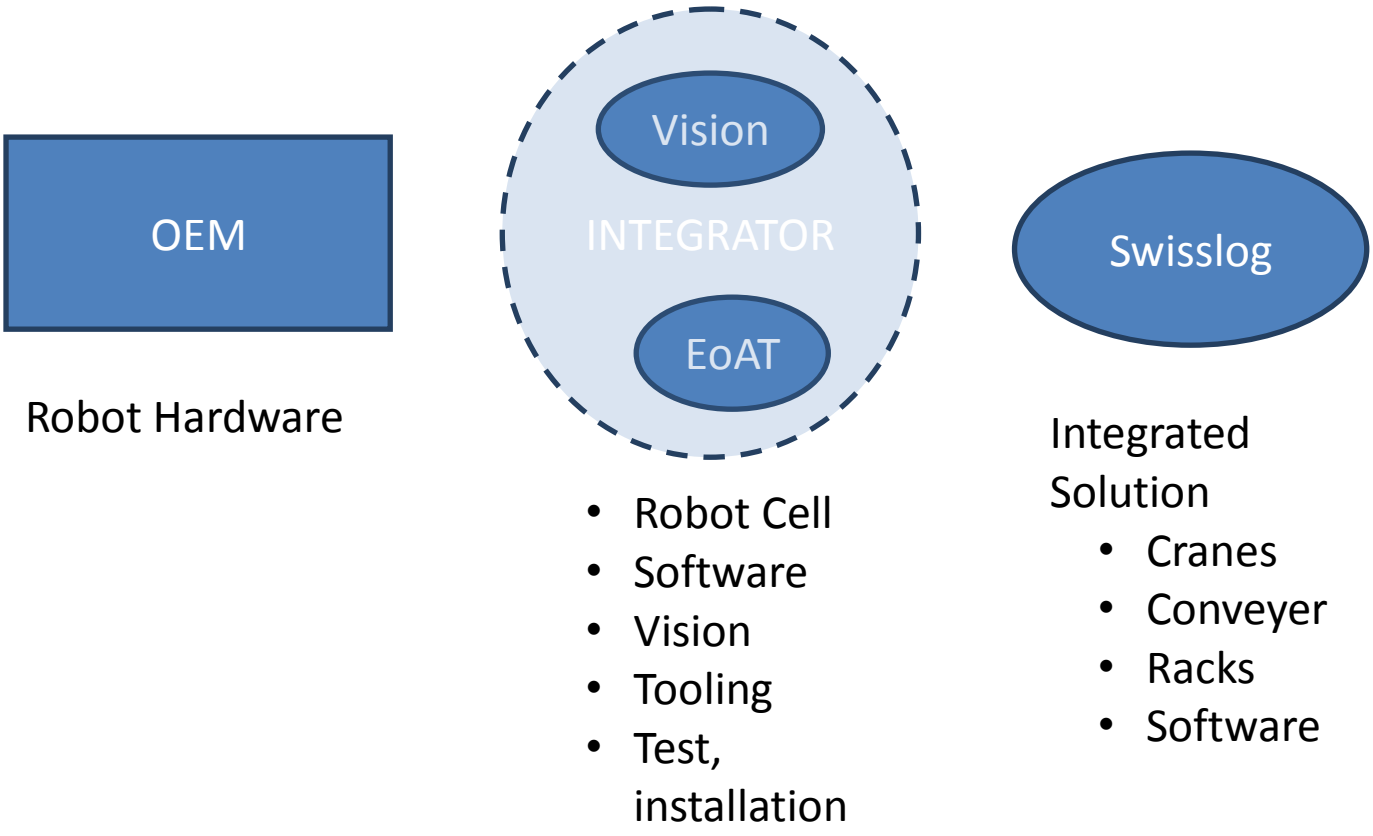

Figure 5-4: Activities, resources and actors involved in solution for the customer

Moreover, as it was portrayed in the Market Review, the OEM's are large global companies manufacturing robots and other components. Their main focus being in the manufacturing of robots and would always intend to sell as much robots as possible. For the integrators, the main area is robot system itself and is specialized in carrying out various complex tasks with this respect. The integrators buy robots from the OEM's in large volumes for various projects undertaken by them. Furthermore, owing to the nature of work which requires increased amount of work on the site, many integrators are local in comparison to the OEM's who are big global players. Many OEM's have strategic partnerships with several integrators across the globe in order to take leverage of the resources; since it is the tooling and robot together create a solution for the end customer. There are many cases where one integrator has partnerships with several different OEM's in order to provide the most suitable solution for the given application. This last case opens the possibility relating with integrators having global scope of operations. Due to their specialization in robotic area, they could provide the benefits of global synergies across regions in terms of the rationalization, development, and structural roles of the sourcing strategy, while at the same time; complement the requirement of local presences during the different phases of the project development process.

In addition, the analysis of the maturity of the purchasing organization has show that Swisslog is moving forward more integration with external suppliers, moving from being commercial oriented to

phase of internal integration where a global purchasing organization is in place. Different communication channels among regions are being built, with decisions made on regional basis but long term sourcing planning is on global and strategic basis. This situation opens the possibility to relate with suppliers operating on the same global scale as Swisslog is performing in order to achieve global synergies but considering of course their capabilities to satisfy the local requirements of the business. Since the achievement of global synergies is one is one of the main dimensions where Swisslog attempts to develop further from a business perspective, then sourcing alternatives should consider this dimension.

With regard to the make or buy decision the analysis has shown that even though by performing activities internally as the tool design have a significant business potential, the independencies among activities, the lack of capabilities and experience, the wide technological gap and the presume high cost will set strong barriers for internalizing these activities. Therefore, the sourcing strategy cannot analyze alternatives where the suppliers are not in capabilities of satisfying the highly customized requirements of tool design. Moreover, the company has invested recently in the production of automation materials increasing their product portfolio implying that Swisslog is open to invest on business that strengthen their business position. But, as it was emphasized the uncertainties in the business environment constraint this possibility for the robot system. For this reason, the alternatives to be analyzed will not include cases where there is direct relationship with EoAT and Vision suppliers since these technologies need to be integrated without risking the functionality of the robot system. With these mind, the alternatives to be evaluated needs to provide Swisslog with EoAT design, robot programming and installation, commissioning and testing from external suppliers as the integrators. The potential of the alternatives to contribute to the rationalization and development role would have to consider these implications.

The fact of having to relate with suppliers as integrators also affects the structural role since the development of new solutions as the innovation processes in Technology Center suggest, would require to increase the dependencies on suppliers due to the difficulties of internalizing the EoAT design. At the same time, due to nature Swisslog business, every project has its own specificities for the robot system reason why the sourcing strategy alternatives should consider this variety among projects. In addition, the alternatives should be able to exploit the potential of synergies due to the internal integration of the purchasing organization and support the different requirements of the project phases. Based on the above, the following three has been established as feasible to possibly satisfy these requirements:

1. Existing Situation: Swisslog selecting a particular integrator and then selecting a particular robot supplier based on the project in order to offer solution to the end customer.
2. Direct to OEM suppliers: Swisslog reaching out directly to select few OEM/robot suppliers, who can in turn develop the solution themselves or suggest a suitable integrator based on the project in order to offer solution to end customer.
3. Global Integrators: Swisslog having partnerships with few global integrators who can cover more than one region, who in turn would buy robots from Swisslog selected OEM suppliers in order to offer solution to end customer.

The above three alternatives/strategies would be further discussed in order to understand the possible short term and long term benefits for Swisslog based on the situation and the nature of projects.

6. Evaluation of Alternatives

With the different alternatives established in the previous chapter, this chapter evaluates the alternatives based on the strategic sourcing framework. First, the alternatives will be discussed individually with respect to their consequences on the supplier base structure, individual relationships and project based characteristics. The discussion on individual relationships will analyze supply chain flexibility and type of relationships separately. Second, the three alternatives will be compared using the same parameters. Finally, the implications that the alternatives would have on the organization and the boundaries of the firm, will be analyzed and discussed.

6.1 Alternative 1: Local Integrators

This alternative deals with the current approach of purchasing. In this process Swisslog buys all the services from the local integrators in various regions, who in turn get in touch with the OEM robot suppliers, EoAT suppliers and vision suppliers as seen in Figure 6-1. The integrators perform all the tasks with regard to the robot subsystem and deliver it to Swisslog according to the specifications and needs. For Swisslog, the robot subsystem is a "black box" and is not concerned about the internal intricacies involved in the system. For Swisslog the integrators are single point of contact for most of the services. Whereas for the end customer, the integrators Swisslog's subcontractors with no direct responsibility but rather, through Swisslog.

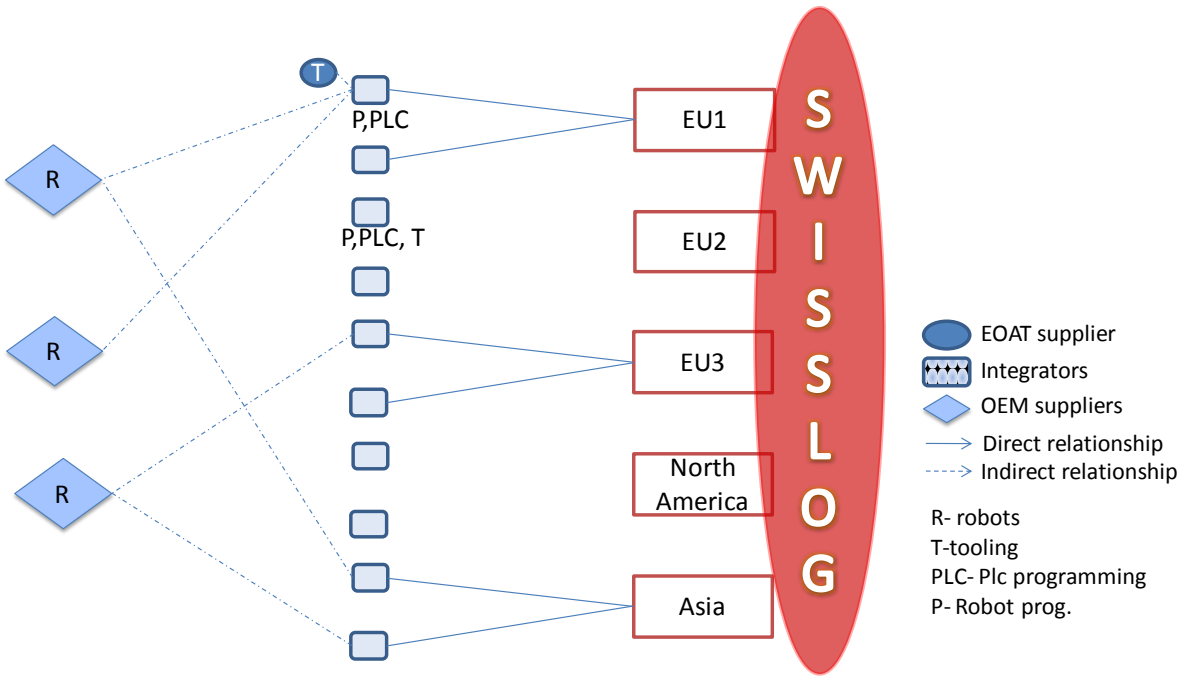

Figure 6-1: Network structure of alternative 1: Local Integrators

6.1.1 Supplier base structure

By going directly to the integrators, there is a benefit by taking the advantage of local aspects that would make it easier in terms of commissioning, installation and testing. All these require a great amount of presence on site and would be difficult to have integrators from other regions perform these activities due to high travel costs and more importantly lack of knowledge of local market and

situation. These also help to gain cost advantage by having local support to customers with long product life cycle. Considering the aspects of static, dynamic and hidden costs as defined by Holweg et al. (2011), local integrators would impact the costs in many ways. These can be mentioned as static, dynamic and hidden costs. Static costs, concerns with the savings on transportation costs since local transportation would cost less than international transportation, savings on avoiding customs duty. Considering the cost of the robots, in cases where local integrators have greater economies of scale in comparison to Swisslog. Hence, if Swisslog buys from these integrators it would get a comparatively lesser price including the margins levied by the integrators. Since all the activities and products are bought from the integrator, it would be possible to gain economy of scale for the entire subsystem. This is however short term and price advantage may vary from project to project.

Dynamic Costs, for example, inventory costs, would be less due to the local presence. This is due to decreased lead times with local presence in comparison to the presence of integrators in other regions. But at times of emergency shipments, which is a matter of situation and highly subjective, costs incurred due to emergency shipments can be reduced. These concerns will be of more relevant for the customer support phase than during the project realization since during project realization phase, there is only one time delivery of the entire robot system. Considering the local nature of the integrators and the decreased financial reliability, there would be a tendency to have increased safety stocks at Swisslog to avoid any untoward situation. Thus, increasing the costs incurred to the company.

Though all the hidden costs cannot be documented and accounted for, few such as currency fluctuations, increase in transportation costs, increased personnel to monitor and coordinate international purchase and transportation can be mitigated to certain extent. Another major contribution in terms of indirect costs can be attributed to loss of intellectual property to certain contract manufacturers. This can totally be avoided by employing long term relationship with local integrators.

However, the lack of interaction with global players directly would prevent the possible access to suppliers global network and hence various resources that would otherwise require investments. Since global companies with access to international markets and vast scale of operations, there could be possible synergies and cost advantages, but cannot be obtained by this option. Holweg et al, (2011) also conclude the possible influence of supplier's performance in the market, company's knowledge on the markets also matters the final decision. For Swisslog, since system integration in this option is done by integrators, the scenario of sourcing would change in case the decision to do system integration to be developed in house.

Regarding the number of suppliers, given the regional nature of these players the approach followed can be a mix between single and multiple sourcing, with single independent suppliers for each one of the regions. However, as it has happened with one of the regions, this approach can lead to increased dependency on suppliers, reflecting one of the major risks from having single sourcing (Trevelen & Bergman Schweikhart, 1988). However, if the relationships are developed enough Swisslog can drive interaction between integrators working on different regions to collaborate in case there are similar projects developed in different regions in the long term. This situation how the benefits from the relationship and the dependency would be reliant on the number of suppliers used as it was defined in the analytical framework.

6.1.2 Supply chain flexibility

Based on (Gosling, Purvis, & Naim, 2010) who define the various flexibility parameters from vendor flexibility, sourcing flexibility and various aspects of external flexibilities the following analysis can be made:

The option of having several local integrators for each region enables the possibility to have different products from various integrators such as the best vision system, best robot and best software in order to provide the required solution, thus scoring high on mix flexibility. This under the assumption that interfaces between the various systems are taken care and according to the Swisslog Integration Standards (SIS). Since there is no commitment to suppliers and relation lasts only for a project, the ability to develop new product would be difficult during that project time period. It can be only limited to the provision of a solution for that particular project reflecting a low product flexibility. Having a local presence would give the required delivery flexibility to Swisslog with its customer support team having the option to place orders with decreased lead time. Considering the access flexibility, since local integrators would not have a global presence, would fail to provide the required support across various region of Swisslog in terms of installation, commissioning etc, though there exits possibility of software support which would come at an increased cost considering the travel costs from one region to another.

Since all the activities are purchased from integrators, there is great amount of flexibility in meeting project requirements since different suppliers could be chosen to deliver the project based on various parameters ranging from costs, performance, capability etc to name a few. This indicates the possibility to change the supplier and having a high sourcing flexibility. The local suppliers would have fewer resources comparatively to global players in terms of support network and other possible services, hence having low vendor flexibility.

6.1.3 Type of relationship

Since it is evident that increased sourcing flexibility would prove an advantage in order to consider new projects and have the ability to deliver unique solutions for each project which has often been the case for Swisslog. Considering the atmosphere, it is always a trade-off between “trust and commitment” and “power and dependence” relation. In the current situation, it is highly uncertain and difficult to have a “trust and commitment” atmosphere. Owing to the tender process of selecting supplier it would in a way lead to “power and dependence” relation. Since Swisslog is very much dependent on the supplier for the robot subsystem. But at the same time Swisslog would intend to have the flexibility in choosing the appropriate supplier. Hence, it would not be possible to have close relationship with suppliers to avoid the lock in effects. This would also mean that Swisslog does not have to invest resources or concentrate on adaptation aspects which are characteristics of long term relationship.

Based on the degree of involvement and continuity matrix by Gadde and Håkansson (2001), the relationship can be determined as that of high involvement and low continuity. This indicating to the complex buying pattern that Swisslog is involved with, project uncertainty, customized solutions, EoAT uniqueness, etc., adding to the complexity. The existing situation is indicated in the below Figure 6-2 at the lower right hand box.

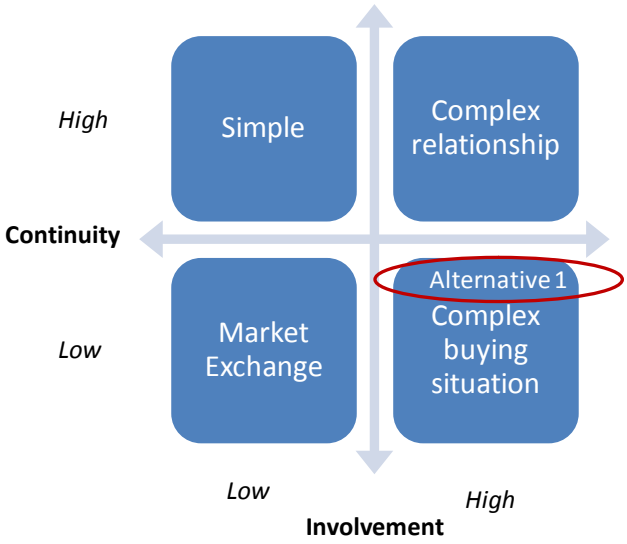

Figure 6-2: Degree of involvement and continuity-Alternative 1

6.1.4 Project based organization

Considering the parameters of the project organization, this option of having local integrators would prevent any standardization from taking place and hence hamper the efficiency of the relationship performance. This leads to arms length relationship between the buyer and the seller. On the other hand increased change of suppliers would lead to increase in transaction cost, new supplier going through the learning curve every time during the project. Thus, not taking the advantage of previous interactions and adaptations obtained during the previous process giving rise to "cost inefficiencies". This leads to the inference of having transactional exchange over relational exchange. The disadvantage of transactional exchange would be inability of the supplier to assign and develop resources according to the needs of Swisslog which would prevent the product development and innovation process. As Briscoe & Dainty (2005) observed the preference of suppliers to have long term relationship with regular projects in order to develop the staff, skills and also decrease the errors through continuous interaction and learning, rather than a one off nature.

Considering the customer support and service agreements, this option would have a drawback of possible increase in cost of the service when considering the robot, since integrators play a limited role if spare parts are considered. Since it is the robot suppliers who provide the spare parts the role of integrators in this case may not add value. But in case the robot supplier gives greater discount to the integrators due to volumes when compared to Swisslog, then integrators would be preferred provided the total cost including the margin added by integrators is less then that compared to robot supplier.

With the option of local integrators, Swisslog can handle the uncertainty and varying degree of applications in the projects by selecting and changing suppliers on project basis. But it would also be a disadvantage, since long term relations, consolidation or cost efficiency beyond a particular project cannot be established.

6.2 Alternative 2: Direct to OEM suppliers

In this alternative the purchasing is done through global OEM suppliers. Swisslog would approach the OEM suppliers for a project who apart from supplying robots would assign a suitable integrator to Swisslog according to the project requirement. This is shown in Figure 6-3. Since the main product in

the entire robot subsystem project is the robot itself, although depending on the type of application the type of robot (gantry, articulated arm etc.) may vary. If Swisslog has a direct relationship with these global OEM's who have global presence, Swisslog can buy robot directly through these OEM's on a global basis by having a global agreements with select few OEM's for all regions. With the vast amount of resources and possible project knowledge through other integrators, Swisslog would possibly gain access to these resources and get in touch with the most appropriate integrator through these OEM's.

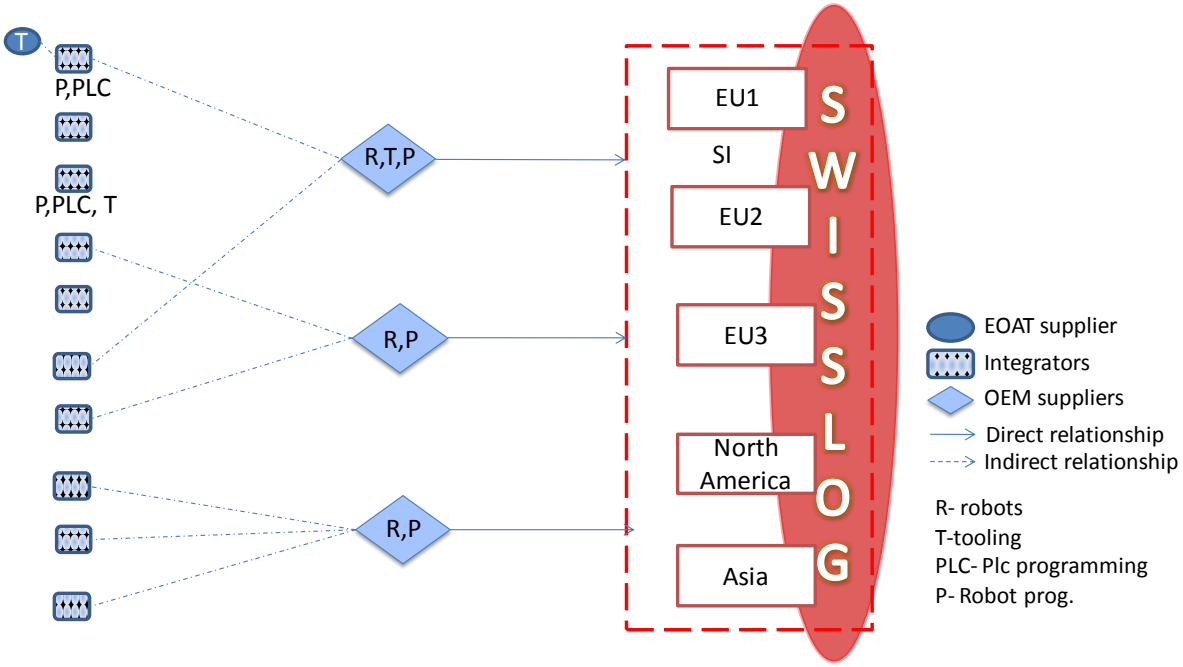

Figure 6-3: Network structure of alternative 2: OEM Suppliers

6.2.1 Supplier base structure

The use of global OEM suppliers in order to have reduced prices and cheaper resources through global consolidation would be beneficial. However the potential for cost reductions will be related not only to the analysis of the static cost. Also, it needs to be identified how dynamic and hidden cost will be impacted when using OEM as global suppliers as suggested by Holweg et al. (2011).

Though the purchase would be from global OEM's, there would be limited effects of static cost as mentioned by Holweg et al. (2011) due to local presence in each region. Since each of the global OEM would have its presence every country increased transportation costs, custom duties would have marginal effects. Apart from these, the cost of the robot hardware itself accounts for the static cost parameter. It is possible to gain a reduced purchase price from the OEM suppliers by directly buying the naked robot from them and eliminating the integrators mark-up from the business. The potential on the price reduction however, will be relative to the possibility of consolidating volumes on one supplier and how relevant will those volumes be for the supplier. Swisslog had bought during the last 4 years around 50 – 60 robots from different OEM suppliers but mostly using the integrators as middle actor. The yearly volumes sold by suppliers analyzed on the other hand range from around 10000 to 20000 robots, out of which, the palletizing robots is only a minority of that share. The integrators on the other hand, usually do not only work on intralogistic application but are also working on other robotic application markets, increasing their buying "power" from robot suppliers, thus can possibly having better deals from OEM's.

On the other hand, there are expectations from Swisslog to have an increase in the robot applications in the near future that, on the best case, scenario could go up to 30-40 robots worldwide as it was identified during the interview process. With great degree of uncertainty these figures have seen a slump, with years that can have 2 or 3 projects using robots while in other years, there can be no projects requiring robots. This high variation in demand can be reduced if there is global visibility across all regions (global consolidation). But even in that case, the volumes globally would hardly be enough to match the volumes purchased by the integrators. Consideration to search cost and cost in terms of resources in searching the right integrator for a given application can be reduced with this option. Since the OEM's with their large global integrator network would have knowledge and previous experience with integrators, Swisslog can take advantage in this respect. Currently, the costs for searching the new suppliers are not clearly accounted and cannot be determined. Mainly suppliers/integrators over the past have been selected with the help of internal associates. But with increasing complexity of the applications and growing demand for more customized solutions, it may be difficult to rely mainly on internal contacts to select the integrators.

Dynamic cost will play a key role on the customer support phase. The customer support requires short lead times for spare parts and service since if the robots are not working, the functionality of the entire integrated system can be jeopardized. With OEM suppliers having global support networks possess the possibility of providing the required service levels, since their customer support network have presence in the regions where Swisslog is operating. In a particular region many OEM's have same day delivery within the particular country. Hence, minimizing the need for having safety stocks by Swisslog and hence the tied up capital. With Swisslog having a centralized spare parts unit located in Sweden, it could possibly take advantage of having central purchasing agreements with OEM suppliers to gain economy of scale. At the same time use OEM local support network for distribution of parts. It would also decrease the length of the supply chain in terms of limiting the role of integrators between OEM and Swisslog at least with regard to spare parts.

But on the other hand, considerations have to be given to the volume of purchase. Similar to the robot volumes, if integrators gets decreased price from OEM's and then it would be cost advantage to go through integrators if the total cost including the integrators margin would be less for Swisslog. But on the other hand the safety stocks may increase. Hence it would be a trade off considering the above parameters.

As far as hidden Costs, due to the global nature of the OEM suppliers, currency fluctuations and international transportation costs would always be involved for few products which need to be sourced from other units of OEM suppliers. The fact that Swisslog would directly deal with OEM would decrease the loss of intellectual property to other small contract manufacturers considering the option of future product development and innovation activities between Swisslog and OEM suppliers. The possibilities of volume consolidation from global OEM's identified earlier will additionally be dependent on the decisions regarding the number of suppliers used. As identified by Gadde & Håkansson (2001), having single source can increase the economy of scale and help in achieving price advantages. On the other hand, looking at the customer support phase, the advantages of consolidation for spare parts will have different features. By having single source for OEM's the number of required spare parts for inventory will reduce and in the long term, Swisslog can be in a better position to negotiate service agreements globally.

With single sourcing, the relationships with OEM supplier can be made more easily, especially during the sales and project realization phase when interaction among actors is required. Moreover, there can be potential for mutual cost reductions with increased interaction. But, these interactions are mostly required for the activities related mechanical design and system integration. Given the general tendency in the strategy of OEM suppliers of not performing these activities for intra-logistics applications there are seldom chances of having mutual cost reduction considering as well the low continuity of project based relationships. But in cases where the integrators are not involved and OEM does all the activities done by integrators, as done currently in one of the regions, single source may be an option in that particular region.. Especially considering the innovation and technology development, close relationship with one or very limited suppliers would prove beneficial by leveraging the specialized knowledge in particular industrial segment (Food and beverages, retail in case of Swisslog). However, this would be beneficial if there were limited applications where products from one single supplier could be used therefore increasing the dependency from OEM suppliers. Even more, given the degree of variation in projects and different types of robots required to be used in the project, there should be multiple sourcing from integrators in order to avoid dependency for project development. This would help in gaining the variety required for solutions, taking advantage of the common product offering between the suppliers by having choice but still. Moreover, the OEM suppliers do have different integration partners globally for intra-logistics applications and they are aware of the different project that has been developed by the integrators in this field. This aspect can open the door for Swisslog to learn more about the new developments in the market and consider the possibilities of using those applications.

6.2.2 Supply chain flexibility

As mentioned earlier, having long term relationships with limited OEM suppliers would help Swisslog in developing solutions and access to resources. It would also help Swisslog identify the most suitable integrator based on the project requirements. Moreover, with supplier 1 providing EoAT solution along with robots and Swisslog able to do PLC programming for few standard applications (eg Star robots), it can consider going to the integrators only for other activities. This would enable Swisslog to take cost advantage in the long term. However, specialized applications with vision systems, custom EoAT would require specialist integrators who would be provided through OEM's.

Therefore, having relationships directly with the OEM could provide Swisslog with new product flexibility since it offers the option of having both close relationship with limited OEM's and at the same time access to large network of global integrators, supporting the innovation process of the technology center. This would imply a medium to high flexibility in terms of developing new solution in long term or specific new design for a project. The same logic as the above would hold good for mix flexibility too, since with access to large number of specialized integrators through OEM, it would be easy to provide the suitable EoAT solution, vision system or robot hardware too. Regarding delivery flexibility, with many OEM's having same day delivery on regional basis, it would be beneficial to have required flexibility in terms of day and time, with this option. Since there would be global agreements and Swisslog having centralized spare parts centre, would gain the required visibility for entire company thus having the possibility to control costs.

Finally, considering the long term nature of relationship and the adaptations of resources for product development, it would be difficult to change the global OEM's on frequent basis, hence having low sourcing flexibility. On the other hand, since the global OEM's would provide most of the required

resources and contacts in terms of the robot subsystem and considering the role of integrators too in providing solutions, vendor flexibility would be medium to high.

6.2.3 Type of relationship

The main aspect of this alternative is related to having main relationships with OEM supplier aiming to serve as single point of contact, where Swisslog can decide whether to have in-house some activities that could eliminate the integrators from the picture. Understanding the atmosphere of this relationship is an important aspect to analyze.

The most important parameter in consideration to the relationships with the OEMs would be related to the power and dependency. As it has been shown, the OEM suppliers are big global players whose major business is not the intralogistics robotics applications, which represents only a minor share of their total business. For Swisslog, on the other hand, that is all what it is about. Therefore from a power and dependence perspective, there is no balance between Swisslog and the OEM supplier's, with the OEM supplier being in better position than Swisslog. However, from a power and dependence perspective is also suggested the unbalance between the companies can be use a constructive way that would benefit both companies (Gadde & Håkansson, 2001). But, that is something that cannot be created by a decision made on a given point of time. It is important analyze how the trust and commitment are involved in the relationships as well as the conflict and cooperation between the actors. The atmosphere for trust and commitment in a relationship cannot be defined by a certain decision, but rather, it is built up over a period of time with series of interactions between the actors.

Since all the OEM's have approved system integrators through which solutions are given to customers like Swisslog, it would be difficult for the OEM point of view to consider Swisslog and system integrators at the same level. This unless, Swisslog tends to do some of the activities regarding PLC programming and engage the OEM's in developing new solutions in the particular industry segments. Currently, many integrators help the OEM in enhancing the robot and major revenue for OEM comes directly through the system integrators owing to high volumes. Hence, going forward with positive outlook on Swisslog specific markets, if Swisslog also manages to gain volumes through global consolidation, then it can take leverage and enhance its power relation.

The purchasing process, where robots are common products to be bought in many projects and the EoAT mounted on the robot that makes the difference, the relationship with Swisslog and OEM suppliers can be treated as "simple" with low involvement and high continuity. But in cases where Swisslog contemplates to do certain activities done by integrators and also develop new solutions for certain industry, then it would lead to high involvement. Since currently the OEM suppliers are not involved to great extent in design phase of projects as compared to the integrators. But going forward this may change leading to "complex relationship" where Swisslog and OEM would have high involvement and high continuity. These dynamics are graphically display on Figure 6-4

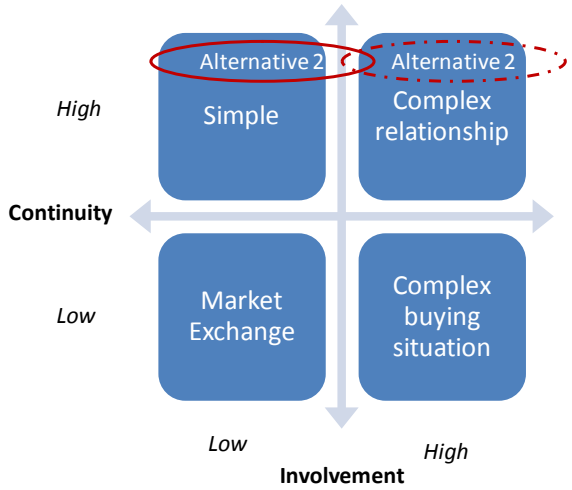

Figure 6-4: Degree of involvement and continuity-Alternative 2

6.2.4 Project based organization

Based on the long term relationship with global OEM's, there would be potential benefits that could be gained which otherwise would not be obtained from a project organization perspective. As discussed in project organization section, there would be effects on the permanent network due to changes in temporary network. This can be seen in terms of development activities where project based solutions developed could be further enhanced to create a new standardized solution due to long term relationship. It would help Swisslog to move away from transactional approach towards relational approach and look beyond the project boundary.

This will also help in creating standardized solutions in the long term when mutual adaptations of both Swisslog and OEM resources have taken place initially for the development of the solution. As it has been seen that individuals sometime hold the link between the organizations, further strengthening the trust and commitment required, this option would help this to happen. This can be started from the sales phase itself in order to take leverage of both the relationship and experience of OEM. This would increase the efficiency of relationship.

From both the supplier and Swisslog perspective, it would be easier to have resources reserved for the robot subsystem activity for development, innovation, etc, so that OEM would for certain the intentions of Swisslog and provide better service in terms of availability of resources and time. But, all this would mean increased investments from Swisslog and long term commitment with the OEM suppliers. Considering the uncertainty, increased investment would be difficult based on the current situation.

To summarize, the option of going to OEM directly, would help Swisslog have consolidation benefits, long term relationship, relational approach and access to global network. But, it would make Swisslog increasingly dependent on the OEM's, increased risk due to increased investments require. This especially a drawback considering the uncertainty involved in getting orders for robot projects.

6.3 Alternative 3: Global integrators

The purchasing approach in this alternative/strategy is to purchase solutions from global integrators who in turn would buy robots from select few robot suppliers as mentioned by Swisslog as seen in Figure 6-5 below. As far as the global integrators are concerned, they can also be limited to select

few in order to have the flexibility of choosing from various specialists for different applications to avoid the risk of being over dependent on single integrator. Considering the projects such as “Star robots” where the logic of the solution holds good in all cases, except the EoAT, global integrators would provide the much needed economy of scale and consolidation benefits that Swisslog lack at the moment. By using the characterization of global integrators, it is mainly those integrators with local presence in more than one Swisslog region so as to gain advantage of local synergy which is very much required considering the nature of the projects. With global agreements with global integrators, bargaining power can be realized across various Swisslog regions. This is an advantage when compared to going with a new integrator in a different region in order to provide a similar solution that was executed in other region.

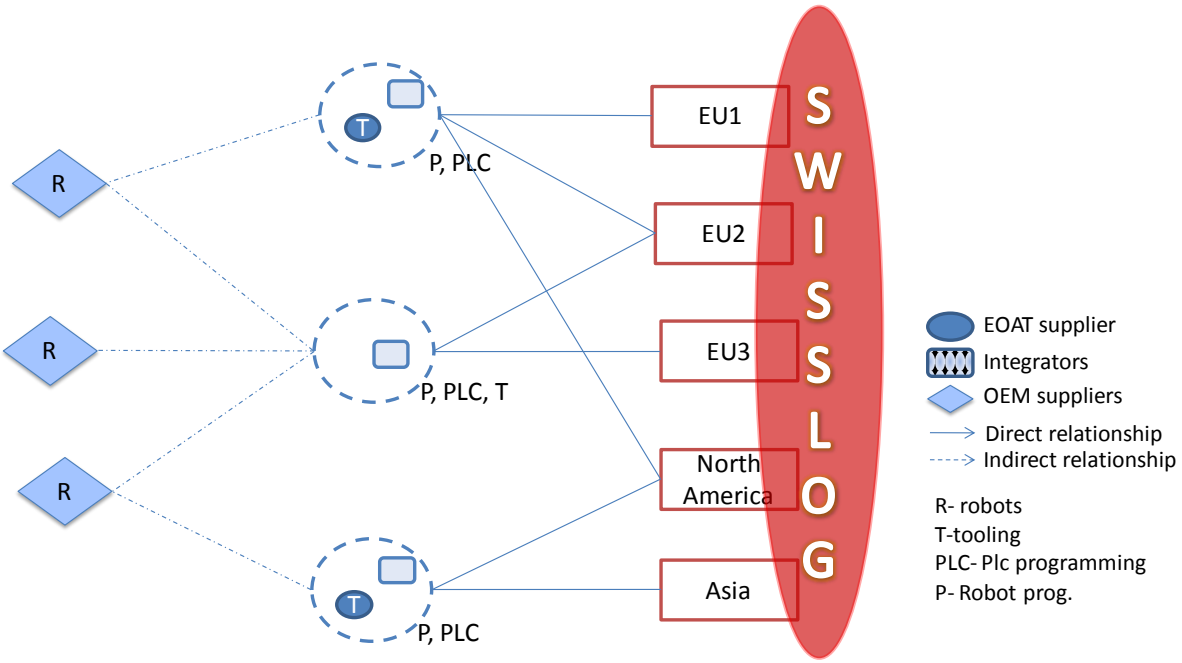

Figure 6-5: Network structure of alternative 3: Global integrators

6.3.1 Supplier base structure

This scenario Swisslog approaches the select few global integrators who are capable of meeting the customer requirements. The global integrators in turn would go to a particular robot supplier based on the choice of Swisslog as the first option. In cases where the Swisslog selected robot suppliers are not able to meet the needs then other robot suppliers are considered. These robot suppliers who would have good relationship or partnership with global integrators would also provide the necessary cost benefit which would benefit the project. Hence in either case Swisslog selected robot supplier or the integrator selected robot supplier would help to gain the cost advantage due to necessary agreements and long term relationship between the firms. Considering the aspects of static, dynamic and hidden costs as suggested by Holweg et al. (2011), global integrators would reduce the costs in many ways. These can be mentioned in the following ways:

With global integrators there would be the possible of static costs in terms of customs and duty to some extent since there would be cases where products may be bought from other unit where integrators have presence. Search cost and agency fees for the identification and interaction with local players from the integrator point of view. This may include the installation and commissioning

in case the global integrators wish to outsource it to their local partners. But from Swisslog point of view it would not affect since the integrators remain the direct point of contact.

As far as the price of robots are concerned, global integrators can take more leverage in terms of volumes from the OEM's, thus benefiting Swisslog to have cost advantage if the margins are not very high from the integrators.

With regard to dynamic Costs, global integrators tend to consolidate warehouse stocks and inventory at a central location without concentration on local regions for cost benefits may give rise to inventory obsolescence due to long logistics lead times. This may be the fact even when global integrators have local presence. This may also lead to emergency shipments on few occasions giving rise to increase in cost. In case there is no same day delivery, it means Swisslog may have to increase the safety stocks giving rise to inventory costs.

There are always hidden costs involved in various forms. At a global scale this would include currency fluctuations, labor cost inflation which would vary across regions, the increase in costs for overhead for dealing with international supply chain. Going global would always deal with the element of political risk and instability.

Considering the global sourcing parameters mention in supplier base structure 2.4.3, having global integrators would enable the opportunity to enter new markets and take leverage of the global experience and network of these integrators. As Gadde and Håkansson (2001)mentioned, the need to share resources is important and not necessarily invest in resources to a great extent. It would also be essential to gain leverage of similar projects done by global integrators that would benefit Swisslog when executing the project.

With Swisslog having a software team if a standardized module can be developed with inputs from integrators over a period of time, Swisslog can benefit from having integration activities for the standard projects inhouse which would reduce the dependency from suppliers when using single sourcing. This however has to be weighed against the possibility of getting standard projects from the customer due to the present uncertainty as mentioned earlier. The possibility to develop and perform the activity in house is only possible with long term partnerships, adaptations of systems and "trust and commitment" (Gadde & Håkansson, Purchasing and the Actor Structure, 2001). However, this could also lead too have single sourcing approach towards the supplier base increasing the dependency from suppliers. Therefore, the potential of achieving standardization is reliant on the risk of becoming to dependant from a single source, possibly leading to price escalation which a major risk of having a single source according to Trevelen & Bergman (1988).

At the same time if one looks at the possibility of developing core libraries, this option would also enable the target to achieve standardization which is part of the global strategy. Through this option in case Swisslog decides to develop the solution in house, the standard modules and the much needed EoAT flexibility would enhance the efficiency and the product offering of Swisslog while at the same time it can serve as means to reduce the dependency from suppliers. Since resources in the robot system are dependent on each other to certain extent, it is only possible to achieve the knowledge and capability to develop standardized solution for PLC programming and not the robot controls as such. Hence it is important to consider the views of all stakeholders internally in order to develop a particular standardized module that would be suitable across all regions.

6.3.2 Supply Chain Flexibility

Considering the various flexibility parameters mentioned by Gosling et al. (2010), this option would have a high opportunity for new product flexibility depending on the market situation and needs by the customer. Global integrator means access to a global network which translates in to high access flexibility to various resources that could be gained on a global scale. On the other hand it would be difficult to have high mix flexibility in the product offering considering the amount of investment done in order to enhance and develop a solution or the robot programming for that matter. However certain mix flexibility can be obtained with the help of another global integrator with which Swisslog has long term relationship with. This can be applied to EoAT, where the design mostly varies from every project, with global integrators and the global network they have the differentiation can still be achieved from Swisslog point of view.

With option of having long term investment with global integrators and possibility to select other integrators based on uniqueness of the projects, the vendor flexibility can vary between being low to medium. On the other hand, considering the medium to long term relationship between Swisslog and global integrators, it would be difficult to change global integrators frequently due to high amount of investments done in the relationship, hence having low sourcing flexibility.

6.3.3 Type of Relationship

Collaboration with global integrators would mean adaptations of resources in order to increase the efficiency of the relationships. Considering the global nature, scale of operations and involvement with the global integrators, Swisslog would need to move towards “trust and commitment” which can be developed over a time through series of interactions. With Swisslog having the capability to do system integration to certain extent based on the project it would take considerable time and resources to match the skills of the integrators. With global integrators, comes the knowledge and skills that are very much required beyond the boundary of the project. This may be in the areas of product development or innovation.

Based on the degree of involvement and continuity matrix by Gadde and Håkansson (2001), the relationship can be determined as high involvement with possible high continuity based on uniqueness of the project. This indicates the complex relationship involved with this option focusing on efficiency improvements through adaptations for cost benefits over time.

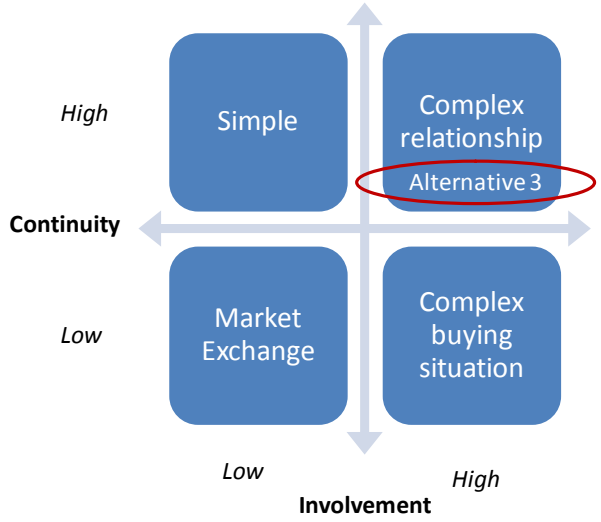

Figure 6-6: Degree of involvement and continuity-Alternative 3

6.3.4 Project based organization

With global integrators and ability to take consolidation benefits, it would be appropriate to have long term partnerships considering the possible benefits that could be gained by adaptations in the long term as mentioned in section 2.5. Since adaptations increase the efficiency of the relationship performance, it is ideal in case of Swisslog and integrators considering the various interfaces and Standard Interface System (SIS) which each integrator has to adapt while working with Swisslog. This would also enable the issues during the interface of various subsystems since the integrator would have experienced the learning curve. This going forward would enable the actors to focus on a bigger picture apart from the existing project, in terms of innovation, new product development or value addition to customer.

Having witnessed the uncertainty in robot project both in terms of volumes of robot purchase and number of project carried on yearly basis, this option may call for risk. This is because long term relationships require investment from both buyer and seller. With resources adapted to each other and the case of lock in effect created due to sharing of resources, it would make it impossible for either party to make profit unless and until there is certain revenue inflow. Lack of robot projects results in inefficient utilization of resources which would result in increased cost to the company.

In case of one off project with unique nature, where the selected global integrators would not be capable of providing solution, then Swisslog has to look for other sources. This being the question based on the company strategy to take the project or not based on the profits, competition and additional cost incurred due to the uniqueness of project. This would also require a view of competitive advantage and return on investment, ROI, which the company would obtain from the project, which are the key aspects of make or buy decisions as mentioned in section 2.4.2

As far as customer support, after sales and spare parts are concerned, the same argument as mentioned in the above section holds well with consideration to cost advantage in comparison to integrators. Another aspect to consider is the decreased cost of inventory for Swisslog in case there would be more spare parts in inventory when sourced from integrators compared to robot suppliers. With few global suppliers offering same day delivery, it may be feasible to have direct agreements with robot suppliers instead of going through the integrators.

In few regions where the supplier themselves take the role of global integrators, this option would be suitable considering the same aspects and leverage in terms of consolidation and standardization benefits it aims to offer. There could also be a mixed strategy considering the market situation in each region. Ultimately it is the benefits that have to be achieved irrespective of the strategy followed.

It can be inferred that, the global integrators provide the much needed consolidation benefits, handle uncertainty by having more than one global integrator for a region and develop long term relationship translating to cost efficiency. However, there is a risk of global integrators becoming competitors and decreased utilization of resources if there are less robot projects to deal with.

6.4 Comparison of Alternatives

Having analyzed the various alternatives in the above section, this section intends to summarize the important parameters and make a comparison between the three alternatives based on the parameters discussed above. This is as shown in Table VI.

Looking at the costs defined as static, dynamic and hidden, it varies based on the options and situation. In alternative 1, where emphasis was mentioned on local suppliers had comparatively less costs on all three parameters but had the disadvantage regarding global access, consolidation and standardization benefits which would have an impact in the long term. Alternative 2 and 3 on the other hand tend to have increased costs due to the global sourcing parameter which would be not attractive in the short term but would be an advantage in the long term. There are several hidden costs as mentioned, all of which cannot be accounted for. This makes the actual comparison of all the three alternatives difficult due to several unknown factors that would arise based on project basis. Moreover, since Swisslog has not been doing any of the PLC programming activities, it would also be difficult to gauge the actual costs in case the activity is performed in house. There would be several costs both from the short term and long term perspective that would arise based on the uniqueness of the project.

Regarding the number of the suppliers and its implications in the dependency, the three alternatives can offer potential benefits if single sourcing is used. However, this single sourcing policy can be taken to single sourcing on regional basis as is the case for alternative 1 or as in alternative 3, one supplier can be have preference for two or more regions in accordance to their global scope. The risk of becoming dependant from suppliers is present in all three alternatives. Nevertheless, the tradeoff against the possible benefits to be gain from the relationship can be considered higher for alternative 2 and 3 due to the possibility to develop global synergies, standardization and/or new solutions.

Concerning the supply chain flexibility parameters, alternative 1 with the ability to choose different suppliers for each project would have low new product flexibility. Alternative 2 would vary between medium to high depending on the possible development of innovative solutions with a particular robot supplier. This holds true with alternative 3 where development of new products with global integrators would be possible only on high continuity basis. This can be in terms of creating standardized solutions or modules for PLC programming that would increase the efficiency. Hence alternative 3 has medium new product flexibility.

Since EoAT is very unique and varies greatly for each project, the global integrators through the global network would be possible to get access to various types of EoAT specialists. This holds well for global robot suppliers too. Hence, alternative 2 and 3 have medium to high mix flexibility. With alternative 1 limited to local presence and able to change suppliers based on project, it would have high mix flexibility.

Delivery flexibility having to deal with less lead times, local presence scores importance where alternative 1 and alternative 2 with suppliers having local presence and warehouse would have high delivery flexibility. With global integrators who also would have local presence, but not necessary in terms of warehouse in every region, hence having low to medium delivery flexibility.

Alternative 1 would have high vendor flexibility in terms of high flexibility this option provides in the choice of products and ability to have various different services from various suppliers based on project. Alternative 2 and 3 which calls for long term relationship would very much depend on the close partners to provide various solutions through their global network. But it would be limited since it is not possible to have all resources and services in form of specialists all time. Hence would have low to medium vendor flexibility.

Sourcing flexibility would be high for alternative 1 since it is easy to change suppliers based on the project, in comparison to other alternatives, where resources would be adapted to certain extent. This would make it impossible to have high flexibility in this aspect.

Table VI: Assessment of alternatives in relation to individual relationships parameters

Parameters	Alternate 1	Alternate 2	Alternate 3
New Product Flexibility	Low	Medium-High	Medium
Mix Flexibility	High	Medium-High	Medium-High
Delivery Flexibility	High	High	Low-Medium
Vendor Flexibility	Low	Medium-High	Medium-High
Sourcing Flexibility	High	Low-Medium	Low-Medium
Degree of continuity and involvement	Complex buying	Simple-Complex relation	Complex relation
Costs	Dynamic costs dominant	Static costs dominant	Static costs dominant

As discussed in the above alternatives, alternative 1 would have complex buying situation where there is high involvement of the supplier during the project but does not continue for all projects. Alternative 3 would have simple to complex relationship since the robot can be bought from different suppliers who Swisslog would have agreements, with robot as such not being critical part of the system. But for the fact if TC intends to develop new solutions in the area of picking then partnership with robot suppliers would be helpful in various aspects.

Having considered the vendor flexibility, sourcing flexibility and the relationship aspects, the below Figure 6-7 intends to place each of the alternatives in the respective positions based on the analyzed parameters.

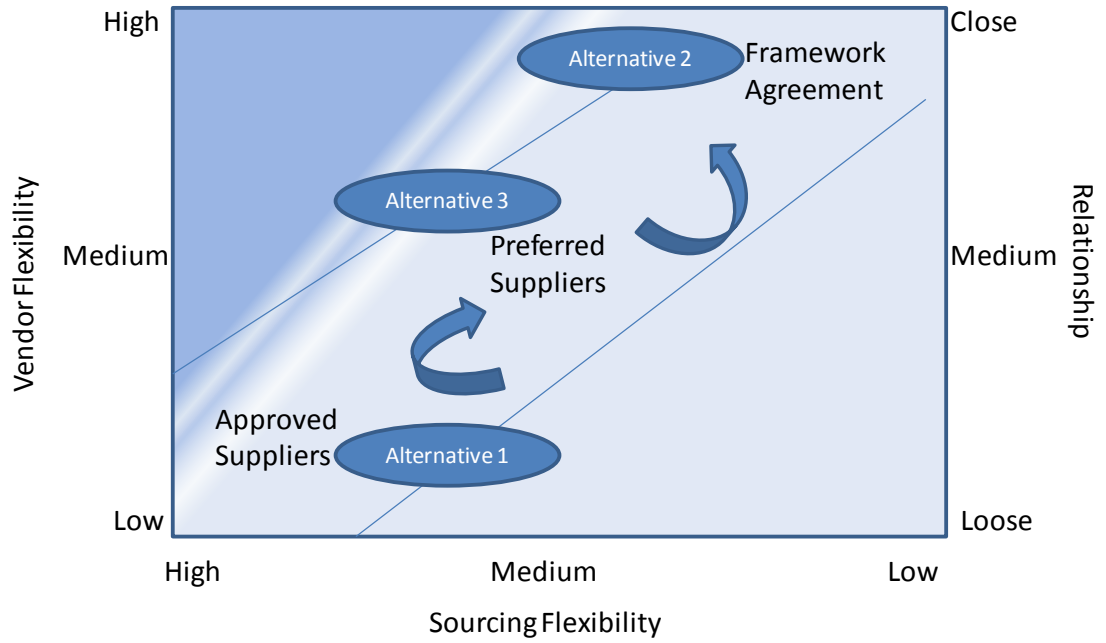

Figure 6-7: Alternative in the context of sourcing flexibility, vendor flexibility and involvement of relationships

As shown in the figure, it can be seen that alternative 1 which deals with high sourcing flexibility, low vendor flexibility would result in loose relationship and hence having certain approved suppliers for each project would be suitable. Alternative 2 with low sourcing flexibility, high vendor flexibility would result in close relationship. It is appropriate to have framework agreements with these suppliers. Alternative 3 with medium to low sourcing flexibility and medium to high vendor flexibility will result in having a medium to high involvement relationship. It is appropriate to have "preferred supplier" agreements so as to make them the first choice suppliers before the approved suppliers. For the development of these types of relationship it would be important to consider the atmosphere of the relationships. As as discussed in the previous sections, trust and commitment for alternative 1 and 3 and the power relationships between Swisslog for alternative 2, emerged as relevant characteristics in the atmosphere and the different types of suppliers would have different facets for each alternative.

As far as the costs are concerned, it is difficult to foresee the exact costs for various activities due to various uncertainties. The table gives a comparison of the dominant costs that would prevail based on the alternative. Due to the local nature of suppliers in alternative 1, there can be increased dynamic costs. The global nature of business and access to various global players, there would be increase in customs, transportation etc thus making static cost dominant in alternative 2 and alternative 3. Hidden costs are always subjective and various parameters would exist at operational level making it difficult to gauge the cost.

6.5 Implication of the alternatives

The previous sections on this chapters has focused on the analysis of the alternatives based on the parameters defined by the supplier base structure and individual relationship parameters as defined by the strategic sourcing framework. At the same time it has used as the specific business characteristics of the company as project based organization as mean of evaluation for alternatives. However the implications of going for each alternative extend beyond these aspects. Although the

organization and interactions and the boundaries of the firm were analyzed first as part of the development of the alternatives, is still important to see how the results of the evaluation of these alternatives have implications over them and how all relate to the contribution to the different roles of the sourcing strategy. As mentioned earlier about the various roles of sourcing which varies from rationalization, development to structural roles. Rationalization dealing with various costs (static, dynamic and hidden), development had been indirectly dealt with the nature of supplier relationship based on the possibility to develop the PLC knowledge, product development and innovation etc that could be associated with some new product and mix flexibility. The structure role which indicates the number of suppliers to be used, pointed towards the use of more than one supplier with advantages of multi sourcing. But in few unique cases it would be inevitable to depend on a single supplier having the advantages single sourcing.

If the current situation remains as is suggested by alternatives 1, there would be important tradeoffs as the structural role of the sourcing strategy suggest. One main gain by the company would be the high flexibility the company would have to change from suppliers when relating with local integrators. In this sense, it can overcome to some extent the uncertainties of the business environment while at the same time having local know-how and interactions for the different project phases. However it would be at the expenses of the possibilities having suppliers who can provide solutions on global scale, diminishing the potential for achieving consolidation, as mean of rationalization role, or developing solutions that could be replicated worldwide. From an organizational perspective, the current purchasing organization has been established to reach global synergies and the potential to be gained by this would be harmed if the relationships remain on regional basis. Still, the role of the sourcing strategy would be to provide knowledge of the market but the geographic limitations of the material group managers can limit the possibilities of providing this knowledge to the project purchasers. On the other hand, there is potential to decrease coordination and interaction since the relationships would remain on local basis, not adding many requirements to organizational changes. The boundaries of the firm conversely, suggested the potential to develop core libraries or internalizing to some extent the PLC programming activities. The approach in alternative 1 would reduce the gains of internalizing the PLC since given the local nature of the relationships and freedom to change suppliers for project to project will increase the learning curve time and reduce the possibilities of achieving synergies both in the permanent and the temporary network.

When it comes to alternative 2, the organizational implications are less clear since they would depend on how the type of relationship develops. As it was shown in the evaluation of alternative 2, this alternative can be beneficial for Swisslog due to the new product flexibility it can offer, reflecting the potential to contribute to the development role of the sourcing strategy through the innovation process of the technology center. However, the potential to mobilize OEM's to engage on new product research can be limited due to the power unbalance to the relationship and their focus on other industries. In addition, the type of relationship would change if Swisslog engage on developing solutions with OEM supplier, switching from being a simple business relationship towards a situation where there are complexities that needs to be managed by the purchasing organization. Although the development of the solutions would be responsibility of the technology center, the purchasing organization would have to increase the interaction and involvement in this process. Since right now the purchasing organization is set with Material Group manager, working on global basis, this person can serve as bridge between the developments in the TC and the rest of the purchasing organization.

For this process to be effective, the communication channels among regions need to be in place and developed even further to address the natural geographical limitations. The boundaries of the firm on the other hand, do offer potential for the development of PLC programming in alternative 2. At this point the OEM suppliers are not working on PLC programming activities but the business environment of the robotic market has shown a tendency of OEM's integrating the Robot Controllers and the PLC into one device or by producing PLC devices. For this reason, the development of core libraries by Swisslog or the internalization of the PLC programming activity could be benefit since Swisslog would be more aware of the changes and plans of the OEM suppliers and increase the potential to contribute to the rationalization role and development of the PLC programming activity in accordance to the market changes.

Finally, working with global integrators as alternative 3 defines, can also have implication for the organization and the make or buy decision. From an organizational point of view, the complexity of the relationship due to the involvement and continuity would require increase interaction of Swisslog' purchasing organization and the integrators even more if one considers the potential for developing new solutions in partnerships with the suppliers. As with the case of alternative two, the material group manager working on global basis can serve as point of contact for the business relationship as long as the communication channels are in placed within Swisslog purchasing organization. However, in the case this alternative, the involvement would be higher since the global scope of integrators implies the possibility of Swisslog developing on different regions with the same integrator. For this reason, the frequency of interactions for the purchasing organization would increase. But this can also open the possibility of the developing organizational synergies and facilitate the interaction between companies and within Swisslog due to the experience in previous projects. These synergies can also be translated to the customer support phase in order to increase the delivery flexibility. However, it can at the expenses of increase dependency from integrators, affecting the structural role through the effects in the organization. On the other hand, having global integrators can result in a great potential with regard to the boundaries of the firm. The global nature of the integrators, their focus on the intra-logistic business and the potential of having long term relationships would be a good scenario for developing core libraries or even internalizing the activities. If core libraries are developed by Swisslog, the global integrators would be knowledgeable of the PLC codes due to the experience in previous projects, reducing the learning times. At the same time, it could represent that Swisslog takes over on the customer support phase since the continuity of the relationship could lead to this situations. However, in order to achieve these benefits, it can be required to have one person besides the Material Group Manager leading the relationship regarding PLC issues on global basis. This is due to the fact that the achievement of these mutual benefits would require high coordination on the permanent network. This could drive possible organizational changes and even the creation of new roles in the organization.

7. CONCLUDING SUMMARY

The main purpose of the thesis was to develop a global sourcing strategy in order to streamline the purchasing process globally across all Swisslog's regions. The thesis started by analyzing the importance of purchasing and the growing strategic importance. After an elaborate literature review, developing a sourcing strategy can be considered as a multi dimensional activity. It requires the consideration of various parameters to develop a strategy. Based on the purpose and the problem of the company, few important parameters were considered in the sourcing model developed that helps to define the strategy based on the existing situation of the company. In order to develop the strategy it was important to understand the internal and external aspects of Swisslog in order to understand the challenges faced by Swisslog. After which three different alternatives were developed, this also includes the existing process followed by Swisslog. This was followed by the evaluation of alternatives based on the sourcing model developed from the theoretical framework.

Understanding the internal parameter of Swisslog based on various theories shows the growing importance of sourcing during the recent past with its multi-dimensional role that affects the bottom line of the company. Swisslog with a new purchasing team have a considerably high sourcing maturity process on paper with increasing importance given to the early involvement of the purchasing team for various projects. Hence, the strategy that would be developed has to consider the sourcing maturity of Swisslog, which enables long term relations and increased cross functional interaction. Additionally, the consolidation of past projects indicates the high variation of unique projects executed across various regions in different ways. It also indicated large uncertainty regarding the robot project orders, volume of robots per project and possibility of having similar projects. This uncertainty challenges the supply side of the company making it difficult to have clear visibility for having supplier relationship and the business potential of investing in developing internal capabilities. The project based characteristics though helps to counter the uncertainty it tends to have larger implication in the long run with regard to supplier efficiency and costs. As mentioned by one of the interviewee, "…… a long term perspective, it is important to develop a product while executing a project". For projects with robots, the robot subsystem has been a critical part of the overall solution offering to end customer by Swisslog. It has been evident that Swisslog have the internal capability for PLC programming limited to projects which are less complex and projects based on previous experience. Within the robot sub system, EoAT has been the most critical and differentiating part of the entire system. This makes Swisslog dependent on the suppliers of these components either directly or indirectly. The various degree of interdependency among these resources (EoAT, robot programming, and installation, commissioning and testing) makes it difficult for Swisslog to make them. Hence, with respect to the PLC programming the analysis has lead to the consideration of providing "core libraries" which could help in mitigating the cost incurred in buying with the help of standardized modules. Considering the robot subsystem being a "black box" and decreased visibility of costs involved for this activity, it would require increased specialization that could be gained over a period of time. This is subjected to the positive market for robots and ability to gain greater leverage during the customer support phase.

The external aspects considering the different suppliers have shown that the OEM suppliers prefer Swisslog to approach the integrators concerning various projects. This can be attributed to various activities which Swisslog needs can only be provided by the integrators, which is their core competence. Supply market analysis of OEM suppliers, integrators, EoAT and vision suppliers has also

shown that, there are many specialized players providing various different solutions. It is difficult to find an integrator who is an expert in all the applications corresponding to the business segments. There also exists a strong collaboration between integrators, vision and EoAT suppliers who together offer various solutions. On the other hand they are cases where OEM suppliers take the role of EoAT suppliers and have partnership with integrators and vision suppliers to provide solutions. Hence, there exists no clear boundary lines and activities are carried out by various suppliers depending on the project and application.

Keeping in mind the above mentioned aspects, three different purchasing strategies were discussed. Purchasing robots through 1) Local Integrators, 2) Direct from OEM suppliers and 3) Global integrators. In order to gain the consolidation benefits, product v/s project approach, long term relationship and the best fit with the overall strategy of Swisslog alternative 2 and 3 outweighs alternative 1. But due to the dependency on suppliers, uncertainty and investments required, alternative 3 has an edge over alternative 2 and alternative 1. As a matter of fact there are tradeoffs in all alternatives that have to be considered and no one solution may be the best considering the dynamic environment. However, it is clear that alternative 2 and alternative 3 do increase the possibilities of the sourcing strategy to contribute to the rationalization and development role. Alternative 1 would decrease dependency on suppliers but at the expenses of achieving cost reductions in the long term through rationalization or increase the business potential of the company as the development role suggest.

Keeping in mind the present Swisslog situation and the overall strategy of the company, alternative 3, global integrators, could be the defining strategy that could serve as a starting point for Swisslog. By purchasing robots through global integrators, Swisslog can have consolidation benefits, find synergies in projects across regions and develop close relationship with few global integrators based on the focus industry segments of Swisslog. With global integrators, Swisslog can also overcome uncertainty in the projects by selecting a particular global integrator specialized in a particular application. Specialized integrators would also mean effective utilization of resources for the projects and decreased risk of investment cost from Swisslog. Though there are very few integrators with global presence, the increasing importance of automation, growing focus on having increased efficiency and long term cost reductions lays emphasis on automation. With the partnership of global integrators who are also in to various other industry segments, Swisslog would gain through increased consolidation and possible development of new solutions through long term collaboration. This would not only ensure the development of project but also the product from a long term perspective.

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APPENDIX A. INTERVIEW QUESTIONS

Common Questions:

1. Can you tell us about your background.(Experience in Swisslog)

Category 1: Project Purchaser Questions – Purchasing organization

The following questions were used as guidelines for the interviews with the members of the purchasing organization.

1. What is the strategic importance of the robot systems in Swisslog solutions?
2. How is the current process of robot purchasing done?
3. Who are the key stakeholders involved in this process? (Role of the person and how many?)
    a. Sales Phase
    b. Project Realization
    c. Customer Support
4. What interdependencies are there between the activities, resources and actors involved in the production of the robot system?
5. How does each of the resources/activities of the robot system contribute to the strategic importance of the robot system?
6. How is the existing relationship between Swisslog and Integrators/suppliers?
7. How were the existing suppliers/integrators chosen?
8. What benefits does Swisslog gain from the existing suppliers/integrators?
9. Value addition to Swisslog customer if Swisslog integrates the software.
10. What are the benefits of having local integrators?
11. How are the local integrators contributing to the VALUE of Swisslog?
12. How are integrators becoming competitors?
13. How much is Swisslog and integrator dependent on each other, who is more dependent?
14. Swisslog go to integrators always or have there been occasions where integrators have come to Swisslog?
15. Key challenges faced in the existing process of purchasing.

Category 2: Other organizational units

The final guideline for interviews with personnel from other organizational units was composed of general questions and specific questions according to the role of the interview

General

The general questions were focused on addressing the implications of relating directly to the OEM suppliers and the integrators.

Direct to OEM suppliers

1. What would be the necessary changes/problems if going direct to OEM and then the integrators?
2. How would the selling process change when dealing directly with OEM then the integrators in terms of:

- Documentation
- Quotation
- ABB, KUKA as a single point contact?, will it be a problem?

3. Will it be easy in the sales phase to prepare quotations for 3 different suppliers in comparison to one supplier in the current process?
4. What resources would be beneficial to have it inside Swisslog if dealing directly with OEM's?
5. In case of a particular resource developed inhouse, what would be the implications if it is CENTRALIZED, region wise (e.g. TC taking the lead)
6. Effect on customer support.
7. Possible benefits to gain from the knowledge of the OEM's and their resources, how easy would that be?

Direct to Integrators:

1. If having local integrators in each region, what would be the feasible number from a sales phase/purchasing perspective?
2. What are the benefits of having local integrators?
3. How are the local integrators contributing to the value of Swisslog?
4. What are the costs of having multiple integrators at each region and interact with them on every new project?
5. How do you avoid competition from local integrators?
6. What if Swisslog is teaching integrators, what activities if done by Swisslog, this process can be avoided?
7. Tie up with complimentary suppliers who do system integration as well as other activities?
8. Partnerships with other similar Swisslog kind of companies?
9. Possibility of having contract dealing with installation, testing etc at local level and the rest developed by Swisslog.

Sales Personnel

The following questions were used in the interview with the sales manager.

Strategy

1. Describe the general, latest WDS strategy of Swisslog for sales.
2. What differentiates WDS Swisslog from the competitors? What is the goal of WDS in order to achieve those potential and strengthen WDS market position?
3. After the recent acquisition, what has been the impact in sales phase? How do customer perceive Swisslog portfolio?
4. What would be the role of Technology Centre in the solutions being developed?
5. How do you foresee the markets for robots?
6. What do you mean by providing standardization solution for customers?

Selling process

1. What is the criteria to approach a project, order value for sure, chances of getting these kind of projects again?, customer scope itself?, customer brand?, global presence?, re order from same customer?, Customer support potential, ROI?

2. What are the main drivers to get orders? How competitors impact the hit rate of WDS projects.
3. What are the challenges of getting order for projects involving for robot systems?
4. What is critical from customer point of view? Different solution totally customized or relies on certain established case studies and proven solution?
5. On the projects in the Nordic region where robot systems were used, what was the contribution of the integrators/robot supplier for winning the projects?
6. How does the sales team manage and control the cost of sales in terms of time spent and additional resources required to develop a proposal for a customer?
7. How important is customer support agreements as selling point? What preferences does customer have when structuring these agreements?
8. Advantages of doing similar projects?
9. Have been several similar projects in Nordic; was it a strategy or co incidence to have got an opportunity to do similar projects?
10. When engaging in a new project, would it be feasible to work only on projects where Swisslog has previously gained experience, where solutions has been delivered in the past?
11. How will knowledge exchanged across each regions for generating new order and share experiences?
12. How does Robot project fit in to the overall strategy of the organization, importance, %resource allocated, % investment etc?

Software Personnel

The following questions were specific topics treated on the interviews with software personnel

1. What is your current role and activities undertaken as software realization manager/ project activities?
2. How is the interaction process with customer undertaken for development of the solutions?
3. Who is involved in the interaction process with customer?
4. Specific, in relation to the robot system what is your involvement on a project?
5. Where are the interfaces, systems where software is used?
6. What are the uses of robot software/programming?
7. How is the integration of the different subsystems activity performed?
8. What specific aspects can be mentioned in relation to the integration of the robot systems
9. How can software solutions provided by robot suppliers facilitate activities as robot programming and system integration?
10. Can system integration, robot programming and tool design be done by different suppliers? What level of independencies and coordination is required for these activities?
11. Does programming change from each robot supplier? Would there be any advantages in software part of project to work continuously with the same robot system supplier?
12. Can Swisslog do the activities done by integrators? (System integration, robot programming, robot software, *tooling?)*
13. What are the capabilities required to develop tooling knowledge/programming knowledge/system integration knowledge?
    a. Can Swisslog develop these capabilities?
    b. What resources would be needed?
    c. How much time would be required for the development

    d. How much time would be required for performing the activities in every project?
    e. Do you see any advantage of doing this?
14. Would this provide competitive barriers for integrators to become competitors?
15. Patent issues related to programming etc if any?
16. What support is required for customer in terms of software support:
17. Role of integrators and suppliers in the customer support process for software.
18. What are the general guidelines followed for robot system development? (NoWaste software architecture?
19. What do you mean by system integration based on the architecture?
20. What is the strategic importance of the robot systems to Swisslog? How specific are the robot programming, tool design and system integration?
21. What value does the each resource activities provide the end customer?
22. In what ways does each activity/resource contribute the core competency of Swisslog?
23. What is the USP/differentiation value created by Swisslog from competitors/integrators?
24. What are your views, adv, disadv if system integration done inhouse?
25. Swisslog teaching integrators.....do Integrators think the same way that they end up teaching robot integration to Swisslog?
26. In case integrators become competitors, what happens to WMS, AMS, past example of integrator becoming competitor.....do they undertake software activity too?
27. If yes, then it seems to be easy to learn and develop the WMS kind of systems.....differentiation holds the key?
28. What is it Swisslog teaching integrators? what activities if done by Swisslog, this process can be avoided?
29. Interdependency.....how much is Swisslog and integrator dependent on each other, who is more dependent?
30. Swisslog go to integrators always....or have there been occasions where integrators have come to Swisslog?

Category 3: Supplier Questions

The question list shown above was used as guideline for the interviews with suppliers.

1. What is the robot strategy of your company?
2. Who do you want to develop close relationship with integrators, Swisslog kind of companies or end customers? And what type of relationship and why?
3. You provide tools, grippers, software etc, what do you see the role of integrators in future?
4. To what extent are you willing to provide customized software solution for end customers with Swisslog?
5. For Swisslog kind of companies, though volume may be less, there seems to be a great potential for product development activities, in coordination with warehouse designer, you views?
6. What are you major requirements from a strategic customer, partners etc apart from volumes?
7. How many Swisslog competitors do you have long term agreement with?
8. What are the benefits that Swisslog kind of competitors brings to your company?

9. If global contract undertaken, there would be consolidation to obtain volumes, but region wise it would not be possible to gain volumes, is that suitable for the company? What are the issues?
10. How is the information sharing process between regions in relation to previous project experiences
11. In addition Gripper portfolio, what relationship do you have with EOAT design companies?
12. How is the structure of Customer Service Agreements with the network of integrators? Who will be responsible for Swisslog's end customers?