Swedish University of Agricultural Sciences
Faculty of Forest Sciences

Department of Forest Products, Uppsala

Cost-based model for international logistics
- Case-study with IKEA Industry's supply chain in Russia

Kostnadsbaserad modell för internationell logistik
- Fallstudie för IKEA Industrys värdekedja i Ryssland

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Front photo: Fredrik Jönsson

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Summary

The global market is constantly changing, which implies that successful companies incessantly need to respond to new conditions of how they operate. One strong trend changing the structure of the market is globalization, making the business arena wider with intensified investments and trade across borders. Increasing the flexibility in international supply chains should be done by broadening the supply chain perspective. Supply chain management (**SCM**) are therefore an important concept, focusing on creating competitiveness by integrating supply chains (**SC**) and manage downstream and upstream relations. Resulting in competition through supply chains rather than individual companies.

Many companies in the forest and wood industry are focusing on company internal activities and therefore lack a broad supply chain perspective. This leads to in-efficient supply chains and limited contributions to the SC flexibility, leaving unused scope of competitive advantage and exposure on an international market. Also, the forest market is constantly changing with new industry investments and shutdowns. This leaves some forest industry companies with uncertain supply since they might lack their own forest possessions and are dependent on bi-products from other forest industries.

This study was conducted with the aim to identify processes, cost-drivers and estimate costs affecting the design of international supply chains of raw material in the forest industry sector. The approach was empirically driven with a flexible design since the method emerged during the time of the study.

The results of this study give a detailed presentation about the processes related to one specific international supply chain. International supply chains assume an understanding of related processes and costs, which could be facilitated by mapping the SC design. This thesis therefore started by mapping the SC and identify processes and cost drivers, followed by a detailed presentation about them and an estimation of related costs. A cost-based model was created to evaluate different SC alternatives and identify individual costs contribution to total SC performance. This gave an indication of the most cost-efficient SC design by including a broad SC perspective.

Implementation of SCM is currently focused on markets with pull characteristics and low customization. However, the findings of this project indicate SCM also being an efficient competitive strategy in forest companies – though the sector is characterized by low customization and market push. Efficient and un-biased sharing of information also was found to be an important aspect in international supply chains which could be managed by technological systems.

Keywords: *Forest companies, IKEA Industry, International logistics, International supply chains, Logistics costs, Mapping, Russia forest sector, Sourcing, Supply chain management, Supply chain performance*

Sammanfattning

Den globala marknaden förändras ständigt vilket förutsätter att framgångsrika företag arbetar kontinuerligt med att svara på nya omständigheter. En stark trend på den globala marknaden är globalisering som resulterar i en expansion av marknaden och intensifierade investeringar och handel över landsgränser. En ökad flexibilitet krävs för att svara på dessa förändringar och detta kan uppnås genom att bredda perspektivet på internationella värdekedjor. Supply chain management utgör därmed ett viktigt koncept som fokuserar på att öka konkurrenskraften genom att integrera och skapa - samt hantera relationer upp och nedströms i värdekedjan. Detta resulterar i konkurrens mellan värdekedjor snarare än konkurrens mellan individuella företag.

Supply chain management (**SCM**) är dock inte fullt implementerat inom skogssektorn där företag fokuserar på sina interna aktiviteter snarare än hela värdekedjans prestation. Detta leder till ineffektiva värdekedjor och begränsad flexibilitet, vilket i sin tur leder till outnyttjade möjligheter till konkurrenskraft och ökad utsatthet för en internationell marknad. Skogssektorn utstår dessutom ständiga förändringar genom nya investeringar eller nedläggningar av industrier. Vilket innebär en ökad risk och osäkerhet för skogsindustrier som använder biprodukter från andra industrier och saknar egna skogsinnehav.

Syftet med denna studie var att identifiera processer, kostnadsdrivare och skatta kostnader som påverkar designen av en internationell värdekedja för att leverera råvara inom sektorn för skogsindustrin. Detta innebar en empiriskt driven ansats med en flexibel design eftersom metoden för studien vuxit fram under tidens gång.

Resultatet från denna studie ger en detaljerad presentation om processer relaterade till en specifik internationell värdekedja. Internationella värdekedjor förutsätter en förståelse för relaterade processer och kostnader, vilket underlättas genom en kartläggning av värdekedjans design. Denna studie startade därför med att kartlägga värdekedjan och identifiera processer och kostnadsdrivare, följt av en skattning av relaterade kostnader. En kostnadsbaserad modell skapades för att utvärdera alternativ och identifiera individuella kostnaders påverkan av den totala prestationen av värdekedjan. Detta indikerade den mest kostnadseffektiva designen av värdekedjan genom att inkludera ett brett perspektiv av värdekedjan.

Implementering av SCM är fokuserad på marknader med hög kundanpassning och en pull strategi. Resultatet från denna studie tyder dock på att SCM utgör en effektiv konkurrensstrategi även i skogssektorn – som traditionellt karaktäriseras av låg kundanpassning och en push strategi. Detta koncept borde därmed implementeras ytterligare i skogssektorn. Slutligen indikerar resultatet också på att informationsflödet i internationella värdekedjor utgör en viktig aspekt. Detta flöde bör därmed hanteras genom effektiv dialog av opåverkad och transparent information, vilket kan underlättas genom tekniska system för kommunikation.

Nyckelord: *IKEA Industri, Internationell logistik, Internationella värdekedjor, Kartläggning, Logistikkostnader, Optimering av värdekedjor, Rysk skogssektor, Skogsföretag, Värdekedjans prestation*

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Uppsala, June 2017

Fredrik Jönsson

Abbreviations

EUR – Euro [European currency].

II(H) – Ikea Industry (Hultsfred)
IKEA Industry followed by an abbreviation of the industry name within brackets. H = Hultsfred, NVG = Novogorod etc.

IoS – IKEA of Sweden
Centralized supply chain planner and organizational unit within IKEA (www, IoS, 2017).

IWAY – The IKEA Way
Policy in IKEA related to social and environmental responsibilities (IKEA, 2016b; Andersen & Skjoett-Larsen, 2009).

PPS – Plant Protection Services

RU – Russia
RUB – Rouble [Russian currency]

RWE – Round Wood Equivalent
RWE short for *Round wood equivalent* is a measure to indicate the volume of wood in log form (ppt, IIH, 2017).

SBA – Swedish Board of Agriculture

SC – Supply chain
Network of actors (suppliers, customers etc.).

SCG – Supply Chain Guru
Supply chain management system developed by IKEA to integrate their supply chain (Jonsson *et al.*, 2013).

SCM – Supply chain management
Relates to integration of actors and management or establishment of upstream and downstream relations in supply chains. (Thomas & Griffin, 1996; Mattsson, 2002; Christopher, 2005).

SEK – Swedish kronor [Swedish currency]

SMA – Swedish Maritime Administrations

Spb – Saint Petersburg in Russia.

SWE or **SE** – Sweden

VAT – Value Added Tax
Value Added Tax is a consumption tax for goods and services sold for use or consumed in EU (www, European commission, 2017).

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1 Introduction

The first chapter provides an introduction and problematization of the study's purpose. This is followed by a presentation of the study's aim and delimitations. Thereafter, the outline of the study's content will be presented.

1.1 Problem background

The global market is constantly changing, which implies that successful companies incessantly need to respond to new conditions of how they operate (Näringsdepartementet, 2015; Mattsson, 2002). One strong trend changing the structure of the market is globalization, making the business arena wider with intensified investments and trade across borders (IVA, 2015; Gurgul & Lach, 2014). One factor behind globalization is technological innovations, reducing costs of transportations and reducing barriers in information-sharing (www, Kuepper, 2016; Gurgul & Lach, 2014). Other factors are political, economic and structural changes which opens up new markets and favour economical trade and investments, together with social interchange across country borders (*ibid.*). These factors are intensifying and contributing to an openness of the market, however they are not a given course. Primarily political factors can affect globalization in two ways, either increasing or restricting the openness of the market. This becomes clear when looking at for instance Russian restrictions in export and import additional to their unfavourable ranking on ease of doing trade across borders (www, WorldBank, 2017; FAO, 2012).

Globalization is a significant contributor to recent economic growth, especially in Central and Eastern Europe (Gurgul & Lach, 2014). However, economic growth also comes with challenges since an increased competition force companies to constantly improve their operations and quickly respond to changes in the market (IVA, 2015; Näringsdepartementet, 2015; Gurgul & Lach, 2014;). Companies in Central and Eastern Europe might face an especially tough challenge, since they lack a thorough experience of dealing with these challenges and to face the opportunities a competitive economy may bring (IVA, 2015; Gurgul & Lach, 2014).

Supply chains should therefore have the ability to be flexible and adapt upon new conditions on the market. This has become a major competitive advantage, especially for companies on a global arena where demand might vary with geography or local trends (Gurgul & Lach, 2014). One single actor has only an insignificant possibility to increase the total performance in supply chains, this is rather dependent on cooperation (Christopher, 2005; Mattsson, 2002). Supply chain management (**SCM**, see further section 2.1) therefore became an important concept in the 1990s, when the importance of different flows between actors were discovered. SCM focuses on optimizing supply chains independent of company borders, by looking at the entire supply chain from first supplier to end-consumer. The trend results in a shift from competition between individual companies towards competition between supply chains.

1.2 Problem

Forest companies and wood industries seem however to currently lack a full implementation of SCM concepts and keeps a narrow supply chain (**SC**) perspective (Larsson *et al.*, 2016). This leads to inefficient supply chains with limited improvement in SC performance, additional to unused scope of competitive advantage. Forest companies should therefore address this problem, especially since the competition of forest raw material increases due to its many applications (*c.f.* www, Skogsindustrierna, 2017). Additionally, climate changes

result in an increased uncertainty of supply of forest raw material, since it obstructs forest operations and transportations (Skogsindustrierna, 2017; Keskitalo *et al.*, 2016). Also, the forest sector is constantly changing with new industry investments and shutdowns (Skogsaktuellt, 2017; Jonsson, 2016; Mörtberg, 2016; Sennerdal, 2016). This result in an increased uncertainty in the sector, especially for forest industries which use bi-products from other industries and might lack their own forest possessions.

Complexities in forest companies also increase due to globalization. This moves current domestic supply chains to an international arena. Resulting in widely disperse actors and increased exposure for external risks (Hameri & Hintsa, 2009; Manuj & Mentzer, 2008; Wood *et al.*, 2002). Companies working in the furniture sector are additional to this facing change in manufacturing, where new production capabilities will arise in both industrial and developing countries (Hameri & Hintsa, 2009) At the same time, the furniture sector have a need for increased SC flexibility to respond towards changes in customer demand with shorter product life cycles and increased customization (*ibid;* Mattsson, 2002; Wood *et al.*, 2002).

To respond to this, companies should continuously improve their processes' and SCs to adapt their designs towards market changes (Krajewski *et al.*, 2016). This is especially true for the international furniture sector, since new markets will open with new demand and production capabilities to reach (Hameri & Hintsa, 2009). Change should however be managed with an understanding of processes, including their context and costs, additional to an identification of opportunities and threats related to SCs. One method of working with this is by mapping the SC (Haartveit *et al.*, 2004). This should facilitate the understanding of companies supply chains and in turn form a basis for a more detailed investigation of its related processes. Also, mapping the SCs of companies should simplify implementation of the SCM concept. This is because the map should provide a broad SC perspective by including all related processes and actors. Thereby simplifying integration and management of relations up and downstream the SC.

Logistic operations as movement of raw material, has one of the biggest impact on the total cost of supply chain activities (see further section 2.2). These should therefore be optimized while keeping the right level of flexibility (Mattsson, 2002). Traditionally, supply chains in companies can be classified as responsive or efficient. The latter strategy is common in forest companies and focus on keeping a low flexibility in SCs to minimize costs. Nowadays, companies should increase their supply chain flexibility irrespective of strategy (Mattsson, 2002; Wood, *et al.*, 2002). Forest companies with low customization and low flexibility should therefore face a great challenge.

Resources are however restricted, resulting in limited means for optimization of supply chains. Forest companies should therefore focus on optimization of SC processes with considerable impact on total cost. Since logistical operations are one of those (Skogsindustrierna, 2017), logistical processes should be broken down to see where costs arise. This study therefore identifies processes related to an international SC and break them down into a cost-based model. This should clarify what, where and why costs arise in the SC and how prioritize in SC optimization. Optimization should however include a SCM concept and a broad SC perspective. Since this has been absent from the forest sector, this study will attempt to apply the SCM concept to a SC related to the international forest industry sector.

1.3 Aim and delimitations

The aim of this study was to identify processes, cost drivers and to estimate costs affecting the design of international supply chains of raw material in the forest industry sector.

This study includes the following research questions:

1. *Can supply chain management affect the performance of international supply chains in forest companies?*

2. *What logistical flows contributes the most to supply chain performance?*

3. *How could SC cost analysis lead to a better performance of international SCs?*

Some delimitations were drawn during the study due to limitations in time and to keep focus on the actual aim of the study. Some of the delimitations are exclusion of corruption and other intangible risks in the cost based model. These should most likely affect the design and performance of international SCs, which is why they in some extent are included in the study discussion (chapter 7). However, since they are difficult to estimate in monetary terms they are left out from the actual model. Other delimitations are the exclusion of sourcing theories regarding location of operations and how to reach new markets, since this did not suit the context of the case. No theories regarding ABC-calculations were either included in the study. Also, a full mapping of the lead-time was not included due to limitation in time. Another delimitation relates to the absence of a full market survey regarding different alternatives and logistical solutions.

1.4 Outline

The outline of this study is presented in Figure 1, demonstrating how the different chapters will be connected to each other and the latter part of the study.

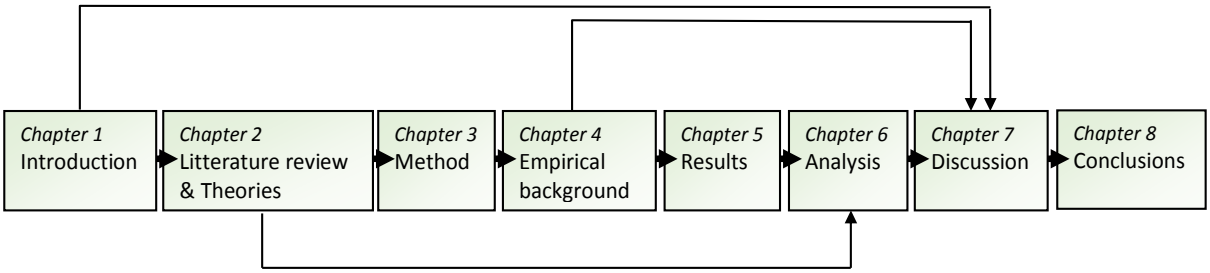

Figure 1. Outline of this study and how the different chapters will connect to each other.

The following chapter presents a literature review and theoretical framework for this study, finished with a conceptual framework. It is followed by a method description and considerations of this study, followed by an empirical background. Thereafter, the results are presented and analysed. The final two chapters contains a discussion and the conclusions made from this study.

2 Literature review and theoretical perspective

Chapter two presents a literature review and theoretical framework of this study. Since the study's main focus is on business processes and agile and synchronized supply chains in the wood and furniture sectors, the first sub-section will use and refer to Supply Chain Management theory. This study also draws on concepts in logistics methodology which will be introduced in section two, followed by key concepts and terminology in international logistics. Following sections will present theories related to Sourcing and Mapping. This chapter is finished in a conceptual framework, presenting how to apply the theories to this study.

2.1 Supply chain management

Before 1990, *logistics* was the common term of research about supply chain perspectives, describing the field of actors, flows and processes included or considered in corporate management (Mattsson, 2002; Christopher, 2005). This perspective was used when working with improvements to fulfil the aims and goals of companies. The most common aims for companies can be summarized as improvements in product quality; minimize costs and prices; and to give better services to their customers. These goals however, were insufficiently achieved through the traditional logistical perspective - aiming to minimize costs and prices by focusing on individual processes (Mattsson, 2002; Wood *et al.*, 2002; Holmberg, 2000). Instead, companies should try to reach their aims and goals through collaboration between actors in the supply chain rather than focus on individual processes (Larsson *et al.*, 2016). Especially since there is only a limited contribution of improvements by focusing and optimizing individual processes limited by company borders. Forest companies are however not taking a full supply chain perspective, resulting in losses of competitive advantage (*ibid.*).

New trends on the market also demanded a new approach in how to manage the supply chain, for instance (Mattsson, 2002; Wood *et al.*, 2002):

- Changing technology.
- Globalization - resulting in an expansion of the market and increased competition.
- The frequency of customer orders increased and the ordered quantity became smaller.
- Increased use of centralized inventories.
- Customers demanded a broader product scope and customized products. Also, they demanded shorter delivery times.

These changes mean that customers demand more services as a part of the total offer from companies, see Figure 2.

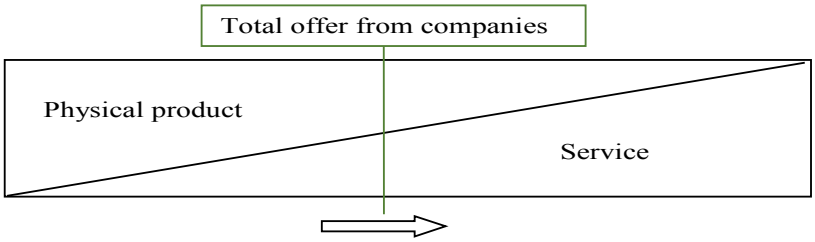

Figure 2. Total offer of companies consists of the physical product and services. Because of recent market trends, the customers demand a larger part of services of the offer (arrow). Figure inspired from (Mattsson, 2002, p. 36).

It is important to keep in mind that these trends will affect companies differently depending on customer approach and the level of flexibility demanded from end-customer (Mattsson, 2002; Wood *et al.*, 2002). Manufacturing companies are additional to the changes above, also facing an increased demand of customized products, while the complexity of products increase with shorter product life cycle (Hameri & Hintsa, 2009). This forces these companies to adapt their supply chains (**SC**) to answer to the demanded flexibility which is done through a combination of two extremes: *efficiency* and *responsivity*. This combination is called strategic fit (Chopra & Meindl, 2016; Krajewski *et al.*, 2016). Efficiency is the extreme with a low degree of flexibility where for instance, lead time in the supply chain is longer due to a focus on minimizing costs. In turn, responsivity is the extreme with a high degree of flexibility with short lead-time and customized products. Because of recent trends however, customers demand more services in the total offer of companies (Figure 2) which makes flexibility an even more important aspect for both extremes. This is especially important for forest companies which traditionally are focused on efficient SCs with low customization and bulk production, focused on market push[1] (Larsson *et al.*, 2016).

To summarize the trends above, changes and expansions of the market has increased the competition and changed customer behaviour with an increased demand of services. This mean that many companies have to change their SCs to become more responsive than traditionally. Forest companies are one of which, since they focus on efficient SCs and optimize individual factors by minimizing costs and maximizing profit (Larsson *et al.*, 2016). Consequently, the importance of flexibility in the SC increased and became necessary to stay competitive and respond to market changes.

2.1.1 Definition

To answer to the trends above and the need for a new approach in supply chain perspectives, *Supply Chain Management* (**SCM**) was developed (Mattsson, 2002). The aim with this new concept was to give a broader perspective on SCs, without consideration of company borders. The difference between SCM and logistics are for many not clear, which is why the terms are wrongly used synonymously. Also, there are a number of SCM definitions which has led to a varying understanding of its actual meaning (Haartveit *et al.*, 2004; Mattsson, 2002; Bechtel & Jayaram, 1997). Christopher (2005) however, gives one common definition on SCM:

[1] Market push is generally a strategy when companies utilize their production based on prognoses and forecasts rather than actual demand (market pull) (Larsson *et al.*, 2016). Generally suitable for products with small uncertainty in demand and a high level of economy of scale.

> ”*The management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at a less cost to the supply chain as a whole*” (Christopher, 2005, p. 5).

Consequently, recent developments led organizations to shift focus towards optimizing the total sum of their processes in the supply chain instead of focusing on their intra-organizational processes. This has broadened the SC perspective and put more focus on building and managing relations up- and downstream the supply chain (Christopher, 2005). These relations should aim towards an increase of net revenue, expressed as gross revenues minus total costs, for the entire SC (Shapiro, 2007). Since organizations work on an arena where one company are a part of many different supply chains, the word *chain* has been criticised due to the sound of focusing on *one* individual chain (Christopher, 2005). Some authors mean that this leads to a narrow perspective on the supply chain where focus should be to give a broad perspective on the many different supply *chains* companies are a part of. This is especially true for companies with international SCs since they include a wide geographical disperse of actors and increased exposure to factors external the SC, e.g. political, social and cultural differences (Manuj & Mentzer, 2008).

2.1.2 Supply chain management measures

Increased flexibility and degree of services connected to the total offer from companies can in a high degree be dependent on logistical factors, for instance: delivery lead time; customer adjustable deliveries; trustworthiness and reliability in payments and order fulfilment (Mattsson, 2002). Logistics also stands for a considerable cost in companies (Christopher, 2005), which is why there’s a need to understand different effects of logistical operations in the supply chain (Mattsson, 2002). This gives in turn an opportunity to minimize costs while optimizing the level of flexibility, resulting in an efficient improvement of the SC performance. Due to globalization, the importance of this will increase in future international SCs (Hameri & Hintsa, 2009).

Optimization of logistical activities affect the SC performance in a number of ways. One particular challenge that can be handled by optimization and coordination measures is named the bullwhip effect, which describes the phenomenon of variation being amplified upstream along the SC (Mattsson, 2002; Chopra & Meindl, 2016). This means for instance for the SC in this study, that small variations in demand from end-customers increase and create a serious variability – and unnecessary costs – in the sourcing regions in Russia. The bullwhip effect is dependent upon the distance between first supplier and end-customer but also upon the relation and integration between these actors. A good integration increases the transparency between actors, which in turn reduce the bullwhip effect (*ibid*.). For instance, if accurate demand forecasts are provided to the suppliers, their responsiveness to market changes will improve. Operations will be more stable and cost efficient. The bullwhip effect also increases with distance between actors, which in turn represents a challenge for international SCs (Hameri & Hintsa, 2009). The importance of efficient sharing of information should therefore increase with globalization. Still, technological innovations are one factor behind globalization which should in turn facilitate communication and thereby reduce the bullwhip effect (Gurgul & Lach, 2014), also for global supply chains.

Logistical activities also affect the flexibility by which companies can adjust their products, product-mix and volumes depending on customer demand and order (Chopra & Meindl, 2016; Mattsson, 2002). Other effects related to logistics is the time delay between processes or between actors in the SC. The sum of these delays might in the end of the SC add significant lead time costs e.g. through low capacity utilization and increased inventories. On

the other hand, since forest production is capital intensive with high investment, un-utilization results in high production costs. These bottle-neck capital intensive processes must always have in-process material available for the operations. The companies handling long supply chains, such as the global furniture company IKEA, therefore face a challenge to strike the right balance between a good availability, which requires inventories – and cost efficiency, which is associated with a high product turnover and low in-process inventories.

Supply chains are dependent of its surrounding context where it is affected both of internal and external disturbances, for example bad relations between actors or natural disasters (Mattsson, 2002). SCs can therefore be classified as stable or dynamic dependent on the frequency of disturbances. Stable SCs operate in a state of equilibrium with a limited influence of changes or disturbances from internal or external the SC. Dynamic supply chains operate in a more unstable context were changes and disturbances occur frequently. The SC must be adjusted upon its current context which might be dependent on line of business (*ibid.)*. Also, since more SCs go international this results in a more unstable context which should be adjusted for when designing SCs (Hameri & Hintsa, 2009).

2.1.3 Processes and flows in the supply chain

Supply chains consists of different processes between actors, which in turn can be divided into different flows: flow of material, payments and information (Mattsson, 2002; *c.f.* Wood *et al.*, 2002). These are illustrated in Figure 3.

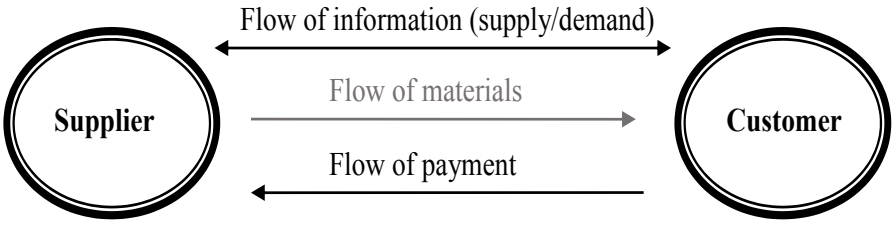

Figure 3. One supply chain broken down into a process between two actors and then further divided into flows between these actors. Figure inspired from (Mattsson, 2002, p. 73; c.f. Wood et al., 2002, p. 420).

Traditionally, flow of information has been a one-way communication from customer to supplier, mostly containing information about demand (Mattsson, 2002). Recent market trends do however requests a higher flexibility and increased responsiveness, resulting in customers demand more information from their suppliers, e.g. about available supply. Therefore, there are a need for a functional interchange of information and a shift from monolog to dialog between actors to integrate the supply chain (**SC**). Forest companies do however lack a use of this model, were especially the flow of information are left out (Larsson *et al.*, 2016). This results in a limited integration of actors in forest SCs and thereby a limited contribution to the SC performance by restraining actors' risk management.

To increase the performance in SCs, Mattsson (2002) and Manrodt & Fitzgerald (2001, referred in Wood *et al.*, 2002, p 423) propose a change in process perspective. From a functional perspective were processes are viewed as separate from each other and narrowed by company borders. Towards a perspective where processes are viewed as a continuous chain, independent of company borders. The functional view gives a fragmented perspective on the supply chain which leads to inflexible companies while the process-perspective gives an opportunity to optimize the total sum of the SC performance. Processes can be divided in different types depending on where and how it takes place (Mattsson, 2002):

- *One-functional processes:* Value creating or adding activities performed within one unit or by one individual actor.
- *Intra-organizational processes:* Value creating or adding activities performed between two or more units or functions in a company. Mostly, these processes branch off into other actors in the supply chain.
- *Inter-organizational processes:* Value creating or adding activities crossing company borders.

In SCM, the two latter types are of great importance (Gardner & Cooper, 2003; Mattsson, 2002) and these are commonly mapped by breaking them down into core-activities (Mattsson, 2002). Classifying activities into different types are necessary since it provides a basis for efficiency increasing actions in SCs. Porter (1985) presented a classification focusing on value adding or supporting activities, see Figure 4.

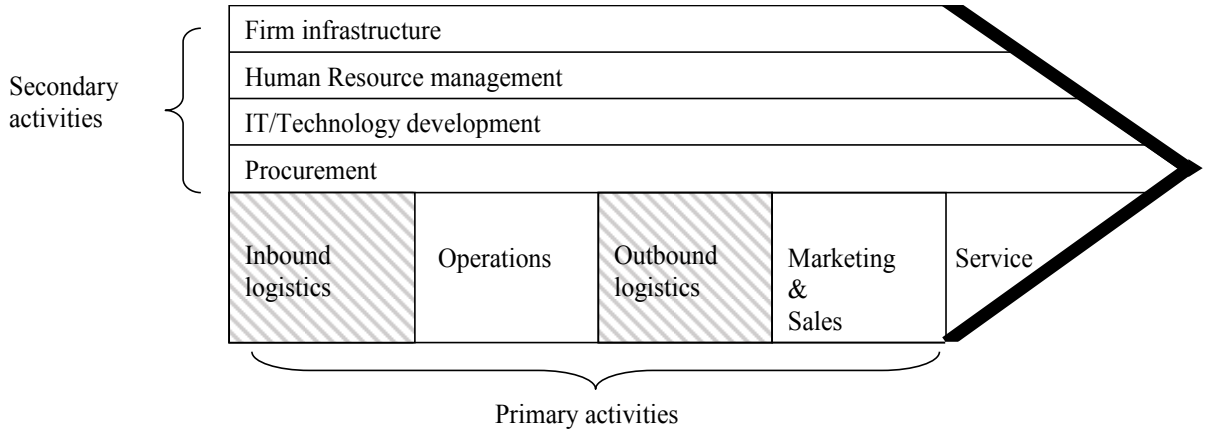

Figure 4. Processes in the supply chain are broken down to two main types of activities, being: primary- and secondary activities. These are in turn further broken down into core-activities. Figure inspired by Porter (1986, p. 16).

Porter (1985) classify activities into primary- and secondary activities. Primary activities create or adds value to companies while secondary activities support the primary but are not adding a direct value to the product, e.g. HR or IT. Inbound- and outbound logistics are activities which pays a great influence on the total cost of supply chains and will be introduced in the following section.

Figure 3 and 4 are linear models providing a simplified explanation of a complex reality with a narrow focus on economic objectives (Sauvé *et al.,* 2015; Brown *et al.,* 1987). The models presume a steady-state society and excludes social and environmental aspects which restrains sustainable development. Since recent trends on the market demand sustainable and responsible businesses, the importance of the two latter aspects has increased (see more in section 4.3). Therefore, though the models (3-4) linear illustration – social and environmental perspectives should be included when using the models (*ibid.*).

2.2 Logistics

International logistics are defined as the organization of flows in supply chains (Wood *et al.*, 2002) and could help to bridge the gap between the two extremes: efficiency and responsivity (PWC n.d. referred in Wood *et al.*, 2002, p 47). Logistical costs have a great impact in companies, restraining their aim to increase their profitability. Therefore, logistical activities should be optimized by minimize costs while keeping required level of flexibility (Mattsson, 2002). Profit is usually measured through profitableness and can be illustrated by the DuPont-model. This model express high profitableness by minimizing cost of capital and maximize the profit, expressed as revenue minus costs. Measures increasing efficiency in SCs should consider all posts in the DuPont-model, which in turn are affected by logistics, see Figure 5.

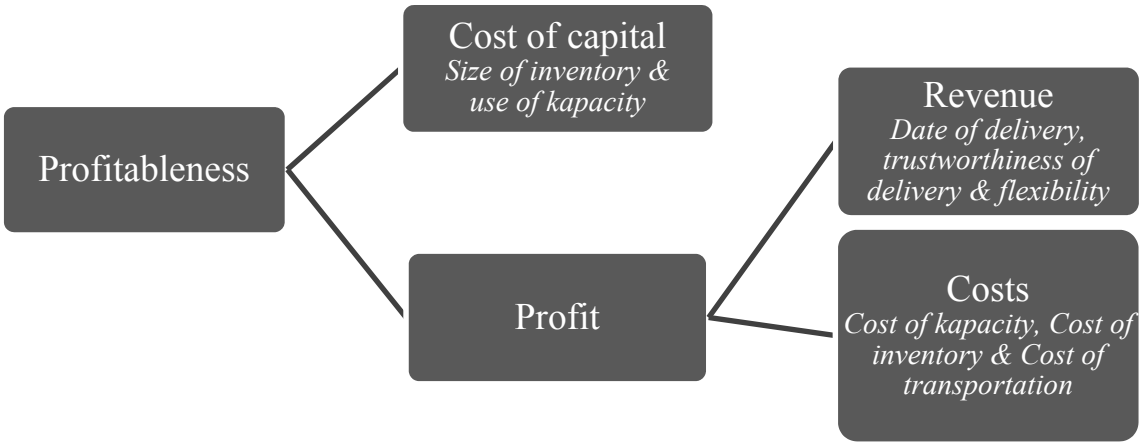

Figure 5. DuPont-model with a specification of how it can be affected by logistics. Logistical costs are presented in italics. Model based from Mattsson (2002, p. 137).

Flow of material is the main logistical function affecting the total profitableness in companies (Mattsson, 2002). This flow can be divided in two dimensions: *customer service* and *resource consumption*. These dimensions affect the profitableness in the DuPont-model (Fig. 5) where customer services affect cost of capital through for instance: inventory levels; inventory availability; precision; delivery reliability and delivery time. Resource consumptions affect the model partly through cost of capital by affecting the quantity of material in process. Also, partly through the bullwhip effect, utilization of capacity and costs of logistics. The latter is a common cost being minimize when increasing efficiency in SCs. Still, it is important to have a broad perspective on the supply chain – which is an absent concept in the forest sector - since different posts are correlated with each other. For instance, changes in inventory size will in turn change the frequency of deliveries, *ceteris paribus*. (Porter, 1996; Fisher, 1997; Mattsson, 2002; Haartveit *et al.*, 2004).

2.2.1 Expenses in international logistics

Increasing SC performance should be based on a survey of costs in logistical activities (Mattsson, 2002; Wood *et al.*, 2002). In international logistics, there is also a need to survey the risks related to policies about international trade (Wood *et al.*, 2002). Import and export might be heavily regulated with controls and tariffs blocking or supporting different flows. (Wood *et al.*, 2002). Russian policies about domestic wood processing and export regulations are one example of regulation, blocking international trade of wood (FAO, 2012). Also, there are risks related to boycotts or sanctions that needs to be considered since it might affect the business of international companies. Russia is one country with a complex situation for

trading across borders, since they are currently ranked number 140 out of 190 countries – the lower ranking the better (www, Worldbank, 2017)". However, one classification of splitting up logistical costs are listed below (Mattsson, 2002). These classes are also categorized in Wood *et al.*, (2002) under the class "*terms of sale*", however he also adds another class, "*terms of payment*", to the list. This includes costs for losses, credibility, banking terms, etc., which will be presented after terms of sale.

Costs of transport and handling: These costs originate from the material flow in supply chains where both internal and external processes take place (Mattsson, 2002). This class can be managed through material and distribution coordination systems in companies. Transportation costs is strongly affected by the sales terms agreed with the seller, for instance the INCO-terms (presented in section 2.3.2) (Wood *et al.*, 2002).

Costs of inventory: This class consists of three types: cost of capital, cost of holding and cost of depreciation (Mattsson, 2002). Cost of capital means that companies have materials in inventory that does not add value to their business. Cost of holding arise when leaving materials in inventory and consists of costs related to stock-house, holding and handling equipment etc. Traditionally, cost of capital is quite high in forest companies' due to long lead times and a high level of inventory. Cost of depreciation increases with time and means that the value and quality of materials decreases because of holdings, e.g. materials with a "due-date". Depreciation of forest raw material means the risk of infections from fungi or insects, which is a risk increasing with time (Skogsstyrelsen, 2009). Costs of inventory might be minimized through collaboration in the SC in order to keep inventory levels low and locate it on cheapest location (Wood *et al.*, 2002).

Shortage and delays: This class arise because of an inability to deliver according to demand or due to shortage or delays from suppliers (Mattsson, 2002). The costs involved are loss in profit due to inability to deliver to customers or costs of extra transportations to secure the supply and keep operations running. In international logistics, this class becomes important due to a higher risk compared to domestic transportations because of an increased risk of thefts, pilferage or damage in transportation (Manuj & Mentzer, 2008; Cooper *et al.*, 1997). This class is important in forest companies because of a high uncertainty in supply from forest operations due to frequent changes and high uncertainty, for instance in operational circumstances related to weather (Larsson *et al.*, 2016). Still, this class is commonly overlooked by forest companies though it could be managed through integration of actors and facilitate flow of informational.

Administration: Involves costs of personnel and other costs for handling and steering the flow of materials and values as licenses, permits and declarations (Mattsson, 2002; Wood *et al.*, 2002). Dealing with international logistics, documentation might include a complex process and represents a large cost (Wood *et al.*, 2002). Most documentations involve a number of procedures complicating the process, which must be cleared when the goods reach the point of import, i.e. in the harbour of the customer. The complexity of this class is however somewhat reduced due to implementation of technological innovations (*c.f.* Gurgul & Lach, 2014).

Also, Wood *et al.*, (2002) adds *terms of payment* as an expense in international logistics which means costs of establishing a relation to new and international suppliers or customers. This category involves the risk of loss in payment due to lack of credibility or credit ability; changes in exchange-rate; administrations of documents and agreements; or the preparations and planning of possible barters.

Optimization of the classes above should increase the total performance of the SC. Mattsson (2002) do however discuss some problems with optimization and taking a broad SC perspective. First, there might be difficult to define the boundaries of the SC perspective since it is important that optimization results in a higher profit than the cost of making it. To answer the question *where should the boundary be drawn to get the most benefit to a low cost?* – companies should include the part of the SC where the material has similar identity (Mattsson, 2002; Lambert & Cooper, 2000). Other problems involve the correlation between different classes where optimization of the cost of capital might increase the cost of shortage and delays, etc.

These problems might be dealt with by a method Mattsson (2002) calls "selective optimization" or "effective efficiency". This means that companies choose to optimize individual classes by focusing on the one contributes most to total performance. By doing this, the efficiency increases rapidly and the total cost in the supply chain decreases more than if the company optimized classes with less influence. Also, since companies have restricted resources they can focus optimization on the classes with the most impact on SC performance.

2.2.2 Methods to improve supply chain performance

According to Krajewski *et al.,* (2016), methods to increase SC efficiency must be understood in terms of actual processes. The authors mean that these methods can be divided in two complementary strategies, either reengineer of processes or improvement of current processes. Process improvement is an emerging method since processes always can be performed in a better way. To do this, there's a need to have a good understanding of current processes and its details.

Irrespective of strategy, there are a need to affect all flows of the SC (Krajewski *et al.*, 2016; Mattsson, 2002). Because of technological developments, companies are able to take a broader perspective on the SC by the use of "*supply chain planning systems*" Christopher, 2005; Mattsson, 2002; Wood *et al.*, 2002). These systems are commonly shared between actors in the SC and tries to optimize the flows in the chain, for instance by sharing information about demand, prognoses, inventory etc. Still, as presented earlier - some kind of limitation in the SC perspective is necessary before companies can take actions to increase the SC performance. Mattsson (2002) propose the following actions in SCs:

- *Simplifications* and *rationalizations* by eliminating wastes and non-value-adding-activities and restructure complicated flows (Mattsson, 2002).
- *Simplify the interchange of information* by identifying what kind of- and how information is communicated between actors (Mattsson, 2002). Since documentation is one flow of information especially important in international logistics. This could be simplified by the use of a SC planning systems to facilitate parts of the documentation processes (Wood *et al.*, 2002).
- *Automation* by sharing computer systems or make systems transparent between actors in the SC. Meaning that one actor can see, for instance, level of inventory at other actors (Mattsson, 2002).
- *Re-configuring* by sharing responsibility and realization of activities and processes (Mattsson, 2002).

- *Collaboration* through cooperation's, synchronizations and coordination's of the flows (Mattsson, 2002).

2.3 Key concepts and terminology in international logistics

This section provides an introduction to key concepts and terminology related to international logistics, which will be used during this thesis.

One common method of transport in international logistics are by sea, which requires a harbour providing necessary requirements, e.g. anchorage, pilotage, stock space (Wood *et al.*, 2002). An increasing number of harbours are privatized which has reduced the control from governments. Harbours are classified as a free-trade zones, meaning that shipped goods can enter and remain free of duty until they enter their "home" customs territory (Barovick, 1997, referred in Wood *et al.*, 2002, p 234). Shipping can be done with three types of carriers: *private fleets*, *tramps* (chartered or leased) and *liner carriers* (Wood *et al.*, 2002). Private fleets are a common carrier in forest companies and gives the opportunity for companies to obtain a fleet that have the right specifications for their needs. Also, this carrier is advantageous due to an increased cost control and to secure the availability of carriers. Since many companies don't have the need of a private fleet because of smaller shipping quantities or less frequent shipping's, this means that a private fleet with large costs of capital would not be optimal. These companies could instead charter or lease a tramp vessel when needed. Companies can send even smaller quantities with liner carriers, which is ships transporting on schedule by certain routes (www, World Shipping Council, 2017; Wood *et al.*, 2002).

2.3.1 Cargo classification

Cargo can be classified as noncontainerized or containerized (Wood *et al.*, 2002). Logs are usually shipped as bulk cargo (neo or break) which means that it is either shipped on specialized ships or in a container, mostly with an open-top. Since containerized cargo is typically shipped in smaller quantities the common types of carrier are by liner or tramps. The total dimension of different vessels is usually expressed in tonnage, for instance *gross tonnage* which is defined as "*the number of 100 cubic feet of permanently enclosed space in the ship"* (Wood *et al.*, 2002, p 95).

Since shipped materials rarely are produced or processed at the harbour, there are a need for land transport to and from the port. After purchasing the materials companies need to decide what port to ship the materials to and from (Wood *et al.*, 2002). This decision is dependent on the facilities and services offered at different ports, e.g. if transport to and from port can be done by train or truck. Also, there might be a need to keep the materials in stock before loading on vessels, which means that there must be enough space in the chosen harbour. Choosing the right harbour is important since it can cause higher costs of the shipment, for instance delays, higher shipment cost, damaged or lost materials etc. (Wood *et al.*, 2002).

2.3.2 INCO terms

Choosing harbour, type of cargo classification and which type of vessel to use, all regards the actual transport of the goods. However, since the time between the agreement of purchase and the delivery to buyer might be prolonged, there's also a need to be clear of when and under what conditions the risk of the cargo transfers to the buyer (Kaufmann, 2014). To facilitate these conditions and make them transparent for all actors in an agreement, the INCO-terms were set out which is presented in appendix 1 (Ramberg, 2011).

The terms are divided into four different groups named E, F, C and D (Kaufmann, 2014). Group E means that the buyer accepts and accounts for all risks, transactions costs, duties and insurance from the seller's location. Group F means that the seller is responsible to deliver the goods to carrier, i.e. the harbour, at the seller's expense. Group C means that the seller pays and plans for the carriage of the goods but the risk is transferred when the order is delivered to carrier. Group D means that the seller takes full responsibility for costs and risks until the order is delivered to the country of the buyer.

2.4 Sourcing

Since globalization opens the market on an international level, this also opens new ways of increasing the competitiveness in companies (Wood *et al.*, 2002). In SCM, companies have to deal with decisions regarding where and from whom they should supply their operations. These decisions are commonly categorized under the term sourcing. Sourcing decisions are affected by globalization and have resulted in more factors and alternatives to consider (Semanik & Sollish, 2011). The sourcing-definition presented by Semanik & Sollish (2011) below are therefore somewhat modified:

> *"*[…] *the decisions to locate, develop, qualify, and employ suppliers* [beyond the organization's national borders,] *that add maximum value to the buyer's products or services"* (Semanik & Sollish, 2011, p 1).

Sourcing decisions aim to increase companies competitive advantage and can be divided in two main strategies, factor-input strategy and market-access strategy (Fawcett & Closs, 1993). *Factor-input strategy* aims to increase the competitive advantage in the domestic operations by sourcing the most suitable factors available on a global level, for example high quality or low cost. Second strategy is called *market-access strategy* aiming to reach new markets by for instance, move the operations to other locations.

Designing a new sourcing strategy, companies should take a SCM perspective to optimize the sum of different decisions rather than optimizing individually (Wood *et al.*, 2002). Since forest companies lack a full SCM perspective (Larsson *et al.*, 2016), the risk of in-efficient sourcing decisions increase. Also, two aspects should be considered being *coordination* and *configuration* (Porter, 1986). Latest term deals with configuration of where to have and in how many places a company should have its operations. The first one deals with the coordination between different operations and places, also how to coordinate the company's activities to the conditions on the market. These two aspects are connected to each other and one process in a company must take both into consideration (Porter, 1986). For instance, the procurement process within an international company must configure where to place the purchasing function but also coordinate how to manage suppliers in different countries.

Cost of raw material and other input products contribute to a great extent to the total cost of SCs (Mattsson, 2002). Therefore, one important question regarding sourcing is the number of suppliers the company should use for each product. This choice can be classified in two strategies, being single versus multiple sourcing (*ibid.*). Multiple sourcing is the most common strategy, especially in forest companies, and mean that the company use a number of suppliers to each product or article. Using multiple suppliers, the purchasing company decreases its position of dependency, since they can always choose another supplier if they are not willing to cooperate or accept the conditions of the agreement. This strategy also decreases the risk for shortage and delays since the purchasing company can distribute its need among a number of suppliers. However, this strategy assumes a low transaction cost meaning that choosing one supplier before another can be done to a low cost, for instance to a

low administration costs. Disadvantages with this type of sourcing is that market trends head towards increased collaboration and sharing of sometimes sensitive information between companies. Increasing the number of suppliers would therefore result in an increased risk for information being leaked. If this is a concern to the company, single sourcing might be the strategy to prefer since it involves one supplier. According to SCM perspectives, single sourcing should also be preferable since it facilitates building and maintaining a relation between actors.

2.5 Modelling the supply chain

A map is a simplified illustration over the complex structure of a company's SC (Haartveit *et al.*, 2004; Gardner & Cooper, 2003; Hines & Rich, 1997). The map should contain information of the actors and processes taking place in different steps of the SC. Maps are an efficient tool for strategic decisions in the SC by making sharing of information easier, additional to facilitate changes and monitoring of the SC and its design (*c.f.* Krajewski *et al.,* 2016; *ibid.)*. However, maps should not be too detailed since this would impede its aim - to give a general and easy-to-handle model over a complex reality. Still, the aim of modelling the SC is to explain rather than describe the SC activities, which is why a deeper description of SC activities should be excluded from the illustration. Also, too detailed maps might compose a risk of sharing competitive information and lead to increased competition. Mapping can be done in a number of ways and the chosen method must fit and adjust to the respective case. Still there's currently a lack of literature clarifying what type and method to use in their creation (Hines & Rich, 1997; Gardner & Cooper, 2003). Haartveit *et al.,* (2004) applies two methods of mapping SCs in forest companies, first a structural- and organizational mapping; second, a lead time mapping.

Structural- and organizational mapping is done through identification and linking of all actors in the SC (Haartveit *et al.*, 2004; Gardner & Cooper, 2003; Lambert & Cooper, 2000). This method should present all actors, processes and activities, in both directions of the SC. However, since some kind of limitation of the SC perspective is necessary, companies should link the relationship between actors to evaluate which are most crucial (Lambert & Cooper, 2000). Links between actors can be divided into four types (Haartveit *et al.*, 2004; Lambert & Cooper, 2000):

- *Managed links:* Means important processes in the company which they operate and manage in-house.
- *Monitored links:* Means processes not as important as managed processes, however there's still a need to integrate and have control over the performance of these processes.
- *Not-Managed links:* Processes where the company have no need to operate nor manage, instead they trust other members in the SC to carry out these processes according to plan. Might also be processes the company doesn't prioritize or have sufficient resources to control.
- *Outside management and control:* Processes taking place outside the firms supply chain perspective which still might have some influence on their SC through other actors.

Even though the mapping method is inconsistent, there are a number of symbols to use. See some of them in Figure 6 (Reding *et al.*, 1998; Haartveit *et al.*, 2004):

Figure 6. Symbols used when mapping during this study. Inspired from Haartveit et al. (2004, p 13).

Many symbols used in mapping are standardized to facilitate recognition of their meaning (Reding *et al.*, 1998). The symbols above relate to control processes which means inspections, measurements or verifications, for instance inspections of the quality of forest raw materials. Transport symbol relates to the actual movement of the material (flow of material) while the inventory symbol shows when the material is stored. Operation symbols relate to value adding processes when the material changes identity.

2.6 A conceptual framework

Based on the study purposes and on the theories and specifications above, Figure 7 illustrates the conceptual framework of this study. The study focuses on products SC from first supplier of forest raw material to value-adding processing in forest industry.

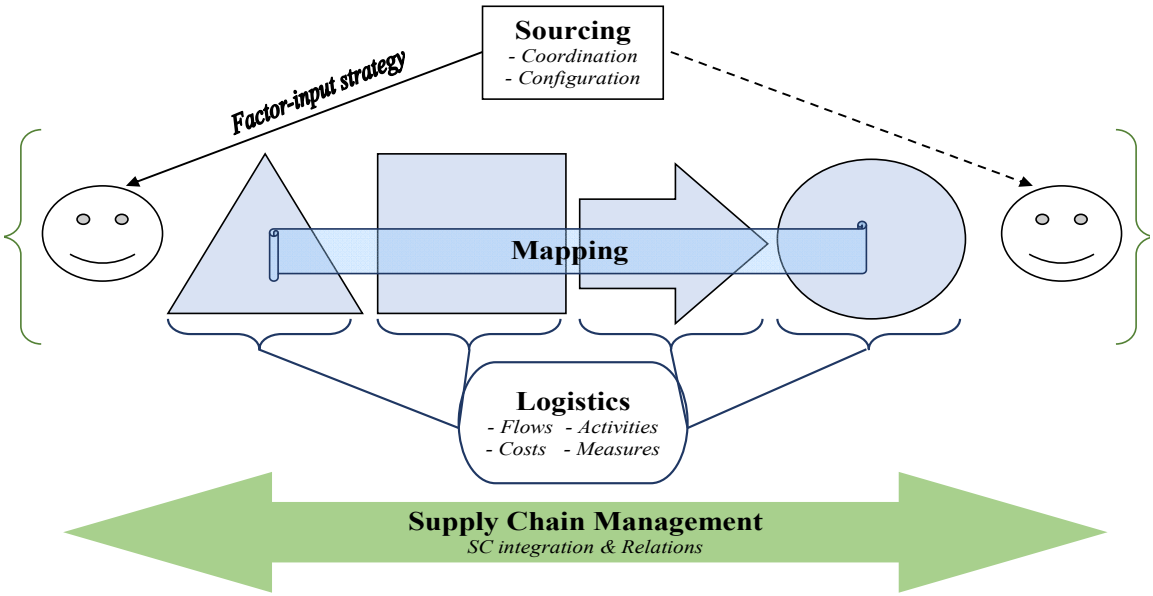

Figure 7. Conceptual framework of how to apply the theoretical framework to the aim of the study when identifying processes, cost drivers and estimate costs, affecting the design of international supply chains of raw material in the forest industry sector. The two faces represent first supplier (left) and end-customer (right) related to the SC. The SC is built on processes which are mapped using standardized symbols which in turn are broken down into logistical concepts and methodology. Sourcing decisions deals in this case mostly with the factor-input strategy to find best solutions (i.e. supplier) to current operations. A general discussion about market-access strategy (dotted line) are however included in chapter 7. All these theories should include the SCM concept which deals with integration and management of relations in the SC.

Increased SC performance and competitiveness on the market should be achieved by continuous improvements through **Supply Chain Management**. The focus of SCM lies in integration and relations of supply chain partners. Since this should affect all decisions in companies, SCM will form a comprehensive structure of SC optimization.

Sourcing decisions relates to supply chain optimization by providing current processes with best solutions available from an international arena, *factor-input strategy*. Since the complexity of SCs increase on an international arena, SCM provides an important perspective

by integrating and optimizing SC performance through focusing on total sum of decisions instead of individuals.

There is however a need to understand and evaluate individual processes to understand how they contributes to the SC performance and in what context they operate. **Mapping** should therefore provide an efficient method for identifying individual processes and put them in a broad SC perspective through a simplified illustration.

When individual processes are identified, they should be broken down into flows, activities and costs to create a full understanding of how they affect SC performance and how to increase the SC efficiency. This relates to **logistical** concepts and methodology which also could provide measures for increasing efficiency of processes with an integrated SC perspective.

Hence, the conceptual framework presented in Figure 7 illustrates how the theories presented above are combined to address the aim of this study. This conceptualization presents a somewhat new way to investigate SC design related to the forest industry sector, by including a full SCM concept and mapping as method. The following chapter will present in detail how this study was carried out and the choices and reflections related to this.

3 Method

This chapter provides information about the method of this study, explaining how the study was approached and clarify the realization of the data collection. In order to ensure the quality and transparency of this study, the relevance and consequences related to these choices are discussed.

3.1 Research design

This project combines inductive and deductive approaches, although it predominantly uses an inductive perspective and an empirical focus (www, Research Methodology, 2017b; Bryman & Bell, 2011). Some level of deductibility was needed, since some results were applicated and analysed from a theoretical perspective, trying to confirm or reject current theories (www, Research Methodology, 2017a; Bryman & Bell, 2011). The inductive approach relates to the purpose of identifying processes and estimate costs related to international supply chains. The deductive approach relates to a general discussion of how the results of this study applicates to the findings in the literature.

Throughout this study, a flexible design allowed the incorporation of unexpected contingencies and new information into the research design (Robson, 2011). There was also a need for qualitative data to create a deeper understanding of the problem and answer the aim of the study.

Flexible studies might have a varying degree of flexibility which has to correspond to how the research is approached (Robson, 2011). Since this study started with a clear aim and purpose but a somewhat unclear understanding of how to approach it, there was a need to keep some degree of flexibility to alter the approach and data collection of the study. Therefore, a flexible design proved to be suitable since there was a need to emerge the method during the study.

3.2 Case study

The aim of this study was to identify processes, cost drivers and to estimate costs affecting the design of international supply chains of raw material in the forest industry sector. This involved an empirical investigation of a specific chain, from supplier of forest raw material to one board industry. Therefore, a case study proved suitable since it includes an emerging approach with qualitative data collection from multiple sources (see section 3.3) (Robson, 2011; Yin, 2009; *c.f.* Bryman & Bell, 2011).

3.2.1 Choice of case and unit of analysis

IKEA is a Swedish furniture retailer offering quality products to an affordable price (IKEA, 2016a). IKEA is currently managing their supply chains through a centralized SC planner called IKEA of Sweden (**IoS**), working under the organizational unit "*range strategy, product development and supply chain*" presented in Figure 8.

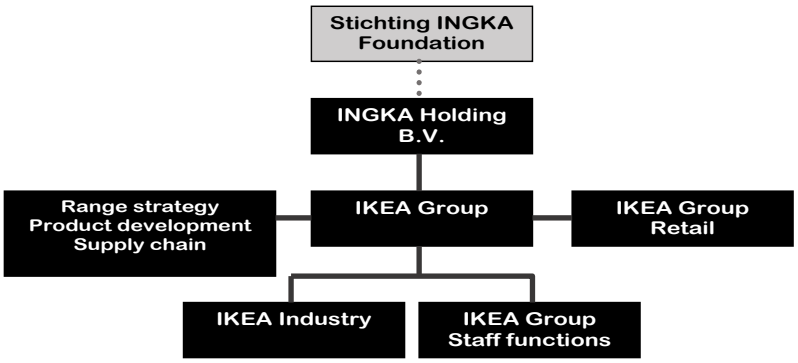

Figure 8. Structure of IKEAs organization. Illustration from (www, IKEA, 2017b).

Until now, IoS have had a lack of knowledge in how to optimize logistical solutions to their facilities. Therefore, they have started an IKEA joint project called Cross Border, focused to:

> *"Create best solutions for IKEA across organisation(s) and segments by quickly respond to rising market opportunities and potential risks"* (ppt, IIH, 2017)

Since IKEA is a global company with experience of managing and building international supply chains, it proved to be a suitable choice for analysing international supply chains. This study is therefore a part of the cross-border project and focus on process improvements by identify processes, cost drivers and estimate costs related to one specific supply chain. This should in turn increase IoS knowledge about SC and logistical optimization by the creation of a cost-based model, presenting the total cost of logistics in the SC. The model was made to be easily understood and easy to change upon different alternatives. Also, the calculations are presented in a transparent way so it can be used in other supply chains. A sensitivity analysis is also presented to see how changes in different costs will affect the total cost of the SC.

The specific SC lies within the organizational unit IKEA Industry (**II**) (Figure 9) and will be based on the supply of raw material from Russian suppliers to II's board unit in Hultsfred (more information about II is presented in section 4.2). The specific SC that were mapped and analysed includes the following alternatives:

i. Two potential suppliers of forest raw material in Russia.
ii. Two potential harbours in Russia
iii. Three potential harbours in Sweden.

Other logistical solutions are also included in the study, for example different transportations to and from harbour. They are however of limited contribution to the study and are not fully investigated.

3.3 Data collection

Data for this study consists of both primary and secondary data. Secondary data was collected from published reports and scientific papers as well as homepages, corporate reports and other company documentation.

3.3.1 Secondary data

A literature review was made continuously during this study to secure its findings and provide arguments and a basis for analysis and discussion (Bryman & Bell, 2011; Robson, 2011).

Also, identifying similar studies provided useful tips for designing the method and theoretical framework of this study. This also reduced the risk of leaving out relevant theories while keeping a narrow focus on the area of interest.

During this study, the literature review was based on certain keywords related to its aim and purpose (Bryman & Bell, 2011). Since this involved *process improvements*, *supply chain management*, *logistics*, *sourcing* and *mapping*, these were the main terms used in the review. Since this case also deals with an international furniture manufacturing company related to the forest industry sector, additional terms were added related to this.

Some of the keyword-combinations used in the review are presented below, however the keywords have also been used individually:

- ("Supply chain management" OR Logistic*) AND forest*
- "Process improvement*" AND (forest* OR "manufactur* compan*")
- ("Supply chain mapping" OR mapping OR "process map") AND forest*
- "Global logistic*" OR "International logistic*"
- (Ship* OR Shipping) AND forest*
- Sourcing AND forest*

The literature review was made in some well-known databases as *google scholar* and *web of science*, also the *Swedish university of Agricultural sciences* library database were used and proved to be efficient in finding empirical literature related to the forest sector. The review provided literature in a variety of types as for instance books, articles, previous research and student theses'. To assure the quality of the findings, most of the articles have been published in peer-reviewed journals, meaning they are examined by experts (www, SLU, 2017).

The empirical findings from the literature are summarized below:

- The review indicates SCM being more investigated and implemented in the manufacturing and retail sector compared to the forest sector, see for instance Haartveit *et al.,* (2004); Larsson *et al.,* (2016) and Manuj & Mentzer (2008); Hameri & Hintsa (2009).

- The literature indicates a narrow perspective on process or supply chain improvements in the forest sector, e.g. Larsson *et al.*, (2016); Audy *et al.*, (2012); Ranudd (2010); Carlsson & Rönnqvist, (2005); Haartveit *et al.*, (2004).

- The findings indicate that IKEA is a company with previous and useful experiences about SCM and (risk-)management of international supply chains, i.e. Jonsson *et al.*, 2013; Andersen & Skjoett-Larsen, 2009.

- Useful literature was also found about the forest sector in Russia which proved useful to understand and analyse the case from its context, see FAO (2012).

Secondary data was also collected to complement and verify the findings of the primary data collection. This data was collected from the homepages of the actors below and consists of published documents and similar information regarding processes and costs relevant for this study:

- *The Swedish Customs* (English www.tullverket.se/en/business)

- *Swedish Maritime Administrations* (English www.sjofartsverket.se/en)

- *Swedish Board of Agriculture* (Swedish www.jordbruksverket.se) These findings were also complemented with information from EU-directives available at http://ec.europa.eu/food/plant/plant_health_biosecurity/legislation_en (English)
- *Swedish harbours:*
  - Oskarshamn and Västervik (English www.smalandshamnar.com/en.aspx)
  - Kalmar Harbour (Swedish www.kalmar.se/kalmarhamn)
- VMF Syd (Swedish www.vmfsyd.se)

Wood and wooden products are often measured with different unit, as m^3ub, m^3pb and $m^3$to. The findings during the study was therefore sometimes converted to keep a constant use of unit during the thesis and in the model. Conversion numbers were collected from the homepage of different Swedish actors, for instance www, Skogskunskap (2017); www, Skogssverige (2017).

Also, since some of these documents were published with other purposes than answer to the aim of this study (Hox & Boeije, 2005). There was a need to critically evaluate the quality of the documents by using Scott's (1990, ref. Bryman & Bell, 2011, p. 550) four criteria:

1. *Authenticity*: Is it a genuine material with clear origin?
2. *Trustworthiness*: Are there any faults, mistakes or distortions?
3. *Representativeness*: Can the material present generalized information?
4. *Meaningful*: Can the material be understood and is it presented in a genuine way?

The secondary data included in this study originates from sources officially representing that type of information. For instance, all data regarding customs in Sweden were collected from the Swedish customs agency, which is the official authority representing customs processes and regulations.

3.3.2 Primary data

Process mapping is an appropriate method when working with process improvements since it gives a simplified illustration over a complex reality (Krajewski *et al.*, 2016; Haartveit *et al.*, 2004). During this study, a general map was made to illustrate the specific supply chain from Russia to IKEA Industry Hultsfred (**IIH**). This was made in collaboration with a project group from IKEA, consisting of people from IoS, IKEA Industry and another student. This map was adjusted during the study and provided an overview of the SC and the related processes and cost drivers. In collaboration with IKEA project group, relevant actors in the SC were identified to form a basis for primary data collection which could explain different processes in the SC.

The following actors were identified during the mapping:

- Two potential suppliers in Russia
- Two potential harbours in Russia
- Two principal shipping companies, however a total of five potential shippers
- Swedish Customs
- Swedish Board of Agriculture
- Swedish Maritime administrations
- Three potential Swedish harbours: Oskarshamn, Västervik and Kalmar
- One potential Swedish trucking company
- One potential Swedish rail company

When the actors were identified, two in-person interviews were made in Russia with the two potential suppliers. This, together with e-mail and phone interviews with the other identified actors, has formed the primary collection of this study. Qualitative interviews provided an efficient method for this collection since it gives a flexibility and a possibility to get a deeper understanding of the interview area (Bryman & Bell, 2011).

The interviews were carried out by two unstructured interviews which emerged during the meetings, however focus was to identifying processes, cost drivers and costs related to the specific supply chain (Bryman & Bell, 2011; Robson, 2011). Some preparations were however made to secure collection of relevant data, which therefore provides some structure to the interviews: what topics to discuss, information to be included etcetera (Robson, 2011). However, no interview guide was made and are therefore not included in this report.

The interviews were carried out in Russia at the respective office of the suppliers'. The agenda of the interviews in Russia started with an introduction to II's cross-border project and how this study relates to the project. After this, the suppliers described their business and information regarding their offer and the logistical solutions related to this. Followed by a discussion between II and the supplier regarding different logistical solutions, conditions of a potential agreement, quality and quantity aspects of the material, etc. A general discussion of the market situation in Russia were also included.

During the interviews, it was important to not interrupt the discussions and formulate the questions in a clear and consistent way, since this could provide limitations in the data (Bryman & Bell, 2011; Robson, 2011). This was especially important because of differences in language and language skills. IKEA employees followed during the meetings to assist with translation (Russian – English), when needed. No audio or video recording were made, which might have increased the risk of missing or leaving out relevant data (*ibid.*). However, notes of the interview were written continuously and was shared with the participants. Also, the notes of the interviews were discussed with the following IKEA employees during the same day as the interviews. More details about the verifications are presented in appendix 2.

Interview with supplier no. 1 included two persons from supplier, one *Key Account Manager* and one *Financial Manager*, additional to one *Business Developer* and one *Business Development Manager* from IKEA Industry. Interview with supplier no. 2 included three people from supplier, title not clear, however all represented the company's Saint Petersburg office through *transport coordination, financial* and *managerial* functions.

Interviews have also been made with one trucking company, Swedish harbours, shipping companies, one Swedish railway company, Swedish maritime administrations, Swedish customs and Swedish board of agriculture. These interviews were not accomplished in person but through e-mail or telephone contact. Some of these interviews were short and consisted of a few complementary questions, since secondary sources could provide most of relevant data. Notes from telephone contacts were not shared with the respondents however all e-mail communication has been saved.

Trucking company: Interviews were made mainly over phone about their business and what transportations they could offer from respective harbour. They provided a summarization of the offer and its contents by mail. Some additional interview-questions by mail were made regarding loading capacities, truck specifications and services. The main person involved were their head of business and development, however transport coordinators were also involved.

Swedish harbours:

- Oskarshamn and Västervik harbours are owned by the same company, Smålandshamnar [Harbours in Småland Ltd.] were interviewed mainly by mail. Additional contact was however made by phone. Since a full price list is published on their homepage, this interview focused on complementary information regarding their offer and included services. Main person involved in the interview was their CEO.
- Kalmar harbour were contacted by mail to get a price list and information regarding their services, etc. Main person involved was their CEO.

Shipping companies: The suppliers provided two different shipping solutions included in their offers, with a full presentation of involved processes, costs and shipping specific information. Therefore, these two solutions were selected (with support from II) as the main shippers to involve in the study, see comfortable-selection further below. However, to get an indication of market price for shipping and verify data from suppliers, three additional shipping companies were contacted by mail. These companies were interviewed through their sales or transport coordination department regarding shipping of the two offers made from suppliers.

Railway company: Contact by mail was made with one company's selling department to investigate alternative distances which could be transported by rail (see section 5.1.3). They did however currently not have available resources to provide a full-train calculation. Mail contact did however result in a call-based wagon system which will be presented in section 5.1.3.

Swedish Maritime Administration: The main data regarding their processes were collected through secondary sources presented in section above. However, additional contact was made through their "*info*"-mail regarding details of their processes, declarations and costs.

Swedish customs: The main data were collected through secondary sources, see section above. Additional contact about their processes, regulations and costs was made by *"info"*-mail and by phone with one of their administrative officials.

Swedish board of Agriculture: The main data regarding their processes, procedures, regulations and inspections were made by secondary sources, see section above. Additional contact was made by mail with one of their phytosanitary inspectors regarding the processes and costs related to their operations.

This project is rich on data collected through electronical means as e-mail and telephone contact. This has simplified the process by shortening the time needed for interviews and travel (Bryman & Bell, 2011). Some problems with follow-up issues have evolved due to this (*c.f. ibid.*) but the use of e-resources has still proven efficient. Especially because this project involved actors on a wide geographical arena where personal meetings would jeopardize the time-frame. In appendix 2, you find a research journal presenting more information about the actors interviewed and involved during the study.

During the data collection, costs were put in *Microsoft Excel* (2016) to build a cost-based model for evaluating alternative supply chain solutions. Also, the model should facilitate evaluation between different costs to see what contributes the most in total cost. By mapping the supply chain and identify actors and processes which then are broken down to costs, the following costs with respective currency were identified:

Price in port (EUR): price of raw material and transport to harbour including inspections

Russian (EUR) and Swedish (SEK) un-/loading and harbour cost: for un-/loading the vessel and costs for staff, storage and services in harbour.

Vessel freight (EUR): price to ship the material to Sweden.

Customs: cost charged upon export/import goods in Russia (EUR) and Sweden (SEK)

Trucking and *measuring* (SEK) cost for transport the material from harbour to industry and measure the quality and quantity of arriving transports.

The model builds on an assumption of a full loading capacity of the vessel and includes three possible currencies: Euro (EUR), Rouble (RUB) and Swedish kronor (SEK). During this project, all costs were expressed in EUR or SEK and if not stated, an exchange rate of 9.5 SEK/EUR have been used. Rouble is however included as a potential currency in the cost-based model to facilitate the use for future cases and alternatives.

Since the selection of actors for data collection were identified and suggested in collaboration with IKEA, this provides a randomized selection named as "*comfortable-selection*" by Bryman & Bell (2011). Comfortable selection means that random actors (i.e. suppliers, harbours and trucking company in this case) are chosen based on what actor comes across the researcher, the ability to generalize the results from this method is questionable (*ibid.*). However, since some identified actors work as official agencies, the results from these collections should be able to generalize to a greater extent. Meaning results from the following actors: Swedish Customs, Swedish Maritime Administrations and Swedish Board of Agriculture.

This project also involved travels to Saint Petersburg, Tihkvin & Lake Ladoga area in Russia and Hultsfred & Älmhult in Sweden. The main reasons for the trip to Russia was to interview potential suppliers. Travels in Sweden was mainly aiming to discuss the project with II and IoS. During these travels, some simple observations was made, providing complements to the other findings of the data collection (Bryman & Bell, 2011). These observations were mostly used to contextualize some of the findings from the interviews and understand the processes and operations of II.

3.3.3 Data analysis

The analysis was structured according to the study's purposes and it was guided by the theoretical framework (Figure 7). First, the supply chains (**SC**) for the base scenario and the alternative solutions were mapped where factors and activities were indicated and described concerning geographical route, supplier region and transportation methods. For this task, both interview transcripts and other written documentation was used in order to map the SC routes and processes as precisely as possible.

Critical processes along the SC routes were then described in detail. Such critical points of factors include custom at borders, phytosanitary regulations, port and associated activities. These stages were then translated into specified calculations and costs. During this stage, logistical concepts and methodology provided useful characteristics. Simplifying the overhaul of activities and flows through classes as cost of inventory, handling & transport, etc. (Mattsson, 2002; Wood *et al.*, 2002). Also, logistical concepts suggested efficiency-increasing measures, e.g. simplification, automation, re-configuration (Krajewski *et al.*, 2016; Mattsson, 2002), providing suggestions for increased performance by taking a broad SC perspective, focused on integration and coordination of actors and processes in the SC (Christopher, 2005; Mattsson, 2002; Wood *et al.*, 2002).

Data was collected and analysed until it was theoretically saturated, meaning to the point where further analysis or collection do not provide any further relevant findings (Bryman & Bell, 2011). Data were also continuously evaluated by comparing it to the findings from the literature review (*ibid.)*. The method for this analysis characterizes as a grounded theory (*ibid*.) since it was empirically driven with an emerging design.

3.4 Ethical and political aspects

Real world research is carried out in an emerging context, influenced by its surrounding world and includes humans that might get negative consequences from the study (Bryman & Bell, 2011; Robson, 2011; Vetenskapsrådet, 2011). Therefore, it is necessary to include social aspects of the study, being ethical consequences, and political aspects as values and judgements (Robson, 2011).

3.4.1 Ethical considerations

This project includes a variety of different actors which is why considerations should be made regarding how the study influences the social context of participants (c.f. Bryman & Bell, 2011; Robson, 2011). One aspect related to this was the confidentiality of involved actors (*ibid*.; Vetenskapsrådet, 2011). There was also a need to consider presentation of value-adding and competitive information collected during the study, especially since the report are to be published on the Swedish university of Agricultural science's open-access database (Vetenskapsrådet, 2011). Confidentiality should therefore be considered in two perspectives, first from IKEA perspective and second for other companies involved in this study. In the same time, there was a need to present un-biased findings and make a discussion of why and how the results could be used. Therefore, confidentiality was considered by neutralizing competitive and company sensitive information from two perspectives. Neutralizing were done by excluding some numbers, prevent identification of actors or present numbers with alternative values (for instance percentage of total cost instead of specific value).

Data collected from agencies or official actors as the *Swedish Maritime administrations*, *Swedish board of Agriculture* or *Swedish customs agency* are not neutralized. The reason for this could be argued with it represents data from official agencies which people should have the right to know, therefore not representing competitive information (Vetenskapsrådet, 2011).

3.4.2 General issues

Doing research in a real-life context comes with a risk of notice of illegal activities, abuse of power and the observance of different moral or ethical values (Robson, 2011). None of which should be accepted by the researcher nor should he or she be forced to engage in such situations.

Serious ethical issues in research also involves in what Beutler & Harwood (2001) divides into inter alia, fraud and plagiarism (c.f. Vetenskapsrådet, 2011). Fraud includes actions to intentionally mislead the results and contributions of the study, being fabrication or falsification of results and leaving out or withhold results from the study (Beutler & Harwood, 2001; Robson, 2011). Plagiarism imply the copying of other people's material and falsely present it as one's own with the consequence of fabricated results and lacking credibility of the research (Robson, 2011). Another issue brought up by Robson (2011) is the withholding of results due to a sponsor forbidding the publication. These actions have been considered during this study by focusing on correct use of references and by keeping a transparent way of how the results were collected and used in calculations. No consent of publication from sponsor were needed, other than ethical and moral, since no formal confidentiality agreement was made.

Observations as a method for data collection usually involves several ethical issues (Vetenskapsrådet, 2011). Some observations were included in this study, even though they have a limited contribution to the general results. However, all observations were made in connection to an interview or similar meeting related to the study. Therefore, the participants were aware of their participation and that they and their surroundings could be included in the study.

This project is carried out in collaboration with an organization (mainly IoS and II) which might affect the context and findings of the study (Vetenskapsrådet, 2011). It should be clearly noted that all empirical findings, conclusions and other statements are related to the business of IKEA and the context of their organization. This might also have affected the study approach and its problematization even though this was not the intention.

3.4.3 Political considerations

The political aspects of research mean that considerations should be made regarding values and value judgements (Robson, 2011). For instance, it might be the production of knowledge which points out a problem or a solution, meaning that someone has done something in the wrong way. Also, there are important to consider how values and norms of the researcher might affect the study (Robson, 2011, p. 225).

3.5 Quality assurance

Since this study is accomplished as flexible case study, it only provides an approximation of the real world and might be hard or impossible to repeat with the same conditions (Robson, 2011). Therefore, it is important to consider how the findings are generalized since there are no statistical analysis supporting qualitatively collected data (Maxwell, 1992). Since this is a qualitative study, the terms of establishing trustworthiness: *validity* and *reliability*, should be adjusted compared to a quantitative research (Bryman & Bell, 2011; Robson, 2011; Morse, 1999).

Validity in research might be accomplished through audio or video taping the data collection and actively consider new and alternative theories (Maxwell, 1996 referred in Robson, 2011, p. 156). Also, the relation between the researcher and the respondents additional to the context of the surroundings during data collection, should be considered. Padgett (1998, referred in Robson, 2011) recommends three types of methods to secure validity in qualitative research: Triangulation, Peer groups and Member checking.

- Triangulation were considered by using multiple sources of data where secondary sources were used to secure primary collected data, and opposite (see further chap. 3.3).

- Peer groups involved a project group composed by IKEA, including employees representing IoS and II, additional to another student carrying out a similar study.

- Member checking was carried out by transcribing and verifying the interviews with the respondents. Also, all e-mail communication has been saved.

Reliability of the research is achieved by keeping a transparent process of the research. This might be accomplished with some kind of record of the raw data, process and other details (Robson, 2011; c.f. Bryman & Bell, 2011; c.f. Vetenskapsrådet, 2011). In this project, a research journal in appendix 2 presents a transparent record of the study's process. Also, the findings from this study should be generalized with caution since it represents one specific

case within one specific context (Maxwell, 1992). However, since the model is created to be adjusted upon different cases and alternatives. Some generalization of the study findings upon other SCs with similar context and settings should therefore be possible.

4 Background for the empirical study

Chapter four provides additional background information of this study and a presentation of previous research to provide a basis for discussion in chapter 8.

4.1 Russian forest sector

Russian forests count for over 20 percent of the planets forest estate though only for approximately 4 percent of the global trade of forest products (FAO, 2012 p. *v*). This is due to a lacking prioritization of the forest sector on the political agenda. Resulting in slow adaption and un-utilization of forest resources. Total forest land in Russia is 882 million hectares with 677 million hectares available for production (*ibid.* p. *ix*). The network of forest roads in Russia should also be prioritized to increase the utilization.

FAO's (2012) outlook study show that the Russian forest sector will increase its rate of production by 2030, however this is heavily dependent on changes in investment climate. This is also dependent on international support in creating reforms about steering and structure. The support of international actors is however restricted by Russia's unfavourable context for international trade and international companies. This is exemplified with Russian rank as number 40 (of 190) in the world banks "*ease of doing business*" and number 140 (of 190) in *"ease of trading across borders"* (the lower number the better ranking) (www, WorldBank, 2017). FAO's (2012) outlook also indicate that the increase in forest production will not affect their export of wood and forest products, since policy's state a development of domestic advanced wood processing.

Approximately 26% of forests leased for logging in Russian are certified, mostly with FSC (FAO, 2012, p. *xi*). In Sweden, this share is 52% FSC respective 50% PEFS, note that some Swedish forests are certified with both standards (www, PEFC, 2017; FSC, 2015). The outlook indicates an increase in Russian certification (FAO, 2012). This will in turn decrease the share of illegal logging even though it is somewhat unclear if this is currently a problem.

Russian forests are owned by the state and its management is leased to private businesses through contracts (FAO, 2012). The length of the leasing-contract differs, though longest period is 49 years. This is only half of the time for forest rejuvenation, resulting in in a limited interest of these activities (www, FAO, 2017).

4.2 IKEA

IKEA is a Swedish furniture retailer established by Ingvar Kamprad in 1943 with stores in 28 countries (IKEA, 2016a). Their vision is to "*create a better everyday life for the many people*", by offering quality products to an affordable price. IKEA Industry is the largest furniture producer in the world (see the location of their industries in appendix 2) with the main focus to supply IKEA stores, together with external industries (www, IKEA Industry, 2017a). They are divided into four divisions, *Solid wood*, for sawn goods; *Flatline,* producing lightweight furniture as storage systems or tables; *Boards* producing fibre-, particle- and lightweight boards to be further processed in other industries; and *Purchase,* which manage relations with external (furniture-)suppliers. A general map of IKEA supply chain, IKEA Industry Hultsfred (**IIH**) specific, are presented in Figure 9.

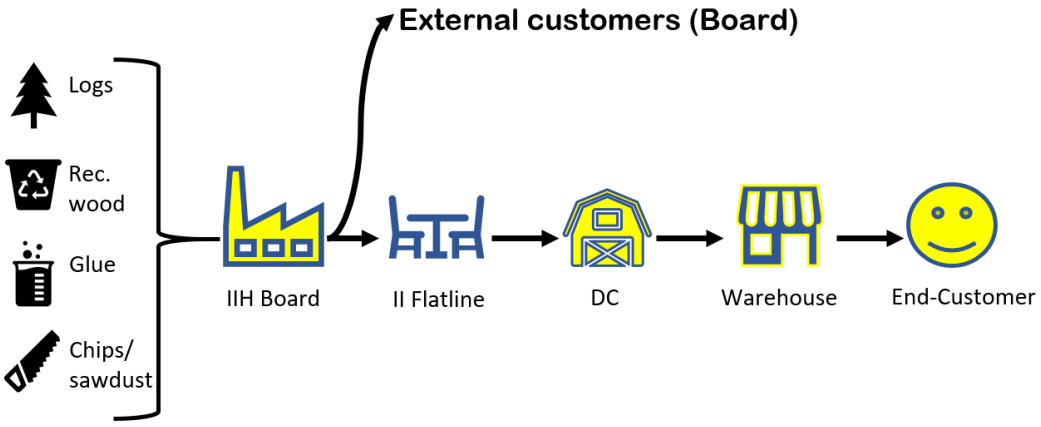

Figure 9. Mapping of IKEAs supply chain, from forest to customer. IIH Board shows IKEA Industry board, Hultsfred specific. II(F) shows IKEA Industry flatline division. DC stands for Distribution central which in turn supplies IKEA Warehouses reaching end-customers.

Mapping the SC of IKEA Industry gave an overview for their current supply chain which could be used to put the case in a context. Figure 9 focus on the parts relevant to this study. First, about four main raw-materials are used in IIH operations: logs, recycled wood, glue and chips or sawdust. These materials are then processed and value-added in IIH industry. The boards are thereafter delivered mainly to II flatline divisions but also partly to external customers. After that, division flatline sends the furniture either to a distribution central (**DC**) which then distributes the furniture to warehouses, or directly to warehouses which then reaches the end-customer.

4.3 The IKEA way

Recently there have been an increasing interest of social- and environmental responsibilities in the business of international companies (Andersen & Skjoett-Larsen, 2009). Social issues involve for instance child labour and other labour conditions while environmental issues deal with emissions and a need to sustainably use natural resources. This have resulted in an increased need and desire to do business in a sustainable and responsible way to account for these issues. Since global SCs increase the importance of these issues - especially when working with developing countries - there is a need to have a clear understanding of how to implement sustainability in companies SCs.

As a global and experienced company, IKEA have developed a clear strategy for how to implement sustainability issues in their business (Andersen & Skjoett-Larsen, 2009). This strategy consists of a staircase model were IKEA together with their suppliers, work with reaching the next level of the staircase, meaning increased sustainability in their business. As a minimum, their suppliers need to fulfil their code of conduct called *The IKEA way (***IWAY***)* (IKEA, 2016b; *ibid.*). IWAY consists of a number of pre-requisites to secure a sustainable business of their suppliers by addressing environmental, social and working standards. The aim with this is in turn to develop and manage responsible SCs for IKEA.

IKEA is also interested in improving sustainability in their own business. For instance, they invest in renewable energy and strategies to increase the share of wood from sustainable sources (IKEA, 2016b). More than half of IKEAs products are wood based and they have a yearly consumption of about 19.3 million m^3 (RWE^2) where IKEA industry consumes 4.4

[2] RWE short for *Round wood equivalent* is a measure to indicate the volume of wood in log form.

million m^3 (RWE) (ppt, IIH, 2017). In focal year 16, 61% of this wood came from sustainable resources. The aim is however to reach 100% by 2020. Sustainable resources mean either FSC certified or recycled wood. Since illegal logging is, or might (FAO, 2012), take place in Russian forests, IWAY state that 100% of Russian wood going into IKEA SC must be certified.

4.4 Previous research related to the study's purpose

Larsson *et al.,* (2016) examines current literature in supply chain management (**SCM**) and how this can be used to overcome problems and challenges related to SCs in the Swedish forest sector. Their findings reveal an increasing attention of SCM in the forest sector, however the main focus seem to be on operational efficiency by increasing throughput and reducing inventories (Larsson *et al.*, 2016; Haartveit *et al.*, 2004). This indicate that the forest sector still keeps a narrow focus on individual processes, restraining the implementation of a full SCM perspective. Still, operational efficiency is an important strategy to remain competitive. It should however include a broad SC perspective to increase the competitiveness even more and make wood and forest products more attractive than substitutes (*ibid*.) The main problem with implementing SCM in forestry is that most of the literature focus on markets with a high degree of customization and markets characterized by a pull[3] strategy (Haartveit *et al*., 2004). This is not the case in the forest sector which use a push strategy with low customizations. Also, forest companies are lacking a model which facilitates integration of actors (Larsson *et al*., 2016). This is necessary, especially since forest SCs involve a high number of actors, i.e. private forest owners, entrepreneurs and a variety of industries in varying sizes and different preference on raw material, which in turn sells to a number of different customers (Larsson *et al.*, 2016).

The literature review also presented empirical findings relevant to SCM- and logistics in the forest sector and logistics in international SCs. These will be presented in the following sections.

4.4.1 Supply chain management in the forest sector

Since a couple of years ago, IKEA have centralized their SC planning by implementing an organizational unit called *IKEA of Sweden (IoS)* (Jonsson *et al.*, 2013). IoS has the responsibility to integrate actors in the SC by making long-term strategies for marketing, logistics and purchasing. Centralization of SCs in the retail sector have been studied before, however Jonsson *et al.,* (2013) is one of few which have studied it in a company as big and global as IKEA.

Centralized SC planning is suitable for companies with functional and low-cost products, benefited from an efficient SC (Jonsson *et al.*, 2013). Also, a high degree of vertical integration is preferred since one actor having control over the SC facilitates the implementation of SCM. Companies with a high pace of growth are also those which would benefit from centralized planning, since it facilitates designing of new networks of SCs. These terms are all fulfilled in IKEA which focus on selling low-cost products with a low degree of customization. They also have a high degree of vertical integration since they either own the suppliers, i.e. IKEA Industry, or represents the largest or most important customer. Therefore,

[3] Market pull is a strategy where utilization of production is based on actual demand rather than prognoses and forecasts (market push) (Chopra & Meindl, 2016). Generally suitable for products with low level of economy of scale and a high uncertainty in demand.

centralized SC planning was implemented. Four major benefits have been identified (Jonsson *et al.*, 2013): *Coordination* and *integration* of processes and actors; *Standardisation* of methods; and *Specialized* knowledge available centrally in the SC. Also, a new computerized system was developed, which could integrate the planning of supply and demand. The system was however not fully implemented (Jonsson *et al.*, 2013). A new system called Supply Chain Guru (**SCG**) has been developed by 2017 and will be implemented in the near future (pers. meeting IKEA project group, Jan 27, see appendix 2). Still, this system does not account and integrate for the suppliers of IKEA Industry (*ibid*.).

4.4.2 Logistics in the forest sector

Audy *et al.,* (2010) discuss how to implement efficient logistical collaborations between actors in the SC. They mean that there are a number of benefits to gain for actors willing to collaborate beyond company borders and share information, risks and resources. It is however not an easy road towards collaboration and they discuss how to build and manage these types of relationships in the SC.

Carlsson & Rönnqvist (2005) present in their article how a Swedish forestry company implement SCM in their operations in order to increase their SC performance, become more customer focused and reduce costs. They find that involvement of actors in various parts and levels of the SC is essential to the implementation of SCM measures.

Ranudd (2010) presented in his master's thesis an investigation of optimizing the raw material flow in a Swedish sawmill. His findings show an example of process improvements in the forest sector by minimizing costs and maximizing throughput by focus on the flow of material and how this can be optimized from a cost perspective.

Larsson *et al.,* 2016 also finds that forest companies lack the use of a SC model dividing flows in information, materials and payments. They mean that this leads to a limited contribution to SC measures and an un-used potential for efficiency increasing measures. It is especially the flow of information that has been excluded from SC integration in forest SCs which restrains the risk management in actors.

Haartveit *et al.,* (2004) presented an earlier literature review (than Larsson *et al.*, 2016) for SCM implementing measures in forest products industries. Their findings are quite similar as presented in Larsson *et al*., (2016) but also focus on how mapping methods can be applied in these industries. They use mapping techniques for three companies in western Canada and find it as an efficient tool to get an overview of actors and structures in SCs. In turn, this gives an overview which is easy to grasp for companies and can be used to find efficiency increasing measures. Some difficulties were however identified, which indicates that mapping methods in forest companies and SCs should be improved to make it even more efficient. This is due to current mapping methods not being adjusted for industries with high uncertainty in raw material supply, long lead times in production and a production resulting in a high number of consequent products.

4.4.3 Logistics in international supply chains

Hameri & Hintsa (2009) presents an article about the future changes of SCM related to international SCs by 2026. A summarization of their findings is presented below:

Customer focused measures in SCs should be most important since demand will change towards increased customization and customer specific services related to the offer. To respond to this, firms must have an efficient management of their flow of material. Also, the

number of inventories are likely to increase to optimize delivery performance and order fulfilment.

Sourcing decisions and sourcing strategies will become more important since the market scope will expand and open up new countries which can provide low cost or high-quality material. Alternatively, sourcing decisions will deal with moving operations closer to customers to reach these new markets.

Logistical solutions by *shipping and air transports* will become more importance which should stimulate investments in infrastructure and services related to these solutions.

Global SCs will result in a *higher degree of vulnerability* because of a disperse location of actors leaving the SC more open to risks from external factors. Also, internal factors will also increase the SC risk because of bottlenecks or unexpected events affecting the following operations in a complex network.

Manuj & Mentzer (2008) presents an article about risk management in global manufacturing firms. They find that current literature is lacking by presenting several strategies for managing SC risks but not when to use different strategies. Their article arguments for increased risk management strategies in international SCs since globalization should increase the geographical distance in supply chains and therefore increase related risks. They also present two new risk dimensions related to lead time and distance from the source of the risk in global SCs. They mean that firms have a smaller control over international SCs compared to domestic, due to an increased distance to the risk and increased variability in lead time. The purpose of these dimensions is to supplement current risk management dimensions: profitability and losses.

5 The empirical study / Results

Chapter five presents the findings from this study which is divided in four parts. ***First part*** *starts by mapping the specific supply chain from first supplier of forest raw material in Russia to board industry in Hultsfred. This is followed by a presentation of alternative Russian suppliers and Swedish harbours. Even though lorry was the main alternative for transports between harbour and IIH, the end of the first part presents alternative distances where transport by rail were possible.* ***Second part*** *of this chapter provides a detailed presentation about compulsory regulations, processes and costs related to international supply chains between Russia and Sweden.* ***Third part*** *of this chapter presents a cost-based model where costs and calculations presented in parts one and two are summarized in an excel-model.* ***Fourth part*** *provides summarizing evaluations regarding different alternatives including a sensitivity analysis of different variables.*

5.1 Mapping of the supply chain and presentation of main alternatives

Several SC processes were identified from supplier of forest raw material in Russia to IKEA Industry Hultsfred. Figure 10 below presents the specific supply chain, assuming the logs are available at inventory by road or at terminal after harvesting.

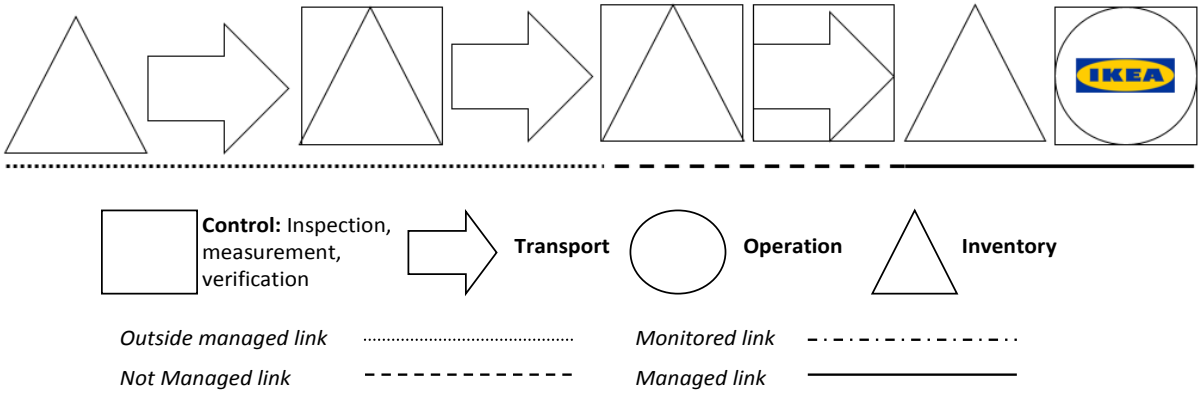

Figure 10. The SC of IKEA Industry Hultsfred broken down into out and inbound logistical processes between supplier of forest raw material and industry. Control symbol means inspections, measurements and verifications of the quantity and the quality of the material. Transport symbol refers to the actual movement of the logs and might in this case be carried out by ship, lorry or rail. Operation symbol means value-adding processes of the logs or operations were the logs change identity. Inventory refers to storage of the logs.

The map (Figure 10) includes the following steps related to the specific SC:

1. ***Inventory***: During mapping, processes taking place in and from the harvesting area were excluded in the analysis since it is not included in IIH's current SC perspective. The logs are therefore seen as available at inventory or terminal connected to road.
2. ***Transport***: The logs are thereafter transported to harbour site.
3. ***Control & Inventory:*** At harbour in Russia, the logs are unloaded from lorry and kept in inventory. Before loading to vessel, the logs are controlled through inspection of the quality, measurement of the quantity and verification by the Plant Protection Services (chap. 5.2.3).
4. ***Transport:*** The logs are loaded to vessel and transported to Sweden.

5. ***Control & Inventory:*** Upon arrival, the logs are unloaded, inspected by the Swedish board of agriculture and kept at inventory at Swedish harbour.
6. ***Transport & Control:*** After storage in harbour, the logs are transported to Hultsfred where they are measured and inspected by VMF Syd (chap. 5.1.4) to secure the right quantity and quality.
7. ***Inventory:*** The logs are then kept at industry inventory.
8. ***Operations & Control:*** The logs are processed and value-added in IIH industry. Control includes measures to steer the operations and result of desired board quality.

Specific aspects for this SC and alternative solutions will be presented below.

The map (Figure 10) also includes an explanation of the process management. This do not affect the cost-based model; however, it simplifies the understanding of IIH's potential SC and how processes would be managed. The impact of IKEA's management decreases with increased distance from IIH industry, from *fully managed* to *not managed* to *outside managed*. Note that IKEA, as presented below, might be willing to increase their management in the future.

5.1.1 Alternative Suppliers

This section regards steps 1-4 in the map and the offer of forest raw material from two potential suppliers. Both offers includes step 1-2, meaning that the material is seen as available at Russian harbour. Also, suggestions of harbour in Russia and transportation method to Sweden (step 3-4) are presented. Figure 11 illustrates where this process take place related to mapped SC.

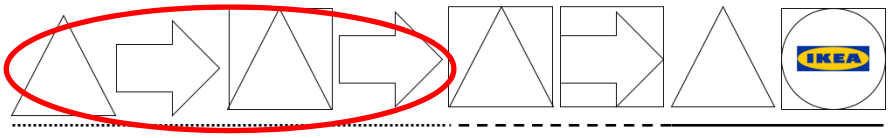

Figure 11. Red circle marking on the map what processes and costs will be discussed related to suppliers.

Two potential suppliers with individual offers were identified, both of which includes all processes upon unloading in Russian harbour (step 1-2). Therefore, inventory in forest or by terminal additional to transport to harbour, will not be presented as individual steps in the following sections.

The two suppliers included suggestions in their offer related to step 3-4 in the map. These offers resulted in different cost alternatives summarized in Table 1.

Table 1. Summary table of costs related to the two alternative suppliers, expressed in Euro per cubic meter. Costs with X are excluded due to confidentiality concerns. Units in m^3ub = cubic meter under bark

Costs	**Supplier no. 1**	**Supplier no. 2**
Raw material price incl. inspections	X €/m^3ub	X €/m^3ub
Transport to harbour	Included	Included
Unloading, Storage & Harbour cost	Included	9 €/m^3ub
Loading to vessel	2.5 €/m^3ub	Included above
Vessel freight	> 15 €/m^3ub	11-15 €/m^3ub
Total	**> 17.5 €/m^3ub**	**20 – 24 €/m^3ub**

Table 1 includes the following costs:

Raw material price: Both offers includes transportation to harbour and inspection by the plant protection service (section 5.2.3). Actual price is excluded due to confidentiality concerns, however the raw material price offered by supplier 1 were lower than supplier 2.

Unloading of lorry, storage in harbour and harbour cost in Russia: These operations were included in raw material price of supplier 1 while supplier 2 estimated this cost to 9 €/m^3.

Loading to vessel: Supplier 1 estimated this cost to 2.5 €/m^3 and supplier 2 included it in the harbour cost.

Vessel freight: The cost of transporting the material from Russian harbour to Swedish harbour. Price suggested by supplier 1 are neutralized, however it was above market price of 15 €/m^3. Supplier 2 offered a price of 11-15 €/m^3 dependent on fluctuations in demand and capacity.

As presented in Table 1, the offer of supplier 1 resulted in lowest total cost. Mainly because of the costs for harbour and other operations were included in raw material price. Even though raw material price is excluded, the summary indicates a difference of at least 2.5 €/m^3. Note that Russian customs are not included in the costs above. Both suppliers do however express that they will take responsibility for Russian customs clearance (see section 5.2.1). However, the cost of Russian customs will in turn be charged upon IKEA Industry Hultsfred (**IIH**). The two potential suppliers and the details regarding their respective offers will be discussed separately below.

First potential supplier

Supplier 1 is a company currently leasing forest area in Russia with annual harvests of approximately 500 000 m^3. This supplier is well-known for IKEA Industry (**II**) since they are swapping approximately 30 000 m^3 of spruce logs for pine, to II's board and sawmill industry in Tihkvin, Russia. II Tihkvin are in turn exporting chips to this supplier and their industries outside Russia.

This supplier is offering an annual delivery of 30 000 m^3 aspen logs from their harbour connected to the Russian river *Svir*. Offered price is relatively low in comparison to market price, especially since it is FSC pure certified. During the meeting, the supplier express that this low price is due to a lacking value of the logs for this company, since it cannot be used in their industries. Aspen logs are a forced outcome from harvesting activities, mainly due to Russian forests being un-managed and consists of varying species in varying age. During harvesting, most species must be clear-cut for the harvester to reach the logs of desired specie, for this company being spruce or pine.

First alternative source of supply would be to accept this offer of a long-term, annual delivery of 30 000 m^3 aspen logs to a competitive price, approximately 50% of harvesting cost. Since the logs lack value for this company, they are currently leaving the logs at inventory. Some logs are stored for 1-2 years, resulting in some being fully rotten and not useful even as energy wood. The supplier suggests that logs, with desired quality, should be transported by vessel on the river Svir directly to harbour in Sweden. The shipping company is suggested by the supplier which provides vessels with a capacity of 3 000 m^3/vessel and might dispose one vessel per month due to lead time. A full calculation of this alternative was presented from the

supplier, showing that storage and loading will be charged with 2.5 €/m^3. Also, inspections (if any) and transport to harbour are included in raw material price. The vessel freight is however relatively high compared to market price (>15 €/m^3). The supplier explains that this is due to a monopoly situation on Russian river systems, resulting in few vessels operating in this area.

A specification of the quality requirements is provided to the supplier. They do not express any concern regarding this since most of the logs are free from soft rot. The length of the logs is between 5-5.5 meters with a diameter suitable for IIH operations. The offer of 30 000 m^3 consists of logs stored in less than one year. After this quantity is delivered, the offer will consist of somewhat newly harvested logs. However, since the river is frozen during winter (September – April/May) there are a need to storage these logs in terminal for some time. The supplier expresses that future changes in quality requirements from IIH side can be provided by adjusting harvesting operations. Potential changes do however need to be expressed in advance.

Second potential supplier

Second supplier are located in Saint Petersburg (**Spb**) where they are buying wood delivered to Spb harbour for a price put out on an auction. This alternative mean that IIH offer a price to the market, through this supplier, that they will buy pulpwood delivered to Spb harbour for a certain price per cubic meter. This means that all transports and operations before and upon delivery to Spb harbour, are included in the price. The supplier will manage this auction by finding potential suppliers willing to accept IIH's offer. They are also willing to manage the transportation by vessel from Spb harbour to Sweden for a market price of 11-15 €/m^3 depending on season and capacity. Two main problems were however identified with this alternative:

First, since IWAY (described in section 4.3) presumes that all logs from Russia going in to IKEA SC are FSC pure certified. This means that all logs bought in harbour must be FSC pure certified. This supplier does however not currently have suppliers available to offer certified logs, especially not to the same low price as supplier 1. Also, they do not currently have the number of suppliers available to face an annual volume of 30 000 m^3 as first supplier. Meaning an uncertainty in volume supplied to IIH from Russia. They do however express that they in the future might be able to build a supply of certified suppliers by expressing a demand on the market.

Second problem identified were a high harbour cost in Spb and costs of extra operations to a total cost of 9 €/m^3. In this alternative, extra operations include unloading from lorry, inspections (if any), storage in harbour and then loading to vessel. Even though a significant difference in vessel price compared to supplier 1, extra costs results in a limited level of price to offer the market. Hence, since the supply of certified logs are restricted, this results in a difficult situation to offer a competitive price to the market while get a lower total price than from first supplier.

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To sum up, two offers was made from two potential suppliers. Supplier 1 offer 30 000 m^3 aspen logs with direct shipping on the river Svir to Sweden. The price of raw material is low; however, a monopoly situation on Russian rivers renders a high price from suggested shipping company. Supplier 2 buys logs on auction - specie and volume not yet specified - delivered to harbour in Saint Petersburg. Suggested vessel price is lower compared to first alternative. Still, a low supply of certified wood increases the market price. This, additional to a high harbour fee and costs of extra operations, results in a higher total cost of supplier 2.

Additional to alternative suppliers, three potential harbours were identified which could provide alternative solutions of arrival in Sweden. These will be presented in the following section.

5.1.2 Alternative Swedish harbours

This section presents alternative harbours in Sweden, which relate to step 5 in the map (Fig. 12). Three potential harbours have been identified during this study: *Oskarshamn*, *Västervik* and *Kalmar*. Prices and conditions from Kalmar harbour are excluded due to confidentiality concerns.

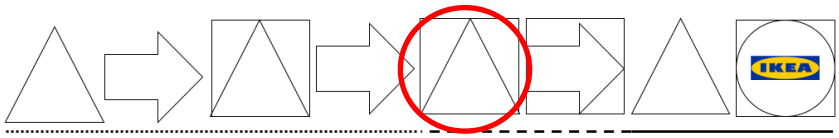

Figure 12. Swedish harbours are related to the process marked with a red circle on the map.

The identified harbours are somewhat similar with railway connections, available capacity for storage, lorries and loading vehicles. Oskarshamn and Västervik are owned by the same company, Smålandshamnar AB [Harbours in Småland LtD] and the harbour in Kalmar are owned by Kalmar municipality. Smålandshamnar LtD's fees for incoming goods are presented in Table 2, all costs from harbours were expressed in SEK and are converted to EUR.

Table 2. Pricelist from Smålandshamnar [Harbours in Småland Ltd.]. Units are measured in m^3ub = cubic meters under bark; m^3l = cubic meter loader; Gton = Gross tonnage of the vessel; m2 = square meter; m = meter

Prices from Smålandshamnar		
Harbour fee (Gton)		
Vessels (≥ 20 m)	0.45	€/Gton
Goods fee		
Waste wood, chips	0.39	€/m^3l
Wood, untreated	0.78	€/m^3ub
Pulpwood	0.72	€/m^3ub
Unloading	2.27	€/m^3
Storage <14 days	free	€/m^3
Storage >14 days	0.27	€/m2, week
Waiting time	1.45	€/m, day

Harbour fee in Oskarshamn and Västervik for vessels with a length with or above 20 meter counts with 0.45 €/gross tonnage (Smålandshamnar chap. 2.1.1). This does not count for vessels in scheduled traffic, for which this fee is negotiated. If the vessels remain in harbour after loading or unloading, they charge a fee based on length of the vessel with 1.45 €/meter and day (Smålandshamnar chap. 2.1.3). A fee is also counted for goods loaded or unloaded in harbour, named goods fee, and are converted with numbers from www, Skogssverige (2017).

The cost of unloading sawn and pulpwood includes staff and cranes for unloading (Smålandshamnar chap. 4.1; mail, Anders, 2017). However, additional costs for trucks might be added depending on if the goods have to be moved within the harbour. This factor is not included in the model presented later but should be considered. Anders (mail, 2017) means this is dependent on the deep of the boat and storage time of the goods. Costs of trucks vary between 61.79 – 81.26 €/h depending on loading capacity (Smålandshamnar chap. 4.2.2).

Storage area is free of charge first 14 days from completed unloading of the goods (Smålandshamnar chap. 5.1.1) and are thereafter charged with 0.27 € per square meter asphalted ground and week (Smålandshamnar chap. 5.1.3).

Services in harbour should be booked in advance. The actor making the booking are also responsible for payments to harbour. As a suggestion, importing company should have this responsibility. This booking should be submitted at latest 13:30 [1.30 p.m.] the day before arrival. Additionally, the ship or it's representative should preannounce its arrival and carriage, 24 hours upon arrival. The ship must follow Swedish working conditions for loading and unloading plus dispose safety measures on the boat. Smålandshamnar express a willingness to reduce prices by making long term agreements (mail, Anders, 2017).

When the material is delivered to harbour, it could be transported from harbour to IKEA Industry Hultsfred by railway or road. These alternatives will be presented in the following section.

5.1.3 Alternative transports from harbour

Transportation from Swedish harbour to IIH can be done by railway or road. The main alternative during this study was transport by crane lorries, however a presentation of railway transports is also included. The trucking company presented three alternative calculations, based on length of the logs and harbour. These calculations will be presented in the first part of this section followed by a presentation of alternative railway transports.

Truck transport from harbour
Transportation from harbour is carried out in step 6 of the map, symbolized with an arrow.

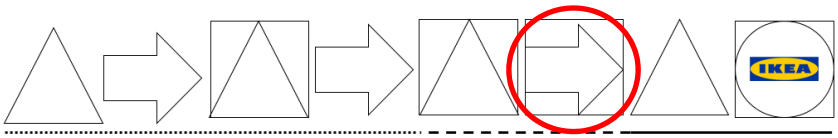

Figure 13. Red circle marking where trucking relates to the map.

The trucking company transporting the material from harbour to IIH offers lorries with crane, enabling self-loading in harbour. According to this company, self-loading in harbour are preferred from both trucking company and harbour company, since there's a risk of damaging the trucks when using big sized machines for loading in harbour. They mean that the trucks in harbour lack experience of loading smaller vehicles as lorries compared to boats. Proposed prices are not presented due to confidentiality concerns.

Prices are expressed in SEK and based on a fuel price of 1.15 €/litre from SCB[4] statistics. Total price of trucking will be affected with ± 0.8% when fuel cost increase or decrease with an interval of 0.02 €. Loading and unloading are included in the total price, however Value Added Tax (**VAT**[5]) is not included. Loading capacity of the trucks are depend on the length of the logs, where 6 meter logs mean a loading capacity of 39 m^3ub/truck and 3-5.5 meter logs 50 m^3ub/truck. A higher loading capacity results in a lower cost. Since the offer from

[4] SCB = Statistiska centralbyrån [Swedish bureau of statistics]. Publishing statistics on a public function from Swedish government. (www, SCB, 2017)

[5] VAT stands for *Value Added Tax* which is a consumption tax for goods and services sold for use or consumed in EU (www, European commission, 2017).

supplier 1 consisted of logs in 5-5.5 meters, this is an optimal solution to utilize full loading capacity of the trucks. Both scenarios assume a maximum loading weight of 40 tons per truck.

The trucking company express that this is a hypothetical scenario where the prices may differ when an agreement is made. Some conditions were stated:

- Agreements with a duration over an extended period might generate a better price due to seasonal fluctuations in price.
- Long term agreements might result in investments in trucks adapted to 6 meter logs since the current trucks are suited for logs with 3-5.5 meter lengths. This would reduce current price proposal of 6 meter logs.
- Short term agreements might result in a higher price during vacations or high demand seasons (May-July).
- Trucking cost are dependent on the quality of the wood where previous experience exhibited a lacking quality of Russian logs. Resulting in a higher trucking costs due to longer time for loading and unloading, additional to a decrease in loading capacity.
- Calculated time of loading and unloading is 45 minutes each.
- Truck transport from harbour to industry will probably have a delivery time of 1-2 weeks from Oskarshamn and Kalmar while 2 weeks from Västervik.

Additional waiting time at industry will be charged with 68.57 €/h. Costs of measuring and weighing the logs at industry are not included. Calculation of trucking cost change with two different scenarios. If current fuel price is higher than 1.15 € use calculation 1, otherwise, meaning a decrease in fuel price, use calculation 2. These scenarios are solved with "*IFS*" formula in Microsoft Excel.

$$1)\ \frac{T_{ij} \times 1{,}008^{k}}{Truck\ capacity}\ \ OR\ 2)\ \frac{\frac{Tij}{1{,}008^{k}}}{Truck\ capacity}$$

Equation above counts with the following conditions:

1. *Tij* stands for trucking cost in € from harbour *i* with tree length *j*.
2. *k* stands for the change in fuel price in absolute numbers (ABS(current price – 1.15 €)) divided in 0.02 € interval rounded to nearest lower integer.

Rail transport from harbour

Transport from harbours could also be carried out by train, since all harbours have railway connections. IIH did however express a concern of the distance from harbour to industry and that it would be too short and not provide a cost-efficient alternative. Contact was made with one Swedish company offering railway solutions, however they did not have the ability to present a full-train calculation. Instead, they are offering a call-based system were wagons could be booked in case of availability. Currently, they only operate from Oskarshamn harbour which is why the calculation take this as an assumption. Also, their calculation present transport of logs since chips, sawdust and bark claims other wagon solutions which have to be booked in advance.

The call-based wagons should be booked two weeks in advance and the availability were estimated to 2-3 wagons per train. In this case, the wagons would be available for loading in harbour for 8 hours and then another 8 hours for unloading in Hultsfred. The cost of this system was estimated to 231.58 € (excl. VAT) per wagon with a loading capacity of 33.5 ton. This means approximately 38 m^3ub assuming wood density of 0.9 ton/m^3ub. This result in a price of 6.10 €/m^3ub.

Loading and unloading operations are not included in the price. There might also emerge costs for using the railways and costs when changing to IKEA tracks in Hultsfred. Also, since the railway is located on the opposite side than storage area in Hultsfred industry, additional reloading and movement by truck is necessary which result in additional costs. Due to limitations in capacity and without a full train calculation, train transports turned out to be an unfavourable alternative and are therefore not included in the cost-based model (section 5.3).

5.1.4 Alternative transport solutions

Three distances could be transported with alternative solutions: 1) from supplier no.1 to harbour in Saint Petersburg; 2) from supplier no.1 to harbour in Finland and thereafter shipping to Sweden; 3) transport on rail entire way from loading place in Russia.

Costs of railway transport on distances 1-3 were expressed too expensive in comparison to vessel or truck. Interviewed persons, being IIH and both potential suppliers, expressed that these distances would either include to many operations, e.g. reloading, or result in a too stretched distance for train being a cost-efficient alternative. Also, the Swedish company offering railway transport of logs could not present a calculation on these scenarios. One alternative for distance 1, would also be to transport the logs offered by the first supplier by truck to Spb. This should decrease the vessel freight compared to the river system. However, due to reloading and a high harbour cost in Spb turn out to be an expensive alternative due to reloading and a high harbour cost in Spb.

5.1.5 Measuring by VMF Syd

Before entering the industry, step 6 in the map involves control measures. This means that independent of transportation solution, the quantity of the material is measured and the quality of the material are inspected. This is accomplished by an organization named VMF Syd and they are an independent actor from IIH and their suppliers. Their operations are marked with a control square on the map together with the transport arrow between harbour and industry. VMF Syd charge a measuring cost of approximately 4.82 SEK/m^3ub (≈ 0.51 €/m^3ub) based on their annual report from 2015 (VMF Syd, 2015). VMF Syd need a declaration from IIH about the volume and quality of incoming goods to be able to measure the logs in the right way and secure that the right logs are being delivered. This is followed by step 7 in the map, where the materials go in to the value-adding processes and operations of IIH.

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To sum up, section 5.1 gives a presentation of alternatives and case specific processes and costs related to the map. This started with a presentation of two potential suppliers in Russia which are offering different logistical solutions related to their offers'. This was followed by a presentation of the three potential harbours in Sweden, all of which offered the same services. Thereafter, lorry trucks seem to provide the most efficient transport solution to industry in Hultsfred where it is measured by VMF Syd before the material goes in to the value-adding process of IIH. These alternatives were later put in the cost-based model to evaluate solutions and identify the most cost-efficient alternative. However, dealing with import and export also includes several compulsory processes and regulations which will be presented in detail in the following section.

5.2 Regulations and compulsory processes & costs

The following section includes a detailed presentation of compulsory processes, costs and regulations related to international supply chains, Russia and Sweden specific. This includes

Customs clearance in Russia and Sweden; **Fairway** regulations and costs; and regulations and costs related to **plant protection** when importing wood and wooden products from outside EU to inside EU, Sweden specific.

5.2.1 Custom clearance

Since this case deals with trading between two countries, two custom duties are charged upon the goods. One on Russian side and the other on Swedish or European Union (**EU**) side. These processes are classified as control measures in the map however, they take place between the harbours and vessel transport (step 3-4 resp. 4-5).

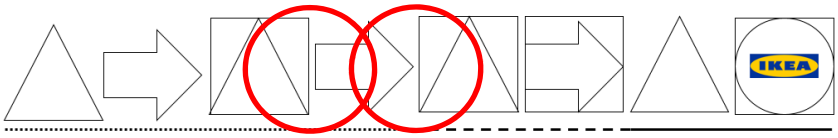

Figure 14. Customs processes are marked with red circles on the map.

Custom duties on Russian side are investigated from IKEA side since earlier and is set as 4 €/m^3. However, one alternative was identified during the meeting with the second potential supplier. They expressed that this duty could be reduced by keeping a certain level of freshness of the wood. This would lead to a decrease in custom cost down to 2-3 €/m^3. Actual level of freshness was not specified; however, it would probably result in a limitation of storage time at supplier to less than 1 year. Since this reduction is not fully examined, a Russian customs duty of 4 €/m^3 were put as a variable in the model, providing a possibility for future adjustments.

Second customs duty is charged in Sweden, or when the goods enters EU. Swedish customs are regulated by EU directive which have been implemented in Swedish law. Import means transporting goods from countries outside EU to countries inside EU. Since both suppliers would ship the logs directly to Sweden, this means that customs should be charged in Sweden.

Before the logs can be used in the company's operations, the goods should be cleared with custom duties, Value added tax (VAT) and other applicable duties. Clearing the goods might be done electronically or by using a SAD form (*Single Administrative Document)*. The process of customs clearance starts with the following steps (Tullverket, 2017): *Classification* of the goods by finding a specific code for the imported goods to apply correct duties; followed by *a calculation of customs value* to form a basis for applicable duties and VAT. These first steps are presented in detail in appendix 4. The offer from supplier no.1 was import of pulpwood of Aspen which would be classified with code 4403 97 00 00 (appendix 4 Table 15) in the declaration to Swedish customs agency. No customs duties are applicated on Swedish side, however a VAT of 25% will be added on customs value (appendix 4). Since the second potential supplier are not offering a certain species, the classification code could not be presented. These two steps are followed by a *customs declaration* of the import, which will be presented in detail below.

Customs Declaration

After customs value is calculated (appendix 4), a declaration should be submitted to the Swedish customs to applicate the correct duties. A declaration is however only needed if the value of the goods exceeds 188 166 SEK [≈ 19 807 €] (Tullverket, 2017, p 23). Also, no declaration is necessary if the customs are calculated based on weight. This is not the case for wood since it is calculated in m^3, which is why a declaration should be submitted for these

goods. Declaration is mostly done electronically and should be submitted when the goods are within EU customs. It is the company industrious within EU customs that are responsible for declaring and stating the right and correct information. Documents verifying the declaration must be retained in five years. Declaration of transaction value (appendix 4) should be done for each individual consignment or through a general declaration when many consignments are sent with the same conditions. A general declaration might also be possible for many suppliers with different conditions, however the latter must be specified in an attachment. However, a general declaration is only recommended for companies with a constant stream of imported goods. Otherwise, single declarations are preferable.

Since the value and volume from second potential supplier is still unclear, a declaration might not be needed if the value is below 188 166 SEK. The offer from supplier no.1 do however exceed this value. Therefore, IIH should submit a declaration since they are the company industrious within EU. Also, since single declarations were preferable according to the customs agency, this should be the declaration to use.

Transport Declaration

Additional to customs declaration, one declaration should be submitted by the transporter preliminary to entry within EU. This can be done in two ways, either with a "*summarisk*"- or a "*transit*"- declaration. A summarisk declaration should be submitted by the transporter to custom services in place of arrival. Some general information about the transport, including loading and unloading, should be declared, for instance information about sender, transporter and receiver. A summarisk declaration can be done for the entire transport, including many senders and receivers. It's an electronical declaration which can be done through an electronical document or through synchronisations of IT-systems between the transporter and Swedish customs. Depending on how the goods are transported, there are different deadlines for submitting of declaration. Shipment of containers means a deadline of 24 hours before the goods are loaded in export-harbour while it is a 4-hour deadline of bulk goods before entering place of arrival. Goods transported on road or rail means a deadline of one- respective two hours before arrival to EU border.

A summarisk declaration is suitable when the goods are transported between EU and one other country but if the goods are transported through many countries, a transit declaration is preferable. However, since this case deals with direct transportation between Russia and Sweden, a summarisk declaration should be made by the shipping company to the customs in Swedish harbour of arrival. Since the logs can be send either containerized or not, the deadline of the declaration vary between 24 hours before the goods are loaded to container in Russia to 4 hours before the non-containerized goods enter Swedish harbour.

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To sum up, customs in Russia is charged with 4 €/m^3, possibly a future reduction if the logs have a certain level of freshness. Both suppliers express that this cost will be added to the price of their offer, however they are the actor responsible for making the payment to Russian customs. Swedish customs are not charging any fee for wood and wooden products according to Table 15 in appendix 4, which is why this is not included in the cost-based model presented later. However, the process of customs clearance in Sweden are divided in two parts. First, the Swedish customs declaration should be submitted by IIH before the goods arrive to Sweden. Second part of the Swedish customs process involves, in this case, a summarisk declaration by the transporter, 24 resp. 4 hours before arrival (containerized resp. un-containerized goods).

5.2.2 Fairway dues

Fairway dues are charged by *the Swedish maritime administrations* upon all vessels loading or unloading goods or passengers in Sweden. This process regards to the control measure between step 4 and 5 in the map.

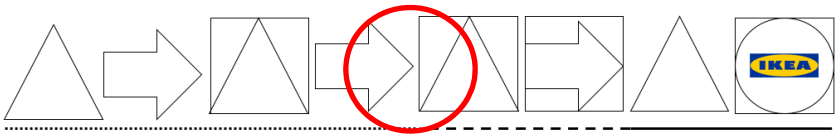

Figure 15. Red circle marking where fairway dues "take place" related to the map.

A declaration of the fairway shall be drawn up by the vessel and sent to the Swedish maritime administrations (**SMA**) through an electrical reporting system called MSW (*Maritime Single Window)* Reportal (www, Sjöfartsverket, 2017a). The declaration counts for vessels that loads- or unloads goods or passengers (SFS 1997:1121, 1§; www, Sjöfartsverket, 2017a). Fairway fee is charged in SEK and divided in two parts, one based on the vessels gross tonnage and the other part is based on the goods loaded or unloaded (SFS 1997:1121, 3§; www, Sjöfartsverket, 2017b). The cost based on the gross tonnage is 2.75 SEK per gross tonnage and is charged for the first two calls per calendar month (SJÖFS, 2016a, 11§). The maximum cost is based on the vessels emission (NO_x g/kWh) and for vessels with a level of emission with more than 6.00 the cost is at the top 91 800 SEK (SJÖFS, 2016a, 12§). A reduction of the fee is feasible for vessels with an emission below 6.00 (g/kWh) after application to the Swedish Maritime Administration which grants a certificate (SJÖFS, 2016b, 16§).

Fairway fee part one

First part of the fairway fee is based on the vessels gross tonnage and could be estimated with the following calculation:

$$2.75\,SEK \times ER \times GTn = First\ part\ of\ fairway\ fee\ (€\ per\ call)$$

Equation above counts with the following conditions:

1. ≤ 2 calls per vessel and calendar month.
2. *GTn* stands for the vessels Gross Tonnage.
3. ER stands for Exchange rate from SEK to EUR.
4. Call = number of times the vessel arrives to Swedish harbour

To get an indication of the fee per cubic meter, the calculation should follow:

$$\frac{2.75\,SEK \times ER \times GTn \times calls}{Total\ offer\ (m3)} = First\ part\ of\ fairway\ fee\ (€/m3)$$

Conditions:

1. *Calls* is the number of calls needed rounded to nearest upper integer assuming that total fee is charged the importer: $Ceiling\ (\frac{Total\ offer\ (m3)}{Vessel\ capacity\ (m3/vessel)})$. This means that in case of a 50 % vessel load, a full fairway fee (pt. 1) is charged on the importer.
2. Total offer is the total quantity (m^3) offered to be shipped.
3. ER stands for Exchange rate from SEK to EUR

Since reduction of first part of the fairway fee is possible with an emission certificate. The first part should have a maximum restriction. Maximum costs for different emissions are presented in Table 3.

Table 3. Reduced fairway fee part one for vessels with emission levels less than 6.00 NOx (g/kWh). Maximum fee is expressed in SEK and converted to EUR with 9.5 SEK/EUR

Reduced fairway fee (part 1)			
Emission NOx (g/kWh)		**Maximum fee**	
MIN	**MAX**	**SEK**	**EUR**
0,00	0,49	0	0
0,50	0,99	14 300,0	1 505,3
1,00	1,99	40 000,0	4 210,5
2,00	2,99	45 300,0	4 768,4
3,00	3,99	50 600,0	5 326,3
4,00	4,99	55 900,0	5 884,2
5,00	5,99	61 200,0	6 442,1
6,00	-	91 800,0	9 663,2

To calculate total cost of fairway due part 1, calculations therefore should consider maximum levels presented in Table 3 above. With a capacity of 3 000 m^3/vessel, first part of fairway due therefore can vary between 0 €/m^3 for emission levels lower than 0.49 g/kWh (0 €/call/3000m^3) to 3.22 €/m^3 with emissions above 6.00 g/kWh ((9 663.2 *€/call)*/3000 m^3). First part of fairway fee should therefore be calculated with the following calculation:

a) IF (2.75 SEK × ER × GTn) ≤ RFF (€) use:

$$\frac{2.75\,SEK \times ER \times GTn \times calls}{Total\ offer\ (m3)} \leq \frac{RFF(€) \times calls}{Total\ offer\ (m3)}$$

b) IF (2.75 SEK × ER × GTn) ≥ RFF (€) use:

$$\frac{RFF\ (€) \times calls}{Total\ offer\ (m3)}$$

Where:

ER stands for the exchange rate from SEK to EUR.
GTn stands for Gross Tonnage of the vessel.
RFF stands for *reduced fairway fee* in euro for certain emission levels, presented in Table 3.
Calls is the number of calls needed rounded to nearest upper integer assuming that total fee is charged the importer: $Ceiling\ (\frac{Total\ offer\ (m3)}{Vessel\ capacity\ (\ m3/vessel)})$.

Fairway fee part two

The fee based on the goods loaded or unloaded from the vessel is fixed at 2.97 SEK per ton (SJÖFS, 2016a) and is charged in the city where the load is carried (SFS 1997:1121, 4§). If

the load contains forest products without information about the gross tonnage, this can be estimated using a conversion table from m^3 to kg, see numbers for ton/m^3ub in Table 4. (SJÖFS, 2016b, 15§).

Table 4. Conversion table presenting density (ton/m^3ub) for different tree species and different harvesting periods. Table also presents fairway fee (pt. 2) in €/m^3ub using an exchange rate of 9.5 SEK/EUR. Windows marked with an "-" are species where density is not stated by the SMA's

Conversion table & Fairway fee (pt.2)						
Pulpwood		**Pine**	**Spruce**	**Birch**	**Aspen**	
	Winter (ton/m^3fub)	1,020	0,990	1,070		0,869
	Winter (€/m^3fub)	0,319	0,310	0,335		0,272
	Summer (ton/m^3fub)	0,880	0,840	1,010	-	
	Summer (€/m^3fub)	0,275	0,263	0,316	-	
Chips (ton/m^3s)		0,325	0,325	-	-	
Chips (€/m^3s)		0,102	0,102	-	-	
Saw logs (ton/m^3fub)		0,910	0,850	1,020	-	
Saw logs (€/m^3fub)		0,284	0,266	0,319	-	

Since the density of the wood varies with specie, this gives different fairway fees (pt. 2). By multiplying 2.97 SEK with exchange rate and respective wood density, this gives the fairway fee in €/m^3ub, also presented in Table 4. Harvesting period (winter and summer) affects the cost by increased density during winter due to frozen water. This gives in turn a higher fairway fee than pulpwood harvested during summer.

Second part of the fairway fee have been calculated with equation below and should be used for offers with varying tree species, rather than the numbers presented in Table 4.

$$\frac{2.97\ SEK\ \times\ ER\ \times\ \sum(Vol_v\ \times\ Conv_v)}{Total\ offer\ (m3)} = Second\ part\ of\ fairway\ fee\ (€\ per\ m3)$$

Equation above counts with the following conditions:

1. Vol_v stands for the volume loaded or unloaded the vessel (m^3).
2. *ER* stands for exchange rate from EUR to SEK.
3. Vol_v stands for the volume (m^3) of tree species *v* multiplied with $Conv_v$ (*ton/*m^3*ub*) for the same specie *v*. For *v* being tree species 1… *n*.

«« »»

To sum up, the Swedish Maritime Administrations charge a cost called fairway fee, which is divided in two parts. First part is based on the gross tonnage of the vessel and the second part is based on the weight goods (ton) loaded or unloaded. The first part might be reduced for vessels with an emission level of NOx below 6.00 g/kWh.

5.2.3 Plant protection regulations

Swedish board of Agriculture is the agency managing and regulating import of wood and forest products which is symbolized with a square in the map (control).

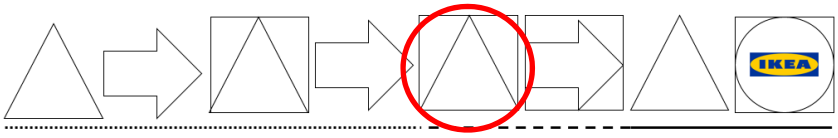

Figure 16. Swedish board of agriculture is related to the process marked with a red circle in the map.

Import of wood and forest products from non-members in the EU bears a risk of bringing organisms that does not have their natural locality within the EU. These organisms might be a danger to the natural resources within EU (Dir 2000/29/EC; www, Jordbruksverket, 2017a). Import operations are therefore regulated with protective measures in EU directive which has been implemented in the member states jurisdiction. These measures consist of a declaration by the *Plant Protection Service* in the exporting country which draws up a *phytosanitary certificate* (www, Jordbruksverket, 2017a). The certificate must be made within 14 days from when the goods leave the export country. Certificate is compulsory for all possible vectors and there is no lower level of acceptance of regulated wood in the sending. Meaning that a certificate should be drawn even though there is only one unit (log, m^3, etc.) of regulated wood in total sending. Regulated wood and forest products from Russia are: unattached barque and solid- and sawn wood from *Pinopsida* (conifers) (SJVFS, 2016a app 5, part B, sec 1.5-1.6) with some of the following conditions (Jordbruksverket, 2016b):

a) it origins from an area without non-European species of *Monochamus sutor, Pissodes spp., Bark beetles (Scolytinae)*
b) it is free from barque and entry-/exit holes wider than 3 mm
c) the wood is dried and marked with "*kiln-dried*" or "*KD*"
d) the wood is heat-treated and marked with "*HT*" or similar.

Some deciduous species are also regulated by the EU directive and phytosanitary certificate are therefore needed (Jordbruksverket, 2016b). From Russia being logs of *Castanea spp.*; *Fraxinus spp.*; *Juglans ailanthifolia*; *Juglans mandshurica; Pterocarya rhoifolia*; *Ulmus davidiana;* barque from *Populus spp.;* and barque from *Quercus spp*. Supplier 1 provides aspen logs, which is not classified as regulated wood, if the supplier can guarantee that no regulated specie, e.g. pine, will follow the sending. Since the specie from supplier 2 is still unclear, this might need a phytosanitary certificate if it is regulated wood according to the regulation above.

To import wood and forest products to Sweden, the company have to be registered to the Swedish board of Agriculture (**SBA**) (www, Jordbruksverket, 2017a). Regulated goods claims, beyond a phytosanitary certificate, an inspection by the SBA when arriving to Sweden or other countries in EU. Importation must be applied in writing in advance by the importer. This should be done at the latest of 10 am or 1 pm the day before, if the inspection takes place in SBA's ordinary place of inspection (*Malmö*, *Helsingborg*, *Gothenburg*, *Landvetter*, *Stockholm* and *Arlanda*). When inspection should be made on other places, the application should be delivered by the latest of five workdays before planned arrival. Inspection on weekdays should be approved by the SBA and are only accepted in exceptional cases.

The costs related to the Swedish board of Agriculture are presented in Table 5. Presented costs are only relevant for tree species regulated by the EU directive were phytosanitary certificate are necessary. These species, from Russia, have been presented earlier in this section.

Table 5. Summarization of costs from SBA's which are relevant for species regulated by the EU directive.

Swedish board of Agriculture (SBA)			
Inspection 3% of sending's	<3 hours	**3 000**	SEK
	>3 hours	**800**	SEK per hour
Application of inspection		**2 000**	SEK
If/When Application granted		**6 000**	SEK
Plant protection fee		**0.01**	SEK per kg, cert.
	Minimum	**500**	SEK per cert.
	Maximum	**3 000**	SEK per cert.

Import of regulated goods are inspected by the SBA upon arrival and is charges with a cost of 3 000 SEK [≈ 316 €] (travel costs included) for the first three hours of inspection (SJVF 2016:14, St. 1:3§). Longer time than three hours is charged with 800 SEK/h [≈ 84 €] (*ibid*.). However, since SBA only makes an inspection on roughly 3% of the import from Russia, this cost is only charged for some sending (mail, Sofie, 2017). For inspections on other than SBAs ordinary inspection places, the importer have to apply for a permission charged with a fee of 2 000 SEK [≈ 211 €] for the application and thereafter a fee of 8 000 SEK [≈ 842 €] when and if the application is approved (SJVF 2016:14, St. 2:2§; mail, Sofie, 2017). IIH do currently have this permission for the potential harbours presented later in this section. Besides that, an additional fee is charged as a plant protection fee which counts per phytosanitary certificate. Since import of round wood from Russia qualifies as reduced inspection under article 2.2 in EG regulation 1756/2004, the plant protection fee is also reduced. According to SBA's (dnr. 6.4.17-4827/16) it is charged with 0.01 SEK/kg, certificate, on the weight stated in customs with a minimum of 500 SEK [≈ 53 €] and maximum 3 000 SEK [≈ 316 €] per sending.

To sum up, plant protection services in Russia should draw up a phytosanitary certificate if the logs are regulated in EU directive. Aspen logs from supplier 1 are not regulated if the supplier can guarantee that no regulated wood will follow the sending. Additional to this, IIH must be registered to the SBA and have a permission to import wood to the chosen harbour. Since they are registered and have a permission for all Swedish harbours related to this case, their only concern should be the plant protection fee and inspection of approximately 3 % of the Russian importations, for regulated wood. However, since aspen logs are not regulated these costs are not included in the cost-based model but have to be added manually if the case regards regulated wood.

Section 5.2 presented regulations and compulsory processes and costs related to import to Sweden from Russia. This involves a customs clearance process, fairway fees to the Swedish Maritime Administrations additional to Plant protection regulations. Since the phytosanitary certificate, if any, are included in the offer of both suppliers – it is only the fairway fee providing an actual cost. This will therefore be included in the cost based model presented in the next section.

5.3 Cost-based model

All costs and calculations presented during chapter 5 were put in *Microsoft Excel* to create a total-cost model, both presented in €/m^3 and in total cost (€). Table 6 below shows the structure of the model, including variable (section 5.1) and compulsory (section 5.2) costs.

Table 6. Cost based model presented in (EUR/m3) for transport to Hultsfred from different harbours with different length of the logs. Some costs are excluded due to competitiveness. The costs presented in the model is based on an exchange rate of 9.5 SEK/EUR, Vessel capacity of 3 000 m3/vessel with a gross tonnage of 3 000 Gton. Vessel freight is put as 15 €/m3 which approximates market price. Variable costs are marked with a line "–" and competitive costs are excluded with an "X"

Cost based model (EUR/m3) to Hultsfred From harbours:				
	Oskarshamn	**Västervik**	**Kalmar**	
RU Transport to harbour	- €	- €	- €	€/m^3
RU Wood in port	- €	- €	- €	€/m^3
RU Loading & Harbour cost	- €	- €	- €	€/m^3
Vessel freight	15,00 €	15,00 €	15,00 €	€/m^3
RU customs incl. Admin	4,00 €	4,00 €	4,00 €	€/m^3
SWE SMA Customs				
1. Gton fee (≤2 calls/month)	0,29	0,29	0,29	€/m^3
2. Goods (Pulpwood)	0,27	0,27	0,27	€/m^3
SWE Harbour cost				
1. Gton (Vessels ≥20 m)	0,45	0,45	X	€/m^3
2. Goods (Pulpwood)	0,72	0,72	X	€/m^3
unloading	2.27	2.27	X	€/m^3
storage	<14 days	<14 days	X	€/m^3
SWE Trucking				
(39m^3 load) 6 m logs	X	X	X	€/m^3
(50m^3 load) 3-5.5 m logs	X	X	X	€/m^3
SWE Measuring (VMF)	0,51	0,51	0,51	€/m^3
Total cost				
Pulpwood (> 6M)	**X**	**X**	**X**	**€**/m^3
Pulpwood (3 - 5.5 m)	**X**	**X**	**X**	**€**/m^3

Table 6 shows the structure of the excel model presenting total costs in €/m^3. Also, a model presenting total cost in euro were based on the same structure to give an indication of different cost drivers relevance for the total cost. Total cost was calculated either by take cost per cubic meter multiplicated with total volume or the number of calls needed. This was related to the context of the costs were for example the total SMA customs (pt. 1) is based on calls while total raw material price is dependent upon the volume of the offer. The result from the cost-evaluation of the two potential suppliers indicates that supplier 1 with shipping on river to harbour in Oskarshamn, resulted in lowest cost. As presented earlier, choice of harbour could in a high degree be connected to the trucking price from respective harbour where trucking from Kalmar had the highest cost.

The model in Table 7 includes variable costs which should be easy to change with different sourcing alternatives or time. All calculations were therefore connected to a separate table, stating different variables related to different alternatives (i.e. those presented in chap. 5.1), see Table 7.

Table 7. Costs varying with different sourcing alternatives and time. Note that some costs have been excluded due to competitiveness. "X" indicates exclusions of competitive numbers

Variable costs	EUR	SEK	RUB
Exchange rate (per EUR)	1,00 €	9,50 SEK	59,93 RUB
Transport to harbour (per m^3)	x		
Price in port (per m^3)	x		
RU Loading & Harbour cost (per m^3)	9,00 €		
Vessel freight excl. Customs (per m^3)	15,00 €		
RU customs (per m^3)	4,00 €		
SE Diesel (SEK/l)		10,90 SEK	

Three potential foreign exchange currencies are feasible when importing from Russia: Swedish kronor (SEK), Euro (EUR) and Rouble (RUB). Which currency to use are highly connected to which country the cost relates to. For example, most costs on Russian side are expressed in rouble while Swedish costs are expressed in SEK. However, since many companies work on an international or intra-European arena, euro are also a common currency. All three currencies are therefore included in the model since their respective exchange rate might affect the total cost. By including all three currencies IIH could use this model to evaluate other currencies which might include rouble as currency.

Also, the costs after exchange rate in

Table 7 should be easy to change in the total-cost model to evaluate different alternatives. For example, first alternative supplier offers logs directly in port, meaning that the cost "*transport to harbour*" is zero. Also, first alternative means a *Russian loading and harbour cost* of 2.5 €/m^3 while the second alternative means a cost of 9 €/m^3. *Vessel freight* are also varying with different shipping companies, however the mean price from Spb to Sweden were expressed as between 13-15 €/m^3. *Swedish diesel price* will also affect the costs by increasing or decreasing the trucking cost. Note that some costs above have been excluded due to competitiveness.

Some of the costs are dependent on variables related to the vessel (Table 8).

Table 8. Specification of vessel specific measures

	Vessel specification
Gross tonnage	3 000
Vessel capacity (m^3/boat)	3 000
Emission level (NOx/kWh)	6,00

Vessels gross tonnage will affect the fairway fee (pt.1) to the Swedish maritime administrations and the cost to Smålandshamnar harbours or Kalmar harbour. Capacity of the vessel affects the number of calls needed which will also affect the fairway fee (pt.1) and the harbour cost. The calls are rounded to the nearest upper integer since the gross tonnage of the vessel are still the same even though it is only loaded with half of capacity. A load of 50% capacity will therefore be charged with 100% of costs related to the vessels gross tonnage. The last variable, emission level, will affect the first part of the fairway fee charged by the Swedish maritime administrations. Since no emission level have been registered for the potential shipper, the level of 6.00 *(NOx/kWh)* have been put to express the maximum emission level (and cost).

Final variable needed in the model is the total offer of pulpwood, presented in Table 9.

Table 9. Total offer of pulpwood should be stated in a variable table. This is needed to calculate total cost and calls needed for the offer, below is the offer from supplier 1 stated. Since density of the wood varies with specie and harvesting period, the table includes a variety of species. There is only one density of Aspen presented in the conversion table from SMA, which is why logs of Aspen harvested during summer is marked with "XX"

	Total offer Pulpwood (harvesting period)	
	Winter (m^3fub)	Summer (m^3fub)
Pine	-	-
Spruce	-	-
Birch	-	-
Aspen	30 000	XX

Total offer of pulpwood is divided in harvesting period and specie since this affect the density of the logs, meaning that the price per m^3 will be different. This counts mostly for the second part of the fairway fee, based on the ton loaded or unloaded in harbour. Also, total offer is needed to present a total cost calculation and the number of calls needed. The offer from first alternative supplier of 30 000 m^3 of aspen is presented above, which is a specie with only one density presented in the conversion table from the *Maritime administrations* (SJÖFS, 2016a attach. 3).

Since different alternatives were identified during this project (see chap. 5.1), these were put in the excel-model to evaluate different alternatives and find the most cost-efficient alternative. These evaluations will be presented in the following section, including a sensitivity analysis of how changes in the variables would change total cost.

5.4 Evaluation of alternatives

The two possible suppliers identified during the project comes with different logistical solutions. These alternatives, additional to the choice of harbour, were the main alternatives during this study. Therefore, they were put in the excel-model to evaluate different costs and find the most cost-efficient alternative.

First supplier means shipping on the Russian river system directly to Sweden, though to a high shipping cost compared to market price. One alternative logistical solutions from first supplier would be truck transport to Spb harbour. This would result in a lower shipping cost (i.e. market price) however it did result in a higher cost since it includes more operations, i.e. reloading and storage.

Second supplier would result in a lower shipping cost. However, due to a current unfavourable market situation with low supply of FSC pure certified wood, the increasing number of operations needed, plus harbour fee in Spb. This turned out to be the least cost-efficient alternative of both suppliers. At least in the current market situation, with time the number of suppliers might increase which should decrease market price and therefore answer to the higher cost of operations.

All three harbours identified in the project had similar costs related to their operations. Therefore, it was rather the trucking cost that affected the total cost related to the choice of harbour. Since the trucking company have no current logistical transports from Kalmar harbour plus this was the harbour farthest from IIH, this resulted in the highest cost. Oskarshamn is the harbour from where trucking can be done to the lowest cost and turned out to be the most cost-efficient alternative. Note that the harbours in Oskarshamn and Västervik have the same prices.

The model is currently based on the same trucking cost from Swedish harbour, for both alternative suppliers. This might however not be the future case, since supplier no.2 could mean an equal distribution of material during the year. This could in turn provide a lower trucking cost since they would utilize capacity during seasonal fluctuations of demand. Supplier no.1 would instead result in transports during the time when river is un-frozen, which also turned out to be the season with highest demand on the trucking company.

5.5 Sensitivity analysis

Some variable costs identified in Figure 8 and 9 were evaluated in a sensitivity analysis to see how changes would affect the total price (*€*/m^3). Emission level were found to have no impact on total price until the levels of NO_x are below 0.49 *g/kWh* which is because of a maximum fairway fee (pt.1) of 0 *€/call* for levels under 0.49 *g/kWh.* For emission levels above this, case specific variables result in a fairway fee (pt.1) beneath maximum level. Gross tonnage of the vessel has neither been put in a sensitivity analysis because of a limited possibility for the company to change this in levels affecting total cost to any appreciable extent.

Exchange rate: Even though the model is adjusted to work with three currencies, only euro and Swedish kronor have been included in the specific case. This is due to all Russian actors

expressed their costs in euro and all Swedish actors in kronor. Changes in this exchange rate (SEK/EUR) are presented in Table 10.

Table 10. Sensitivity analysis of exchange rate (SEK/EUR)

Rate SEK/EUR	**8.00**	**8.50**	**9.00**	***9.50***	**10.00**	**10.50**	**11.00**
Change in total cost (%):	+ 3.74 %	+ 2.34 %	+ 1.11 %	*0 %*	- 0.98 %	- 1.89 %	- 2.69 %

Table 10 shows how total cost is affected by changing the currency rate. As presented, a lower rate will result in a bigger change in total cost compared to the same increase in rate.

Price in port: Symbolizes the cost of the raw material when it is delivered to harbour. How changes in this price affects the total cost is presented below.

Table 11. Sensitivity analysis of the raw material price, when it is delivered to port

Change in price (%)	**± 5 %**	**± 10 %**	**± 15 %**	**± 20 %**	**± 25 %**
Change in total cost (%):	± 0.78 %	± 1.54 %	± 2.26 %	± 3.09 %	± 3.86 %

As presented in Table 11, the same change in price (%) results in the same change in total cost (%) irrespective of if it is an increase or decrease in price.

Vessel freight: Since the vessel freight is higher compared to market price in the specific case. One sensitivity analysis was made to evaluate how changes in freight affect the total cost, see Table 12.

Table 12. Sensitivity analysis of vessel freight

Change in freight (%)	**± 5**	**± 10 %**	**± 15 %**	**± 20 %**	**± 25 %**
Change in total cost (%):	± 2.57 %	± 5.14 %	± 7.71 %	± 10.28%	± 12.84 %

The same counts for changes in the vessel freight as for changes in raw material price (price in port), the same change in freight results in the same change in total cost. Because of the case situation, were a high freight price were presented. A reduction of freight price would be most likely.

Vessel capacity: The vessel specified in the case have a capacity of 3 000 m^3, however changes in vessel capacity and how it affects the total cost is presented below.

Table 13. Sensitivity analysis of vessel capacity (m^3)

Capacity of vessel (m^3)	**2 000**	***3 000***	**4 000**	**5 000**	**6 000**	**15 000**
Change in total cost (%):	+ 0.77 %	*± 0 %*	- 0.29 %	- 0.60 %	- 0.75 %	- 1.23 %

As presented above, an increase in capacity will lead to a decrease in price. The capacity of the vessel affects mainly the number of calls needed to deliver the total offer (m^3). Number of calls affects in turn the total fairway fee and harbour-related costs, which decrease with a decreasing number of calls. Note that the model is adjusted to count full loads, meaning that half loads or cases were total offer divided by vessel capacity is unequal, will result in a higher cost per m^3 compared to full loads.

6 Analysis

This chapter presents an analysis of the empirical data collected in previous chapter. First section provides answers to the research questions of this study. This is followed by a general analysis of the conceptual framework including Sourcing decisions related to international forest companies; Shipping as transport solution and Mapping as a method for modelling the SC.

6.1 Analysis related to the research questions

First part of this chapter follows the structure of the research questions presented in chapter 1 and includes an analysis of the empirical data related to the conceptual framework and the research questions:

1. *Can supply chain management affect the performance of international supply chains in forest companies?*
2. *What logistical flows contributes the mots to supply chain performance?*
3. *How could supply chain cost analysis lead to a better performance of international supply chains?*

6.1.1 Supply chain management for increased supply chain performance

The market is constantly changing where recent trends demand increased flexibility and responsiveness of SCs (Mattsson, 2002; Wood *et al.*, 2002; Chopra & Meindl, 2016; Krajewski *et al.*, 2016; Larsson *et al.*, 2016). These changes are affecting the entire market, including the forest sector and IKEA – which is currently focusing on efficient SCs with low flexibility. To increase SC flexibility in these companies, SCM could provide a central concept - bridging the gap between efficiency and responsiveness in SC's. Therefore, IKEA and the forest sector could use SCM as a strategic concept to handle a changing market.

Market changes also include globalization, resulting in international SCs with increased complexity in SC management and integration (Wood *et al.*, 2002; Christopher, 2005). Also, the geographical distance between actors in the SC increase - which also increases the complexity related to differences in language, culture and time-zones. The international SC presented in this study shows one example of the complexity in SC integration compared to a domestic one. One example of this is through optimization of trucking cost from Swedish harbour related to the choice of supplier. As presented, the trucking company expressed an opportunity to reduce trucking cost through long-term agreements over seasonal fluctuations. This would however only be possible with supplier 2, since this offer could be shipped throughout the year. Supplier 1 would instead result in transportations during summer time, when the river is unfrozen. Summer time also happens to be the season when the trucking company have the highest demand. Still, trucking price should not increase by choosing supplier 1, however it might involve a future decrease in price by choosing supplier 2.

To deal with these issues, IIH should broaden their SC perspective in order to optimize the SC performance. The perspective should involve first supplier as the forest, including forest operations, and the last actor as the one buying IKEA furniture (*c.f.* Shapiro, 2007; *c.f. ibid.*). This provides a possibility to change forest operations and optimize the characteristics of the raw material, i.e. quality, length and diameter. This could in turn affect the trucking cost from Swedish harbour since this is dependent on the log characteristics. A length within 3-5.5 meters and an acceptable quality would secure a full loading capacity.

A broader SC perspective should lead to more efficient implementations of performance increasing measures in the SC. Logistics is a large contributor to overall SC performance and should therefore be optimized. Logistical operations might increase the flexibility in several ways, for instance through lead times (*c.f.* Mattsson, 2002). Looking at the map and the different processes presented with their respective time-frame's, the time from supplier in Russia to IIH is very long. The future offer from first supplier means a storage time of the logs for approximately 6-8 months of winter harvested logs, shorter for logs harvested during summer. After storage at supplier, additional time of approximately 1 month is added due to shipping. Then the logs are stored in 14 days at Swedish harbour and then stored once again at industry unit in Hultsfred. This result in a lead time of at least 7-9 month and 3 weeks before the logs are operated in Hultsfred.

Traditionally, long lead times are seen as a restricting factor of SC flexibility, since long lead times usually results in low possibility for customization and responsiveness towards changes. Still, IIH's processes are relatively fixed where their products are not in a high degree affected by the quality or type of raw material. Also, their productions involve a certain capacity which should be fully utilized to yield liquid capital from fixed invested capital. Long lead times in raw material deliveries might therefore not restrain flexibility in IIH's SC since this rather should be dependent upon further value adding of their products, for example colouring of the boards. On the other hand, since IIH's operations are not very dependent upon the quality of the material. This creates an opportunity for IIH to find low-cost suppliers on an international arena and use the potential savings to increase their flexibility in other parts of the SC. For instance, move further value-adding of their products closer to customer and thereby increase the possibility for customization.

The findings of this study did not find any direct costs related to the long lead time, except the cost of capital and reserves by not using the logs in a value-adding process (Mattsson, 2002). One process that might result in costs related to lead time is storage at supplier. In this case, this is free of charge for supplier 1 and included in harbour cost for supplier 2. Therefore, storage time should not have a negative impact on total cost. Also, no concern about limitations in storage area at supplier 1 were raised during the data collection. Meaning nor this aspect is negatively affected by lead time. Shortening the time of shipping would reduce the lead time, however this opportunity is restricted due to the monopoly situation on Russian rivers. Storage time at harbour did not result in extra costs since trucking from harbour could be carried out within the time of free storage. Therefore, the only aspect with negative impact from lead time should be the decreasing quality of the logs. However, this factor is overseen by IIH stating their quality requirements and force the suppliers to deliver according to this. This will in turn prevent a negative impact of the lorries loading capacity.

One effect related to long lead times might be the bullwhip effect (Mattsson, 2002), resulting in an increased uncertainty in planning and forecasting. This should be dealt with through establishing and maintaining a transparent relationship between actors. Transparency between actors presumes an efficient dialog where information is shared in an open and unbiased way. The long lead times related to this case should therefore demand a transparent dialog during the entire process to reduce the bullwhip affect. This is especially true for supplier 1 which is offering a long-term agreement with the possibility to adjust harvesting operations to IIH's desire. A transparent dialog should in this aspect lead to a more efficient implementation of changes and planning of utilization of harvesting operations.

Designing an international SC should also consider its external context (Mattsson, 2002). A SC in an unstable context with continuous changes should be dynamic, while a SC in a stable

context should be fixed (*ibid.*). The market situation related to this case will be discussed in the following chapter. Lead time might however affect the choice of SC design since long lead times result in a long time from agreement to delivery of the logs. The context therefore becomes relatively stable, where changes in external factors are not likely to affect the terms of the agreement. The agreement should reduce the uncertainty of IIH since they are certain of a quantity being delivered in a certain time. Therefore, a highly dynamic SC should not be efficient in this case. On the other hand, some level of dynamics could provide flexibility for IIH to find other solutions regarding transportation or custom classification, etc. This could in turn result in a more cost-efficient SC compared to a stable one.

6.1.2 Processes and flows related to the supply chain and its performance

In SCM, intra or inter organizational processes taking place between actors in the SC are of greatest and can in turn broken down into primary and secondary activities (Porter, 1986; Mattsson, 2002). In and outbound logistics are two types of primary activities.

The processes identified in the map are all related to these primary activities. However, some processes are classified as compulsory and might not add direct value to the process. Therefore, it is somewhat tricky to characterize all processes involved in the SC as primary. The result of this study therefore fairly questions the division in primary and secondary activities, since they rather include a varying degree of both types. For instance, drawing up a phytosanitary certificate increases the value of the logs since it guarantees a certain quality. However, it is not an activity directly adding value to the process since quality requirements are already stated.

A SC is first built upon different flows between actors which in turn is divided into processes and core-activities (Mattsson, 2002; Wood *et al.*, 2002). In this study however, in and outbound logistical activities will be divided into different flows to make a distinction of what SCM measures can be implemented in each flow. There are three types: flow of information, material and payments.

Flow of material

The flow of material involves the actual movement and are highly connected to the mapped SC. However, Figure 17 illustrates the movement of the material related to the actors in the SC.

Figure 17. Flow of material presenting the actual movement related to different actors in the SC.

The specific SC includes movement of the material from supplier to vessel company which ships the material to Swedish harbour. In SE harbour, the material is stored before loading to trucks which transports it to industry in Hultsfred. However, during each step several procedures are connected to make the goods moving. This include for instance customs clearance, booking of transportation, booking inspection of the SBA and plant protection services to draw up a phytosanitary certificate, etc. These steps are more about sharing information between actors in the supply chain which will be analysed in the following section.

Flow of information

A lot of processes in the supply chain includes information which should be communicated. This flow has traditionally been a one-way communication (monolog) but since the increased importance of SCM, this have shifted to become a two-way communication (dialog) (Mattsson, 2002). Sharing of information is in this case a requirement to build and manage the SC in an efficient way. Also, a dialog provides increased transparency for risk management, reduces the bullwhip effect and allow more confident prognoses.

Information about the offer (or case) and its settings, are needed at each step of the map to plan and design the performance of each activity. For instance, the trucking company needs to know in advance the size of the offer, the capacity/load on the boats, the quality of the logs, time of arrival or at least time for departure and then an estimation of shipping lead-time. Otherwise they would not be able to plan their business and make it cost-efficient. For the trucking company, this is important both economically and environmentally, since shorter transports without cargo means more efficient utilization while reducing environmental impact. Also, sharing of information provides an opportunity for IIH to change the quality specification with supplier no.1. Resulting in increased customization of harvesting operations which could provide logs better adapted to IIH or other SC processes. For instance, changing length of the logs in order to optimize the loading capacity of shipping.

Presented in Figure 18 below, you find an illustration of the informational flows identified during this study.

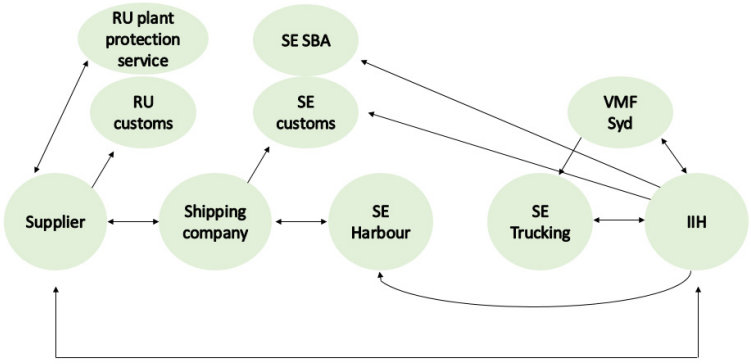

Figure 18. Mapped supply chain adjusted to illustrate all flows of information taking place between actors.

Between IIH and supplier: Suppliers provides information about the specific offer and information about transportation. In turn, IIH provides information to the supplier about the arrangements according to their responsibilities and information about deliverance and volume. This dialog might also include future offers, changes in quality, transportation, SC structure, etc.

Between supplier and shipping company: In this case, the supplier is the actor providing the shipment and should therefore make the order. The shipping company provides information about the delivery time and information about the specific vessel; gross tonnage, capacity, emission level. This dialog might also be with the shipping company and IIH, depending on which actor is responsible for providing the shipment. This is in turn arranged by the terms of the contract, i.e. INCO-terms.

Between supplier to Russian customs and Russian plant protection service: This is also dependent upon the conditions of the contract. However, in this case it is the supplier responsible for clearance of customs in Russia. This includes a clearance from the plant

protection service when exporting regulated wood. They are in turn inspecting the logs and provides a certificate to follow the logs during transport.

Between shipping company to Swedish harbour and Swedish customs: Shipping company should make a preliminary declaration to the Swedish customs, 4 hours before arrival (un-containerized goods, see chap. 6.4.2) through a summarisk declaration. They need information about what kind of load the vessel carries, specification about the vessel and planed rout and time of arrival. This should also be communicated to the Swedish harbour which provide more details about the arrival: where to arrive, unloading etc.

Between trucking company to IIH and VMF Syd (measuring company): IIH is in this case the actor responsible for booking the trucks. The trucking company provides details about the transportation, for instance delivery time and how many trucks needed for the delivery. When arriving to IIH, the trucks are measured by VMF Syd. They provide in turn a receipt for the trucking company which secures the quality and quantity of the deliveries.

Between IIH and Swedish harbour: IIH is the actor responsible for booking the operations needed at Swedish harbour. This booking is done prior to the communication between shipping company and harbour (the summariska declaration). Booking is submitted to prepare the harbour about incoming delivery and arrange serviced as unloading and storage.

Between IIH to SBA and Swedish customs agency: Regulated wood shall be announced to the SBA's so they can arrange inspections, this is however done on approximately 3% of Russian consignments. SBA also control the phytosanitary certificate provided from the Russian plant protection service. IIH should also make a customs declaration to the Swedish customs.

Between IIH and VMF Syd (measuring company): A pre-declaration should be sent from IIH to the measuring company in order to prepare arrangements and specify volume and quality regulations of the logs. By measuring all incoming goods, IIH gets a receipt of the deliveries and information about current level at industry inventory.

Flow of payments

Third flow in supply chains is the flow of payments. This is traditionally a one-way flow were the customer makes one payment to the supplier. In this case however, there are some more costs charged upon different actors. Flow of payments is presented in Figure 19.

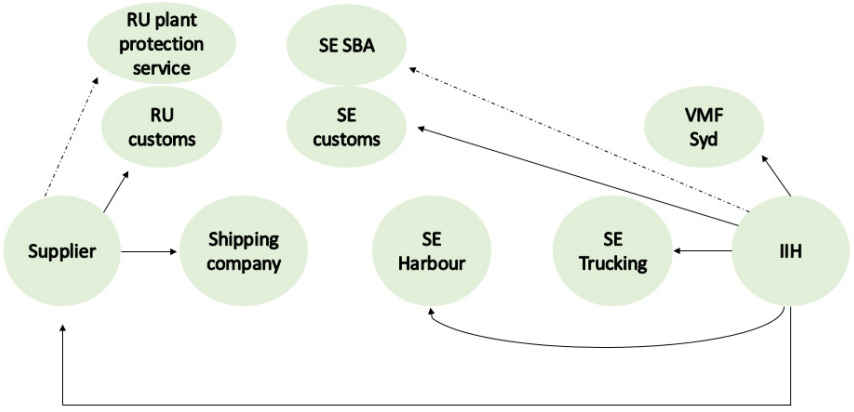

Figure 19. Mapped supply chain adjusted to illustrate all flows of payments taking place between actors.

As presented above, either the supplier or IIH is responsible of payments to the other involved actors. The payments between supplier to Russian plant protection service and IIH to Swedish

board of Agriculture is presented with a dotted line, since this only counts for regulated wood. Regulated wood is charged with a cost for certificate additional to plant protection fee.

The responsibility of payments should be stated by the terms of the contract (i.e. INCO-terms) and should be cleared before making an agreement. To summarize, the payments made on the Russian side is paid by supplier and the costs on the Swedish side is paid by IIH. In the end however, most costs end up included in the price paid from IIH to supplier. Therefore, all costs are stated in the model to increase the transparency of SC related costs. The costs of forest operations are however not included, even though they should be included in SC perspective.

6.1.3 Logistical concepts & methodology for supply chain cost analysis

Logistical operations can affect the overall profitableness of companies and should therefore be optimized (Mattsson, 2002, p 137). Important to keep in mind however, is that all dimensions of profitableness are correlated. This became clear by looking at different logistical alternatives during the project. For instance, a reduction of the vessel freight would result in a higher total cost, since it included additional operations. Therefore, the results of this study correspond to the literature arguing for a broader SC perspective included in logistical decisions, since many factors are correlated (Porter, 1996; Fisher, 1997; Mattsson, 2002; Haartveit *et al.*, 2004).

Expenses in international logistics

Identification and survey of the costs in logistical activities are necessary when making efficiency increasing measures in the SC (Mattsson, 2002; Wood *et al.*, 2002). All costs were presented in a cost-based model during the project, resulting in an efficient tool when evaluating alternative logistical solutions. Also, the model facilitated evaluation of costs by comparing individuals but also in relation to total cost. To structure and facilitate the survey, costs could also be categorized in different classes:

Cost of transport and handling originates from the material flow in SCs and can be affected by the INCO-terms of the contract (Mattsson, 2002; Wood *et al.*, 2002). Most of the costs and processes identified during this case would be characterized as this type of cost. Meaning costs related to the actual movement of the logs from Russia to Sweden. These costs are mostly related to the arrow-symbol in the map, since this regards actual transportations. However, breaking down the different processes shows that operations as loading, unloading, inspection, control and measuring should also be included.

Costs of inventory can be divided in three types: *cost of capital*, *cost of holding* and *cost of depreciation* (Mattsson, 2002). As pointed out earlier, no costs related to the fixation of capital or for holding the logs have been identified. This does not include the cost for storing logs at harbour for more than 14 days, since transportation can be done within this time. The only cost related to this category might therefore be the cost of depreciation, this should however not be an issue since the supplier agreed to deliver the logs with and according to quality specification.

Shortage and delays are an important cost in forest industries because of a high amount of money invested in all machines. Resulting in a need to utilize capacity to yield liquid capital. This class also includes costs of risks or uncertainty, which might result in extra transportations or IIH being forced to buy expensive logs to satisfy their demand (Mattsson, 2002; Wood *et al.*, 2002; Larsson *et al.*, 2016). This risk is commonly increasing when dealing with international sourcing (Wood *et al.*, 2002; Hameri & Hintsa, 2009). To manage this class, IIH could keep a safety inventory to secure supply and prevent industry hold-up's

due to delay or shortage. Also, risk could be managed by integrating the information flow between actors.

Administration deals with costs for personnel and handling of managing the flow of material (Mattsson, 2002; Wood *et al.*, 2002). In this case, this class should include costs for managing the phytosanitary certificate, customs declaration, SBA application, booking of transportations and harbour(s). Different documents in international logistics presented by Wood et al., (2002, pp 312-320) regards insurance, the quality of the wood and receipts. Insurance is not needed for IIH since this is provided by the seller (see further about INCO-terms). One important aspect regarding this class however, is the FSC certification. This should be secured through some documentation. This aspect is especially important for IIH, since IWAY policy (chap. 4.3) state that all wood imported from Russia must be 100% certified. Insufficient guarantees of certification would mean a lacking environmental responsibility and might result in boycotts from IKEA customers. During this case, a lot of costs related to administration were presented. Approximately the entire flow of information deals with documentations or declarations that should be communicated among SC actors. Results of this study therefore agrees with the literature since it presents a great deal of documentation needed in international logistics, even though technology has made the processes more efficient (Wood *et al.*, 2002).

Another category discussed in the literature is "*terms of payment"* (Wood *et al.*, 2002). One class related to this, is the cost of establishing a relation with new suppliers or customers. In this case, the relation to supplier no.1 is relatively new. II are currently swapping logs with this supplier however they are currently unknown for IIH. IIH do though work in close collaboration to other II units. This should result in a lower cost of establishing a relation with supplier no.1 compared to supplier no.2, which is an entirely new relation. This mean that the cost for lack in trust and extra credibility should be higher for supplier no.2 (Wood *et al.*, 2002).

Three problems might arise by optimization of the costs above. First, there might be difficult to define the boundaries for the SC perspective (Lambert & Cooper, 2000; Mattsson, 2002). Even though SCM builds on an idea of a broad SC perspective where all actors are kept in mind, this might cost more resources than it yields. So where should the boundary be drawn? In this case, optimization should be most beneficial by taking a perspective including forest operations to IIH. Because of the logs change identify and lose their original form through IIH's value-adding processes (Lambert & Cooper, 2000; Mattsson, 2002). Forest operations are however not included in the results of this study, since the offer from first both suppliers' regard logs already harvested. This should however not be the case in future consignments, were forest operations also should be included in the integration.

Second problem involves the correlation between different classes where a decrease of log price might result in an increased cost for risk-management, for instance if it's a supplier with bad trustworthiness and credibility (Mattsson, 2002). This problem is somewhat managed by IWAY-policy which state's certain terms the supplier must fulfil.

Third problem involves the fact that the cost of an optimization should not be higher than the yield of the optimization. In this case, this problem involves the fact that limitations should be done. For instance, there are several shipping companies operating or willing to operate from Russia to Sweden. However, requesting offers from all these companies would probably cost more than resulted reduction of price.

One way of dealing with these problems might be through the method selective optimization, which means that the class contributing most to total cost and overall profit should be optimized (Krajewski *et al.*, 2016). In the excel-model built during this project, the costs are presented individually in two ways, first in €/m^3 and second in total cost (€). Looking at the total cost of an individual step gives the opportunity to compare it to other costs. For instance, looking at costs individually indicates that the vessel freight contributes most to total cost. Optimizations efforts should therefore, according to selective optimization, focus on this cost. However, this is somewhat complicated because of the monopoly situation on Russian rivers. Therefore, it might be more beneficial to focus optimization efforts on the second most contributing cost. Selective optimization should therefore bear in mind the external situation related to each cost and focus on the one was measures can be done without or with limited restrictions of external factors.

Methods to improve SC performance

There are two complementary strategies for improving in supply chain performance, either reengineering of processes or improvement of current processes (Krajewski *et al.*, 2016). This case involves mostly reengineering of processes since IIH are not currently buying material from Russia. A new supply chain was therefore presented with information about involved processes and alternatives, since this is required before implementing measures for improvement (Krajewski *et al.*, 2016). Also, important to keep in mind is that improvement measures have to affect all flows in the SC (Mattsson, 2002). Some measures for increasing the SC performance are presented below (*ibid.)*.

Simplification and rationalization means eliminating wastes and activities that are not adding value to the supply chain (Mattsson, 2002). No wastes have been identified during the study however non-value-adding processes might concern the need for customs declarations etc. Still, as discussed earlier, all activities are characterized as what Porter (1985) presents as primary activities. Meaning that they are a part of the value adding process and cannot be eliminated from the SC due to legislation etc. These measures also relate to the design of the SC where the findings of this study indicate that a "simpler" SC, including a less number of extra operations, resulted in lowest cost.

Simplify interchange of information means that un-biased information should be easy to communicate in the SC and be communicated as a dialog (Mattsson, 2002; Wood *et al.*, 2002). Technology can contribute to this measure, since it makes information sharing easier, faster and even automatically by sharing the same system between actors. Many procedures and declarations are feasible by electronical declarations, for instance Swedish customs declarations, however they are currently separate from each other. Meaning that all actors have their individual system. Next step for more efficient supply chains could therefore be to implement one system for all actors which correlates to one other measure called *Automation*.

Re-configuring and *collaboration* are two measures for increased efficiency, meaning sharing of responsibilities and synchronizing or coordinating flows (Mattsson, 2002). This measure might not be in question for this specific case but will be discussed later in this report.

6.2 General analysis related to the conceptual framework

The conceptual framework also presents theories related to sourcing decisions for increased SC performance, key concepts and terminology in international SCs and mapping as a method for modelling the SC. This section will present an analysis of the results of this study related to these theories.

6.2.1 Sourcing decisions in international supply chains

Sourcing deals with choices regarding location of factories and the location, qualification and employment of suppliers by looking beyond national borders (Semanik & Sollish, 2011). These should aim to increase the value of the buyers' product or service in order to increase the competitive advantage of companies (Fawcett & Closs, 1993; Wood *et al.*, 2002; Semanik & Sollish, 2011).

Since this case involves finding most suitable raw material supplier to provide current domestic industry. The sourcing strategy involved in this study should be classified as a *factor-input strategy* by Fawcett & Closs (1993), since IIH are, in this case, not aiming to reach new markets. Sourcing decisions should consider two terms presented by Porter (1986): *coordination* and *configuration*. This case deals with supplying current operations by finding new suppliers, which mostly concern coordination of market activities and operations on a global level. Coordination can be done in several ways, however choosing the number of suppliers is one question involved. Since IIH are using multiple suppliers to their board industry, this should be called a multiple sourcing by Mattsson (2002). This strategy is preferable for risk sharing and decreases the position of dependency.

This case indicates that the transaction cost of involving first potential supplier would be quite high due to long lead times and agreements over an extended period. Also, this specific SC requires several resources to manage all flows, which in turn becomes more complex working on an international arena. Supplier 2 would therefore result in a lower transaction cost and a higher flexibility, since IIH could choose to buy on auction when needed without long-term agreements. A high transaction cost is not preferable in multiple sourcing, since it limits the flexibility of using many suppliers (Mattsson, 2002). However, by looking at the total need of IIH, supplier 1 is only contributing with a certain amount of material. This means, in turn, that IIH have a rather low position of dependence, since they also claim other suppliers to secure their total demand. The high transaction cost might therefore not be of immense importance. The results of this study show that gains could be made from managing a (SCM) relation between actors in the SC. Even though it should be more feasible with a single supplier (Mattsson, 2002), it should also be accomplishable in a multiple sourcing strategy.

6.2.2 Shipping as transport solution in international logistics

Most ports are privately owned (Wood *et al.*, 2002), which is also the case for the three Swedish harbours involved in this study. All of which have the requirements necessary to make shipping a thinkable logistical solution in this case, including unloading-equipment, staff and storage-area. Ports are classified as a free-trade zone, which means that goods remain free of duty until they enter their "home" customs territory (Barovick, 1997, referred in Wood *et al.*, 2002, p 234). For member countries in EU, this means that the goods are free of duty until they arrive within EU customs. Even though the vessel is making a stop in other EU harbour before further transport to Sweden, a customs declaration should be submitted. In this case however, vessels will go directly to Sweden, meaning that the Swedish harbour is the first harbour of arrival inside European union. Therefore, customs declaration should be submitted, preferably electronically, when the goods arrive to Swedish harbour.

Shipping can be done via three common types of carriers: Private fleets, Tramps or Liner carriers (Wood *et al.*, 2002). In this case, companies offering tramp vessels for non-containerized goods have been evaluated by focusing on the most cost-efficient alternative. The monopoly situation of Russian rivers is however a restricting factor to bear in mind which results in a restricted number of actors willing to operate on these rivers. This situation

makes it possible for the company operating here to charge a higher cost compared to market, since the competition between shipping companies decrease.

Dealing with shipping, terms stated for the agreement are summarized under INCO-terms (Ramberg, 2011; Kaufmann, 2014; Larsson & Stenberg, 2016). During this case, the conditions states that first cost falling on IIH is when unloading vessel in Swedish harbour. The risk is also transferred at this time, in turn the seller is responsible for clearing for export and booking the vessel. These conditions correspond to the INCO-term DAP (*Delivered at place;* appendix 1), which is not shipping specific.

6.2.3 Mapping as a method for supply chain modelling

Mapping provided a simplified and efficient illustration during this case to facilitate identification and implementation of measures to increase SC performance (Hines & Rich, 1997; Gardner & Cooper, 2003; Haartveit *et al.*, 2004). The link between actors can be divided into: Managed, Monitored, Not-Managed and Outside Managed links.

In this case, the links closest to IIH, e.g. their operations and storage, are managed links. Meaning that these processes should be of importance to the company and managed in-house. This is quite comprehensive, since inventory is essential to the productivity and adds most value to the finished product. Swedish harbour and truck company are not managed links, meaning carried out by another actor according to a plan or agreement. These are often processes not prioritized by the company, for instance due to limited resources. Also, it would probably not be of value to IIH to have their own trucking company or harbour, since the demand of IIH unit would not claim their full capacity.

All processes between forest (supplier) and harbour are outside managed links. Meaning that they are managed by actors outside II, even though IIH might influence them. In this case, these processes are managed by the potential supplier (no.1). A shift of the links to increase the level of management in processes closer to forest are feasible. The results of this study did however indicate that this would not be the most cost-efficient alternative. The findings of this study could however be used in the future, if or when IIH want to manage more of these links in-house.

7 Discussion

This chapter starts with reflections of the method of this study, limitations, sources of error and how the results should be generalized. Thereafter the findings will be discussed of how it relates to the problematization of this study additional to previous research about SCM and logistics in the forest sector and international supply chains. This was followed by a discussion of mapping and sourcing decisions related to the international forest sector.

7.1 Reflections of study method

This study was approached with a predominantly inductive and flexible case study, since it was empirically driven with an emerging design (Bryman & Bell, 2011; Robson, 2011). Most of the data were collected through qualitative interviews however secondary data through a literature review formed the basis for the project. The literature review started with identification of relevant areas of research to answer the aim of the study. Since it was reviewed continuously, this reduced the risk of leaving out relevant literature providing alternative or complementary perspectives of the case. There was however a need to define some delimitations in the review to keep a narrow focus on the relevant area of interest. Therefore, theories regarding for instance service dominant logic and activity based costing were excluded.

The choice of a flexible case study is motivated by a need for an emerging design of the method through keeping a level of flexibility to adjust the design upon findings during the study. Approaching a flexible study should however include an open mind of the researcher and be open to new fields of research and alternative solutions of the problem. This was mainly accomplished by a continuous review of the literature and discuss the approach and findings with a peer-group. However, since this study did not follow a predetermined structure, the risk of missing out on some factors or areas increase.

It should be clearly noted that this project was carried out in collaboration with IKEA (IoS & II). The findings of this study represent one specific case which presents an approximation of the real world. The findings should therefore be critically examined before applying them to other cases.

Some delimitations regarding alternative solutions were made during the study, mainly because of limitation in time. The selection of interviewees involved a comfortable-selection. This resulted in for instance a lacking investigation of train and truck transportations in Russia, all potential shipping companies were not contacted and one individual Swedish trucking company were contacted. A deeper investigation might therefore provide a more cost-efficient SC than presented in this study. One delimitation was also made regarding train transports, since the Swedish railway company could not present a full-train calculation for this study. Sourcing decisions also regard the physical location of operations. This could have been investigated through for instance, moving chipping operations to a stage before shipping which could provide other logistical solutions.

The lack of an interview guide might have reduced the transparency of the data collection and result in some details or areas of research being missed out on. Since some interviews should be considered as business meetings, this provided a context were information might not have been shared in a fully transparent way. During the interviews, IKEA employees were present to assist with translation (Russian – English), this might have resulted in some relevant data being left-out or lost in translation.

The personal interviews were transcribed and verified with the interviewees to reduce bias. This was however not the case for some e-mail interviews but many of which were instead confirmed by secondary data. Electronical interviews gave a limited possibility of asking follow-up questions since the flow of the interview was divided with a separation of questions. This might have affected the findings and the interviewees ability to give a complete answer to the questions.

Secondary data was collected to complement and verify the findings of the primary collection. Since these data were presented in sources with a different aim than this study, some details might have been missed out. Therefore, it was needed to critically evaluate this data which was done using Scott's (1990, ref. Bryman & Bell, 2011, p. 550) criteria: *Authenticity, Trustworthiness, Representativeness and Meaningfulness*. However, since most of the secondary data was collected from representative and official Swedish authorities – this provided secure findings from secondary sources.

Validity of the research was accomplished by continuously discussing and searching for theories and methods that could be relevant for this study. Also, considerations of the data collection involved *triangulation* by using multiple sources of data, *peer groups* composed by IKEA to discuss the approach and the findings of the study and *member checking* through transcribing and verifying the data collection with the respondents.

Reliability was achieved by keeping a research journal presenting when, how and where data was collected. Some of the findings were however neutralized due to competitiveness which might affect the transparency of the findings and not present it in an un-biased way. This was dealt with by clearly state when, how and what part of the data details were left out.

Since the interviews regard company information about their offers and services rather than how they do business, no information have been expressed that could put the respondent in a harmful position. Also, notice of illegal activities, abuse of power and/or observance of different moral or ethical values might put the researcher in a harmful or uncomfortable situation (Robson, 2011). None of which have however been noticed during this study.

7.2 Reflections of findings

Following sections will provide a discussion and reflections of the findings related to its problematization and previous research.

7.2.1 A globalized forest sector

Globalization is one of the most obvious changes on the market, leading to increased competition and an expanded market scope (IVA, 2015; Gurgul & Lach, 2014; Hameri & Hintsa, 2009). These changes are also affecting the business for IIH, which expressed an increased competition and uncertain supply of forest raw material on the Swedish market. This leaves a company as IIH, focusing on efficient SCs, vulnerable to the future. Since increased competition and uncertainty indicates a future increase in market price, this made the company searching for alternative, international, sources of raw material. Globalization therefore affects the business of IIH through increased risks and uncertainty, e.g. competition, while opening new opportunities with finding suppliers on an international arena (c.f. Hameri & Hintsa, 2009).

Technological innovations are one factor behind globalization resulting in more efficient sharing of information and decreased transportation costs (Gurgul & Lach, 2014). Without these innovations, IIH would lack information about international potential suppliers.

However, it would also mean a problem with finding cost-efficient transportations, since current prices are affected by global competition. Political factors are also affecting globalization, resulting in structural changes as legislation, regulations or subsidies affecting global trade (*ibid.*).

This study deals with supply from Russian actors and their lack of globalization experience (Gurgul & Lach, 2014) should be kept in mind when prognosticate future market situation. During this project, this has not been expressed as a concern, since identified suppliers are both experienced international companies. However, since the Russian forest market are not as experienced of globalization, this could affect the context of future forest market and forest sector in Russia. Since they are currently ranked low in ease of trading between countries (www, WorldBank, 2017). This indicates that Russian forest sector involves a high uncertainty and unfavourable context. International supply chains related to Russia should therefore take this in concern and provide appropriate risk management strategies (c.f. Manuj & Mentzer, 2008). For instance, it might result in a need to adjust SCs related to Russia to have a more dynamic design.

The lacking prioritization and un-utilization of Russian forest resource (www, FAO, 2017) might in some extent be connected to the ownership of the forests. Since the state owns the forests, it is the political agenda deciding the pace for the development of the sector. Also, un-managed forests results in heterogenous standing crop. This do in turn result in in-optimized forest operations, since unattractive species obstructs reaching desired species. To increase the utilization and forest management, there are a need to increase their prioritization of the sector. Globalization might affect this agenda since the demand for sustainable products might increase, due to climate change. This would in turn lead to a higher demand of environmental and socially responsible products (c.f. Andersen & Skjoett-Larsen, 2009), which might increase the political awareness of the forest resources.

Since IIH demand FSC certified logs from Russia, they should benefit from an increase in the share of certified wood (www, FAO, 2017) because it should reduce the price. One problem might however be the leasing-system of Russian forests, since the longest period is 49 years. This do not only result in a limited interest in regeneration of forests, but might also result in a limited interest of certification, since this is dependent on long-term conditions. Also, certifications claim regeneration of harvested areas which might be complicated to secure if the date of the leasing is ended during the time of regeneration.

7.2.2 Supply chain management and logistics in the international forest sector

SCM as a concept are currently most focused on markets with a high degree of customization and market pull, which is not the case for the forest sector (Haartveit *et al.*, 2004; Larsson *et al.*, 2016). Instead, SCM measures in the forest sector are focusing on a narrow SC perspective with cost minimization and capacity maximization, which is still important. However, the findings of this study correspond to current literature, saying increased SC performance should be accomplished through a broad SC perspective. Which in turn should be further introduced in the forest sector.

The findings of this study indicate that IIH would like to develop their relations upstream and downstream the SC. Meaning that SCM measures are actually being implemented and advantageous in forest companies, despite low customization and market push. Still, this regards one individual company where the result cannot be generalized for the entire forest sector. However, this result contributes to current field of literature, for instance Carlsson & Rönnqvist (2005) study about implementation of SCM measures in forest companies.

IIH might however have more experience from SCM compared to other forest industries since they have a centralized SC planning division (IoS) (Jonsson *et al.*, 2013). Jonsson *et al.,* (2013) study do however focus on IKEA as a retail company, indicating that IIH as a supplier to IKEA Group, might make up one of the first actors in their SC perspective. Since the material change identity to a high degree in IIH operations, this correspond to Mattsson (2002) and Lambert & Cooper (2000) boundaries in SC perspective for an efficient implementation of SCM measures. Therefore, IIH should not be entirely dependent upon IoS as a SCM planner but also carry out their own SCM measures, since their perspective should include forest operations. This project is however carried out in collaboration with IIH and IoS, which indicates that IIH could get help and experience from IoS when implementing SCM measures focused on their part of the SC.

The findings of this study indicate that different systems are used by actors and found no clear method of how and where companies should start with the SC integration. Mapping is the method used in this study, proving to be an efficient method to illustrate where and what kind of SCM measures to implement (Haartveit *et al.*, 2004). However, there still seems to be a lack of clear guidelines of how to implement a full SC integration. One measure might be implementation of a joint system to facilitate information sharing among actors (Mattsson, 2002; Wood *et al.*, 2002; Christopher, 2005). Especially since the findings indicate many processes attributes to a complex flow of information. Still, most of the SCM improvements suggested during this study were presented individually in the literature. Presenting no clear and efficient guidelines for this implementation. This might result in few forest companies implementing SCM measures, since it demands certain resources to make a full investigation of what and how to implement a full SC integration.

The flow of information is often excluded from SCM in forest companies (Larsson *et al.*, 2016). The findings of this study question this exclusion, since most processes in the specific SC belong to this flow. A large amount of information should be shared, indicating this being one of the most important flows. Therefore, IIH will not be able to perform this SC if they exclude the flow of information.

During this study, information seems to have been communicated as dialog in a transparent and un-biased way. Still, since this regards a large amount of information. One measure to facilitate this communication might be through implementation of a jointly system, where actors share real-time updated information about e.g. demand, inventory and transportations. This seems not to be a planned measure for IIH, however it should be implemented in the future to facilitate risk management. Still, this case regards only a portion of the total demand of IIH, meaning that many, smaller, actors should be included in this system. This could result in an increased risk of leaking competitive information. A jointly system between suppliers and IIH should therefore be limited and include information relevant to the respective case.

One supply chain management system is currently being developed in IoS, called Supply Chain Guru (SCG) (c.f. Jonsson *et al.*, 2013). This system is however, as presented earlier, mostly focused on IKEA SC where IIH represents one of the first actors in the SC. IIH's suppliers and the operations from forest to IIH unit are therefore not included in the SCG. The implementation of this system should however result in some improvements also in IIH's SC and might in the future include the suppliers of IIH.

7.2.3 Mapping in the forest sector

During this study, mapping have been used as a method to increase IIHs knowledge about processes, actors and costs related to the SC from supplier of raw material in Russia to their

industry in Sweden. This should in turn provide a basis for working with continuous improvements and increase their competitiveness (Mattsson, 2002; Wood *et al.*, 2002; Audy *et al.*, 2012; Krajewski *et al.*, 2016). The findings therefore indicate mapping being an efficient method to increase SC performance in forest companies and should be further introduced (Haartveit *et al.*, 2004). Increasing SC performance means optimizing the total SC cost – both in economic aspects but also by including social and environmental aspects. Mapping did also facilitate identification of potential SCM measures and where in the SC they should be applied.

The map in this study should be adjusted upon each new SC or logistical solutions for other cases. Still, compulsory processes and procedures related to export to Russia and import to Sweden have been identified, e.g. customs clearance and phytosanitary inspection. Therefore, the model could work as a general map even when designing other logistical solutions, although adjustments must be made.

7.2.4 Sourcing in the international forest sector

Sourcing decisions should take two aspects into consideration: *coordination* of operations, between places and market activities and *configuration* of operations quantity and location (Porter, 1986). This case focus on the first aspect, coordination of current operations. However, configuration should also be considered and might deal with alternative locations of operations. For instance, shifting the chipping operations of the logs closer to supplier in Russia. This might result in decreased vessel freight and a higher utilization of loading capacity, since chips can be shipped as solid, containerized goods. Other aspects of configuration could be to investigate if the suppliers in this study could supply other II units more efficient than to IIH.

Configuration was also presented by Mattsson (2002) as a measure for increasing the efficiency in SCs, named *re-configuration* together with *collaboration*. These focus on sharing of responsibilities and synchronizing or coordination of flows (Mattsson, 2002). These might not currently be in question for the specific SC. However, in future solutions they could be related to coordination and collaboration of transport. For instance, two customers (IIH and other) buying from the same supplier could coordinate and collaborate their transport solutions to harbour. This could in turn decrease the transportation cost and therefore make shipping from Spb harbour a more cost-efficient alternative.

Choosing an appropriate and efficient shipping method is also one important consideration for increased SC performance. This case deals, from both suppliers, with the use of Tramps. Other shipping alternatives include using private fleet or liner carriers. A private fleet would probably not be beneficial regarding the offer from supplier 1, since the offer is of limited quantity and available only during summer season. This would result in a limited utilization of the fleet's full capacity and should therefore not be economically beneficial. A private fleet could potentially be used all year from supplier 2 and from harbour in Spb to Sweden. Still, the volume is probably too low to utilize full capacity. This could however be attended by offer shipping capacity on the market, especially since future demand of sea-transports should increase (Hameri & Hintsa, 2009). This would however claim a lot of organizational resources from IKEA perspective, which might not be suitable for current organizational structure. Liner carriers are also one alternative, however most suited for smaller volumes, in containers, on schedule and certain routes (Wood *et al.*, 2002). However, configuration of the SC and shift the chipping process closer to supplier could make this an efficient shipping method.

In earlier chapters, depreciation was indicated as a limited consideration for SC performance. However, there are two risks related to SCs and depreciation. First, the supplier wants to be sure that IIH does not reject the logs due to lack in quality after delivery to Sweden. This also includes the risk of IIH overstating the share of logs delivered with quality flaws, since IIH would not pay for these logs. Second risk relates to IIH which should secure the quantity of logs delivered are the same as stated as sent by the supplier. Both risks can be managed with the same measure, placing an independent actor to measure and verify the quantity and quality of the logs at two places in the SC. First when the logs are sent from Russia and again before entering IIH. This would also increase the transparency in the SC since IIH would be able to tell from the measurement if the logs are being sent in the right time to be delivered with stated quality. This should therefore provide a suitable risk strategy for dealing with uncertainty and risks in international SCs in forest companies (Manuj & Mentzer, 2008). Since all incoming goods are currently measured by VMF Syd before entering IIH, the strategy should focus on finding an actor on Russian side.

8 Conclusions

The aim of this study was to identify processes, cost drivers and to estimate costs affecting the design of international supply chains of raw material in the forest industry sector.

The findings of this study indicate that the processes related to the supply chain of a forest company can be classified by using common categories in mapping: Control, Transportation, Inventory and Operations.

Control processes presented in this study involves:

Inspection and *Verification* take place by the Swedish board of Agriculture (**SBA**) or Russian plant protection services (**PPS**) before the material leaves Russia and again when arriving to Sweden, if they are classified as regulated wood by the EU directive or SBA. SBA and PPA also draws up a certificate to verify that the material is being free from potential hazardous organisms. Verification should also include documents or similar to secure the certification (mainly FSC) of the material. Inspection of the quality of the material is also carried out by VMF Syd on Swedish site and should include inspection on Russian side to assure specified quality of the material

Measuring takes place before leaving Russia and again before entering IIH industry. VMF Syd is the actor responsible on Swedish side and should include similar actor on Russian side. Measuring of vessel and goods also takes place when the vessel arrives to Swedish harbour (fairway fee and harbour cost).

Transportation processes involves actual movement of the material and is in this case related to transport by lorry and vessel. These transportations take place between forest and harbour, or alternatively from forest to terminal and then to harbour; additionally, from Russia to Sweden and finally from Swedish harbour to industry. Alternative logistical solutions involve transports by railway however this turned out to be a less cost-efficient alternative based on the context of the case.

Inventory processes are continuously taking place in the specific supply chain to answer to a variety in lead times between different processes. Inventories allows an even and optimized performance of different operations. These processes take place between harvesting of forests and transportation to harbour, in Russian harbour waiting for loading of vessel, after unloading in Swedish harbour and finally before entering the processes in the industry.

Operations occur as value-adding processes where the material change identity. This is not a part of the specific supply chain since the material keeps the same identity upon delivery to industry. After this, the material is operated in industry which provides a boundary for this supply chain perspective.

The result of this study also indicates that costs related to the specific SC, to a high degree can be classified into the following classes: Costs of transport and handing; Costs of inventory; Costs of shortage and delays; and Costs of administration.

Cost of transport and handling originates from the material flow which relates to the actual movement of the material from Russia to Sweden. This involves cost for loading, unloading, vessel freight, trucking cost and costs related to the control process.

Costs of inventory relates to costs for storage, cost of fixating liquid capital and cost of depreciation. The findings of this study show that the first two types are somewhat difficult to

measure in terms of actual payments since they are intangible and somehow included in the price. To minimize the cost of depreciation, a quality specification is included in the contract with supplier.

Costs of shortage and delays. The findings of this study indicate that the risk for this class increases when dealing with international supply chains. This is due to the SC being more disperse and includes a high number of actors.

Cost of administration includes cost for handling all administration related the material flow. This regards mostly administration as customs clearance, inspections, booking of harbour services and trucking. Also, the findings indicate that administration and sharing of information become more complex working with international supply chains.

8.1 Answers to research questions

1. *How can supply chain management affect the performance of international SCs in forest companies?*

   Despite low customization and a market push strategy, the findings of this study indicate that efficient implementation of SCM measures would increase SC performance.

2. *What logistical flows contributes the most to supply chain performance?*

   The result of this study did not find differences regarding importance of flows. However, the findings indicate that the flow of information is an important flow to be considered in SC integration of forest companies. Since this affects risk management and SC integration negatively.

3. *How could SC cost analysis lead to a better performance of international SCs?*

   This study indicate that the creation of a cost-based model provided an efficient tool for increasing corporate knowledge about SC processes and the influence of related costs. This could in turn form a basis for increasing the SC performance by identify most efficient alternative in a broad SC perspective.

8.2 Practical implications

- The findings of this study indicate that technological innovations could provide efficient methods to facilitate the information flow in international supply chains.

- Selective optimization should consider the external situation related to each cost and focus on the one was measures can be done without or with limited restrictions of external factors

- The findings from this study indicate accomplishable improvements in SC performance by managing relations and integrating actors in the SC, though a multiple sourcing strategy with relatively high transaction costs.

- The findings of this study indicate mapping provides an efficient method for working with improvements in supply chain performance in forest companies

8.3 Future research

This study focused on mapping in a structural and organizational perspective, excluding a focused investigation of the lead time's correlated to supply chains. One suggestion of future research could therefore be to map international supply chains in forest companies in a lead time perspective.

Since this study is based on the context and business of one specific case, it's findings should be further investigated by investigate their application to other forest companies.

The findings of this study should also be further investigated by quantitative studies about how individual SCM measures could increase the SC performance in forest companies. Also, further research could involve evaluation of SC performance or SC measures in domestic versus international supply chains.

Another suggestion of further research might investigate sourcing decisions regarding reaching new markets or move location of operations to optimize SC performance in forest companies.

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Anders. (2017-03-23). CEO of Smålandshamnar.
Questions related to their price-list and other services. This contact provided answers regarding the terms of their price-list – what is included/excluded in the services (i.e. machinery/staff etc.).

professor Schroeder, M. (2017-03-23), SLU/dept. Forest entomology.
Questions regarding flight period of Monochamus.
Sofie. (2017-03-23). Inspector at the Swedish board of Agriculture.
Questions related to SJVFS 2016:14 and inspections of imported wood. She explained how inspections take place and how these works. Also, she clarified the level of regulated wood needed to classify the entire sending as regulated.
IIH (2017). Meeting with instructor at IKEA Industry Hultsfred. Presentation of the industry, business, markets and current market situation, IWAY, presented logistical and transport situation etc. Hultsfred.

Appendixes

The following chapter provides attachments to the project.

Appendix 1 – INCO Term summarization

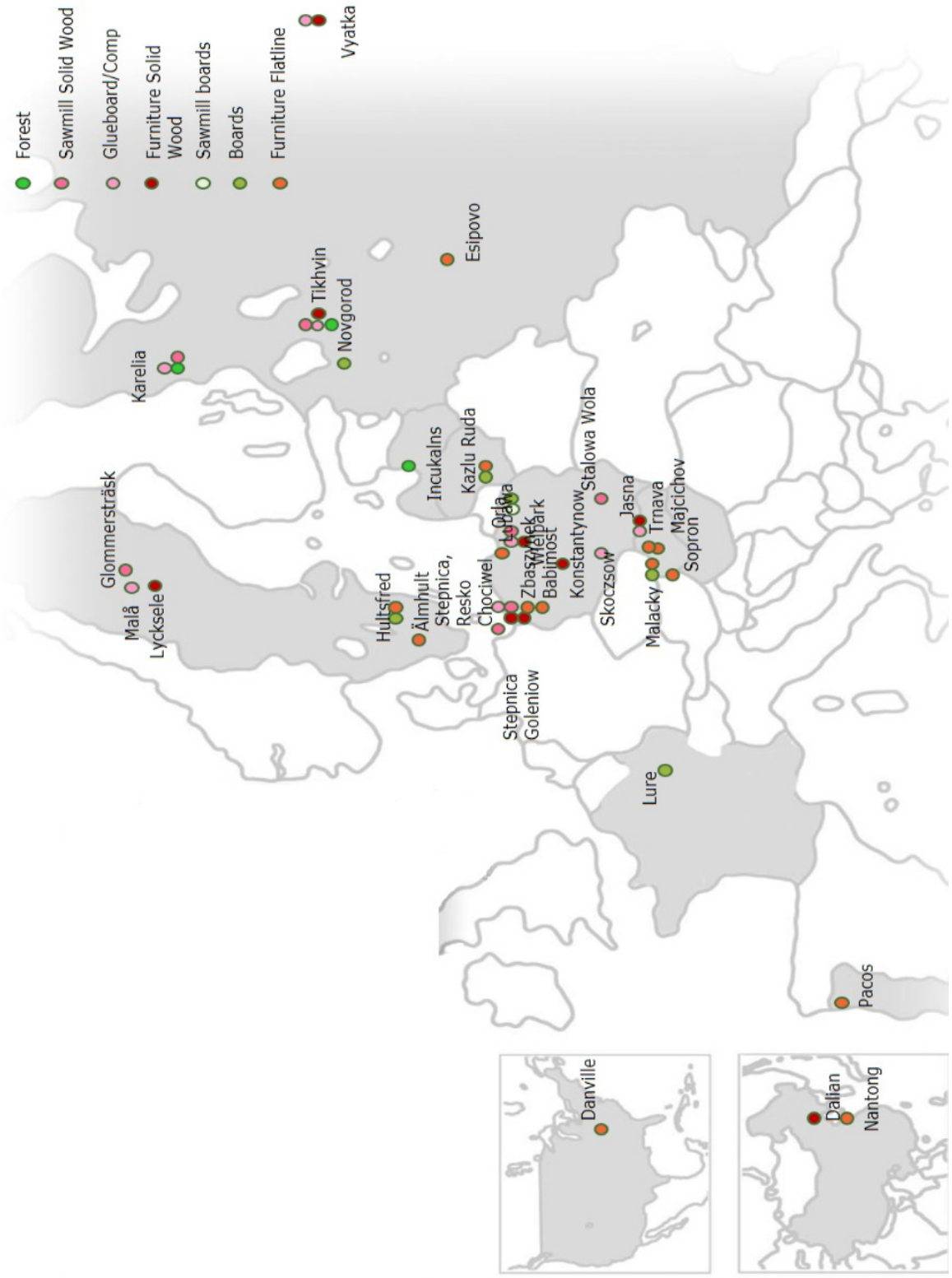
Table 14. Summarization of responsibilities/conditions for different INCO-terms regarding the update from 2010. Terms followed by a circle are shipment specific. Table inspired from (Larsson & Stenberg, 2016, p 119) with additional information from (Ramberg, 2011).

Incoterm	Carriage	Insurance	Transfer of Risk
EXW	Provided by buyer.	Paid by buyer, buyer clears for export.	When goods are at the buyer's disposal at seller's premises or another named place.
FCA	Provided by buyer.	Paid by the buyer, buyer clears for export.	When goods are available at carrier.
CPT	Provided by the seller to a named destination.	Paid by the buyer, seller clears for export.	When the goods are available at carrier.
CIP	Provided by seller to a named destination.	Paid by seller, seller clears for export.	When the goods are available at carrier.
DAP	Provided by the seller to a named place.	Paid by seller, seller clears for export.	When the goods are provided to the buyer for unloading.
DAT	Provided by the seller to a named terminal.	Paid by the seller to a named terminal, seller clears for export.	After the goods are unloaded by the seller.
DDP	Provided by the seller to a named terminal.	Paid by the seller + seller clears for export and import + duty.	After the goods are unloaded by the seller.
FAS ⊙	Provided by the buyer.	Paid by the buyer + seller clears for export.	When seller delivered the goods alongside the ship (quay or barge).
FOB ⊙	Provided by the buyer.	Paid by the buyer + seller clears for export.	When seller delivered the goods on board the ship.
CFR ⊙	Provided by the seller to a named destination.	Paid by the buyer + seller clears for export.	When the seller delivered the goods on board the ship.
CIF ⊙	Provided by the seller.	Paid by the seller + seller clears for export.	When the seller delivered the goods on board the ship.

Appendix 2 - Research journal

Date (2017):	Description:	Location:
Jan 27	*Meeting with IKEA project-group to kick-off the project. Introduction to IKEA Industry and their "cross-border-project", expectations and aim with this study etc.*	IKEA of Sweden (IoS), Älmhult, Sweden
Feb 1	*Meeting with instructor from IKEA. Presentation of logistical costs in Russia, excel-sheet shared via e-mail.*	Skype meeting
Feb 15	*Tutorial with IKEA instructor where we discussed the organization structure of IKEA Industry, their way of doing business, market situation etc. Also, a tour on their board industry in Hultsfred with a presentation of their background/historical.*	IKEA Industry, Hultsfred, Sweden
Feb 16	*Working with thesis at IoS-office with various contact with a few from IoS and the project group.*	Ikea of Sweden, Älmhult, Sweden
Feb 17	*Update-meeting with IKEA project group. Updated project plan incl. time-plan. Planning of Russia-visit. Specific case set to delivery of raw material from Russian supplier to IIH. Agreed to continually be invited to company skype-meetings regarding wood supply etc.*	Ikea of Sweden, Älmhult, Sweden
March 8	*Contact with trucking company in southern Sweden after recommendation from IKEA. They will look into the project and present data during next week (w.11).* *Also, contact via mail with the Swedish customs service about customs classification and declarations.*	SLU, Uppsala, Sweden
March 10-17	*Phone contact with the Swedish customs service about declarations when importing, e.g. summarized declaration and import declaration. Also about the connection between certification (phytosanitary…) and declarations. Contact was also made with the Maritime administrations and Swedish board of Agriculture during this period.*	SLU, Uppsala, Sweden
March 27-31	*Visit to Russia where we met possible suppliers (2 actors) and discussed conditions and costs related to this. Also visit to IKEA Industry in Tihkvin to discuss about their experience about export. They have own forests and exports wood chips to Finland with a company they swap logs with.*	Saint-Petersburg area and Tihkvin, Russia.
April 3-7	*Contact with shipping companies to see if any of them operate on Russian rivers plus to get an indication of market price.*	SLU, Uppsala, Sweden

Appendix 3 – IKEA Industry facilities



Appendix 4 – Detailed presentation of Customs classification and calculation of Customs value

Customs Classification

First step to clear the goods consists of a declaration were a specific code for the goods are found, which in turn regulate the duties being applied. These codes are fully presented on the Swedish Customs Agency's website. A summarization of the codes applicable for wood and wood-products are however summarized in Table 15.

Table 15. Classification codes of different wood materials/products. Observe that these classifications are regularly updated available at (www, Tulltaxan, 2017)

First four:	*Code:*	*Classification:*	*Duty:*	*VAT:*
4401	**Firewood in shape of logs, blocks, knots, chips, sawdust etc.**			
	11 00 00	… of softwood	0%	25%
	12 00 00	… of hardwood	0%	25%
	21 00 00	Chips or sawdust of softwood	0%	25%
	22 00 00	Chips or sawdust of hardwood	0%	25%
	40 90 00	Other wood wastes (e.g. barque), not agglomerated	0%	25%
4403	**Timber (softwood), non-treated, stripped from barque etc.**			
	21 90 10	… (non-saw logs) of Pinus spp., with a widest diameter of minimum 15 cm and exported from Russian fed., according to EU 498/2012	0%	25%
	22 00 10	… (non-saw logs) of Pinus spp., exported from Russian fed., according to EU 498/2012	0%	25%
	23 90 10	… (non-saw logs) of Abies spp., and Picea spp., with a widest diameter of minimum 15 cm. Exported from Russian fed., according to EU 498/2012	0%	25%
	24 00 10	… of Abies spp., and Picea spp., exported from Russian fed., according to EU 498/2012	0%	25%
	25 90 00	Other (non-saw logs), with a widest diameter of minimum 15 cm	0%	25%
	97 00 00	Other (non-saw logs) of Populus spp..	0%	25%

Generally, the first four numbers in the code are standardized in several countries to facilitate the classification process. Wood and wooden products are classified in chapter 44 where all are charged with a duty of 0 % and VAT of 25%. The reason for wood and wooden products being free of duty is because they are instead regulated through the Swedish board of Agriculture.

Customs Value

After a correct classification, next step is to calculate the customs value of the goods which in turn form a basis for accountable duties. Customs value should also be calculated on goods

without customs duty since VAT will be accounted upon this value. Companies registered for VAT pays this to the Swedish tax agency, while unregistered companies pay to the Swedish custom service.

The customs value can be calculated with different methods however the most common method is to use the goods transaction value. The transaction value of the goods means the price of the goods when importing to customs area within European Union. This method is also feasible for barters when the value should be based on both the actual price and the value of the traded goods. However, to use the transaction value method, there are five compulsory terms stated below:

1. The goods have to be sold/bought and not been free, rented or borrowed.
2. There can be no limitations in how the customers use of goods, except limitations due to laws, regulations, geography and those which not affect
3. Price cannot be dependent on conditions without a specific value, meaning that there can be no terms that the price will be affected on future settlements.
4. The price must be adjustable to future sales when the seller gets a share from the buyer's future selling/divestments/use of the goods.
5. The price cannot be affected due to relationships between buyer and seller, neither relations through family nor business.

The price of the goods implies all actual or future payments according to the contract of sales and should be converted to Swedish kronor (SEK) according to rate in contract. If no rate appears in the contract they can use the rate published by Nordea, a Swedish bank. Some reductions of the transaction value are feasible with costs that has not been included, or discounts that have or will arise due to the import, being:

a) Cash discounts of the actual reduction, if the payment is done before delivery or if the discount can be verified by receipt, invoice or other accountancy.
b) Discounts because of quantity or bonuses are deductible when they are attained.
c) Costs due to import quotas should be included in the transaction value.

Also, some costs should be added to the price on the invoice, being:

d) Commissions on sale and brokerage.
e) Costs of packaging and wrapping should be added, however not costs for containers, tarpaulins, cargo arrangements etc.
f) Insurance and transportation costs dispatched to place of arrival should be include in the transactions value. Place of arrival is the first harbour the goods arrive to inside EU customs, even though it is not unloaded and are to be transported to another harbour. If the transportation costs are not specified to the place of arrival but to the final harbour, they should be split up based on distance outside and within EU customs. These costs are dependent on the INCO-terms of the agreement. Cost of unloading the goods in place of arrival should not be included.
g) Costs for loading and handling before the place of arrival should be included. Also, additional costs because of delays in loading should be included.

Rate of interests; commissions to the buyer's agent; customs or other import/export duties should not be included in the transaction value.

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