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FEASIBILITY STUDY OF MANUFACTURING HYDRAULIC PIPING COMPONENTS IN CHINA

Master's Thesis

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ABSTRACT

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The objective of this study was to find out if manufacturing hydraulic piping components in China is feasible for a hydraulic piping system provider. The study investigates what are the key strategic motives to locate component manufacturing in China, how the cost of components manufactured in China compare to Finland, and what is the most suitable mode for component manufacturing.

The primary data in this qualitative multi-case study consists of interviews and observations of the issuing company and four pre-selected case companies. Ad-hoc surveys and written documentaries are used as supportive secondary data. The cost comparison data used in the study was collected from the case companies with a specially designed quotation process.

The results of the study indicate that manufacturing hydraulic piping components in China is not only feasible but advisable for the hydraulic piping system provider. In addition to answering the research questions, the study gives practical recommendations on what should be the next steps to implement the results.

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Työn tavoitteena oli tutkia onko hydrauliikkaputkistokomponenttien valmistaminen Kiinassa kannattavaa hydrauliikkaputkistoja valmistavalle yritykselle. Työssä selvitettiin mitkä ovat strategisesti tärkeimmät motiivit valmistaa komponentteja Kiinassa, kuinka komponenttien valmistuskustannukset eroavat Suomen ja Kiinan välillä, ja mikä on sopivin tapa valmistaa komponentteja.

Kvalitatiivisen case-tutkimuksen ensisijainen tutkimusaineisto koostuu haastatteluista ja havainnoista työn toimeksiantajalla sekä neljässä ennalta valitussa case-yrityksessä. Aikaisempia tutkimuksia ja kirjallisia dokumentteja käytetään toissijaisena tukevana tutkimusaineistona. Työssä hyödynnettävää vertailevaa kustannustietoa kerättiin case-yrityksiltä erikseen kehitetyn tarjousprosessin avulla.

Tutkimuksen tulokset osoittavat, että komponenttien valmistaminen Kiinassa ei ole ainoastaan kannattavaa mutta myös suositeltavaa työn toimeksiantajalle. Tutkimuskysymyksiin vastaamisen lisäksi työssä annetaan käytännön neuvoja siihen, mitkä tulisivat olla seuraavat askeleet työn tulosten käytäntöön panemiseksi.

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1 INTRODUCTION

GS-Hydro is a non-welded piping system provider originally founded in Finland in 1974. Today it is a fully owned subsidiary of Swedish private equity company Ratos with its corporate headquarters in Espoo, Helsinki. GS-Hydro has a presence in 17 countries, where it serves off-shore, marine and land-based customers. Altogether GS-Hydro employs over 600 people worldwide with annual sales of 125M euros in 2015. (GS-Hydro 2016)

Figure 1. GS-Hydro logo and tagline

GS-Hydro is the original provider of non-welded hydraulic piping connections, and their product offering consists of both trading items and own products. The company produces its own flanges and related piping components in Hämeenlinna, Finland in its GS Supply unit. These so-called GS components consist of over 6 000 items that are manufactured both in-house and by local subcontractors. The components are used in local production or sold to customers and subsidiaries, and shipped to various locations around the world. (Honkala 2016; Kuisma 2016a)

GS-Hydro's customers have been traditionally local and global companies in off-shore and marine industries that require high-quality hydraulic products and services for demanding applications (GS-Hydro 2016). These customers include shipyards, shipbuilding companies and ship-owners. GS-Hydro can service its customers through global network of coordinated functions such as engineering, logistics and manufacturing hubs. Recently there has also been incentive to increase land-based business sales by

introducing new product lines, however these will not be addressed in this study.

Despite its strong brand and global presence, GS-Hydro has experienced decrease in sales especially in Europe in recent years. The only markets where GS-Hydro has seen growth are China and Korea, where the shipbuilding industry has mainly moved. Although GS-Hydro already has subsidiaries in both countries, the components are still mainly shipped there from Europe. The market development however has lead GS-Hydro to re-evaluate its capabilities in the big Asian markets, and according to the company's new growth strategy especially the role of China is now being re-examined. (Honkala 2016)

Together with change in market focus, GS-Hydro is also facing cost pressures from dropping margins in Europe. This has lead the company to look for cost savings in its component manufacturing. The labor costs in Finland are known to be high, and adding high transportation costs to product margins is not seen as a sustainable a business model anymore, especially in Asia. Because of these reasons the company is currently considering whether it should continue producing flanges and other components in Finland, or in a low-cost country such as China. (Honkala 2016)

1.1 Research questions and objective

The objective of the study is to find out if manufacturing GS components in China is feasible for GS-Hydro. The comparison is done between the current manufacturing unit in Finland and four predefined Chinese companies using both cost measures for selected GS components and evaluation of suitability of different operation modes. The study is written from a global sourcing perspective, and the basic logic of the study is also

applicable in the future sourcing/manufacturing decisions considering GS components production.

From the research objective three research questions were formulated for the study:

1. *What are the key strategic motives to locate component manufacturing in China?*
2. *How does the cost of components manufactured in China compare to Finland?*
3. *What is the most suitable mode for component manufacturing in China?*

The first research question aims to provide a fundamental logic in what setting a company should consider locating its component manufacturing abroad. The second research question takes a cost-based approach in choosing between different locations and manufacturing alternatives. The presumption in this study is that if the landed cost of components manufactured in China to Europe is found to be less than 20% of the cost of components manufactured in Finland, it is cost-wise to acquire the components from China. The final question assesses what is the most suitable mode of acquiring the components. The alternatives that are studied are global souring, joint-venture and company acquisition.

1.2 Methodology

This study is a cross-sectional, qualitative multiple case study that utilizes multiple methods of data collection. In this study's research setting the researcher was part of the issuing company's organization to ensure access to data necessary to conduct the study in both issuing company and case companies. The data used in the study consists of primary data collected from the issuing company and selected case companies, and secondary data collected from company databases and third-party sources. The complete list of types of data used in the study is presented in Table 1.

Table 1. Research data

	Type	**Source**
Primary data	Interviews	Issuing company Case companies
	Observation	Company visits
Secondary data	Written documentaries	Company databases Credit reports Institutional data Online articles Online publications
	Ad-hoc surveys	University publications Institutional publications

1.2.1 Participants

The participants in the study were the issuing company and four case companies. The case companies were pre-selected by the issuing company based on their past performance and expected potential to become a global supplier for GS-Hydro. The selection was done prior to the study and could not be affected by the researcher. The four case companies are all Chinese manufacturers, but differ from each other in variables such as size, business scope and production process. This variety was seen as a sufficient representation of available supplier alternatives.

1.2.2 Primary data

The primary data from the issuing company was collected by interviewing employees related to the study in Finland and China. The subjects were selected based on their expertise and involvement in the research topic. The collected data consists of information about company business,

production processes and cost accounting. This data is analyzed together with secondary data collected from company databases to form an understanding of company's present situation and existing cost structures regarding component manufacturing.

The primary data from four case companies was collected through semi-structured interviews and observation during company visits in China. All participants in the case companies were top management and in a position to decide their level of involvement as well as to provide the data required for the study. The participants were briefed to be part in business negotiations with GS-Hydro, and were made to sign a non-disclosure agreement before discussions. Also included in the primary data from the case companies is cost information collected through a quotation process specifically designed for the purpose of the research. This process is explained in detail in Chapter 8.1.

1.2.3 Secondary data

The secondary data used in the study consists of data collected from company databases, ad-hoc surveys and written documentaries from third-party sources. This data is utilized in the study in two different ways. The secondary data from the written documentaries and ad-hoc surveys is used to provide a context to the research, while the data from company databases is used together with the primary data to make a detailed analysis of the case companies within the study context. A detailed descriptions of the secondary data used in the study are found in their respective chapters in the study.

1.2.4 Validity and reliability

The study is a cross-sectional in a way that it describes a situation in a single point of time. This means that the results are only valid at the time of writing

the study, and cannot be used for decision making later. The data collected in this study however can be used as a reference for later studies of the same area. The research is also designed so that its fundamental logic can be used by the company later in time when faced with a similar decision. This was also a requirement from the issuing company.

The study design is multi-method to ensure data reliability. Data triangulation from multiple independent sources (interviews, observation and secondary data) was included in the study design to minimize subject and observer errors and biases. Similar methods were used to ensure the validity of the data collected during the research. Threats to reliability and validity in this study is discussed more in the conclusion chapter.

1.2.5 Research timeline

The research was divided into two phases. In the first phase the issuing company's operations in Finland were examined. During this phase the final decision on study variables was made based on the results of the investigation. The first phase was completed in Hämeenlinna, Finland during a one-month period in autumn 2016. The second phase of the study was conducted in China between November 2016 and March 2017 in issuing company's subsidiary in Shanghai. Final compilation and analysis of the data was done during spring 2017, and the final report written during summer and autumn 2017.

1.3 Delimitations

There are several limitations in the study that make it specific to the defined study context. Firstly, the study concentrates only on one company and its decision making concerning specific component acquisition from four pre-selected manufacturers in the Chinese market. Secondly, the studied alternatives for cooperation (subcontracting, acquisition and joint-venture)

do not represent all the available operation modes that could be considered for component acquisition. Finally, the costs that are being reviewed do not cover all the costs related to component manufacturing and acquisition to due to limitations in getting information from the studied suppliers.

1.4 Structure of the study

The study consists of four main parts: Introduction, literature review, results, and discussion and conclusion. The introduction chapter has briefly introduced the issuing company of the study, study background and research questions. Methodology and delimitations have also been discussed in this part. The literature review of the study consists of two main chapters: strategic motives to move component manufacturing abroad including relevant foreign operation modes and cost-based decision making. The objective of the literature review is to bring forth the theoretical background of the study, and put in in a wider context of academic research.

The results part of the study presents the empirical data collected during the study. It consists of findings about the component manufacturing in Finland and China, and the comparison between the two. A review of China as a manufacturing location and previous studies about Finnish companies in China are also included in this part. Finally, the discussion and conclusion chapters analyzes the results of the study, gives further recommendations to the company and evaluates the research project as a whole. References and appendices are listed at the end of the report. A detailed description of the structure of the study is presented in Table 2.

Table 2. Structure of the study

Introduction	Background of the study Research questions and objectives Delimitations Methodology Structure of the study
Literature review	Strategic approach to internationalization Cost-based decision making
Results	Component manufacturing in Finland Locating component manufacturing in China Experiences from Finnish companies in China Supplier evaluations Supplier cost comparison
Discussion and conclusion	Discussion Conclusion References and appendices

2 STRATEGIC APPROACH TO INTERNATIONALIZATION

This chapter establishes the theoretical base why a company in specific industry should consider the location of its value chain activities in order to be competitive in international markets. First, the drivers of internationalization are reviewed from the perspective of different industries and their potential to support internationalization strategies. Secondly, it is explained how individual companies can generate competitive advantage over their competitors through international configuration of their value chain. An alternative model for traditional view of internationalization is presented. Finally, three different modes of operating abroad are presented.

2.1 Industry drivers for internationalization

Not all companies should pursue internationalization strategy. Yip (2003, p. 10) presents four drivers that need be assessed to determine the scope of internationalization in a particular industry (Figure 2). The *market drivers* refer to the level of standardization of markets. Here the enabling factors are the existence of global customers, similar customer needs and marketing that can be done similarly across the markets. The *cost drivers* enable companies to reduce their costs by operating internationally. These are scale economies, exploitation of country specific differences and favorable logistics. The *competitive drivers* recognize the interdependence between country operations and the need to react to competitors' global strategies. Finally, the *government drivers* can either facilitate or inhibit internationalization in a certain industry.

Porter (1985, pp. 11-2) classifies different industries based on their international characteristics. In *multi-domestic industries* the competition is independent of competition in other countries. The *global industries* are those in which *"firm's competitive position is significantly influenced by its position in other countries"*. Grant (2010, pp. 372-3) expands Porter's

classification by differentiating industries based on the extent of international trade and role of foreign direct investment (FDI) with different implications to international strategy. Grant (2010, pp. 372-3) states in his categorization that if operating in global industries, companies need to consider both where to make the foreign direct investments and how to best serve their trade business.

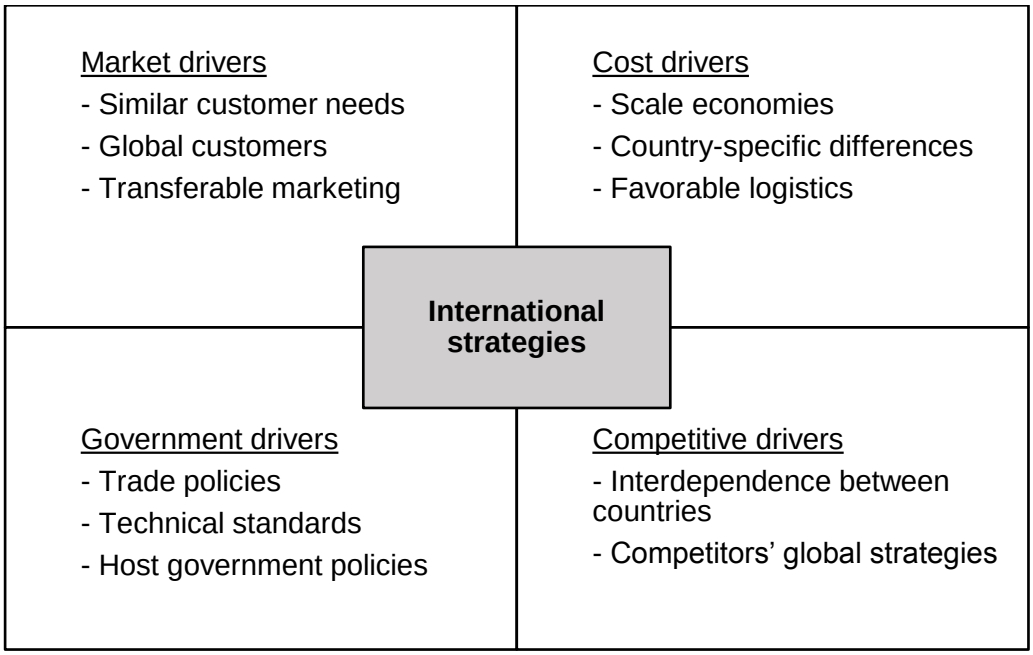

Figure 2. Drivers of internationalization (Yip 2003, p. 10)

2.2 Configuration of value chain

To succeed in an established industry, a company needs to have a competitive advantage over its competitors (e.g. Porter 1985; 1986). This advantage is a result of either low relative cost or differentiation (Porter 1985, p. 11). According to Grant (2010, p. 374) competitive advantage is achieved "*when a firm matches its internal strengths in resources and capabilities to key success factors of the industry*". In global industries, this advantage is an outcome of integrating company activities on a worldwide scale (Porter 1986, p. 13).

A systematic way of viewing company activities is called a *value chain*. In value chain each activity within and around the company contributes to the final product (or service), which is the ultimate source of company value (e.g. Porter 1985; Johnson et al. 2009). These activities are connected together by linkages, and changes in one activity affects the overall cost and effectiveness of the whole value chain (Porter 1985, p. 15). According to Porter (1985, p. 14), the basis for international strategy is the configuration and coordination of these value-adding activities. The configuration refers to the worldwide location of an activity, and coordination how different activities are coordinated together (Porter 1985, p. 14).

In international business, companies can exploit the *comparative advantage* of their home nations to be competitive in international markets. Comparative advantage theory (later expanded by Porter (1990) with his national diamond framework) refers to the factor-cost (cost of production) and factor-quality (quality of production) differences between countries. The theory states that different countries are abundant in different resources, so that the relative efficiency of producing certain products (i.e. performing certain activities) in some countries is greater than in others (Grant 2010, p. 374).

While the home-based conditions can offer basis for initial international competitive advantage (Johnson et al. 2009, p. 213), companies can also look more opportunities from beyond their national borders. The globalization of markets enables companies to disaggregate their activities and locate them wherever there is comparative advantage. This means that companies do not move outside of their national borders only to seek foreign markets, but also to access the resources and capabilities available in other countries (Grant 2010, p. 378).

From the perspective of competitive advantage, the key choice for the international companies is the international configuration of their value

chain. This means that international companies need to *"systematically exploit the skills, resources and costs of different countries that offer comparative advantage in the most effective way"* (Johnson et al. 2009, p. 213). This can be done through either foreign direct investments, collaborative ventures or global sourcing (Johnson et al. 2009, p. 213). These different modes are assessed later in the chapter.

2.2.1 Location of activities

Following the strategic model of internationalization, the key decision for the company is where each value chain activity is best located. Johnson et al. (2009, pp. 213-4) identify three advantages that can be "*systematically exploited in order to locate each element of the value chain in that country or region where it can be conducted most effectively and efficiently*". *Cost advantages* are all the factors that affect the cost of operations in a certain country. *Unique capabilities* refer to special characteristics of a place that cannot be found elsewhere. *National characteristics* in turn are the demand conditions existing in a specific country. This classification is an extension of location-specific advantages in Dunning's Eclectic (OLI) paradigm (e.g. Dunning 1988; 2001), which states that companies are more likely to locate their activities in a location where there are more local resources that can be utilized together with company's competitive advantage.

2.3 Alternative model of internationalization

The traditional view of internationalization has been that it is based purely on assessing costs and risks of the target market. The Uppsala internationalization model was developed in the mid-70s as an opposing model for that view. The theory leans on empirical observations of Swedish manufacturing companies that had established subsidiaries abroad, and suggests that internationalization is in fact a step-by-step process (Johanson & Vahlne 2009, p. 1412). The model describes the observed

pattern of internationalization with an establishment chain (Johanson & Vahlne 2009, p. 1412). This chain is normally portrayed to have four distinguished steps (Johanson & Wiedersheim-Paul 1975, p. 307):

1. No regular exports
2. Export via independent representative (agent)
3. Establishment of foreign sales subsidiary
4. Foreign production/manufacturing units.

The subsequent steps in the chain mean higher degree of international involvement and market commitment (Hollensen 2007, p. 64). However, these steps are only a simplified representation of the actual situation, and do not specify in what way the company might increase its commitment, or that the commitment might even decline or cease (Johanson & Vahlne 2009, p. 1412). Although the theory might accurately describe the early steps of the internationalization process of some firms, it might not be suitable for describing decision making process for established international companies. This has resulted the theory later being expanded to include networking aspects (Johanson & Vahlne 2013) that are however not assessed in this study.

2.4 Joint ventures and acquisitions

Companies can choose between different modes of operation in a foreign market. A fundamental decision a company has to make first is wheter to invest directly, or to use other means to access the markets and resources. The decision on between these operation mode is a strategic, and according to Grant (2010, p. 382) depends on the market attractiveness and the ability to establish competetive advantage in it. Besides operating in a foreign market *in actu*, companies can also utilize global sourcing and contract manufacturing as a mean of outsourcing from a foreign market by using external independent suppliers (Cavusgil 2014, p. 438).

Grant (2010, p. 382) classifies foreign operation modes based on company's resource commitment to direct investments and transaction based market entry strategies. Peng (2014, p. 21) uses similar distinction between equity modes (foreign direct investment, FDI) and non-equity modes. Peng's full categorization is depicted in Figure 3. In this study, the theoretical review of foreign operation modes is limited only to direct investments (equity modes), specifically to joint ventures and acquisition. Global sourcing is reviewed as a third alternative.

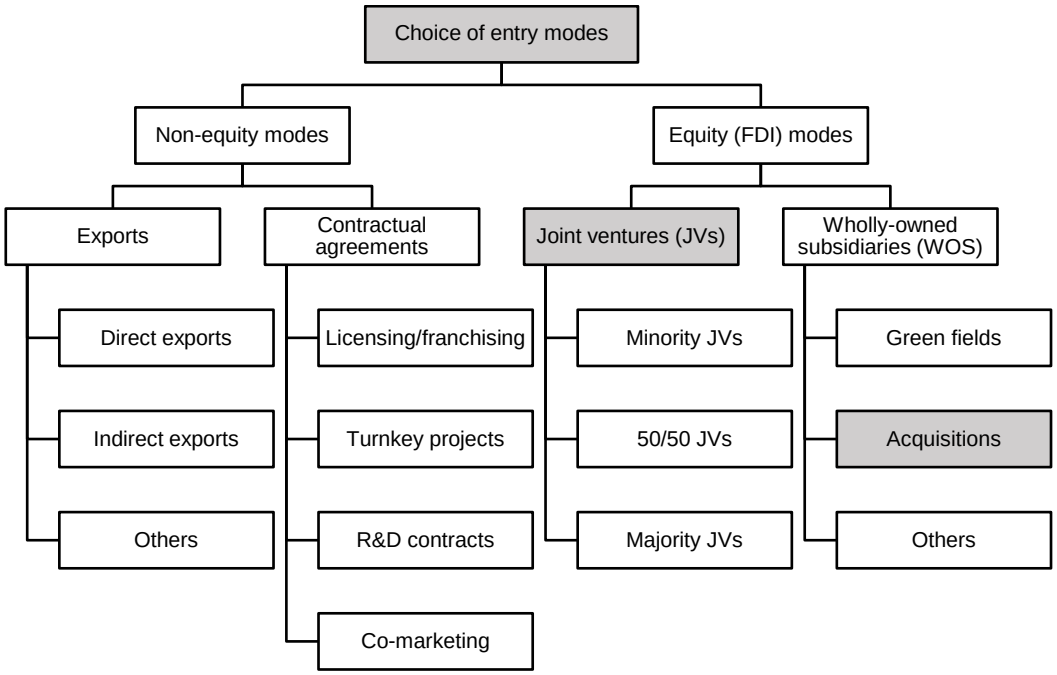

Figure 3. Choice of entry modes (adapted from Peng 2014, p. 321)

2.4.1 Joint ventures

International joint ventures, also called international collaborative ventures in the context of cross-border business (Cavusgil 2014, p. 384), are cooperative foreign direct investments where the equity and profit in the company are shared between parties from different countries. The rationale of international joint ventures can be explained through the theories of transaction costs, strategic behavior and organizational theory. They state that company's motivation for a joint venture comes from minimizing its

transaction costs, improving its competitive position in the market and transferral of know-how between the counterparts (Kogut 1988, pp. 319-22).

The equity in a joint venture can be either shared equally, or other company can own the majority of the company (Grant 2010, p. 385). It has been found out in earlier studies that the equity share in international joint ventures is influenced by the strategic importance of R&D or marketing expenses and product diversity (Kogut 1988, pp. 328). In another study by Kogut and Singh (1986; 1988 p. 328) it was found out that companies with larger cultural distance to their counterparts tend to prefer joint ventures over company acquisitions. Joint ventures are also often formed in industries under government restrictions (Yu & Tang 1992 pp. 331-332). The advantages and disadvantages of joint ventures are reviewed in Table 3.

Table 3. Risks and advantages of international joint ventures (adapted from Cavusgil 2014, p. 399; Johnson 2009, p. 224, Peng 2014, p. 322; Hollensen 2007, p. 349)

Advantages	**Disadvatages**
• Requires less capital and management resources than wholly-owned subsidiary • Can remove political barries and restrictions in establishing operations • Risks and costs are shared with the foreign partner • Access to partner's assets, including local contacts and expertise • (Joint) control over the decision making	• Limited equity and operational control with large investment • Difficulty of finding a suitable partner and agreeing on contractual tems • Complex management structure and cultural differences • Disproportioned contributions from partners can result in conflicts • Changing goals and interests makes coordination difficult • Integration and coordination of global activities is limited

• Common goals between partners can drive the joint venture • Knowledge transfer between partners • Partners can concentrate on their core competences	• Exposure to political risk through foreign counterpart • Transfer pricing between partners • Loss of confidentiality and increased risk of imitation • Termination of operations is difficult

2.4.2 Acquisitions

Acquisitions are a form of foreign firect investment, in which the company acquires direct ownership of existing company or facility in a foreign country (Cavusgil 2014, p. 394). This entry mode enables the company immediate access to fully controlled assests in the target country by establishing a wholly-owned subsidary. Compared to international joint ventures, they have a higher potential of generating profit for not having to share it with a local counterpart, and are thus usually preferred alternative if there are no environmental constraints such as government restrictions (Yu & Tang 1992 pp. 331-332). The advantages and disadvantages of aquisitons are are reviewed in Table 4.

Table 4. Risks and advantages of international acquisition (adapted from Johnson 2009, p. 224; Peng 2014, p. 322; Hollensen 2007, p. 349)

Advantages	**Disadvatages**
• Immediate access to distribution channels, local labor force, contacts, local management and knowledge • Access to established brand names and reputation in target market	• Substantial investment and commitment to host country • Full economic and financial exposure • Problems in integrating and coordinating acquired operations • Potentially high development costs

• Full control of resources and capabilities • Integration and coordination of global activities is unrestricted • Protection of intelectual property rights	

2.5 Global sourcing

Global sourcing is the procurement of goods from external independent suppliers from another country (Cavusgil 2014, p. 438). In global sourcing the company does not enter the foreign market *de facto*, but instead uses third-party suppliers to perform its value-adding activities. Global sourcing can take the form of contract manufacturing, where the company outsources its manufacturing to a company that is specialized in production and production technology (Hollensen 2007, p. 330). The motives to outsource production vary greatly, and as pointed out by Dabhilkar (2011, p. 165) are often in conflict. A company choosing to outsource should thus "*appreciate and balance the trade-offs between its outsourcing motives and competitive strategy*" (Dabhilkar 2011, p. 165). The advantages and disadvantages of global sourcing are are reviewed in Table 5.

The (global) sourcing mode is closely related to decision making concerning whether the company should invest in own production or not (Tyles & Drury 2001, p. 606). One key focus in theoretical literature concerning sourcing is the time horizon which the company uses in its decision making (e.g. Ford et al. 1993; Tyles & Drury 2001). The short-term focus is often on cost reductions and profitability due to perceived efficiencies of the supplier (Ford et al. 1993, p. 207). Ford et al. (1993, p. 212) call this approach 'Operational/cost-based approach' which however "*often fails to achieve all potential savings and has no relationship to any overall company strategy*".

The more strategic view on outsourcing decisions is the allocation of capital in the company, which outsourcing leaves to be used elsewhere (Tyles & Drury 2001, p. 606). The strategic focus also takes company's technological strengths and weaknesses into consideration and combines them with the company's overall strategy. Ford et al. (1993, pp. 212-213) classifies the strategic focus as 'Policy approach', and it states that company should consider carefully which types of technologies it should strategically source and which to keep in-house, as the company might become dependent on its suppliers or lose its design or production skill (Ford et al. 1993, p.207; Tyles & Drury 2001, pp. 605-6). The financial rationale of outsourcing (make-or-by) decision is looked more closely in the next chapter.

Table 5. Risks and advantages of global sourcing (adapted from Cavusgil 2014, p. 446; Hollensen 2007, p. 348)

Advantages	**Disadvatages**
• Access to resources abroad without investments • Potential for increased productivitiy, lowered costs and improved profitability • Provides operational and technological flexibility • Enables shedding of overhead without financing problems • No transfer pricing issues associated with subsidary	• Overreliance on suppliers • Difficulty of finding a suitable supplier • Possibility for lower-than-expected cost savings • Transfer of production know-how can be difficult without training • Risk of creating of competitors • Control of manufacturing quality • Legal environment in source country can be unfavorable • Control of Corporate Social Responsibility in source country can be difficult to control • Dissatisfaction among home-country employees

3 COST-BASED DECISION MAKING

This chapter provides the theory on cost-based decision making when choosing whether the company should manufacture products by themselves or to outsource the production. The chapter first presents basic cost definitions that are used throughout this study, and the second part examines how cost of individual products are formed. The third part presents basics of make-or-buy decisions from cost perspective, and finally two other types of costs associated with outsourcing are presented.

3.1 Cost definitions

Cost is this study is defined according to Horngren et al. (2012, p. 27) as *"a resource sacrificed or forgone to achieve a specific objective*". Costs here are measured in monetary terms, and they accumulate as a company acquires goods or services. Costs are measured for specific *cost objects*, and assigned to them following the principle of causality (Neilimo & Uusi-Rauva 2007, p. 109). The principle states that only the costs that are caused by the cost object can be assign to it.

In relation to cost objects, costs can be either direct or indirect. *Direct costs* are those that are "*related to the cost object and that can be traced to it in an economically feasible way*". For a manufacturing company these normally mean costs that can be traced based on material requisition documents. *Indirect costs* are also related to the cost object, but cannot be traced to it in a cost-effective way. In manufacturing, indirect costs normally refer to manufacturing overhead costs. (Horngren et al. 2012, pp. 28-9)

Another way to classify costs is to link them to a specific activity. *Variable costs* are those that change in total as the activity level changes. For example, if a company produces more products, it needs more raw materials which results in more costs. *Fixed costs* are those that remain the

same in total even if the activity level changes. However, if the examined cost is not the total costs but a unit cost, then the cost behavior is the opposite. (Horngren et al. 2012, p. 30-1)

3.2 Cost of products

Companies are interested in knowing the cost of their products for example in order to be able to set a correct price for them to cover their costs and ultimately create profit. To know the cost of a single product, a manufacturing company needs to have a clear understanding of all the costs related to producing it. These calculations are called product costing, and they require an in-depth knowledge of company's overall cost structure (Neilimo & Uusi-Rauva 2007, p. 114).

In product costing, all the direct and indirect costs are assigned to a single cost object either by cost tracing or cost allocation. Direct costs can be traced directly to the cost object through a process of cost tracing. Indirect costs, also called a *cost pool*, however, need to be assigned to the cost object usually via *cost-allocation base*. The cost-allocation base is a way to link indirect costs systematically to cost objects based on certain measurable quantity, such as the number of machine hours. (Horngren et al. 2012, pp. 99-100)

3.2.1 Machine-hour rate

One way to allocate costs to cost objects in manufacturing environment is called *machine-hour rate*. When calculating machine hour rate, all the direct and indirect costs associated with using a specific machine are either traced or allocated to that machine according to principle of causality (Suomela et al. 2011, p. 257). When the utilization of the machine is known, it is possible to calculate the hourly rate of what it costs to run it. The cost for a single product made on that machine can then be calculated based on how much

machining time it takes to complete a that product (or part of it). A critical factor in determining machine-hour rate is what is the capacity used for the machine in the calculations (Suomela et al. 2011, p. 257).

3.3 Make-or-buy decisions

Companies often face a question which products they should produce by themselves (insourcing), and which ones to buy from outside (outsourcing). These decisions are called make-or-buy decisions, and although there is often a strategic component to them, cost accounting plays a big part in providing information to support the decision making (Suomela et all. 2011, p. 269). Following the same logic, this approach can be also used to choose between alternative suppliers while comparing them to own manufacturing.

3.3.1 Make-or-buy analysis

Make-or-buy analysis is a tool that can be used to choose between alternative future cost and profit scenarios. In the analysis, the costs and profits of insourcing and outsourcing (or between outsourcing alternatives) are compared against each other to provide a cost-based points of differences between alternatives. A comprehensive make-or-buy analysis should take into consideration all the relevant costs and revenues that can be affected by the decision making (Suomela et al. 2011, p. 269). Relevant costs are defined as “expected future costs that differ among alternative courses of action being considered” and following the same logic expected future revenues are called relevant revenues (Horngren et al. 2012, p. 391). However, according to Suomela et al. (2011, p. 269) a thumb rule for making a good make-or-buy analysis is to only include all the related direct costs into cost calculations

3.3.2 Strategic and capacitive factors

The overall motivation of choosing between insourcing and outsourcing is usually economical (Suomela et al. 2011, p. 269). However, in the long perspective the financial benefits and costs become more uncertain, and the strategic aspects of the decision more important (Horngren et al. 2012, p. 400). This can ultimately mean that even if the outsourcing costs are higher than insourcing, a company can still end up choosing to outsource. For example, outsourcing some part of production can be used to secure supply in times of high demand, or to lessen the risk of overcapacity when the demand is lower. With international sourcing, a company can also protect itself against risk caused by fluctuating currency by having a supply in other currency area (Horngren et al. 2012, p. 401).

Linked closely to strategic aspects of the make-or-buy decision are the concepts of *idle facilities* and *opportunity costs*. (Horngren et al. 2012, p. 401). By idle facilities it is meant that if the production of (some) products is outsourced, the capacity used to produce these products in-house will become available to other use. If this capacity cannot be released or used in other way, it becomes idle and can undermine the cost benefits gained from outsourcing (Suomela et al. 2011, pp. 270-1). This is because the unit costs of other in-house products will now have to include the fixed costs of idle capacity as well, making them more expensive to produce. In make-or-buy decision opportunity costs should also be considered. Opportunity cost is the missed profit that is lost when a certain resource is not used in its next-best alternative way (Horngren et al. 2012, p. 402).

3.4 Other outsourcing-related costs

Asides from purely production-related costs, other costs associated to outsourcing should also be considered when making a make-or-buy decision. It is estimated that “hidden costs” can add up to 14-60 percent of

the purchase price in outsourcing (Burton 2013). These costs vary from easily quantifiable to costs that are difficult to measure. Here two types of hidden costs are examined more closely: *transaction costs* and *quality costs.* Transaction costs are associated with buyer-seller relationship and can affect the level of commitment the company should have with its potential supplier. Quality costs in turn can diminish the gains from lower production costs of the supplier due to costs resulting from low-quality products or their prevention.

3.4.1 Transaction costs

Transaction costs are defined as "*the 'friction' between buyer and seller, which is explained by opportunistic behavior*" (Hollensen 2007, p. 76). This definition is a reference to Williamson's (1981) work on Transaction Cost Analysis (TCA), which explains why firms choose to either do activities themselves (internalize) or use outside providers (externalize). According to the theory, a company will internalize activities that it can do with the lowest cost, and externalize the functions where outside suppliers have more advantage. There are, however, transactional costs related to using outside providers that need to be considered when making the decision. (Klein et al. 1990, pp. 196-7).

A transaction occurs "*when a good or service is transferred across a technologically separable interface*", and during the transaction some loss is always experienced due to imperfect conditions (Williamson 1981, pp. 552-3). These imperfections can be divided in to three categories: search and information costs, bargaining and decision costs and policing and enforcement costs. The search and information costs are a result of insufficient information about the target market. The bargaining and decision costs are a result of finding the right partners and negotiating an agreeable contract with them. The policing and enforcement costs come in to play

when one or both parties violate the terms of the agreement. (Dahlman 1979, p. 148)

3.4.2 Quality costs

Quality is subjective and can be defined in a variety of ways. The International Organization of Standardization (ISO) defines it as "*degree to which a set of inherent characteristics of an object fulfils requirements*" (Anttila & Jussila 2016), while American Society of Quality (ASQ) states that quality is the "*total features and characteristics of a product or a service made or performed according to specifications to satisfy customers at the time of purchase and during use*" (Horngren et al. 2012, p. 671). Quality in manufacturing can be generally divided into two aspects, design quality and conformance quality. *Design quality* refers to the overall characteristics of a product in relation to customer requirements, while *conformance quality* refers to the performance of the product in relation to those characteristics (Horngren et al. 2012, p. 672). In this study, only the concept of conformance quality is examined.

Quality costs are defined here as "the costs incurred to prevent, or the costs arising as a result of, the production of a low quality product" (Horngren et al. 2012, p. 673). According to the definition they can occur in two different ways; there are costs to prevent quality problems, and costs to correct quality nonconformities (Suomela et al. 2011, p. 275). More detailed classification (PAFF-model, Feigenbaum 1991) divides quality costs into four categories: prevention, appraisal, internal failure and external failure (Omachonu & Suthummanon 2004, p. 278). Prevention costs are a result of preventing errors from occurring within a company, and appraisal costs incur from the identification of poor quality products before their shipment to customers (Omachonu & Suthummanon 2004, p. 278). Internal failure costs are "all the costs of deficiencies discovered before delivery which are associated with the failure, and external failure costs are "*costs associated*

with deficiencies that are found after product is received by the customer" (Juran & Godfrey 1998, p. 254).

It is estimated that quality costs in manufacturing industry are between 5-25 percent of sales (Omachonu & Suthummanon 2004, p. 279). The costs of correcting quality nonconformities are usually easier to measure in company than prevention costs, which are more challenging to identify (Burton 2013). It has been found out in studies that failure costs are always higher than prevention costs, and that there is a relationship between these two costs (Juran & Godfrey 1998, p. 271). In one case study, Omachonu and Suthummanon (2004) found out that as appraisal and prevention costs increase, the failure costs decrease. This also has a direct improving effect on the overall quality. These results follow the model of optimum quality costs (Juran & Godfrey 1998, p. 271) presented in Figure 4. It is noteworthy that there is an optimum for total quality costs, and that it is less than 100 %.

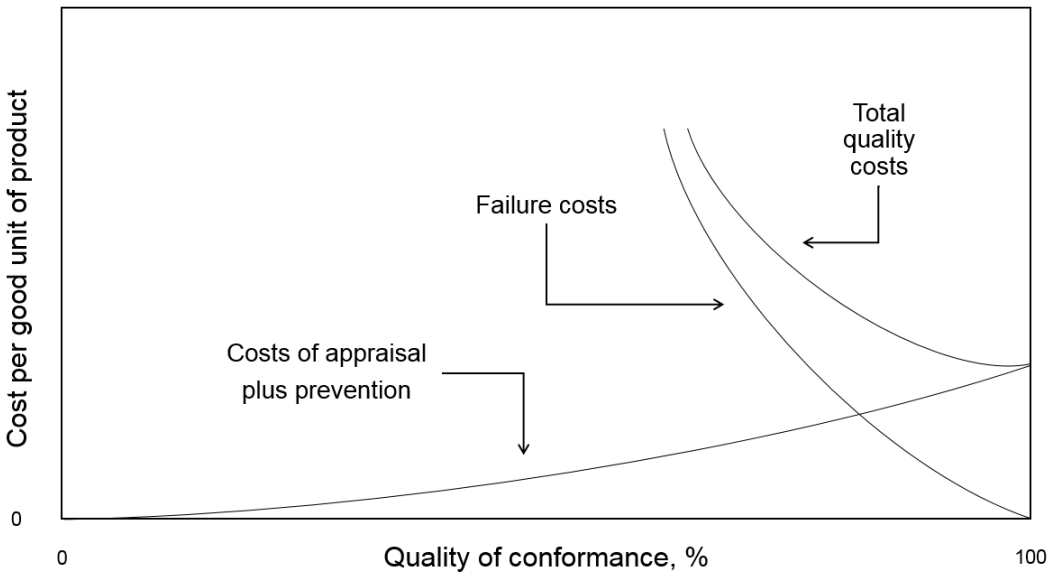

Figure 4. Model for optimum quality costs (adapted from Juran & Godfrey 1998, p. 271)

4 COMPONENT MANUFACTURNG IN FINLAND

This chapter describes the current GS component manufacturing in Finland. First an overview of GS components and the general production process is presented with detailed description of raw material, forging, machining, quality control and production planning. The second part of the chapter describes how the product costing is done for GS components, and finally five GS components are selected for detailed examination. The cost structure of these five items in Finland is presented in the end of this chapter.

4.1 GS components

GS components refer to components mainly designed and manufactured by GS-Hydro and manufactured by GS Supply. They consists of over 6 000 items including flanges, insert cones, sleeves, valves, welding nipples and blocks. The components are primarily used together with hydraulic tubes to create non-welded hydraulic piping systems to various applications. The main building blocks of non-welded piping systems are special flanges that are the original innovation of GS-Hydro. They can connect two hydraulic tubes together leak-free without welding even in high-pressure applications. A representation of 90 degree flange connection is presented in Figure 5.

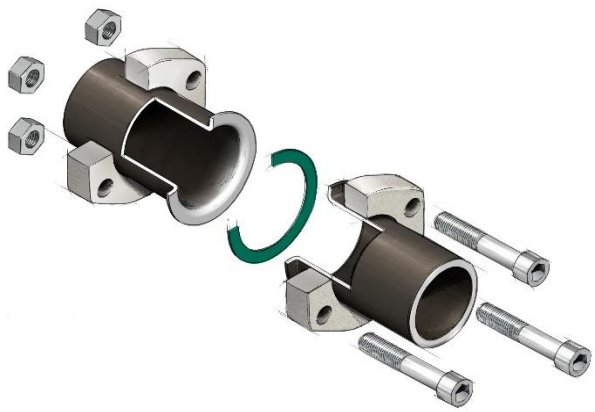

Figure 5. 90 degree flange connection (GS-Hydro 2017)

GS components are often used in demanding applications that are controlled by international standards. The quality of the components in turn is governed by various classification agencies that, depending on the application, grant type approvals to components. The type approvals require that the components such as flanges are manufactured according to classification society standards from materials that can be traced throughout the supply chain. The GS flanges have been awarded with various type approvals, which are required by many customers as a perquisite for their use. (Kuisma 2016a)

4.2 Production process

The raw materials and forgings for GS flanges are purchased from suppliers. These raw materials and half-finished products are for the most parts machined in-house, unless subcontracting is used for production planning reasons. If the machined products require surface treatment it is done by an outside supplier. The typical flange production process of GS Supply is presented in Figure 6, and explained in detail in the following chapters. (Kuisma 2016a)

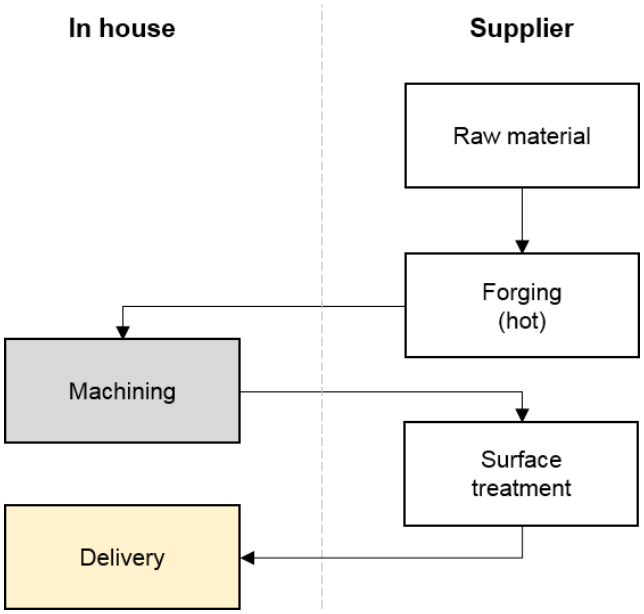

Figure 6. Manufacturing process of GS-Supply

4.2.1 Raw material and forgings

The forgings for flanges are purchased from a supplier in Italy and shipped to Finland for machining. The forgings are made based on standard sized forging molds. The type of forging process used by the supplier is hot forging. Two types of forgings are being used for manufacturing GS flanges, structural steel forgings and stainless steel forgings. The raw material for structural steel is P355 NL1 and for stainless steel AISI 316 (L). The flange sizes that cannot be made from forgings are made from locally purchased steel plates. (Kuisma 2016a)

The supplier provides material certificates and smelting number for the forgings which are required by different classification societies. The forgings are given a material tracing number, based on which the material certificate can be traced. This tracing number follows the components throughout the manufacturing process. The tracing number is visible both in the forgings and in the work order. If the raw material does not have a material certificate, a test piece need to be sent out for the material to be type approved. (Kuisma 2016a)

4.2.2 Machining

Most of the flanges that are manufactured in Finland are SAE type flanges. They are mainly machined from standard type forgings with CNC lathes. Only the sizes that cannot be made from forgings are machined from steel plates. Production batches above 300 pieces are machined with automated CNC lathes that are fed by a robotic arm. Depending on the flange type they can machine about 20 flanges per hour, the biggest production batches taking about 1.5-2 weeks to complete. The smaller batches of about 50-80 pieces are machined manually with a rate of approximately 14 pieces per hour. (Kuisma 2016a)

The basic SAE-type flanges are machined from forgings that has a hole in the middle. Depending on the flange type, different amount of machining is required for different flanges. The surface and bevels are machined from one side together with the central hole. The bolt holes are then drilled into the flange, their size and positioning depending on the flange type. The bolt holes can be machined from one side with special tools that allow the opposite side to be beveled without having to turn the flange. This has sped the drilling process which has conventionally been the most time consuming part of flange machining. (Kuisma 2016a)

4.2.3 Quality control

The quality control in GS Supply is based on quality documentation and divided in to two parts: own manufacturing and supplier quality control. One person is currently responsible for the quality control work, although everyone is expected to report any non-conformities. The need for quality control is reviewed case by case, especially with the suppliers. If there have been any problems with the quality in a certain area, the quality control will be more frequent and precise. All the measurement devices are calibrated regularly either by sending out them for outside measurement or tested against calibration pieces. (Kuisma 2016a; Joutsensaari 2016)

The quality control in GS component production is done usually by measuring the first 1-5 pieces and the final piece of a production batch. This ensures that there are no set-up or programming mistakes. After the machining is completed the batch will be measured again to identify any systematic errors in dimensioning. Normal quality problems in flange production include problems in grinding of the surfaces and bevels, concentricity of the holes, dents and scrapes in sealing surfaces, wrong markings, visual defects or problems in surface treatment. (Joutsensaari 2016)

4.2.4 Production planning

Production planning is carried out with an ERP software. With the software, it is possible to choose different production paths for incoming orders based on the current workload estimate. Based on this information, the software gives recommendations for production plan that can be adjusted depending on the available capacity. Normally the production plan is made one week before the actual production. If the production capacity is exceeded the biggest batches will be moved to subcontracting to keep the flexibility in own production. The ERP software also allows the review of resource consumption on a product level as well as machining and set-up time monitoring. (Kuisma 2016b)

4.3 Product costing

The product costing in GS-Hydro is based on machine hour rates. The machine hour rate calculation includes all the costs that are a result of the production activities. These costs are assigned to individual CNC machines used in the making of GS components and divided by their actual working hours. The product level cost is then calculated in the ERP system based on the selected production path defined for the component. The calculation takes into consideration the set-up and machining time for the production batch derived from the machine hour rate and the raw material consumption. The production cost per unit is the sum of these costs. (Kuisma 2016b)

4.3.1 Machine hour rate

The machine hour rate calculation in GS Supply includes both direct and indirect machine and labor costs. The machine costs consist of the upkeep and facility costs of the production. Some upkeep costs can be directly traced to a machine, but majority are assigned to a common cost center.

These are then allocated to different machines based on machining area. Supporting functions for the machining are allocated to CNC machines based on the estimated work load. The facility costs are assigned to a machine based on the area which the machining area covers. The remaining area is considered a common cost which allocated to the machines based on actual working hours. (Kuisma 2016b)

The labor costs in the machine hour rate calculation are assigned either directly to the machines based on the actual costs or to a common cost center. The common costs consist of warehouse management costs and machine workshop management costs. These costs are allocated to machines based on the estimated management workload. The other labor costs that are allocated to the machines include material handling, sawing and programming. These costs are allocated to CNC machines either based on actual working hours or estimated workload. (Kuisma 2016b)

4.4 Selection of components

Two list of components were selected from the total list of GS components for cost comparison. The first list of components consists of five items that were examined in detailed level. The second list of components had over 100 items that were used for quotation as well as to arouse the interest of the potential suppliers. The purpose of the detailed costing was to get a better understand the cost structures of the component manufacturing and cost levels in Finland and China. Only the detailed costing of the five items is examined in this study whereas the second list is used only for referencing.

The components for detailed analysis were selected based on the rolling consumption data of GS components from the last two years and expert evaluation. Previous experience from sourcing from India was also utilized in the selection process. The target of the selection process was to choose

five standard components manufactured by GS-Hydro that had high and stable sales volumes. The components were also to be from different product categories and different sizes. No stainless-steel components were selected for the comparison because of their low consumption and low sales predictability. The top 10 product categories by sales from the last two years are displayed in Figure 7.

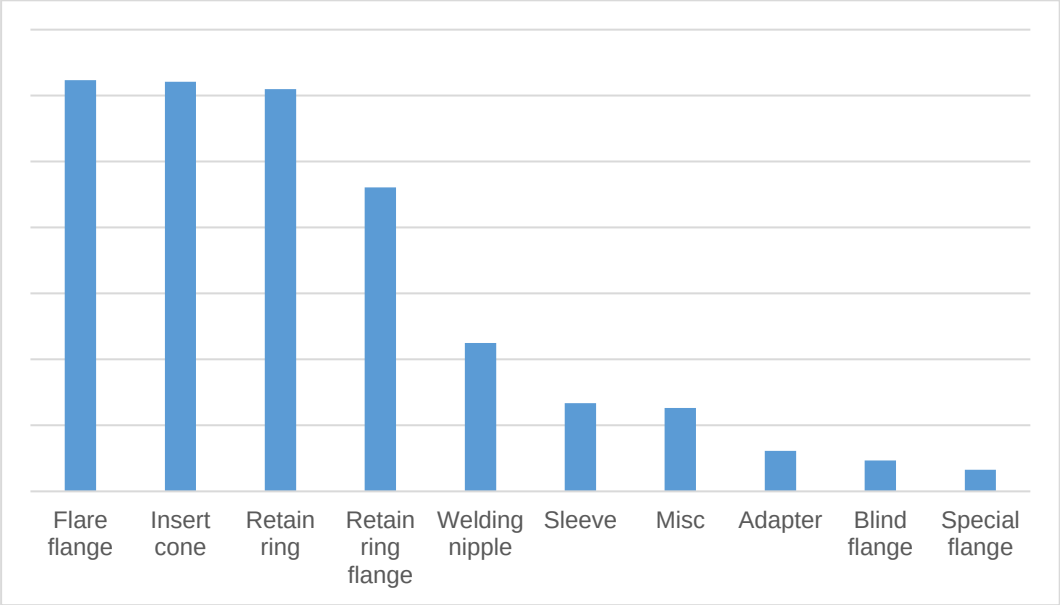

Figure 7. Top 10 product categories by sales

The product categories that were chosen based on the data were flare flanges, retain ring flanges and insert cones. Retain rings were dismissed because they are standard items that are not produced by GS-Hydro. As the target of the research was especially to study the manufacturing costs of flanges in Finland and China, three different types of flanges were included in the detailed examination. The top 10 flanges by sales from the last two years are presented in Figure 8.

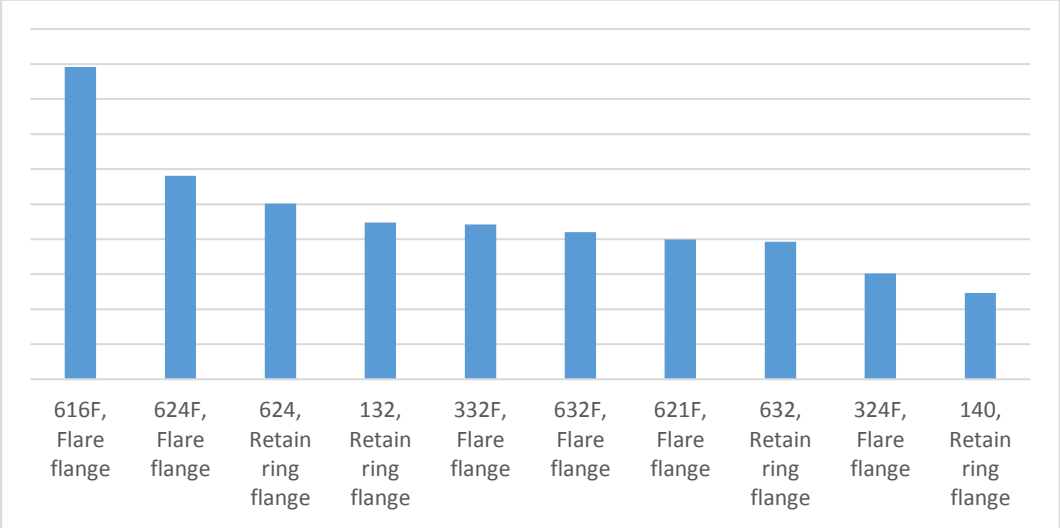

Figure 8. Top 10 flanges by sales

Although the flare flange 616F and the retain ring flange 624 had high sales volumes, they were not selected for the detailed analysis. This was because it was recognized that their sales came from a single customer project which distorted the data. Instead, the flare flanges 624F and 332F, and retain ring flange 132 were selected. From the insert cones sales data types 24/50X5FC and 32/60x3FA were selected based on expert evaluation. The top 10 insert cones by sales from the last two years are presented in Figure 9.

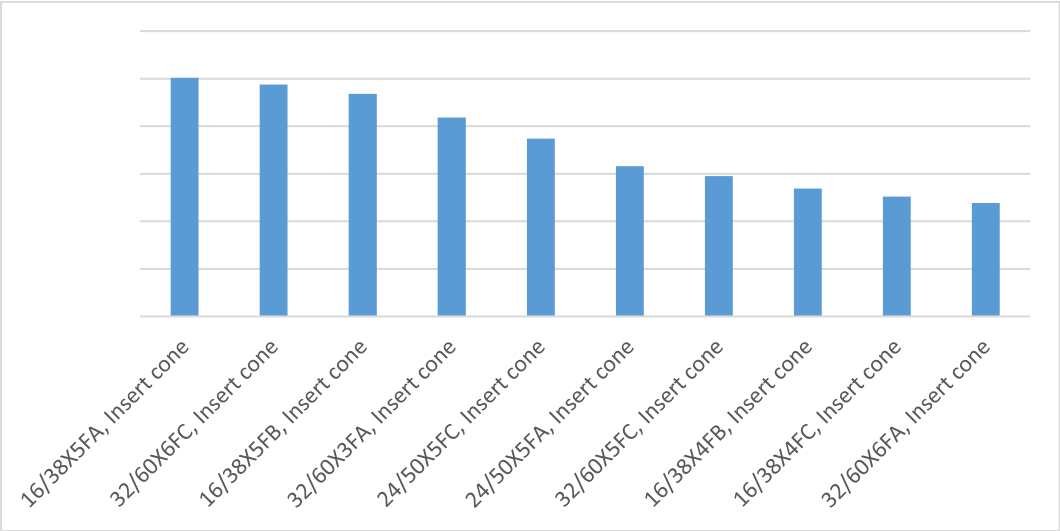

Figure 9. Top 10 insert cones by sales

4.5 Cost structure in Finland

After the selection of the five components, the cost structures of those components were exported from the ERP software. Their actual costing is presented in Figure 10, and percentage of total cost in Figure 11. For the flanges, the raw material cost is included in the forging cost as the forgings are bought directly from a supplier. For the insert cones forging is not needed. Because the sample size is limited to three flanges and two insert cones, the conclusions derived from the data are only directive. The actual monetary values are omitted from this study because of confidentiality.

When the costs of the five items are presented as actual costs, the selected flanges are more expensive to manufacture than the insert cones because of the higher cost of raw material or forging. Flare flange 624F is the most expensive to manufacture with highest actual costs in all the examined categories. The cost in all categories seem to increase proportionally to the flange size. However, in the insert cones only the cost of machining is different between the two flanges.

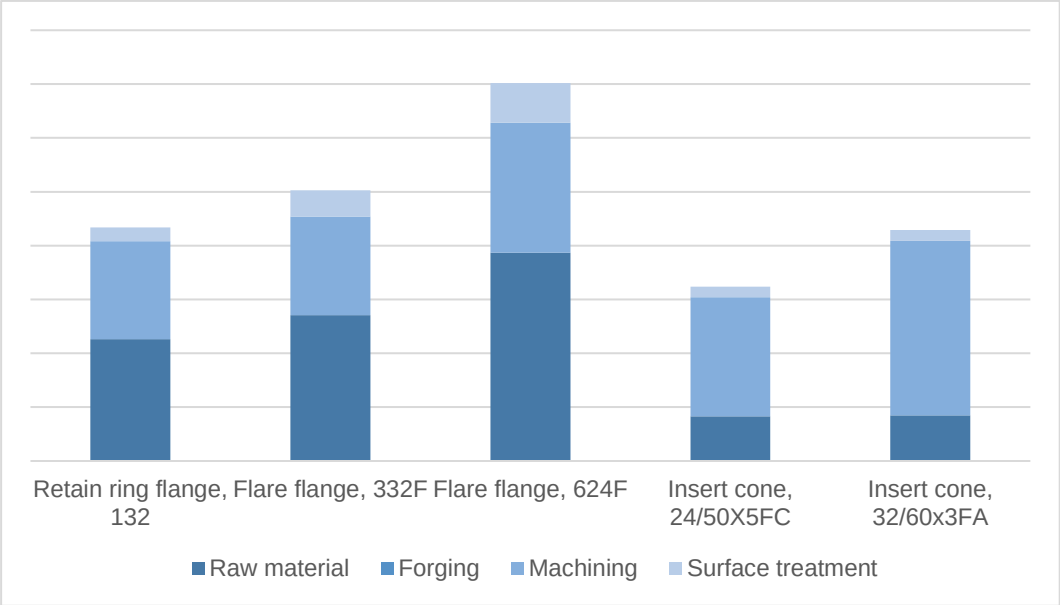

Figure 10. GS Supply cost structures, actual

If the costs are examined as a percentage of total cost, the raw material cost in all flanges is more than half. As the size of the flange increases, so does the share of the raw material while the machining cost decreases. Furthermore, as the size of the flange increases, so does the portion of the surface treatment cost of the total cost. However, the surface treatment cost is still by far the smallest compared to raw material and machining costs.

For the insert cones the share of raw material cost is much smaller than in the flange production only 20-25 %. The most expensive part of manufacturing insert cones is the machining, which is more than two thirds of the total cost in the examined insert cones. The surface treatment cost is also smallest in the insert cone production, around 5-6 %.

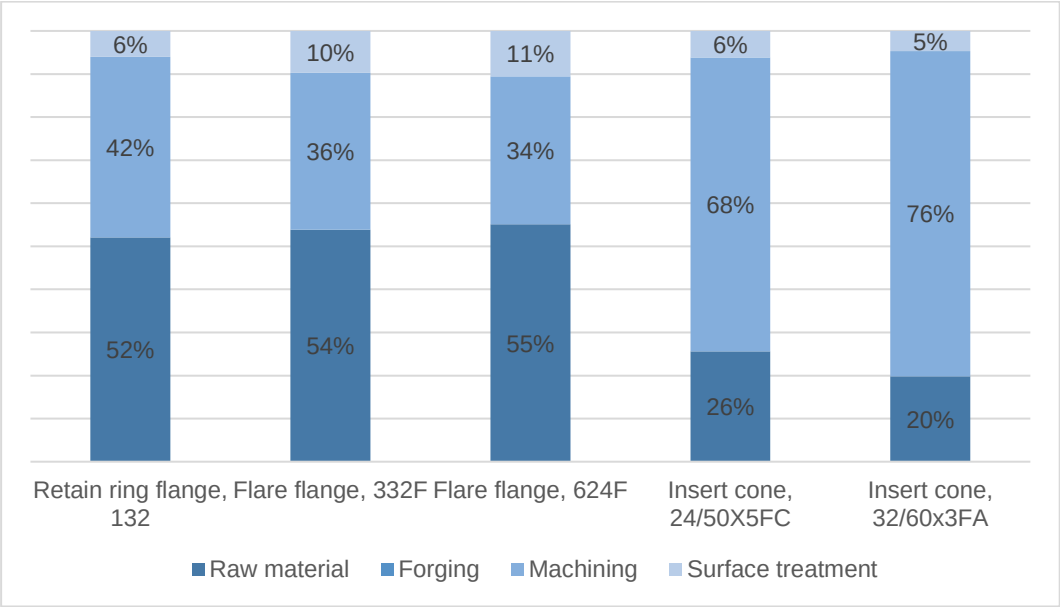

Figure 11. GS Supply cost structures, percentage

5 LOCATING COMPONENT MANUFACTURING IN CHINA

China has many special characteristics as a target country for investments and sourcing. Ever since it first started transitioning towards market economy in the late 1970's and finally its membership in the WTO in 2001, China has been a major player in global business and target for extensive investments. Although China's economy has been showing signs of slowing down during the recent years, it still possesses many qualities that makes foreign manufacturing companies interested in tapping into its resources and markets.

This chapter presents the characteristics that are most relevant for locating component manufacturing in China. These include the development of industrial manufacturing and raw material production, labor costs, currency risks and transportation costs. The secondary data used here is collected from two types of sources: data provided by Finnish institutions to help businesses, and international and Finnish online newspapers that provide news and data for businesses. The suitability of the data is assessed based on the recentness, objectivity and relevance to the research questions.

5.1 Industrial production

As industrial manufacturing in rest of the world has been fairly stable during the last 15 years, at the same time it has more than tripled in China (Figure 12). This has not only helped China to become the second largest economy in the world, but also made China one of the biggest manufacturers and markets for industrial products. In the more recent years however, there have been growing concerns of declining economic figures and slowing down of industrial production (e.g. Helsingin Sanomat 2015; Elinkeinoelämän keskusliitto 2015; Talouselämä 2016a). However, with a strong support from the government, China is expected to adjust to a slower but more sustainable growth rates in the coming years (Qi & Zhu 2017).

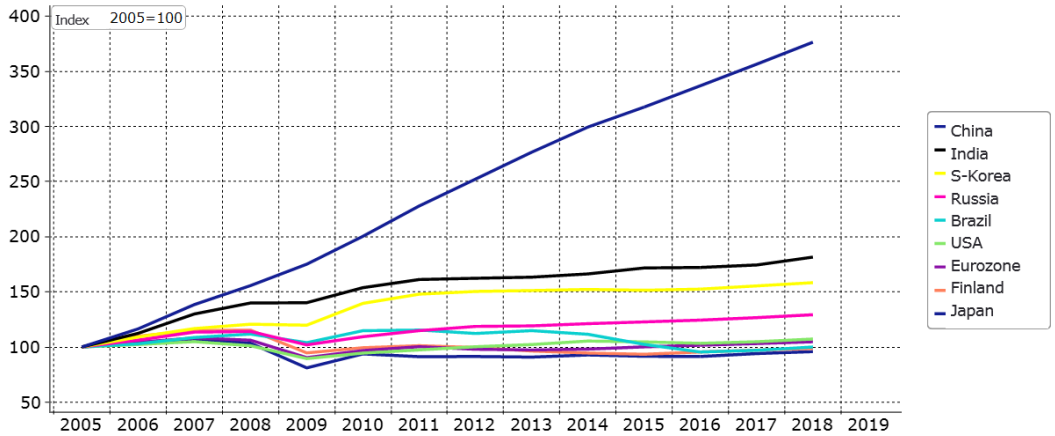

Figure 12. Industrial production around the world (Teknologiateollisuus 2017)

5.2 Raw material

As the industrial manufacturing has multiplied in China during the past 15 years, so too has the steel production (Figure 13). When in 2001 China produced 150 million tons of steel, in 2016 the production peaked at 800 million tons (Taloussanomat 2016). At the same time its production capacity has increased to 1200 million tons (Taloussanomat 2016a). This development has led to overproduction of steel, which China is trying to unload by exporting and restraining its steel production. Despite increased international concerns about China dumping its steel to other markets, 87% of steel manufactured in China is still consumed domestically (Mauno 2017).

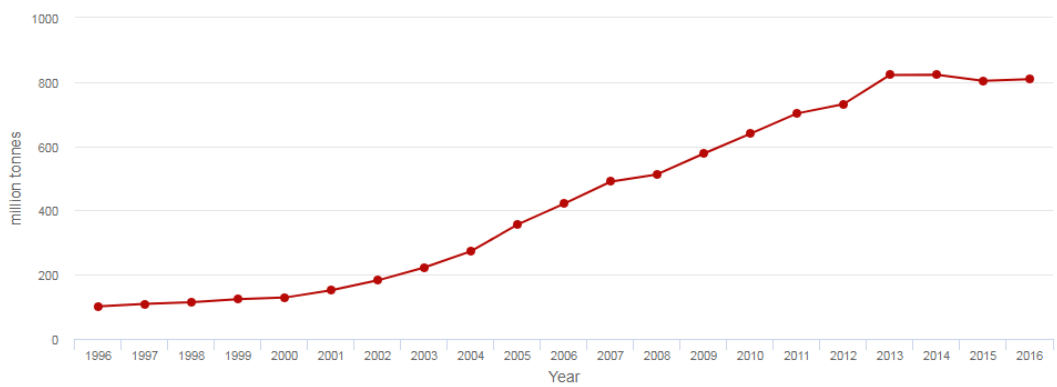

Figure 13. Crude steel production in China (World Steel Association 2017)

The overproduction of steel in China together with low global demand has collapsed the steel market prices in the last 10 years (Figure 14). There are however signs that the steel prices are starting to slowly increase due to ecomomic revival and China decreasing its production capacity by shutting down ineffiecient production plants (Talouselämä 2017). Also the tightening environmental legislation and government campains are affecting steel production and prices in China. In early 2017 the price of Chinese steel had increased 40% in the market (Talouselämä 2017)

Figure 14. Steel price index 2006-2016 (Hellenic Shipping News 2016)

5.3 Manufacturing labor costs

China has been traditionally views as a low cost country when it comes to manufacturing wages. This however has changed during the last ten years with average wages increasing more than 10% annually. Although the rate of increase seems to be slowing down (7% annual increase in urban areas in 2017, Bank of Finland 2017), the trend is still expected to continue. The same development can been seen in the average wages in the manufacturing industry (Figure 15). This has already led many companies in labor-intensive industries moving their production outside from China in to lower-cost countries (Bank of Finland 2017).

Figure 15. China average yearly wages in manufacturing 2006-2016 (Trading Economics 2017)

5.4 Currency risks

When manufacturing is located in a different currency area than the markets, there is always a currency risk that needs to be considered. Simplified, if the market country's currency is strong compared to the manufacturing country, the goods are less expensive to manufacture. However, if the manufacturing country's currency is getting stronger, it might undermine the benefits of moving the production to a different currency area. Currency fluctuations also determine the buying behavior of customers. In the case of exporting goods from China to Europe there are usually three currencies that need to be assessed: Euro (EUR), Chinese yuan (renminbi) (CNY) and US dollar (USD).

Figure 16. Exchange rate, EUR to CNY (XE 2017a)

In relation to Chinese yuan, euro hit its recent low in 2015 (Figure 17). In 2015 China devalued yuan in order to speed up its slowing economic growth (Korhonen 2015). Since then euro has slowly increased its value, however the experiencing downturns on the way mainly due to recession in the Eurozone. After the devaluation, the value of Chinese yuan has become more determined by the markets and thus more difficult to predict (Korhonen 2015). Since then yuan has also been introduced to IMF's (International Monetary Fund) Special Drawing Rights (SRD) reserve assets in 2016, however this has not been considered to affect its position in the market (Korhonen 2016).

Figure 17. Exchange rate, USD to CNY (XE 2017b)

Compared to Chinese yuan, US dollar has increased its value compared except for the last quarter of 2017 (Figure 17). This has made dollar business in China profitable in the recent years, and also helped China to export its goods to dollar area. The recent developments however show that the US government has taken countermeasures to decrease the value the dollar against yuan (Reuters 2017). Nevertheless the future developments of the two currencies are difficult predict as China is looking to strengthen its position in the global currency markets (Korhonen 2016).

5.5 Transportation costs

When the goal is to manufacture goods in China and them to another country, one of the key cost element is the transportation cost. The transportation cost largely depends on the used transportation mode between the two countries (Chopra & Meindl 2013, p. 50). Depending on the demand for lead time and shipment sizes companies normally choose either air freight, land freight or sea freight to ship outside from China (Chopra & Meindl 2013, p. 51). Transportation mode being equal, the variable that has the most impact on the profits of a global supply chain is fuel cost (Chopra & Meindl 2013, p. 112).

Figure 18. Crude oil price, last 5 years (Macrotrends 2017)

The price of oil has fluctuated significantly during the last 5 years (Figure 18). Overall the price of oil is currently at a low level, about 60 dollars per barrel, having positive impact on transportation costs. Although there have been efforts by the OPEC countries to increase the price of oil, the current of production of shale oil by the United States has kept the oil prices low (Hänninen 2017).

6 EXPERIENCES FROM FINNISH COMPANIES IN CHINA

There are only few recent public studies made of Finnish industrial companies establishing their operations in China. This chapter presents three studies that explore Finnish companies' establishment and operations in China during the last 20 years. The studies were issued by Helsinki School of Economics, CIRCMI group of the University of Tampere and Finnish Innovation Fund, the Finnish Funding Agency for Technology and Innovation, and Finpro.

- **Suomalaisyritysten strategiat Kiinan muuttuvassa toimintaympäristössä** (Strategies of Finnish companies in the changing business environment of China) (Kettunen, Lintunen, Lu, Kosonen 1998)
- **Suomalainen silkkitie** – Suomalaisyritysten kokemuksia selviytymisestä Kiinassa (Finnish Silk Road – Experiences of Finnish companies' survival in China) (Kaislaniemi 2003)
- **Kiina liiketoimintaympäristönä** – Haastattelututkimus suomalaisjohtajien kokemuksista Kiinassa (China as a business environment – Interview study of the experiences of Finnish managers in China) (Ahoniemi 2010)

The studies rely on qualitative data and interviews with both Finnish and Chinese country managers and employees. The chapter presents the key findings and recommendations from those studies relevant to this research, particularly establishing partnerships with Chinese companies and supplier-customer relationships in China. A summary of experiences is presented in Appendix 1.

6.1 Background of Finnish companies in China

Until the early 1980's Finnish companies were mostly involved in export business to China. After the economic reforms in China in the late 1970's and the signing of TTTT-agreement (economy, industry, technology and science) between Finland and China in 1979 Finnish companies became increasingly active in the Chinese markets. Part of this progress were the special economic zones in China and the legislation allowing joint ventures between Chinese and foreign companies. The partner was usually either a big government-owned company or a local privately-owned company. (Kettunen et al. 1998, pp. 82-4)

In 1990's there was a rise in the number of Finnish subsidiaries with more customer-supplier relationships with local companies. However, because of the changing legislation, increased regulation and rising costs the interest towards China decreased in the mid-90's. The Asian financial crisis in 1997 however did not affect China as much as it did other Asian countries, and many company started to move their operations to China. Towards the end of 1990's there was speculation about the WTO membership of China, which further increased interest. (Kettunen et al. 1998, pp. 84-7)

Coming to the 2000's the number of Finnish companies increased in China, and the confirmation of China's membership in WTO at end of 2001 strengthened China's position as a lucrative market. At this point, increasingly many Finnish company also moved their production to China, which was referred as 'losing jobs to Fareast'. The number of Finnish companies increased steadily in China, and by the 2005 there were over 200 companies operating there. However, the increasing labor costs, problems with quality and delivery accuracy has forced some companies also to retreat from China. (Kettunen et al. 1998, pp. 87-107)

Before the motives of Finnish companies in China were mainly rooted in the big markets and cheap labor. Coming to the end of 2010's the motives of Finnish companies have become more varied, albeit the old reasons are still present. Many company is following their big customers to Asia, and differentiation their supply chains to increase their delivery accuracy in the Asian markets. China has also increased its relevance as a hub to enter the other major and rising markets in Asia. Companies also seek more value added by transferring their total production to China. (Ahoniemi 2010, p. 84)

6.2 Establishing a joint venture

Before the opening of China to the west, a joint venture was the only accepted operation mode for foreign companies to establish their operations in China. Even this barrier has been mostly eliminated, excluding certain industries, many companies still choose to enter or expand their operations in China through joint ventures. A local partner can provide potential benefits when operating in a foreign market, but also contain risks.

6.2.1 Reasons for joint venture

If the joint venture was not required by the Chinese government as an operation mode, it was emphasized that there needs to be a clear strategical reason to partner with a Chinese counterpart (Kaislaniemi 2003, p. 31). Working with a partner can complicate matters, so companies should consider carefully if there is a real need for a partnership. For example, one interviewee advised that if the partnership is only about manufacturing, it might not be advisable to start a joint venture as it can be easier to "grow" your own personnel. (Kaislaniemi 2003, p. 28).

On the other hand, if a company believes that it can benefit from the partner's experience regarding customer relationships, local markets and culture, a joint venture might be advisable (Kettunen et al. 1998, p. 163).

However, even in that case there needs to be a real mutual benefit from the partnership for both partners. (Kaislaniemi 2003, p. 29)

6.2.2 Finding and choosing a partner

According to the interviewees in one study, there are usually no shortage of willing business partners in China. The challenge therefore is to find a good local partner. The usual problems with Chinese companies are with company and business culture, as well as in language and communication. Problems might also surface because of poor profitability of the partner, outdated technology or partner's aim for 'instant gains' instead of long term investment to the partnership. (Kettunen et al. 1998, pp. 163-4)

To minimize the risk of poor choice, it was emphasized that it is essential to gather real information about the status and motives of the potential partner. Also the company's ownership, financial and market situation should be checked from a trusted source. It was separately mentioned that the financial status and liquidity of the company should be verified (Kaislaniemi 2003, p. 29). However, it was acknowledged that in China the acquiring of the information might prove to be difficult (Kettunen et al. 1998, p. 163).

The most important criteria for choosing a partner in China were business expertise, technological know-how, quality and reliability. The best way to ensure the level of know-how according to the interviewees was to visit the supplier and monitor their manufacturing on site. Overall, the interviewees had the best impression of Chinese companies that had earlier experience working with a western company (Kettunen et al. 1998, pp. 163-4).

6.2.3 Establishing a partnership

According to one interviewee, the two conditions for a successful partnership with a Chinese counterpart are the ownership structure of the

joint venture and a real interest to develop the partnership (Kaislaniemi 2003, p. 29) Both parties need to have something to give to the partnership, and to support and develop the joint venture in the long run (Kaislaniemi 2003, p. 29). According to another interviewee, the key question for the successfulness of the partnership was how to fit company's global strategy with the partner's strategy (Kettunen et al. 1998, p. 164). The basis of the strategy should be that there is no competition with the Chinese counterpart (Kaislaniemi 2003, p. 31).

The negotiations with a completely new partner might take a very long time, even years, as building trust in China is a lengthy process (Kettunen et al. 1998, p. 163). This process can be significantly shorter, however, if the partner is previously known, such as an old agent for the company (Kettunen et al. 1998, p. 163). In negotiations, Chinese companies have been known to present the state of matters in a better light than they are, and even in partnership a company should never rely solely on trust – control measures are the way to go. (Kaislaniemi 2003, pp. 28; 32). It was also brought up that the ownership arrangements of the Chinese company can change during the negotiations, especially if the negotiations take a long time (Kettunen et al. 1998, p.163).

6.2.4 Ownership issues

According to the studies, many problems in the joint venture with a Chinese partner were related to ownership structure of the company (Kettunen et al. 1998, p. 165; Kaislaniemi 2003, pp. 29-30). The problems surfaced especially if there was no common vision about the partnership and its development. In these cases, interviewees felt that the Chinese owners were only interested in the partnership to acquire western technology and know-how (Kettunen et al. 1998, p. 166).

There was a consensus in the studies that the Finnish company should have the majority ownership in the joint venture (Kettunen et al. 1998, pp. 166-7; Kaislaniemi 2003, p. 32). The most troublesome situation that the interviewees mentioned was a 50/50 share between Finnish company and Chinese counterpart. The most dissatisfied Finnish companies, however, were those with a minor share in the partnership. This meant that the Finnish company had only little or no jurisdiction in the company, and it was felt that the Chinese partner reaped all the benefits. (Kettunen et al. 1998, p. 166)

For the companies that had been obliged to start a joint venture because of government regulation, many sought to buy out the Chinese partner immediately after it became possible (Kettunen et al. 1998, p. 167). It was even advised by one interviewee that Finnish companies should not consider a joint venture unless there is no other option (Kettunen et al. 1998, p. 167). Another advice that was that you should never start a joint venture with a Chinese partner with minor or even 50/50 shares (Kaislaniemi 2003, p. 32).

6.2.5 Responsibilities

According to the study by Kettunen et al., a typical division of responsibilities in a Finnish-Chinese joint venture is that the Chinese partner manages the local relationships and supports the development of business and operations in China. The Chinese partner will also provide the facilities, sales team and workers. The Finnish company will provide the technologies, machinery, specialists, training, global customer relationships, brands and financial supervision. However, the views of the responsibilities sometimes differed greatly among the partners and caused problems during the course of the partnership. (Kettunen et al. 1998, p. 167)

From the commercial perspective, the usefulness of the Chinese counterpart was seen as a “door opener” to local markets (Kaislaniemi

2003, p. 28). It was also regarded positive that the Chinese partner could strengthen the relationship with public sector and local companies (Kettunen et al. 1998, p. 167). However, for this the partner should have relevant know-how to handle relationships to local authorities (Kaislaniemi 2003, p. 31).

6.2.6 Other issues

The studies also raised many other possible issues that a company might face when entering a joint venture with a Chinese counterpart. The problems were usually accumulated in the beginning of the partnership, and a good communication was seen as a key to solve. It was seen important that there were no mixed interest in the partnership regarding the cooperation such as markets, products and R&D. Another key issue was the perceived time span of the partnership – Finnish companies often felt that the Chinese partners were only after quick gains instead of long term cooperation. (Kettunen et al. 1998, pp. 164-6)

One interviewed Chinese manager raised concerns about the decision making process in the partnership. He felt that the foreign parent company should not make decisions without consulting the Chinese partner, or else it would not be a real partnership. Another manager said that even if the cooperation in the higher level of the organizations was good, the lower level employees might still only think about the interest of the own parent company. Also third parties might cause problems. (Kettunen et al. 1998, pp. 164-5)

6.3 Supplier relationships

Low costs have drawn many companies to source products and components from China. However, for a long time using suppliers in Chinese communist planned economy was relatively unknown, as factories

produced their products from beginning to end. Suppliers were only used if the quota could not be achieved, and the factory had to ‘plead for help’ from another factory. This meant that there was no need to worry about the quality or delivery time. This attitude still affects the mentality of many companies in China, and causes problems for western companies who try to develop long term relationships with local companies. (Kettunen et al. 1998, p. 168; Kaislaniemi 2003, p. 71)

6.3.1 Sourcing from China

The interviewees emphasized that before sourcing from China, there should be a detailed feasibility study made to find out if sufficient savings can be achieved. For example, according to one interviewee the manufacturing costs in China are already close to Finnish cost level. Because of this the only cost savings that could be achieved was a result of not needing to ship the products from Finland to China (Ahoniemi 2010, p. 43). It also was highlighted that the final decision should not be made only by looking at manufacturing costs, but that the quality and supply also needs to be reliable. According to one manager, working customer-supplier relationship in China requires hard work, quality training and constant supervision. (Kettunen et al. 1998, pp. 168-71)

6.3.2 Choosing a supplier

According to the interviewees in the studies, there are no problems finding willing suppliers in China. The problem with them is first to choose the ones that are capable of making what they promise. The second selection should be to choose from the capable ones the ones who are willing to invest in the partnership, and who are willing to learn and develop their products while keeping their costs in check. (Kettunen et al. 1998, p. 168). The references and the background of the supplier should also be checked carefully (Kaislaniemi 2003, p. 70). It is also important to keep the supplier and the

end customer separated from each other, otherwise there is a real risk that the supplier will become a competitor at some point (Ahoniemi 2010, p. 68).

The three key criteria for supplier selection mentioned were the supplier quality, the level of know-how and the motivation to deliver orders on time. (Kettunen et al. 1998, p. 168). Before proceeding with the supplier it is minimum requirement to see their manufacturing in person (Ahoniemi 2010, p. 22). All the agreed things need to be in writing even though it still might not be enough to enforce the contracts. It was also recommended to establish personal relationships with the key personnel of the supplier (Ahoniemi 2010, p. 40). According to one interview, the best way to commit the supplier was to create a win-win situation where both parties profit (Kaislaniemi 2003, p. 71)

6.3.3 Manufacturing

Considering supplier manufacturing, it was recommended that if the manufacturing work is relatively simple, the supplier should be located away from big economic centers where the labor is cheaper and easily replaced. Related to this, it was noted that in China the increases in productivity and cost savings do not go hand in hand because of big differences in wages in different areas. (Ahoniemi 2010, p. 46).

The production should be ramped up first with simple and standard products, gradually moving to more complex items. Before a full order, a small batch of products should be produced first, preferably with someone overseeing the production on site. Everything related to manufacturing should be specified in detail so that there is no room for misinterpretations by the supplier. (Ahoniemi 2010, p. 22).

6.3.4 Quality

Overall, the interviewees felt that that the quality level is in China has improved over the years (Kettunen et al. 1998, p. 170). The notion of “Chinese quality”, however, may affect the decision making both in company’s own organization and its customers (Ahoniemi 2010, p. 36). Nevertheless, it was noted that it might be difficult for the Chinese suppliers to understand the value of quality in the long term (Kettunen et al. 1998, p. 171). For example, the level of quality can be acceptable in sample batches, but drop later after initial orders (Kettunen et al. 1998, p. 170).

According to the interviewees, in order to achieve the desired quality level in China companies should first identify the key points regarding quality risk and delivery process and invest heavily on those. “Handing the supplier a quality manual and expecting quality products” was a sure way to failure according to one interviewee (Kaislaniemi 2003, p. 68). In addition to the quality of the components, also the reliability of supplier’s own quality inspection, the share of local sourcing and the reliability of the deliveries should be considered. The willingness to learn from the purchasing company was also mentioned as one of the success factors in supplier selection considering quality. (Ahoniemi 2010, p. 36-37)

According to the interviewed managers, quality problems were usually visible from the day one of the partnership. It was emphasized that all the quality problems should be addressed immediately, and make sure that all the products are even quality. One interviewed company started by inspecting all the delivered products from their supplier, and only after the supplier learned their requirements gave them more freedom. However, if supplier’s potential is recognized even with some quality issues in the beginning, a company should consider giving some support to them to improve their quality level. (Kettunen et al. 1998, p. 169)

According to the studies, the best way to ensure the quality of the supplier is to be present at the factories, or as one manager put it, in China “you get what you supervise”. One company had good experiences doing their own quality inspections at the supplier’s production facilities inspecting the products before deliveries. (Kettunen et al. 1998, p. 169) The buyer should also be aware of all kinds of surprises on the way, for example supplier might change their raw material to cut costs (Ahoniemi 2010, p. 39). Suppliers might also try to make more profit through intentional mistakes, asking extra payments for fixing the products (Ahoniemi 2010, p. 39).

6.3.5 Delivery accuracy

The control of delivery accuracy was mentioned as one of the key criteria for a successful customer-supplier relationship in China. At the same time as the overall quality level of Chinese suppliers have risen, the competition for good suppliers has also become tougher (Kettunen et al. 1998, pp. 170-1). This has meant that being a small customer might cause problems in the delivery accuracy. Small orders might be lower priority compared to big customers who buy in huge quantities (Kettunen et al. 1998, p. 170). Also, if the supplier is able to get business elsewhere they might not be interested in improving their quality level for smaller customers (Kettunen et al. 1998, p. 170).

7 SUPPLIER EVALUATIONS

For this study, four previously known suppliers of GS-Hydro were selected as case companies for detailed analysis. The company analyses consists of the basic information of the company and its business, financial analysis, production process description and the assessment of their manufacturing and quality control capabilities. Considering type approved flange manufacturing, also the raw material and forging capabilities and the related type approvals and certifications were examined.

The analyses are based on public marketing material, site visit observations, credit investigation reports and interviews with the suppliers and employees of GS-Hydro. The credit investigation reports were bought from a third party that specialized in business credit investigation in China. However, as the companies are not publicly listed, the accuracy of the financial information displayed in this report cannot be fully verified.

7.1 Company A

Company A is an industrial, trade and service company located in Jinshan district of Shanghai, China. Its main business is the design, processing, cleaning and install services for hydraulic pipeline and valves. Company A also has an agent status for GS-Hydro in China (Toxvig 2016). Company A currently has approximately 30 employees including a field installation team. Its turnover in 2015 was CNY 7.36 million (CIB 2016a). The summary of findings of Company A is presented as SWOT analysis in Appendix 2.

7.1.1 Company and business

Company A is a privately-owned company that was established in 2008 by a former sales director of GS-Hydro Shanghai, Mr. Xu, who is the current Executive Director of the company (Toxvig 2016). He is also the major

shareholder of the company with 85% of the company shares, with two other owners of 10% and 5% ownership. The owner Mr. Xu is financially well backed up by his parents, who own garment factories in Shanghai area. The relationship between Company A and the current management of GS-Hydro Shanghai is considered trustful and cooperative (Toxvig 2016). (CIB 2016a)

Company A is engaged in the same business as GS-Hydro and producing similar type of products. It also purchases GS components from GS-Hydro Shanghai. Currently all its sales come from domestic markets without any export activities. Its main customers are mostly local shipbuilding and industrial companies, most notably Shanghai Waigaoqiao and Shanghai Dinglin shipbuilding companies. Company A only uses direct sales without any local distributors. (CIB 2016a)

7.1.2 Financial information

Based on local credit investigation report from 2015, Company A's operating capital is weak and profitability is at loss. The report indicates that the company has problems to generate enough income to maintain its financial health and growth. With a turnover of CNY 7.36 million the company made CNY 30,000 profit before tax with a gross margin of 16.68 %. Company A's EBIT in 2015 was CNY -34 000 and EBIT margin -0.46 %. Company A's liquidity in the same year was poor indicating that the company has problems meeting its short-term financial obligations. Company's debt-to-equity ratio was appalling 7.13, indicating that the company is overleveraged and has high risk. (CIB 2016a)

7.1.3 Production process

Company A purchases hot forgings for flange production from a local supplier, who also provides the raw material. Company A does their own

machining, and for surface treatment they use outside supplier. Company A's production process of flanges is presented in Figure 19.

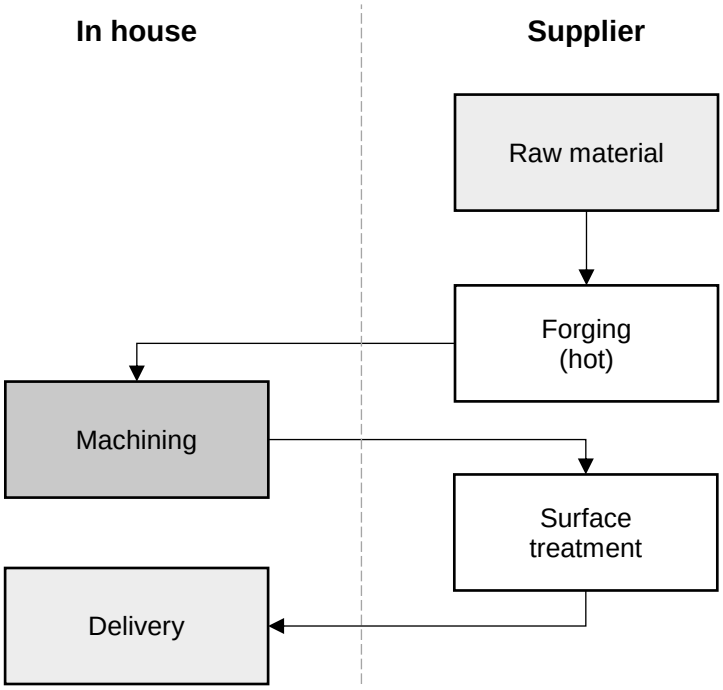

Figure 19. Production process, Company A

7.1.4 Raw material and forging

Based on material certificates the raw material for Company B's forgings comes from the same steel mill as for the other suppliers. All forgings have forging numbers for traceability. Currently all the steel used by Company A is grade Q345B, but according to their owner it is possible to use Q345D - 20 grade steel.

7.1.5 Manufacturing

Company A's machine base is small with only four CNC machines. There are not many tools or capacity for large scale machining. During the site visits the workshop was empty most of the time and there was no on-going production activity. Only one production worker was seen operating the

machinery. Company A also had some welding equipment and a pipe pending machine, as well as a testing bench.

7.1.6 Quality control

Quality inspection tools and test pieces were available at the workshop. However, it was noted that they were exposed to constant temperature changes. Some calibration records were also available. Overall Company A's quality control capabilities are limited. Company A has CCS ISO9001:2008 and GB/T 19001-2008 quality management system certifications.

7.1.7 Certifications and type approvals

Company A has mill certificates for their forgings from ABS, KR, BV, LR and DNV-GL. The mill certificates for the raw material had not been confirmed by the time of writing, but it was assumed that the steel mill had also been certified due to another supplier using the same factory. Company A does not have any type approvals for their own products.

7.2 Company B

Company B is a manufacturing company located in Changzhou, Jiangsu Province, China. Its main business is the production and selling of hydraulic parts directly to other manufacturing companies both inside and outside of China. It currently has about 100 employees, and its turnover in 2015 was CNY 48.3 million. (CIB 2016b). The summary of findings of Company B is presented as SWOT analysis in Appendix 3.

7.2.1 Company and business

Company B is a privately-owned company that was established in 2001 as a cooperative partnership between a Chinese and foreign owner. Its

majority owner (51%) is a German citizen who is also the company's Chief Executive. Other owners are Chinese Ms. Hu (48%) and Mr. Song (1%), who is also Company B's Managing Director. The foreign owner is also the CEO of GS-Hydro's competitor. However, according to Mr. Song, the owner is not actively involved in the management of the company, nor that the competitor is exerting any influence over the company (Song 2017). (CIB 2016b)

Company B's main products are flange pressing plates, flange welded pipe assembling units, flange transition joints and other different types of flanges. Company B sells majority of its products to domestic markets (about 70% of sales), with its export sales declined during recent years. Its main customers are Chinese subsidiaries of well-known foreign hydraulic component manufacturers. Company B uses solely direct selling without any distributors. Company B has been a supplier for GS-Hydro for about seven years (Toxvig 2016). (CIB 2016b)

7.2.2 Financial information

Based on local credit investigation report from 2015, Company B's operating capital is sufficient and it is financially stable company. With a turnover of CNY 48.3 million the company made CNY 3.37 million profit before tax with a gross margin of 18.25 %. Company B's EBIT in 2015 was CNY 3.54 million and EBIT margin 7.31 %. Company B's liquidity in the same year was good, however its high current ratio (6.98) and quick ratio (3.19) indicate poor asset usage due to their high stock value. Company's debt-to-equity ratio was low 0.13, indicating that the company does not use debt to finance its operations and has low risk. (CIB 2016b)

7.2.3 Production process

Company B purchases its raw material for flange production from local steel mills and stocks it in its warehouse. Company B sends the raw material from their warehouse to an outside forging company. The unmarked blank forgings are stocked the warehouse. Company B has own zinc plating workshop where it sends its machined products for surface treatment. Company B's production process of flanges is presented in Figure 20.

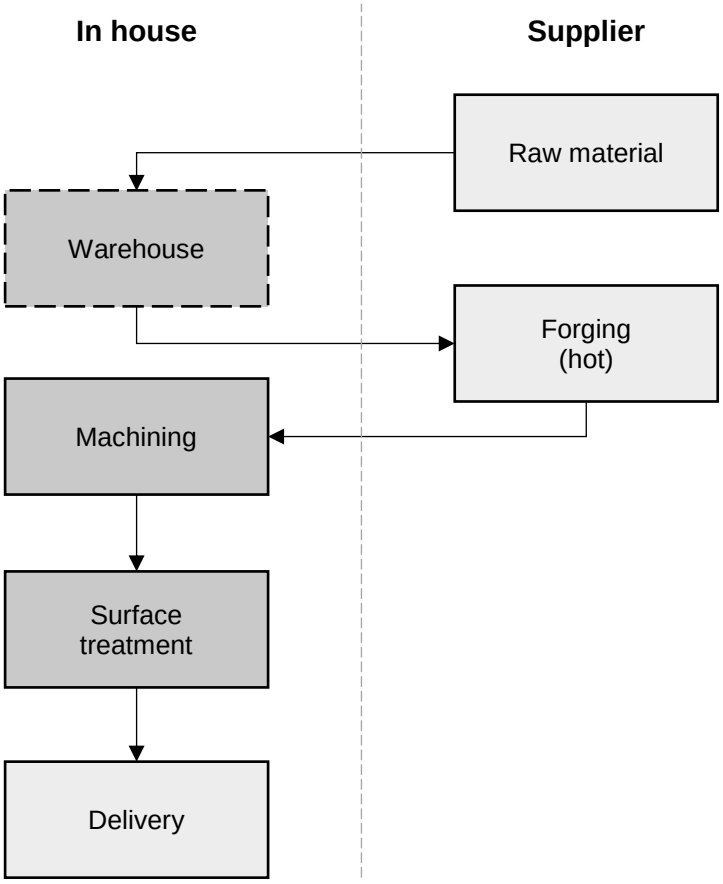

Figure 20. Production process, Company B

7.2.4 Raw material and forgings

Based on unclear material certificates the raw material for Company B's forgings comes from the same steel mill as for the other suppliers. The company did not disclose which forging company they used. Company B

currently uses Q345B steel grade for all of their products. However, the company has informed that with a big enough yearly volume they can consider changing the material to Q345D -20 steel required to manufacture type approved GS flanges.

7.2.5 Manufacturing

Company B's machining workshop is efficient and optimized to produce flanges and insert cones. The workshop is clean and organized with lots of machining capacity. For flange and insert cone production Company B's uses multi-step machining process but with very efficient change times. There are also specially built machines for different machining stages. Company B's machine operators work in two shifts operating two machines at the time. According to specialist observation "they have really thought about how to make their set up efficient".

7.2.6 Quality control

Company B has two separate quality inspection rooms in their workshop. One is used for machined parts and the other for final inspection of the products. Both rooms are heated with even temperature. Company B uses both imported and local measurement tools and calibration pieces. The local tools are calibrated using imported ones, and both are sent outside for calibration according to calibration schedule. Based on site visit and earlier quality experience with Company B their quality is under control. Company B has ISO9001 quality management system certificate.

7.2.7 Certifications and type approvals

Currently Company B cannot provide any mill certificates for their raw material or forgings. However, it was assumed that the steel mill that they used for their raw material has been certified due to another supplier using

the same mill with type approvals. Company B does not have any type approvals for their own products.

7.3 Company C

Company C is a manufacturing company located in Jianhu County in Jiangsu Province, China. Its main business is the production and sales of hydraulic components and deck machinery. Company C currently employs about 350 employees, and its turnover in 2015 was CNY 213 million. The summary of findings of Company C is presented as SWOT analysis in Appendix 4.

7.3.1 Company and business

Company C is a privately-owned company that was established in 2003 by the current owner Mr. Li (Lee). Mr. Lee is also the major shareholder with 70% shares of the company, together with Mr. Sun (30% ownership). Mr. Lee started the company to produce low cost and low quality flanges for local shipyards. The company has since grown to include other products for offshore industries. Mr. Lee is strongly connected in the marine and offshore industries, and the company enjoys a strong support from the local government. Company C is affiliated with Mr. Lee's other companies that for example produce mechanical equipment for oil fields. (CIB 2016c; Toxvig 2016)

Company C's main products are hydraulic pipe fittings, flanges, cylinders, valves and deck machinery such as anchors, mooring and crane equipment. Company C is both a supplier and a competitor for GS-Hydro in the marine and offshore industries in China. Company C sells its products only for domestic Chinese markets without any export activity. Its main customers are in the marine, offshore and military industries, such as TTS Marine, Jiangnan Shipyard and Yangzijiang Shipbuilding companies. Most of

Company C's selling is direct selling with 20% done by distributors. Company C has been a supplier for GS-Hydro Shanghai for almost 10 years (Toxvig 2016). (CIB 2016c)

7.3.2 Financial information

Based on local credit investigation report from 2015, Company C's operating capital is moderate, its operating income grows steadily and its overall profitability is good. With a turnover of CNY 213 million the company made CNY 36,3 million profit before tax with a high gross margin of 27,17 %. Company C's EBIT in 2015 was CNY 36.2 million and EBIT margin 16.98 %. Company C's liquidity in the same year was moderate with 1.52 current ratio and 1.32 quick ratio. Company's debt-to-equity ratio was also moderate 0.66. (CIB 2016c)

7.3.3 Production process

Company C purchases its raw material for flange production from a local steel mill usually as steel bars and stocks it in its warehouse. It uses its own hot forging machinery to produce forgings which it machines in its workshop. The finished products are sent to surface treatment to an outside supplier. Company C's production process of flanges is presented in Figure 21.

7.3.4 Raw material and forgings

The raw material for Company C's forgings comes from the same steel mill as for the other suppliers. Company C uses many different steel grades including Q345D -20, which can be used to manufacture type approved GS flanges. Forging of the raw material is done at Company C's own workshop. Company C has material tracing and identification processes implemented in their production.

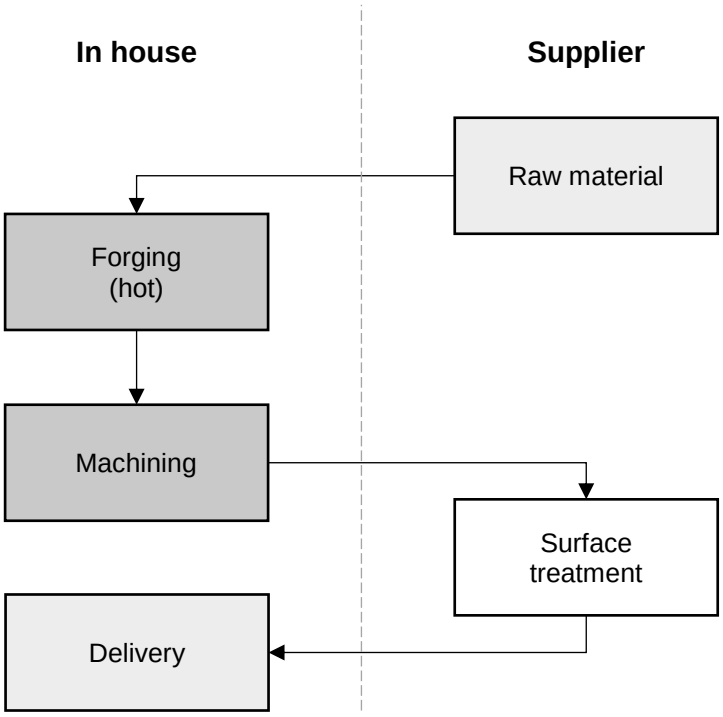

Figure 21. Production process, Company C

7.3.5 Manufacturing

Company C's machining workshop's machine base for small parts is old. The workers use only one machine to machine the parts and there is no automation or feeding machines. In contrast, Company C's new workshop in different location has very modern and expensive machinery. Company C's flanges and internal parts are machined from both sides in a multi-step process which makes it time consuming and costly.

7.3.6 Quality control

Company C's machining hall has a separate quality inspection room/space, where workers inspect the first pieces of machining batch. Random checks are also done during the production depending on the order size. Some measurement devices are in the production hall and are kept in a separate room. GS-Hydro has negative quality experience with Company C, and the

overall quality control insufficient. Company C has Chinese CCS quality management system certificate.

7.3.7 Certifications and type approvals

Company C has several type approvals for their products including pipe couplings, hydraulic cylinders, actuators, fittings and flanges. Company C also has in-house forging process approvals from ABS, DNV, KR and GL. As Company C has type approvals for their products, it is likely that the steel mill that they use for raw material also has mill certificates from some classification society. This is the same steel mill that the other suppliers use.

7.4 Company D

Company D is a manufacturing company located in Funing Development Area in Jiangsu Province, China. Its main business is the production and sale of hydraulic products, and it currently employs about 200 employees. Its turnover in 2015 was CNY 31 million (CIB 2016d). Company C did not provide adequate information for detailed SWOT analysis.

7.4.1 Company and business

Company D is a privately-owned company that was registered in 2006. However, its predecessor was already founded in 2004. Company D’s only shareholders are the company’s current Executive Director Mr. Wang (Siru) (53%) and Ms. Wu (47%). The General Manager of the company is Mr. Wang (Yajun). According to a report, Wang Siru seldom participates in the management of the company, and Ms. Wu is mainly in charge of the administration and finance. The person in charge of the daily operations is Mr. Wang Yajun. (CIB 2016d)

Company D's main products are hydraulic clamps, but it has also started to manufacture high pressure hydraulic flanges because of better profits. Company D is both a supplier and a competitor for GS-Hydro in China. Company D sells its products mainly to domestic markets with only 10% of its sales exported. Its main customers are offshore industry and shipyards, most notably Jiangsu Dongfang Shipbuilding, Shanxi Natural Gas, China National Offshore Oil Corporation and Zhejiang Ouhua Shipbuilding. Company D has a history with GS-Hydro for almost 10 years (Toxvig 2016). (CIB 2016d)

7.4.2 Financial information

Based on local credit investigation report from 2015, Company D's operating capital is abundant, its cash flow indicator is normal and its overall profitability is average. With a turnover of CNY 31.2 million the company made CNY 426,000 profit before tax with a gross margin of 19.19 %. Company D's EBIT in 2015 was CNY 295,000 and EBIT margin 0.95 %. Company D's liquidity in the same year was moderate with 1.55 current ratio and 1.08 quick ratio. Company's debt-to-equity ratio was also moderate 0.53. However, based on earlier experience on the company there is a substantial off-the-book risk (Toxvig 2016). (CIB 2016c)

7.4.3 Production process

Company D purchases its raw material for flange production from a local steel mill. It has its own forging machinery in-house, and is the only supplier who uses cold forging process. The forgings are machined in Company D's own workshop and the finished products are sent to surface treatment to an outside supplier. For Company D, only an overview of their production process is reviewed due to insufficient information from the supplier. This process is presented in Figure 22.

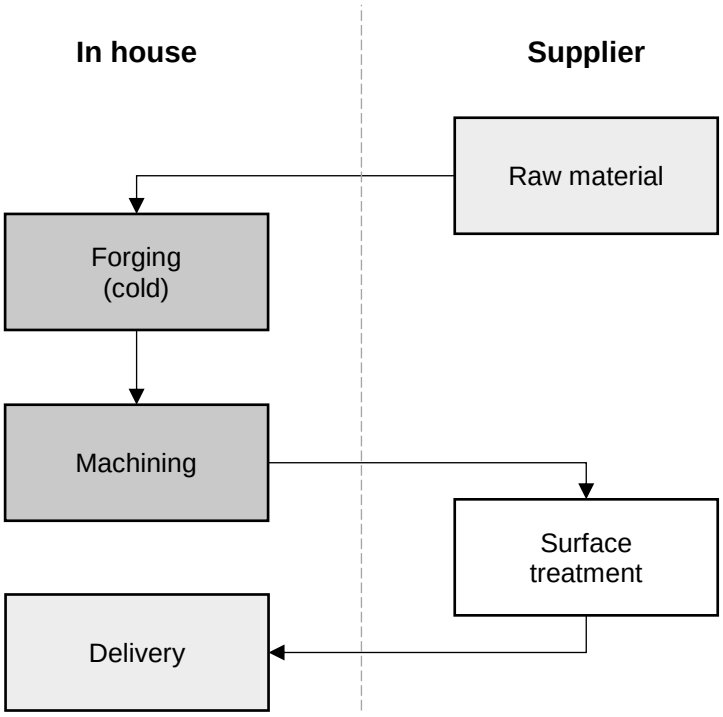

Figure 22. Production process, Company D

8 SUPPLIER COST COMPARISON

In order to get detailed cost data of selected items from the Chinese suppliers, a quotation process approach was designed. This chapter presents the process and the results from the quotations. The results are summarized and compared to Finnish and global benchmarks to confirm their validity, and to establish a benchmark for production costs in China. Based on the results a detailed analysis of landed cost in Europe is made and compared against the set target. Finally, a cost sensitivity analysis is made for currency and freight rates to estimate potential risks.

8.1 Quotation process

The quotation process was designed to be multi-staged. Before the first round it was not sure how much cost information the suppliers were willing to share, or whether they were interested in entering more detailed negotiations. After each round of quotations suppliers were assessed for their cooperation potential and cost levels. Based on this information it was decided whether the supplier would progress to the next round. Because of the sensitive nature of the information, each supplier was asked to sign a non-disclosure agreement with GS-Hydro before entering the negotiations. The pricing negotiations were performed simultaneously with supplier visits.

8.1.1 Costing elements

Each participating supplier was asked to provide a detailed costing for five predetermined items together with a pricing for about 100 other GS components that are only referenced in this study. The target of the detailed costing was to get a better understanding of the price levels of the suppliers as well as their cost structures. This also made it possible to benchmark the suppliers against each other and the cost levels in Finland. The prices were

quoted as Chinese renminbi, and Finnish prices were converted to local currency using a set exchange rate.

The quoted costing elements corresponded for the most part with the cost information from Finland. Suppliers were asked to provide their product unit prices separated into five elements: raw material, forging, machining, surface treatment and profit margin. These cost elements also corresponded with the suppliers' production processes that were reviewed during the site visits. Because of confidentiality, the actual costs are not displayed in this paper, only the percentages.

8.1.2 Technical requirements

Together with the request of detailed costing information, suppliers were given technical requirements that their products and manufacturing had to fulfill. These requirements were related to the used raw material, processes and certifications. Because the target was to find vendors who could manufacture products to global markets, their technical properties had to be in unison with the products manufactured in Finland. Another factor was the possibility to use same type approvals for the products as for those manufactured in Finland.

It was decided before and during the evaluation process that the raw material for flanges should be structural steel Q345D impact tested in -20 degrees Celsius. With this raw material, it was possible to fulfill the requirements for GS flange type approvals, given that both the steel mill and manufacturer were eligible or already had mill certifications from at least one approved classification society. This eligibility for mill certifications was the second requirement. The final discussed requirement was the type of forging process, which could be either hot forging or cold forging. It was decided that the process itself was not decisive, but the properties of the forgings which could be tested later.

8.2 First round quotations

The target of the first round of quotations was to get the latest cost information from the suppliers, which was to be used as a starting point for further negotiations. Another target was to assess the suppliers' willingness to do business with GS-Hydro and possible ground for cooperation. There were no target prices set for the customers for the first round, nor were the cost levels from Finland revealed to them. Internally suppliers' prices were compared against other suppliers, internal costs and a global benchmark. The results from the first round of quotations is presented in Figure 23.

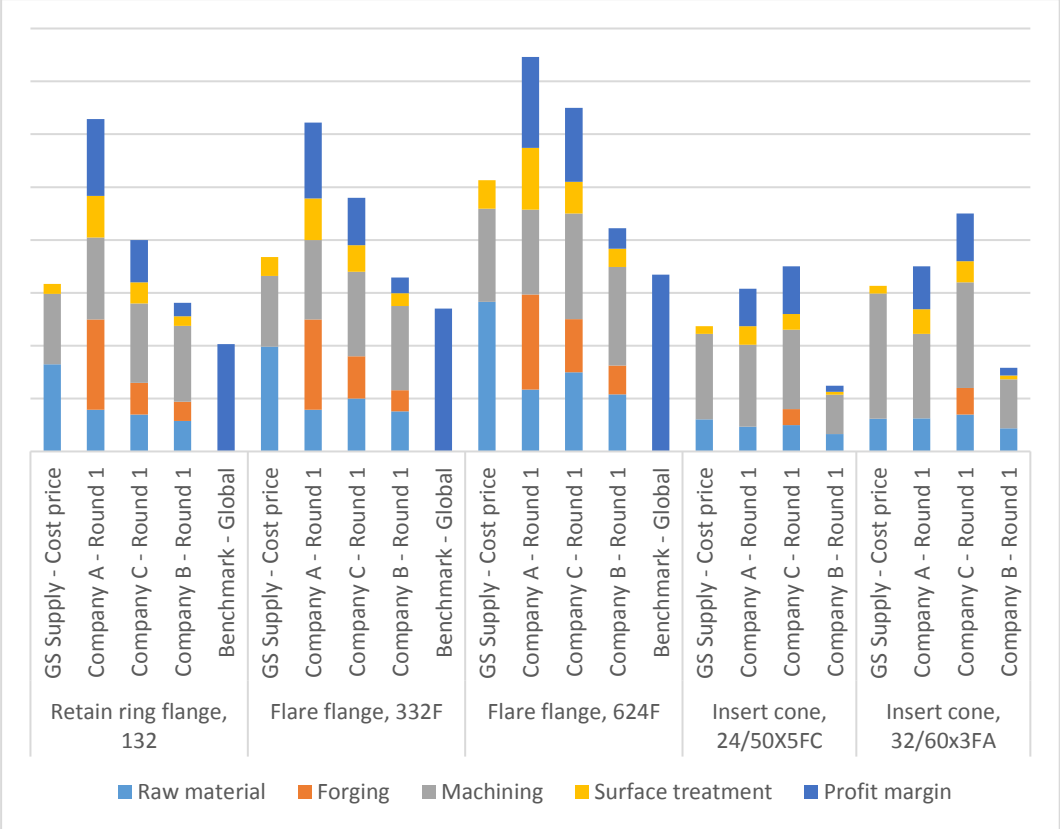

Figure 23. First round quotations

8.2.1 Company A

Overall, Company A was the most expensive supplier in the first round. Their raw material and forging prices were not competitive against the other

suppliers' prices or prices in Finland. Company A's machining costs were on about the same level as in Europe, and their surface treatment costs were high compared to other local suppliers. In addition, Company A's informed profit margin 30% was the highest of the suppliers. Compared to the global benchmark, Company A was almost three times more expensive. All the prices were quoted with the correct raw material.

8.2.2 Company B

Compared against other suppliers, Company B's prices were the most competitive on the first round. They were also the only supplier whose prices consistently lower than the cost prices in Finland. On insert cones their pricing was by far the lowest of the suppliers, and about 50 % cheaper than in Finland. For flange manufacturing, Company B's raw material and forging prices were on a good level, however they were not able to provide the required raw material. Company B's machining costs of flanges was on the same level as in Europe, but on a much lower level on insert cones. Also, their surface treatment cost was lowest of the suppliers. Company B's profit margin 10% was acceptable.

8.2.3 Company C

Compared against the cheapest local supplier, Company C's prices in the first round were about 20-30% higher, and significantly higher than the global benchmark. Their raw material and forging costs were about 30% higher than the cheapest local supplier, and machining cost for flanges higher than in Europe. Also, Company C's surface treatment costs were higher than the local benchmark. On insert cones Company C was the most expensive supplier. Company C had informed their profit margin to be 10%, but in their calculations, they had added about 20 % to their cost prices. All the prices were quoted with the correct raw material.

8.2.4 Company D

During the first-round visit to Company D, the owner informed that he was not interested in participating the quotation process without a promise of a substantial order from them. The reason he gave was that he had grew tired of inquiries from GS-Hydro without any concrete results. It was decided that Company D was to be approached again only with a component list with clearly defined target prices, if all. Company D is not evaluated further in this study.

8.3 Second round quotations

After the first round of quotations, all the suppliers' prices were analyzed and compered against each other and benchmarks. Based on the first round of quotations it was evident that especially the suppliers' machining costs could be lowered as they were on the same level as in Finland. During a visit from a technical expert from Finland participated it was also noted that suppliers' machining processes itself could be improved. This information together with a comparison against local and global benchmarks was presented to each supplier in a face to face meeting, which was expected to show in their second quotations. There were no target prices set for the second round, as it was feared that it would direct the pricing process too much at the current stage. The results from second round are presented in Figure 24.

8.3.1 Company A

Company A lowered their prices significantly for the second round. However, the changes were very inconsistent. On some items, Company A lowered their raw material and forging cost for almost 50%, while on other items the drop was incremental, or the price was even higher than on the first round. On machining, Company A came down on average about 20%

from its first-round pricing, while their surface treatment cost remained relatively unchanged. The biggest drop came from profit margin, which was lowered to acceptable 10% on all items. The second round put Company A's flange prices on same level with cost prices in Finland, but on insert cones they were the most expensive supplier.

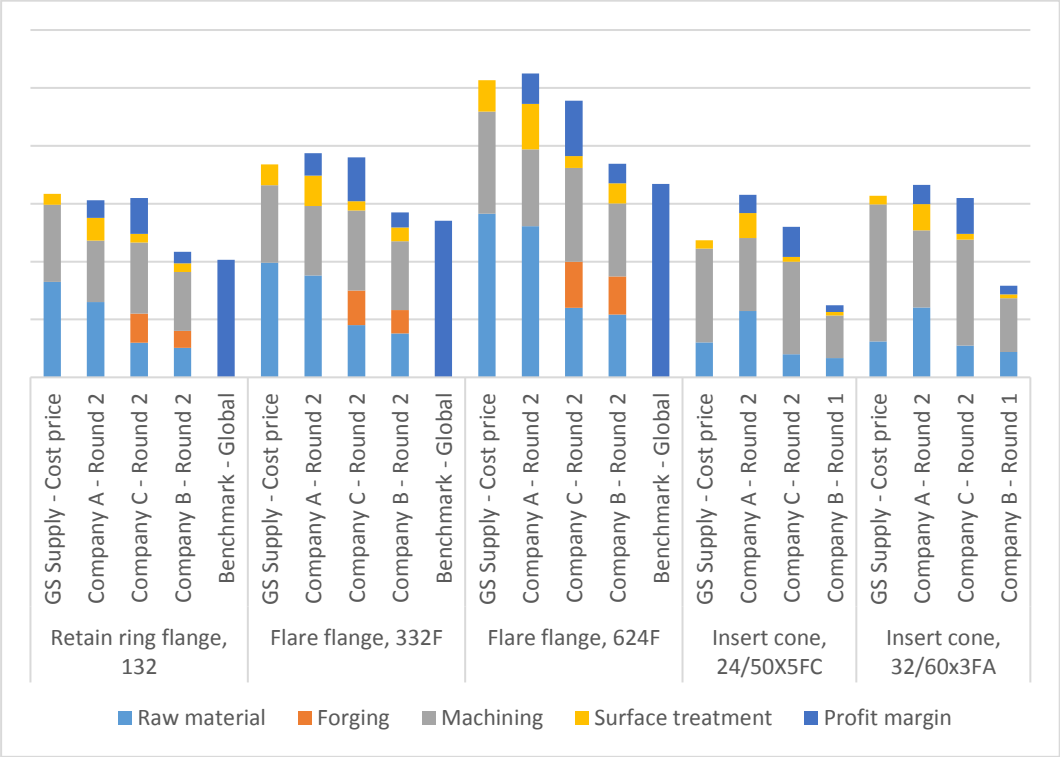

Figure 24. Second round quotations

8.3.2 Company B

Company B also lowered their prices for the second round. However, it was agreed that because of their pricing on insert cones was so strong on the first round, they would only revise their flange pricing. Company B lowered their flange pricing on average 33%, the biggest drop coming from machining costs. There were also some marginal changes in raw material and forging costs. On second round Company B was able to come very close down to the global benchmark prices on selected flanges, and widen the gap to cost prices in Finland.

8.3.3 Company C

Company C also revised their pricing for the second round, but more marginally than the other two companies. They had corrected their profit margin error and lowered their prices on average 20% from all cost categories. In their second round pricing Company C came down to the cost price level of Finland on selected flanges, but was still significantly higher than the global benchmark. On insert cones the forging cost were removed from the total cost as unnecessary production phase, and together with other cost reduction flange prices with margins corresponded with cost prices in Finland.

8.4 Summary of quotations

Based on the second round of quotations, Company B had the lowest prices for both flanges and insert cones. They had the lowest cost for all the five costing elements, the pricing on flanges being about 30% lower and insert cones being 50% lower than the internal cost. Including all the quoted items, their pricing on flanges was on average about 35% lower than cost prices in Finland, and on insert cones about 65% lower.

Company A had on average the second lowest prices, but their pricing was very inconsistent. On three selected flanges, they were on the same level with GS-Hydro’s internal cost prices, but on a larger sample their flange prices were on average 20% lower. Their insert cone pricing for the two selected items were the most expensive, but on average they were about 12% cheaper than GS-Hydro’s internal cost.

After the second round of quotations, Company C ended up being the most expensive supplier. Their pricing on the detailed five items was on the same level with GS-Hydro’s internal cost both in flanges and insert cones. Including all the quoted items, Company C’s prices for flanges were on

average 7% lower than GS-Hydro's internal cost, and on insert cones 25% lower.

8.4.1 Cost price percentages

It was decided that the target price for suppliers was -40% of the internal cost of GS-Hydro. This was relatively close to the global benchmark prices, which was considered to be an appropriate target for Chinese suppliers. When comparing the detailed costs, Company B is closest to this target on flanges and even lower on insert cones. On flanges the difference is on average 7% higher, and on insert cones 42% cheaper. For Company A the difference for flanges is 30% and, for insert cones 47%. For Company C the difference on flanges is 55% higher and on insert cones 24% higher. The comparison of detailed cost to this target is presented in Figure 25.

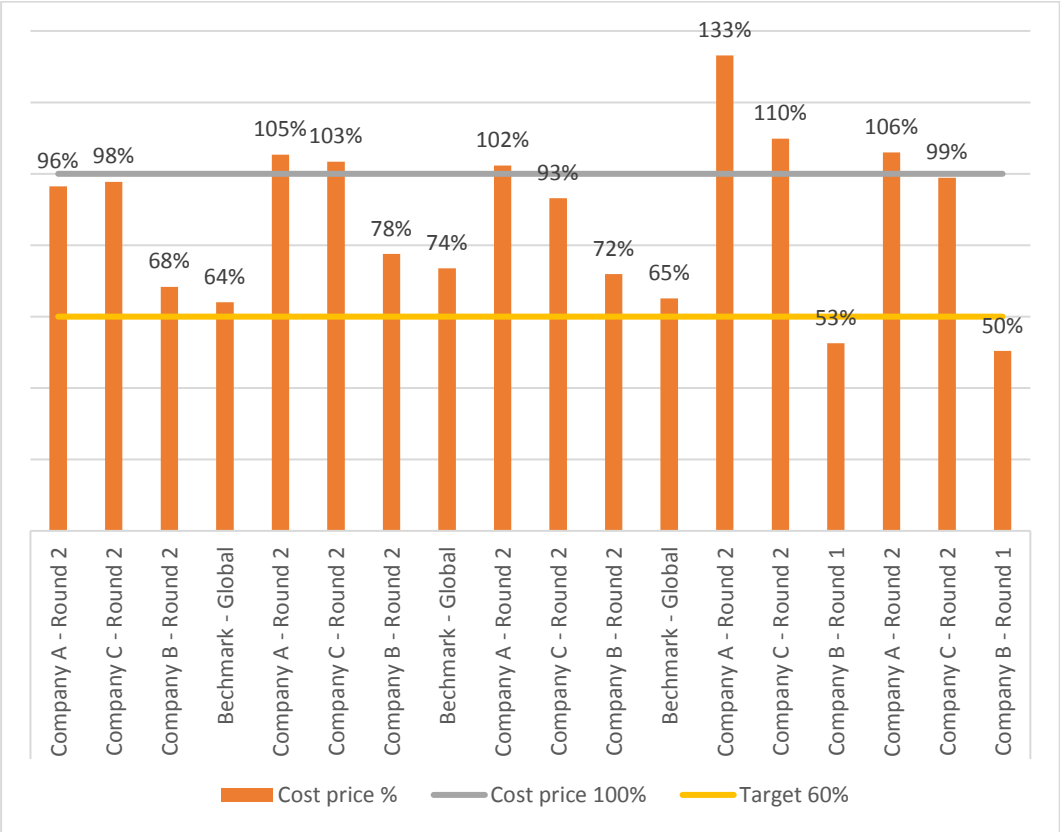

Figure 25. Cost price percentages

8.4.2 Landed cost percentages in China

Because the suppliers' manufacturing is located in China, it was decided to compare their prices to the landed cost of GS-Supply components sent from Finland. To this calculation internal group profit, air freight, duty and custom clearance fees were added to internal cost price of the components. The result was that the landed cost in China including the internal profit margin is 74% higher than the cost price in Finland. The comparison presented in Figure 26 shows the potential savings from Chinese market perspective between different suppliers. The biggest savings could be achieved in Chinese market with Company B's prices, on average 63% on flanges and 80% on insert cones, without including VAT.

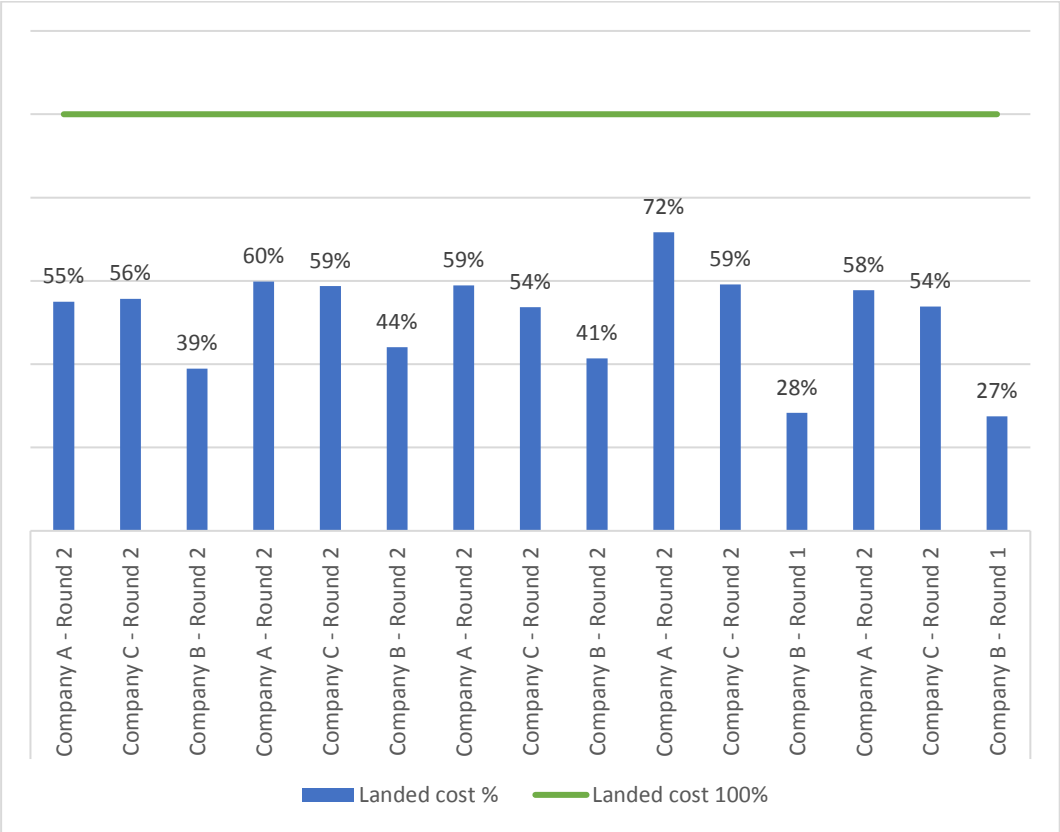

Figure 26. Landed cost percentages

8.4.3 Cost summary table

Table 6 presents the summarized findings from the cost comparison between suppliers. The colors indicate in which categories the company has the lowest prices (green), and in which the most expensive (red).

Table 6. Cost summary table

	Company A	**Company B**	**Company C**
Detailed costing	On average the second lowest prices, but very inconsistent Flanges on the same level with internal cost prices, but most expensive insert cone pricing	Lowest cost in all the five costing elements Flanges about 30% lower and insert cones about 50% lower than internal cost price	Most expensive supplier Same level with internal cost both in flanges and insert cones
All items	Flange prices on average 20% lower and insert cones on average 12% lower than internal cost	Flanges on average 35% lower and insert cones on average 65% lower than internal cost	Flanges on average 7% lower and insert cones on average 25% lower than internal cost
Target -40% cost price	Flange prices on average 30% higher and insert cones 47% higher than target	Flange prices on average 7% higher and insert cones 42% lower than target	Flange prices on average 55% higher and insert cones prices 24% higher than target
Summary	The biggest savings could be achieved in Chinese market with Company B's prices, on average 63% on flanges and 80% on insert cones compared to landed cost.		

8.5 Landed cost in Europe

It was decided early on in the study by the issuing company that strong emphasis for the final decision on suppliers would be based on total cost savings in Europe. This exercise was done after the second round of quotations, and only Company B's pricing data was selected because of their highest potential savings. The calculations take into consideration the price of flanges in China, VAT loss required to export the flanges from China to Europe (9%), export fees (1%) and freight percentages for different freight alternatives.

Three types of freight were selected for calculations: Full container load by sea (FCL, 1,5%), less than container load by sea (LCL sea, 4,5%) and less than container load by air (LCL air, 11%). The different percentages of transportation costs were based on company's experience on exporting products from China to Europe in the past. These three alternatives were compared against the cost prices in Finland, target being 20% lower than the cost prices in Finland. The results are presented in Figure 27.

The first analysis is made for selected flanges and insert cones on individual component level. Regardless of the shipment type, all of the insert cones prices are above the target price. For flanges, all of the LCL air shipment prices and two out of three LCL sea shipment prices are above the target price. For FCL shipment, one flange price is below the target price (132), one is on the target level (624F) and one above it (332F).

It was noted that at this level of analysis three flanges were not sufficient representation of the full list of quoted components. When all the quoted flanges were analyzed, most of the FCL prices (85%) and more than half of the LCL prices (70%) were below the target prices. Only about half of LCL air shipment prices were above the targeted prices.

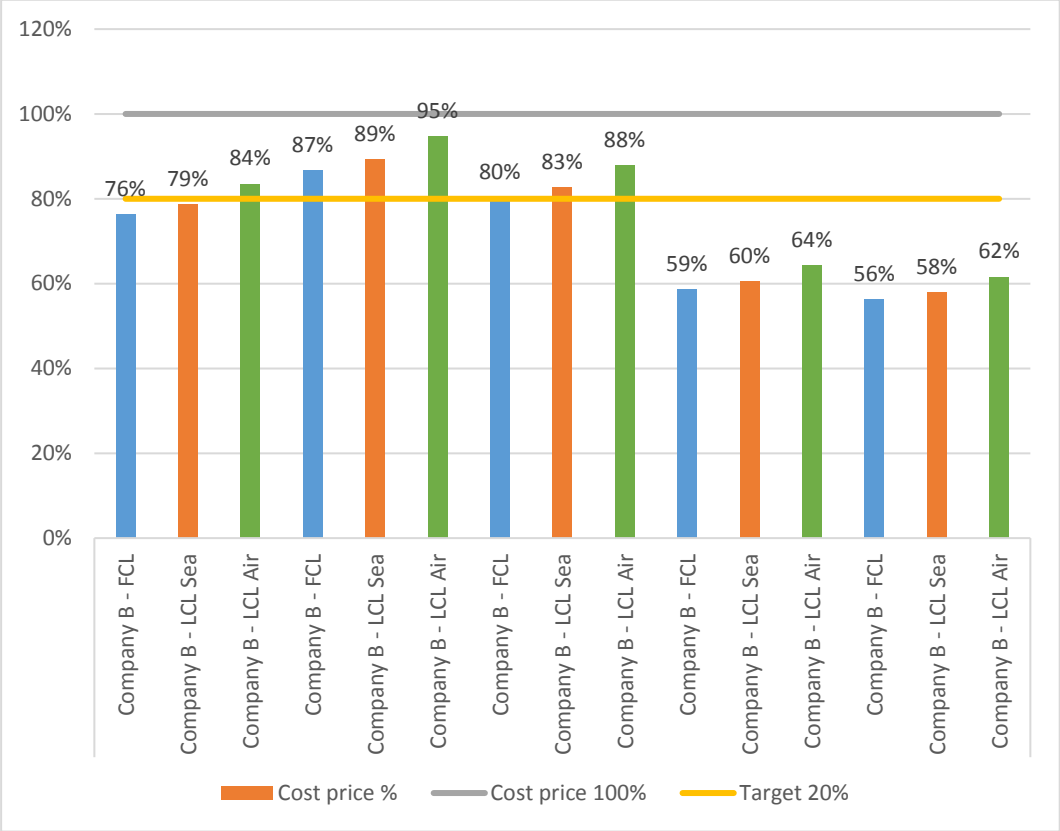

Figure 27. Landed cost in Europe, Company B

Second analysis was made on a component group level. In this analysis the total volume of the quoted items were multiplied by the total price shipped to Europe for different shipment types. This figure was then compared to similar calculation made with cost prices in Finland. The total amount consisted of 101 different items with total amount of over 70 000 components which were considered a good representation of yearly volume of items that could be shipped from China. The results are presented in Figure 28.

If all the quoted components and their estimated yearly volumes are taken into consideration, the total cost is below target 20% with all the shipment types. This is mainly due to the significantly lower cost of internal parts. If only flanges are taken into consideration, both FCL and LCL sea freights are below the target. The combined total cost for LCL air freight for flanges is almost at the target level.

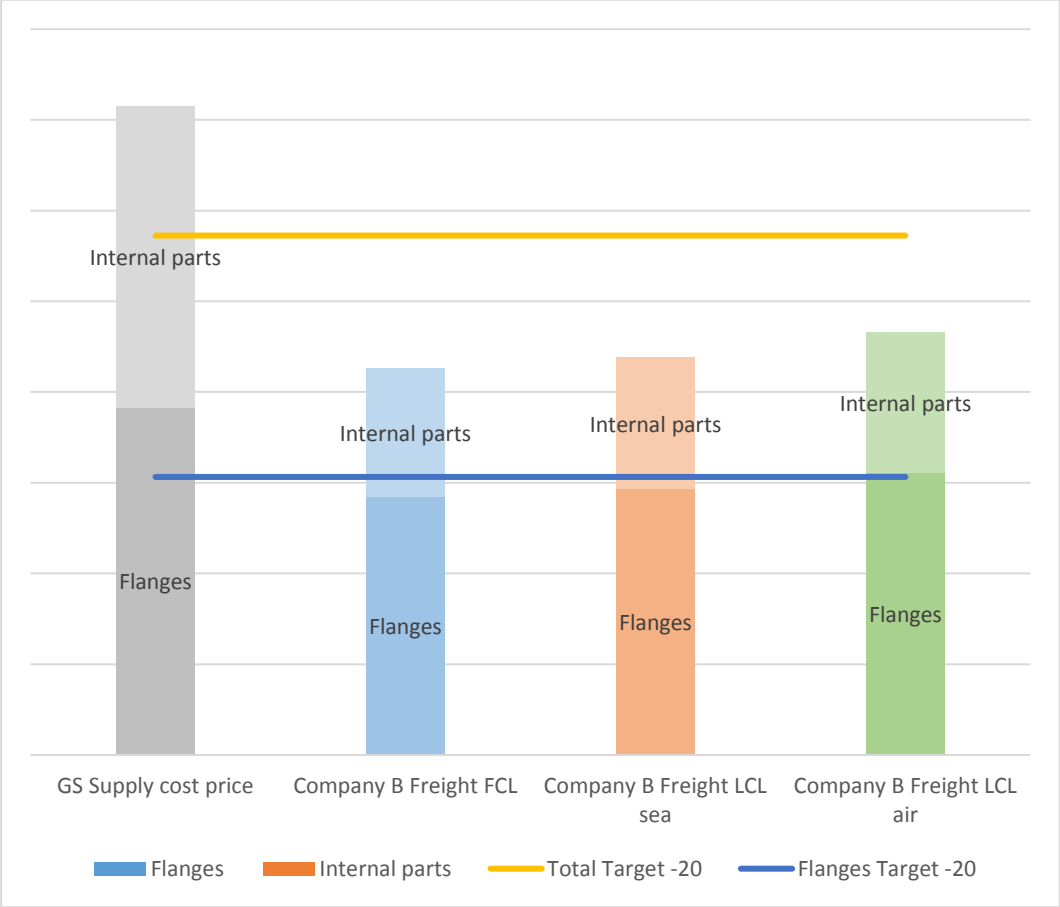

Figure 28. Landed total cost in Europe, Company B

8.5.1 Currency sensitivity analysis

As a part of the study it was also investigated how currency fluctuations would affect the potential cost savings. Flare flange 624F was selected as the target for analysis because of its yearly volumes and significance to the total cost savings. In this exercise it was assumed that the goods are sold by the vendor from China with USD prices. It should be pointed out that these calculations are based on exchange rates that are only valid at the time of the writing. The result of the sensitivity analysis is presented in Figure 29.

From the sensitivity analysis it can be seen that approximately 15% change between EUR and USD would result in 10% change in cost savings. If USD strengthens compared to EUR (or EUR loses value compared to USD) the

cost savings will come down, and vice versa. For FCL shipment 15% increase in USD value compared to EUR would bring down the cost savings to 10%. On the other hand, 15% decrease in USD compared to EUR would result in 20% savings in LCL air shipment.

Figure 29. Currency sensitivity analysis

8.5.2 Freight rate sensitivity analysis

Similar sensitivity analysis was also made for freight rates. This sensitivity analysis looks at freight cost percentage, and how a change (for example due to oil price increase) would affect the potential cost savings. Flare flange 624F was also selected as the target for analysis for this exercise. The result of the freight sensitivity analysis is presented in Figure 30.

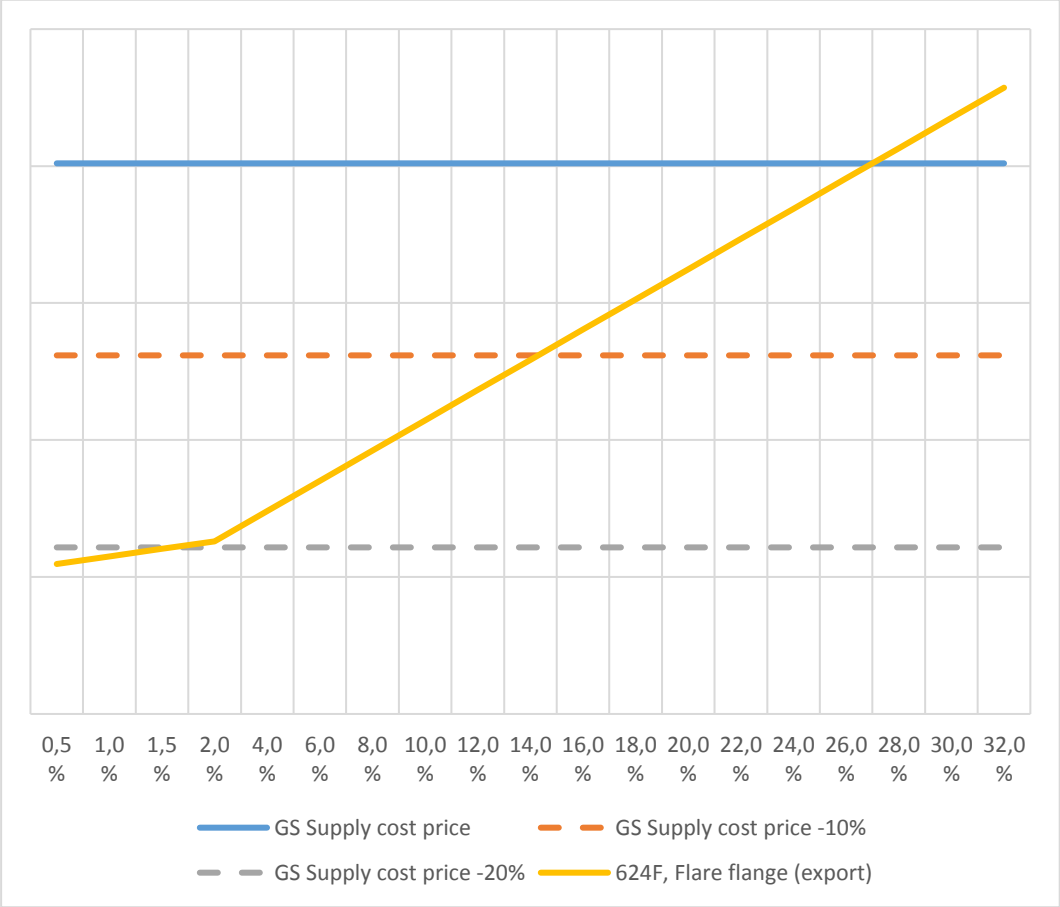

Figure 30. Freight rate sensitivity analysis

From the analysis it can be seen that 10% change in cost savings would require approximately 10% change in overall freight cost. This compared to freight costs used in earlier calculations would mean that FCL sea freight cost per unit would have to increase about 450%, LCL sea freight about 150% and LCL air freight about 100% to have a 5% negative impact on cost savings.

9 DISCUSSION AND CONCLUSION

The final chapter of the report accomplishes the study objective by answering the three research questions. The questions are answered by comparing the empirical findings to the theory, and discussing the implications of these findings. After the discussion, a conclusion and recommendations are given for the issuing company.

9.1 Research questions

What are the key strategic motives to locate component manufacturing in China?

The industry in which GS-Hydro operates is global with customers all around the world. The big customers operate in multiple markets, where the components that GS-Hydro supplies are regulated by international standards. These components are universally available, and the production is not exclusive to any geographical location. They are also easily transportable, so there are no limitations where the manufacturing should take place. These are also the factors that enabled GS-Hydro to establish a strong global presence with a single manufacturing location.

In the past, GS-Hydro has enjoyed very good market position in marine and offshore markets. Its competitive advantage has roots in innovative and high-quality flange systems, for which its customers have been willing to pay a premium price. Although the design patents have already expired, GS-Hydro is still recognized as the original manufacturer who can provide quality and service for demanding applications. This position has in the past enabled GS-Hydro to support its current supply chain, where flanges are manufactured solely in Finland and shipped around the world, although previously predominantly to Europe.

The long-term developments in the marine and offshore market, however, have driven GS-Hydro's major customers to become more cost-conscious in Europe. Simultaneously the demand for GS-Hydro's major customers' systems has shifted more towards China and Asia, where subsequently the conditions are more favorable for low-cost manufacturing. This development has already driven many of GS-Hydro's global competitors to manufacture or source their components from a low-cost country, which can give them cost advantage when operating in global markets. To answer this challenge, GS-Hydro also needs to get an access to low-cost manufacturing.

From the Chinese market perspective importing parts from Europe to China with current set-up of is no longer a sustainable business model. Although some of the customers in China are still willing to pay for the transportation and duties of goods in product pricing, increasingly many are not. At the same time many local competitors are entering the market with low-cost products and increasing quality. Many of them can already produce flanges with quality that matches that from Finland with similar type approvals, but with significantly lower cost. This development requires that either the landed cost of components from Europe can be reduced significantly, or that the production takes place inside China.

There are several strategic factors besides costs advantages that promote either locating manufacturing in China, or sourcing GS components from there. The first type of advantages come from having another source of supply, which is located in another currency area. Having an alternative source of supply can minimize the risk of production halt, and locating it in another currency area mitigates risk of financial fluctuations. The second type of advantages are location-specific. Having a supply close to customers minimizes supply chain costs, and can serve other units in the area. There is also an existing business unit in China, which can mitigate many risks associated with foreign direct investment and outsourcing.

How does the cost of components manufactured in China compare to Finland?

In original research plan the manufacturing costs of Chinese suppliers were planned to be calculated with machine hour rates similarly with Finland. However, the approach would have required a very in-depth understanding of the supplier's business processes. Because that information was unobtainable, the final evaluations were based on supplier provided cost data. This information was backed up with site visits, interviews and credit reports as well as cross-checking with other supplier's cost data and historical data from GS-Hydro. Based on this information it was possible to accurately evaluate the cost data validity and correctness.

On the first level of analysis the manufacturing cost were compared directly with manufacturing costs in Finland. The difference with the manufacturer with lowest cost on a product level was significant. On a general level of comparison, the manufacturing of GS components including raw material, forging, machining and surface treatment was found to be 40% cheaper in China than in Finland. On some product categories the difference was even greater. The greatest savings were due to lower raw material and forging cost. It can be speculated that the actual costs are even lower, because the numbers were based on quotation information from a supplier.

The biggest cost savings with Chinese manufacturing could be achieved in the Chinese market. When comparing the landed cost of GS components manufactured in Finland to those manufactured in China by the supplier with the lowest cost, there was found to be a potential for 63% savings on flanges and 80% savings on insert cones. By purchasing directly from a Chinese supplier, the biggest savings would come from the lack of internal profit, air freight and duty. However, if these components were to be shipped out from China to other locations, exporting and shipping would incur extra costs.

The second level of analysis compared the landed cost of components sent from China to Europe to those manufactured in Finland. Here the target was to achieve 20% cost savings. On a product level this could be achieved with all shipment types on insert cones, and on flanges with full container load sea freight. When examining the estimated yearly volumes of all component types, the target level could be reached with all freight types. However, this situation could be only achieved due to very low cost of insert cones and other internal parts.

The previous results have not taken quality costs into consideration. Based on the theoretical review, the quality costs can add up to anywhere between 5-25 percent of sales. It is clear that if realized, they would have a significant impact on the viability of the results. There has not been a study made on quality costs on examined GS components, but according to a product expert once the supplier quality has been lifted to desired level the quality issues have reduced significantly. This observation together with planned initial investments on quality inspection set-up can predict the quality costs being higher in the beginning of the cooperation, and reclining after a learning period.

What is the most suitable mode for component manufacturing in China?

The third research objective was to compare three modes of component manufacturing in China with four preselected suppliers. Of these modes company acquisition and joint venture are equity modes, and sourcing a non-equity mode. Based on the theory and literature, the most risky mode was found to be a joint venture with a Chinese partner. Also acquisition of an existing Chinese company is considered risky due to existing company culture. For a pure manufacturing need, sourcing was seen as the best alternative if quality and delivery times can be controlled.

The original research plan was to compare all the component manufacturing modes equally. However, during the research it became apparent that the equity modes were not going to be feasible at least in the beginning of the component acquisition process. This meant that no matter which company was to be selected as the best candidate, the cooperation would start as the sourcing alternative. This decision was a combined result of findings, resources and the schedule of the acquisition process. These reasons together with a heavy emphasis on purchase prices directed the study towards the sourcing alternative.

Company A showed the most promise for very close cooperation. There is an existing history with the company key employees, which would mitigate the risks in cooperation. However, their manufacturing capabilities were very limited, and the current costs high. The actual costs were speculated to be even higher in the beginning of the cooperation, and a lot of support would have to be given at the early stages. Due to high debts and poor liquidity GS-Hydro might end up having to bail the company out in the future, which could mean an acquisition at some point.

Company B had the lowest cost of components. Their production setup was the most efficient, and they had the best quality control. Company B is solely a manufacturing company specialized in flanges and internal parts, and they have extensive experience with working with foreign companies and exporting their products. They would be easiest to start manufacturing cooperation with without any initial support. Their competitor ownership raises a small concern, but the risk could be mitigated by partial ownership later. Company B could not provide the required material for type approved parts, but this issue could be also discussed according to their owner if the volumes were high enough.

Company C was the most interesting considering their overall business scope. Most of their sales come from outside small part manufacturing, and

they have a big capacity and market potential in the industry. Company C's owner has very good relationship with local government, shipyards and classification agencies. The preferred operation mode with Company C would be a joint venture. However the company would require a lot of support in the beginning in order to ramp up their manufacturing to required quality level. Company C would also be the most risky alternative due to existing company culture and strong ownership.

9.2 Conclusion

The study objective was to find out if the acquiring of GS components from is China feasible for GS-Hydro. Based on the theoretical review and results of the study, acquiring components from China is not only feasible, but advisable. The total cost reduction target set for selected components delivered to Europe can be achieved with a low-cost supplier with the examined volumes, given that the quality costs can be kept to a minimum. The preferred way to transportation would by full container load sea freight. The cost savings in China would be even more significant, and would help GS-Hydro's competitive position in the market.

Based on the results the most cost-effective and risk-free alternative would be to source high-volume components from Company B. The cooperation should start with long-term binding agreements, and could be solidified with a minority ownership later to mitigate ownership risks. Sourcing would have to be started with non-type approved components, while assisting the supplier to get necessary certifications for type approved parts. GS-Hydro should ensure sufficient purchasing volumes for most benefit for both parties. Standard lead times should be negotiated with the vendor, and a buffer stock arranged. A quality control plan should be implemented immediately to minimize quality costs from the beginning of the cooperation.

During the finalization stages of this study the first steps towards cooperation with Company B have already been taken.

REFERENCES

Ahoniemi, L 2010, Kiina liiketoimintaympäristönä – Haastattelututkimus suomalaisjohtajien kokemuksista Kiinassa, Tampereen yliopisto, Tietojenkäsittelytieteiden laitos, D-2010-20, Published online.

Anttila, J & Jussila, K 2016, Mitä laatu on?, Suomen Standardisoimisliitto SFS ry, viewed 26 December 2016, http://www.sfs.fi/ajankohtaista/uutiskirjeet/uutiskirjeet_2016/mita_laatu_on_artikkeli.

Bank of Finland 2017, 'Palkkojen nousu hidastui Kiinassa, palkkataso on jo suhteellisen korkea', BOFIT Weekly 2017/09, viewed 10.11.2017, https://www.bofit.fi/fi/seuranta/viikkokatsaus/2017/vw201709_4/.

Burton, TT 2013, The 10 hidden costs of outsourcing, CSCMP's Supply Chain Quarterly, viewed 5 January 2017, http://www.supplychainquarterly.com/topics/Procurement/20130621-the-10-hidden-costs-of-outsourcing/.

Cavusgil, ST, Knight, G & Riesenberger, JR 2014, International Business: The New Realities, 3rd Edition, Pearson Education, Upper Saddle River, New Jersey.

Chopra, S & Meindl, P 2013, Supply Chain Management: Strategy, Planning and Operation, 5th Edition, Pearson Education, Upper Saddle River, New Jersey.

CIB 2016a, Credit report Company A, China International Business Investigation.

CIB 2016b, Credit report Company B, China International Business Investigation.

CIB 2016c, Credit report Company C, China International Business Investigation.

CIB 2016d, Credit report Company D, China International Business Investigation.

Dabhilkar, M 2011, ‘Trade-offs in make-buy decisions’, Journal of Purchasing & Supply Management, Vo. 17 (2011), pp. 158-166.

Dunning, JH 1988, ‘The Electric Paradigm Of International Production: A Restatement and Some Possible Extensions’, Journal of International Business Studies, Vol. 19, no. 1, pp. 1-31.

Elinkeinoelämän keskusliitto 2015, 'Kiinan talouskasvu hiipuu', Elinkeinoelämän keskusliitto, published 24.9.2015, viewed 13.11.2017, https://ek.fi/ajankohtaista/2015/09/24/kiinan-talouskasvu-hiipuu/.

Ford, D et al. 1993, ’Make-or-buy decisions and their implications’, Industrial Marketing Management, Vol. 22 (1993), pp. 207-214.

Grant, RM 2010, Contemporary Strategy Analysis, 7th Edition, John Wiley & Sons, West Sussex, United Kingdom.

GS-Hydro 2016, GS-Hydro History, GS-Hydro Group, Viewed 4 October 2016, http://www.gshydro.com/gs-hydro/gs-hydro-history.

Hellenic Shipping News 2016, 'China’s Steel Industry is Dominating the Global Market — But Will it Last?', Hellenic Shipping News, published 28.4.2016, viewed 10.11.2017,

http://www.hellenicshippingnews.com/chinas-steel-industry-is-dominating-the-global-market-but-will-it-last/.

Helsingin Sanomat 2015, 'Kiinan teollisuustuotanto sukelsi eniten 15 kuukauteen', Helsingin Sanomat, published 24.7.2015, viewed 13.11.2017, https://www.hs.fi/talous/art-2000002840455.html.

Hollensen, S 2007, Global Marketing: A Decision-Oriented Approach, 4th Edition, Pearson Education, Essex, England.

Honkala, J 2016, Group VP, Supply Chain Management, GS-Hydro Corporation, Interview 22.9.2016.

Horngren, CT, Datar, SM & Rajan, M 2012, Cost Accounting: A Managerial Emphasis, 14th Edition, Pearson Education, Upper Saddle River, New Jersey.

Hänninen K 2017, 'Venäjän näkymät synkkenevät - USA nokittaa Opecia liuskeöljyn ennätystuotannolla', Kauppalehti, published 16.8.2017, viewed 9.11.2017, https://www.kauppalehti.fi/uutiset/venajan-nakymat-synkkenevat---usa-nokittaa-opecia-liuskeoljyn-ennatystuotannolla/8DXCjDCF.

Johanson, J & Wiedersheim-Paul, F 1975, 'The internationalization of the firm: Four Swedish cases', Journal of Management Studies, Vol. 12, no. 3, pp. 203-323.

Johanson, J & Vahlne, JE 1977, 'The internationalization process of the firm: A model of knowledge development and increasing foreign market commitments', Journal of International Business Studies, Vol. 8, no. 1, pp. 23-33.

Johanson, J & Vahlne, JE 2013, 'The Uppsala model on evolution of the multinational business enterprise: From internalization to coordination of networks', International Marketing Review, Vol. 30, no. 3, pp. 189-210.

Johnson, G, Scholes & K, Whittington, R 2009, Fundamentals of Strategy, Pearson Education, Essex, England.
Joutsensaari, K 2016, Production Manager, GS-Hydro Finland, Interview 13.10.2016.

Juran, JM & Godfrey, AB 1998, Juran's Qualiy Handbook, 5th Edition, McGraw-Hill, New York

Kaislaniemi, I 2003, Suomalainen silkkitie – Suomalaisyritysten kokemuksia selviytymisestä Kiinassa, Sitra-Tekes-Finpro: Kiina-haastattelun raportti, Painorauma Oy, Rauma.

Kettunen, E, Lintunen, J, Lu, W & Kosonen, R 1998, Suomalaisyritysten strategiat Kiinan muuttuvassa toimintaympäristössä, Helsingin Kauppakorkeakoulun julkaisuja B-98, HSE-Print, Helsinki.

Klein, S, Frazier, GL & Roth, VJ 1990, 'A transaction cost analysis model of channel integration in International markets', Journal of Marketing Research, Vol. 27, no. 2, pp. 196-208.

Kogut, B 1988, ‘Joint ventures: Theoretical and empirical perspectives’, Strategic Management Journal, Vol. 9, no. 4, pp. 319-332.

Korhonen I 2015, 'Kiinan valuuttakurssien uudistuksella monta tavoitetta', Euro ja Talous blog, web log post, published 14.8.2015, viewed 9.11.2017, https://www.eurojatalous.fi/fi/blogit/2015-2/kiinan-valuuttakurssiuudistuksella-monta-tavoitetta/.

Korhonen I 2016, 'Kiinan juan liitettiin IMF:n valuuttakoriin – mikä muuttuu?', Euro ja Talous blog, web log post, published 3.10.2016, viewed 9.11.2017, https://www.eurojatalous.fi/fi/blogit/2016-2/kiinan-juan-liitettiin-imfn-valuuttakoriin--mika-muuttuu/.

Kuisma, T 2016a, Category Manager, Supply Chain Management, GS-Hydro Corporation, Interview 4.10.2016.

Kuisma, T 2016b, Category Manager, Supply Chain Management, GS-Hydro Corporation, Interview 11.10.2016.

Macrotrends 2017, Crude Oil Prices - 70 Year Historical Chart, Macrotrends LCC, viewed 10.11.2017, http://www.macrotrends.net/1369/crude-oil-price-history-chart.

Mauno, H 2017, 'Kiinan terästuotanto kiihtyy edelleen', Taloussanomat, published 2.1.2017, viewed 9.11.2017, https://www.arvopaperi.fi/kaikki_uutiset/kiinan-terastuotanto-kiihtyy-edelleen-6612037.

Omachonu, VK & Suthummanon S 2004, 'The relationship between quality and quality cost', Internatonal Journal of Quality & Reliability Management, Vol. 21, no. 3, pp. 277-290.

Peng, MW 2014, Global Business, 3rd Edition, South-Western, Cengage Learning, Mason, USA.

Porter, ME 1985, Competitive advantage: Creating and sustaining superior performance, The Free Press, New York.

Porter, ME 1986, 'Changing patterns of international competition', California Management Review, Vol. 28, no. 2, pp. 10-40.

Porter, ME 1990, 'The competitive advantage of nations', Harvard Business Review, Vol. 68, no. 2, pp. 73-93.

Qi, L & Zhu, G 2017, 'China's industrial growth shifts down a gear', Market Watch, published 14.9.2017, viewed 13.11.2017, https://www.marketwatch.com/story/chinas-industrial-output-grows-less-than-expected-2017-09-14.

Reuters 2017, 'China yuan to slip as U.S. dollar regains lost ground: Reuters poll', Reuters, published 9.11.2017, viewed 10.11.2017, http://www.reuters.com/article/us-forex-poll-asia/china-yuan-to-slip-as-u-s-dollar-regains-lost-ground-reuters-poll-idUSKBN1D90GO?il=0.

Song, K 2017, General Manager, Company B, Interview 15.2.2017.

Talouselämä 2016, 'Kiinan talouskasvu hitainta 25 vuoteen – Teollisuus supistui jo viidettä kuukautta putkeen', Talouselämä, published 2.1.2016, viewed 13.11.2017, https://www.talouselama.fi/uutiset/kiinan-talouskasvu-hitainta-25-vuoteen-teollisuus-supistui-jo-viidetta-kuukautta-putkeen/ed2662c7-56d1-3bcf-98af-882b3161ec6c.

Taloussanomat 2016, 'Kiinalainen teräs pursuaa maailmaan ennätystahtia tulleista huolimatta – EU ja Kiina perustavat työryhmän', Taloussanomat, published 13.7.2016, updated 13.7.2016, viewed 9.11.2017, https://www.is.fi/taloussanomat/art-2000001916116.html.

Talouselämä 2017, 'Teräksen hinta korkeimmalla tasolla kolmeen vuoteen', Talouselämä, published 20.2.2017, viewed 10.11.2017, https://www.talouselama.fi/uutiset/teraksen-hinta-korkeimmalla-tasolla-kolmeen-vuoteen/bc2770ac-97d7-3a81-8a5b-83549cb7383e.

Tayles, M & Drudy, C 2001, ’Moving from make/buy to strategic sourcing: The outsource decision process’, Long Range Planning, Vol. 34 (2001), pp. 605-622.

Teknologiateollisuus 2017, 'Teollisuustuotannon määrä maailmalla', graph, in Tuotanto & liikevaihto, Teknologiateollisuus ry, 12.10.2017, viewed 9.11.2017, http://teknologiateollisuus.fi/sites/default/files/file_attachments/teollisuustuotanto_ja_liikevaihto.pptx.

Toxvig, C 2016, Managing Director, GS-Hydro Piping Systems (Shanghai), Interview 11.11.2016.

Trading Economics 2017, 'China Average Yearly Wages in Manufacturing', Trading Economics, website, viewed 9.11.2017, https://tradingeconomics.com/china/wages-in-manufacturing.

Williamson, OE 1981, 'The economics of organization: The transaction cost approach', American Journal of Sociology, Vol. 87, no. 3, pp. 548-577.

World Steel Association 2017, 'Crude steel production 1996-2016', graph, in Global interactive map, World Steel Association 2017, viewed 9.11.2017, https://www.worldsteel.org/steel-by-topic/statistics/global-map.html.

XE 2017a, XE Currency Charts: EUR to CNY, viewed 10.11.2017, http://www.xe.com/currencycharts/?from=EUR&to=CNY&view=1Y.

XE 2017b, XE Currency Charts: USD to CNY, viewed 10.11.2017, http://www.xe.com/currencycharts/?from=USD&to=CNY&view=5Y.

Yip, GS 2003, Total Global Strategy II, 2nd Edition, Pearson Education, Upper Saddle River, New Jersey.

Yu, CMJ & Tang, MJ 1992, ‘International joint ventures: Theoretical considerations’, Managerial and Decision Economics, Vol. 13, no. 4, pp. 331-342.

APPENDIX 1/4. Summary of experiences from Finnish companies in China

Joint ventures
- Have a clear strategical reason for partnership - Ensure that both parties have a real need for partnership, and that there is a mutual benefit from the partnership - Gather real information about the status and motives of the partner, and check their ownership, financial and market information - Choose a partner with experience working with western companies - Visit partner's production facilities in person - Ownership issues are the major source for problems, ensure that the western company has the majority ownership - Have clear and well-defined responsibilities in the partnership with no mixed interests - Ensure the lower level employees' and third parties' support - Good communication is the key to solve problems
Supplier relationships
- Prior to sourcing decision, make a detailed feasibility study if sufficient savings can be achieved - Do not make final decision only based on manufacturing costs, but also quality and supply of the supplier - Choose a supplier who is capable of making the products, and who is willing to invest in the partnership and learn and develop their products - Establish personal relationships with the key personnel of the supplier, and have everything agreed in writing - Keep the supplier and end customers separated from each other

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Supplier relationships
Manufacturing - Before a full order, order a small batch of products preferably someone overseeing the production on site - Ramp up the production with simple and standard products, and gradually move to more complex items - Have everything related to manufacturing specified in detail so that there is no room for misinterpretations **Quality and delivery accuracy** - Be aware of the notion of ‘Chinese quality’ in own organization and customers - Identify key points regarding quality risk and delivery process and invest heavily on those - Be present at the factories, consider making own quality inspections at supplier’s production facilities - Consider giving supplier support to improve their quality level - Be aware of surprises e.g. supplier changing raw materials or intentional mistakes - Make sure supplier has motivation to deliver orders on time

APPENDIX 2/4. SWOT, Company A

Strengths	**Weaknesses**
Owner is an old GS-Hydro employee Owner is western educated Owner is very cooperative Good knowledge of GS components No fear of competition in the marketplace Big facilities Close to GS-Hydro workshop Mill certificates for forgings Owner is eager to invest in manufacturing Western quality management system	Very small company Not profitable High debts and poor liquidity Management is slow to react No own forging or surface treatment capabilities Very small machinery base No capacity for large scale manufacturing Limited quality control capabilities
Opportunities	**Threats**
Possibility of manufacturing cooperation Possibility to combine all operations Support can be done from Shanghai Easy to establish own culture Owner is eager to follow GS-Hydro's advices GS-Hydro would be the key customer Processes can be set up by GS-Hydro	GS-Hydro might end up having to bail supplier out Owner is desperate to take risks Expensive labor and overhead costs because of location Actual costs could be higher than anticipated Needs most support to start the production Need to start with small volumes Capacity could be difficult to increase Long lead time in the beginning

APPENDIX 3/4. SWOT, Company B

Strengths	**Weaknesses**
Financially stable and operationally solid Only focused on manufacturing Current supplier for big foreign companies Good English speaking capabilities Transaction/Western style business culture Experience working with foreign companies Cost structures are very well known Own surface treatment capability Efficient and optimized machining workshop Lots of machining capacity Quality control is well implemented Positive quality experience with GS-Hydro Western quality management system	High stock value Declining turnover Far away from GS-Hydro workshop Cannot directly provide Q345D -20 material Cannot currently provide any mill certificates No own forging capability
Opportunities	**Threats**
Eager to cooperate due to declining business Sales channels in North-America could enable co-selling Does not need support in starting component production	Current majority owner is the CEO of competitor Current supplier for big foreign companies Supplier sells flanges with their own product catalogue Volumes might not be big enough to have bargaining power against other customers Control over raw material

APPENDIX 4/4. SWOT, Company C

Strengths	**Weaknesses**
Big company with established business Very profitable and good liquidity Owner is strongly connected in the marine and offshore industries Strong support from the local government Experience working with foreign companies Mill certificates for their own forging Extensive range of certificates and type approvals One-stop-shop for GS components Own forging capability Material tracing and identification processes implemented	Competitor of GS-Hydro in China Low English speaking capabilities Guangxi/Chinese style company and business culture Furthest away from GS-Hydro workshop No own surface treatment capability Old machinery base for flange manufacturing Inefficient machining processes without automation Inefficient quality control Negative quality experience with GS-Hydro No western quality management system
Opportunities	**Threats**
Extensive product range outside of flange manufacturing Possibility to increase product offering Possibility to lower costs while increasing markets in China Benefit from customer relationships, local markets and government connections Owner is motivated by international market opportunities Owner is interested in new business opportunities Owner is willing to invest in the partnership	Support might create a stronger competitor Strategical fit between companies might be difficult Decision-making in possible partnership Managing sales-setup between companies Supplier might prioritize production resources to bigger customers Owner’s connections in the marine and offshore industries Owner lacks attention to details on management

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Opportunities	Threats
Owner can get certifications through his connections in China Capacity and possibilities to improve manufacturing Production would be relatively easy to start Second workshop with modern machinery for land-based oil well intervention products	Difficulty of changing established company culture Extensive on-site support is needed in the beginning of the cooperation Supplier's willingness to improve quality for GS-Hydro