Diploma Thesis

Strategic Sourcing in Low-Cost Countries

A Framework for Sourcing in Plant Construction

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Graz, 2012

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Statutory Declaration

I declare that I have authored this thesis independently, that I have not used other than the declared sources / resources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

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Abstract

To remain competitive in the current global market, companies must look for new ways to reduce costs. ANDRITZ Energy & Environment GmbH does this through a diversified procurement strategy, with materials and parts sourced from various international locations. While the potential for greater cost savings and ultimately profits is clear, there are, as may be expected, new and greater risks associated with this approach. Countries that offer the largest potential savings have lower labour and material costs and these are referred to as low-cost countries. Often the other key influential factors when sourcing globally are quality, flexibility and reliability. Thus, selecting the most capable and consistent suppliers are crucial.

ANDRITZ Energy & Environment GmbH already has experience in global sourcing from low-cost countries, purchasing steel from China. However, this is their first venture in sourcing more complex engineering components. The aim of this thesis was to provide a comprehensive practical framework that outlines all the essential steps to follow when sourcing components in low-cost countries for plant construction, in particular China. The foundation for the framework is supported by three information inputs. These are the theoretical underpinning of global sourcing, the existing experience of ANDRITZ Energy and Environment GmbH in sourcing and lastly a business case study relating to the sourcing of an induced draft fan for a gas cleaning system. In this case study the focus is supplier selection and production facilities from Europe and China were approached and analysed for comparison.

When sourcing critical components, such as an induced draft fan, it is essential to carefully weigh cost saving benefits that may be available in China against the reliability and quality that is known to exist in parts of Europe. The risk of insufficient time and resources for undertaking this process also significantly impacts sourcing outcomes.

Kurzfassung

Um im globalen Markt wettbewerbsfähig zu bleiben, müssen Unternehmen nach innovativen Wegen suchen, Kosten zu reduzieren. ANDRITZ Energy & Environment GmbH lebt eine diversifizierte Beschaffungsstrategie, in welcher Materialien und Teile von verschiedensten internationalen Standorten bezogen werden. Während das Potenzial der Kosteneinsparung und damit letztlich der Gewinn klar ist, sind mit diesem Ansatz jedoch neue und höhere Risiken verbunden. Länder, welche die größten Einsparpotenziale bieten, haben geringere Arbeits- und Materialkosten und werden als ‘Low-Cost Länder‘ bezeichnet. Andere wichtige Einflussfaktoren bei der weltweiten Beschaffung sind Qualität, Flexibilität und Zuverlässigkeit. Deshalb ist die Auswahl der fähigsten und zuverlässigsten Lieferanten entscheidend.

ANDRITZ Energy & Environment GmbH hat bereits Erfahrung in der globalen Beschaffung von Stahl aus dem Niedriglohnland China. Jedoch ist dies ihre erste Unternehmung in der Beschaffung komplexer Engineering-Komponenten. Das Ziel dieser Arbeit bestand darin, einen Rahmen zu schaffen, der alle wesentlichen Schritte umfasst, die bei der Beschaffung von Komponenten für den Maschinen- und Anlagenbau in Niedriglohnländern, insbesondere in China, zu berücksichtigen sind. Die Grundstruktur des Rahmens setzt sich aus drei Informationsquellen zusammen. Diese sind die theoretischen Grundlagen des Global Sourcing, die vorhandenen Erfahrungen in der Beschaffung der ANDRITZ Energy & Environment GmbH und ein Fallbeispiel über die Beschaffung von einem Saugzuggebläse für eine Rauchgasreinigungsanlage. In dieser Fallstudie liegt der Fokus auf der Lieferantenauswahl, wobei Lieferanten aus Europa und China kontaktiert und analysiert wurden.

Bei der Beschaffung von kritischen Komponenten, wie zum Beispiel einem Saugzuggebläse, ist es von großer Bedeutung, kosteneinsparende Vorteile, welche möglicherweise in China vorhanden sind, gegen die bekanntermaßen hohe Zuverlässigkeit und Qualität, die in Teilen Europas gegeben ist, abzuwägen. Außerdem werden die Beschaffungsergebnisse durch zu eng bemessene Zeitpläne und ungenügend vorhandene Ressourcen für die Durchführung dieses Prozesses signifikant beeinflusst.

Acknowledgement

I have imagined this moment for a very long time, when I have finally completed my thesis and all going well will receive my Diploma. I have gained much confidence in the process and feel well prepared looking forward to the new tasks and challenges the working world will bring. This confidence comes from the successes I have personally achieved but also from the many other people, who have encouraged, supported and generously shared their time and knowledge with me.

Firstly I would like to thank my professor and head of Institute of Industrial Management and Innovation Research, Univ.-Prof. Dipl.-Ing. Dr.techn. Christian Ramsauer, and my supervisor at the Graz University of Technology, Dipl.-Ing. Hans Peter Schnöll, who supported me in my thesis and assisted with useful advice and tips. They have walked me through all the stages of the writing of this thesis, and inspired me to overcome the challenges that I encountered.

Next my sincerest thanks goes to the people at the company ANDRITZ Energy & Environment GmbH. A special thank you to my thesis supervisors at ANDRITZ Energy & Environment GmbH, Ing. Josef-Peter Köck and Dipl.-Ing. Erwin Jäger. They gave me constructive feedback as well as flexibility to fully explore and develop my work and potential. Their time, support and expertise enabled me to have a rewarding and enjoyable working experience in the company.

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1 Introduction

The purpose of this chapter is to outline the general objectives and structure, providing a background and context for which this thesis is based on. As this thesis is written with the support of the company ANDRITZ Energy & Environment GmbH, an overview is given of their motivations, history and organisation, including a detailed description of one of their primary business divisions, Air Pollution Control.

1.1 About ANDRITZ Energy & Environment GmbH

This chapter profiles the company at which this thesis is being conducted providing details of its history and current market focus. It also explains in some depth what Air Pollution Control (APC) is and why it is an area of focus for ANDRITZ Energy & Environment GmbH (AE&E).

1.1.1 General Information about AE&E

Previously operating as AE&E Austria GmbH & Co KG, ANDRITZ Energy and Environment GmbH (AE&E) has over 150 years of experience in design, manufacturing, installation and service (see also Figure 1.1).[1]

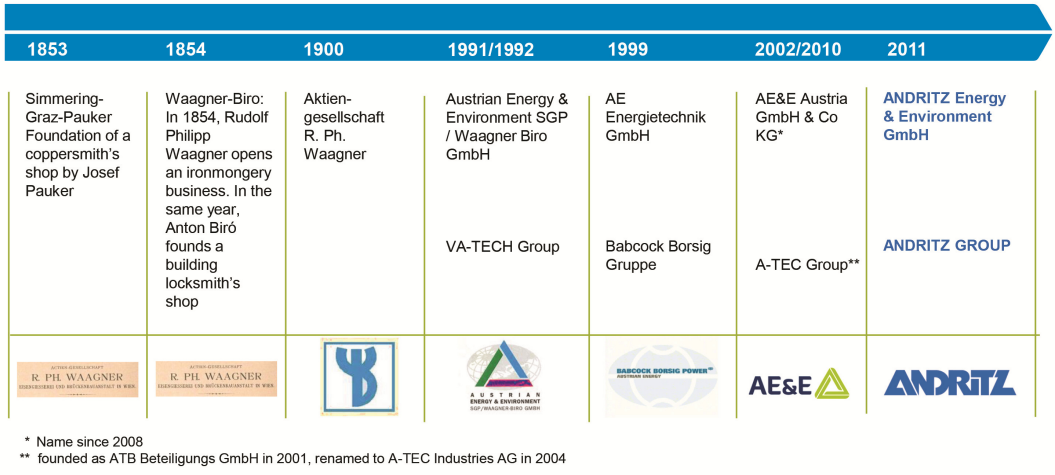

Figure 1.1: AE&E's history[2]

[1] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011c), p. 22f.
[2] ANDRITZ ENERGY & ENVIRONMENT (2012), p. 10

As listed in Figure 1.2, their focus is on steam generators, air pollution control systems and the service of existing plants. They aim to advance towards generating power from efficient, sustainable fuel sources.[3]

AE&E was acquired by the ANDRITZ GROUP in early 2011 and became a part of a global network of over 16,000 employees in 43 different countries. The ANDRITZ GROUP's strength lies in power generation and environmental processes, with more than 50% of their revenue coming from technologies that generate energy from sustainable resources. The organization is a specialist in the design of processes and works across the chemical, mechanical, electrical, and civil engineering disciplines. ANDRITZ GROUP operates in the low-cost countries of China, India and South America and is currently expanding their manufacturing presence here to reflect the markets growth.[4]

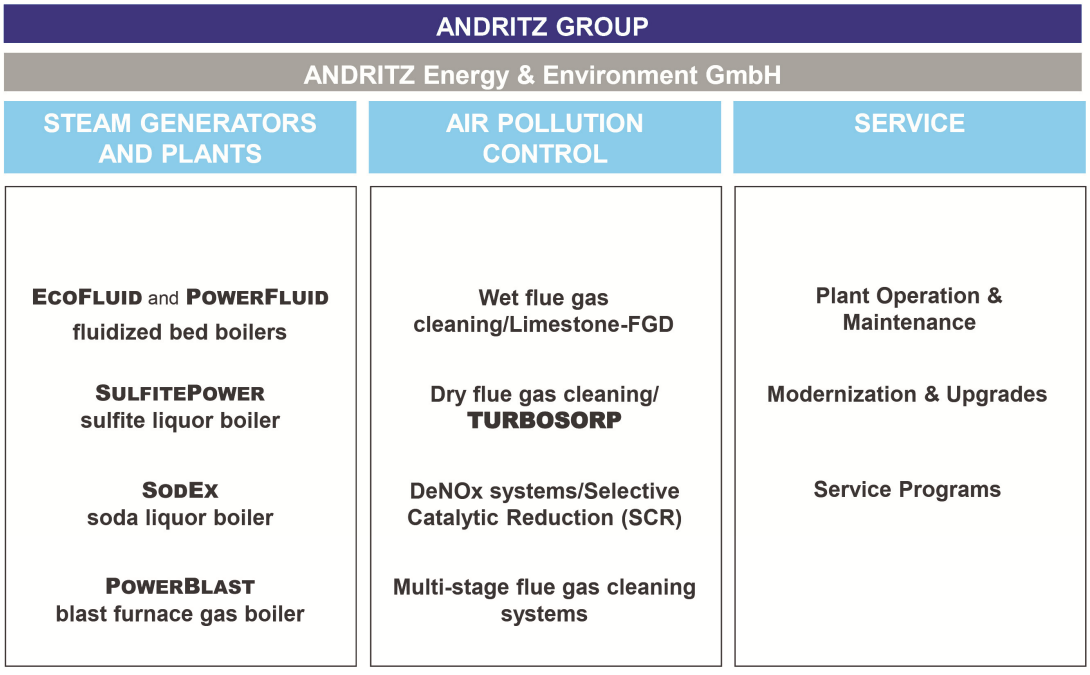

Figure 1.2: Overview AE&E[5]

[3] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011c), p. 22f.
[4] ibidem
[5] ANDRITZ ENERGY & ENVIRONMENT (2012), p. 11

1.1.2 Air Pollution Control

AE&E is an international supplier of Air Pollution Control (APC) technologies for power stations and industrial plants. Air Pollution Control is a separate division of the ANDRITZ GROUP within the PULP & PAPER business unit. In 1983, AE&E, which at that time was still Waagner-Biro received their first contract for a flue gas desulphurisation (FGD) system. This project for the coal-fired power plant in Voitsberg, Austria, was also the first flue gas desulphurisation for a lignite-fired boiler in Europe. To date, AE&E has supplied over two hundred flue gas cleaning plants, primarily for coal-fired power plants. It is one of the leading companies in Europe and China in the sector.[6]

The steam generators in large power plants and industrial plants burn considerable amounts of fossil fuels and emit large amounts of flue gas to the ambient atmosphere. The combustion of fossil fuels (oil and coal) creates pollutants containing emissions such as sulphur oxides, nitrogen oxides, dusts, heavy metals, chlorides and fluorides. Sulphur oxides and nitrogen oxides are responsible for the creation of "acid rain”. The massive forest decline in the early 1990s in Northern Bohemia in the Czech Republic a region with many coal-fired power stations is directly linked to this. Consequently soon after this, flue gas desulphurisation systems were installed nationwide.[7]

In the last decade, the division Air Pollution Control of AE&E was focused on the sale of large flue gas desulphurisation plants using the wet limestone process. This is most commonly used in the construction of new coal-fired power plants in China (shown in Figure 1.3) and Europe and made up more than 90% of the revenue achieved in this segment.[8]

[6] Cf. ANDRITZ GROUP (2012), p. 7f.
[7] ibidem
[8] ibidem

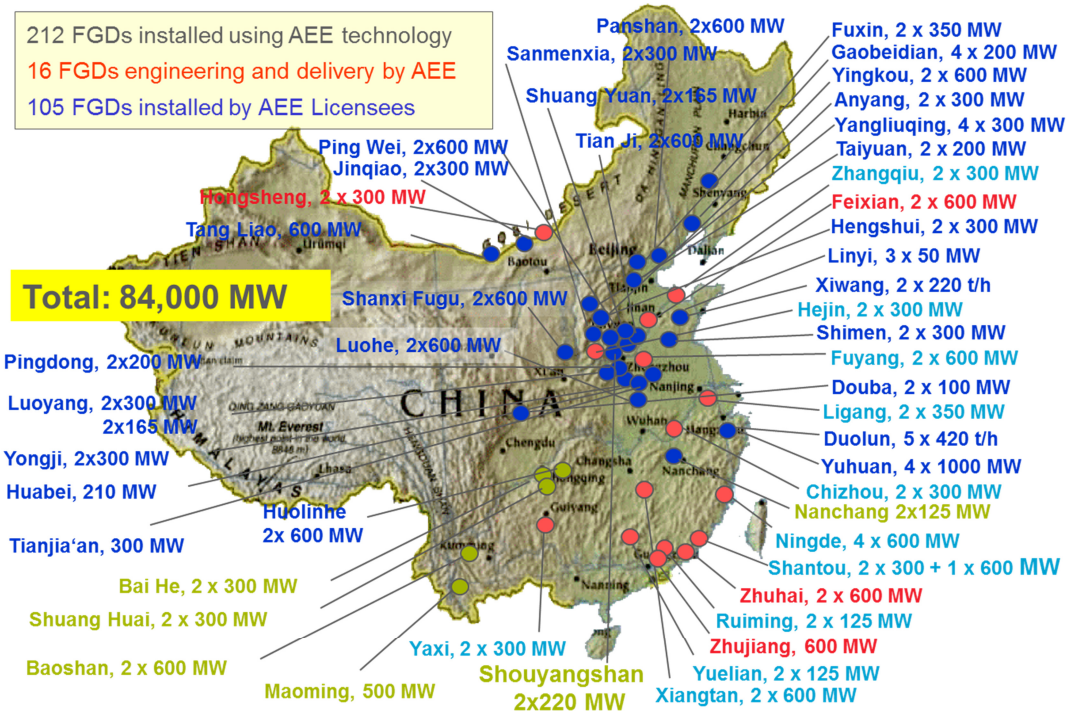

Figure 1.3: AE&E – References in China[9]

This market for flue gas desulphurisation plants in new coal-fired power plants has declined in Europe, as many proposed power stations will not be realized due to the economic crisis and environmental concerns about the impact of carbon dioxide (CO_2). There is however, great market potential in Europe still in the retrofitting of existing power plants that require flue gas desulphurisation systems. The Air Pollution Control division also expects high demand for retrofits from the United States of America and India in the future, where new environmental legislation is imminent.[10]

[9] ANDRITZ ENERGY & ENVIRONMENT (2010b), p. 42

[10] Cf. ANDRITZ GROUP (2012), p. 7f.

1.2 Project Motivations and Objectives

The aim of this thesis is to provide a comprehensive practical framework for ANDRITZ Energy and Environment GmbH that will outline all the essential steps to follow when sourcing components in low-cost countries (LCCs) for plant construction, in particular China. Sourcing in global markets is a process that requires careful consideration. The foundations of this framework are based on current best practice as identified in published and well-regarded industry literature. Several projects and theories will be analysed, examined and compared in an effort to develop the most comprehensive and valid framework. This thesis also includes a case study review of a recent major project in Chile in which four induced draft fans were intended to be sourced from China while compared to sourcing from European suppliers.

The proposed framework aims to provide a structured and systematic approach to sourcing and focuses on key issues such as supplier qualification, request for quotation and award negotiation. The significant criteria when purchasing in low-cost countries relate to costs, quality, time and flexibility.

With the continued need to reduce total costs and fierce competition for projects within the industry, it is imperative that companies take advantage of lower prices amongst suppliers, in order to gain and remain competitive in the market.

Since the early 1990s, ANDRITZ Energy and Environment GmbH has been obtaining structural steel from China for projects in Eastern Europe as well as for projects in China. However the sourcing of the components themselves from low-cost countries is a new and exciting business strategy. Many European suppliers are beginning to design their products in a Western European country and then manufacture the components in low-cost countries like China or India. ANDRITZ Energy and Environment GmbH see a lucrative opportunity in directly searching for new suppliers in low-cost countries. This will enable the current profit margins enjoyed by European suppliers to be gained by ANDRITZ Energy and Environment GmbH themselves. While the potential for greater cost savings and ultimately profits is clear, there are, as may be expected, new and greater risks associated with this direct approach. Specifically the risks associated with quality and security of supply. Long and well-established negotiations and relationships

with Western European suppliers have enabled these risks to be addressed, managed or controlled. With direct sourcing these become significant issues that must be considered very carefully if any of the potential returns are to be achieved.

The recent flue gas cleaning project that required the sourcing of components from China provides a case study for the review of sourcing components from low-cost countries. This project is supported by the office of ANDRITZ Energy & Environment GmbH in Shanghai, which plays a key role in bridging the cultural differences. However while cultural differences were significant there were additional challenges in the process of sourcing Chinese components that needed to be addressed. These required a different strategy from the process used in the 'local' sourcing strategy. Sourcing in China is associated with added challenges, such as differing quality expectations, longer transport distances and various legal and technical conditions. In this thesis the following outcomes from this project are described:

- a guideline of the tasks for purchasing components based on research and knowledge
- the conditions under which sourcing in China is useful as well as the risks and opportunities associated with the purchase of Chinese components
- the total cost analysis for a major project in Chile including a comparison with European and Chinese suppliers to determine whether the purchase of Chinese components is profitable

1.3 Approach and Structure

Figure 1.4 summarises the sequencing of the content of this thesis as well as a simplistic representation of the development process of the proposed framework for sourcing components for plant constructions in low-cost countries.

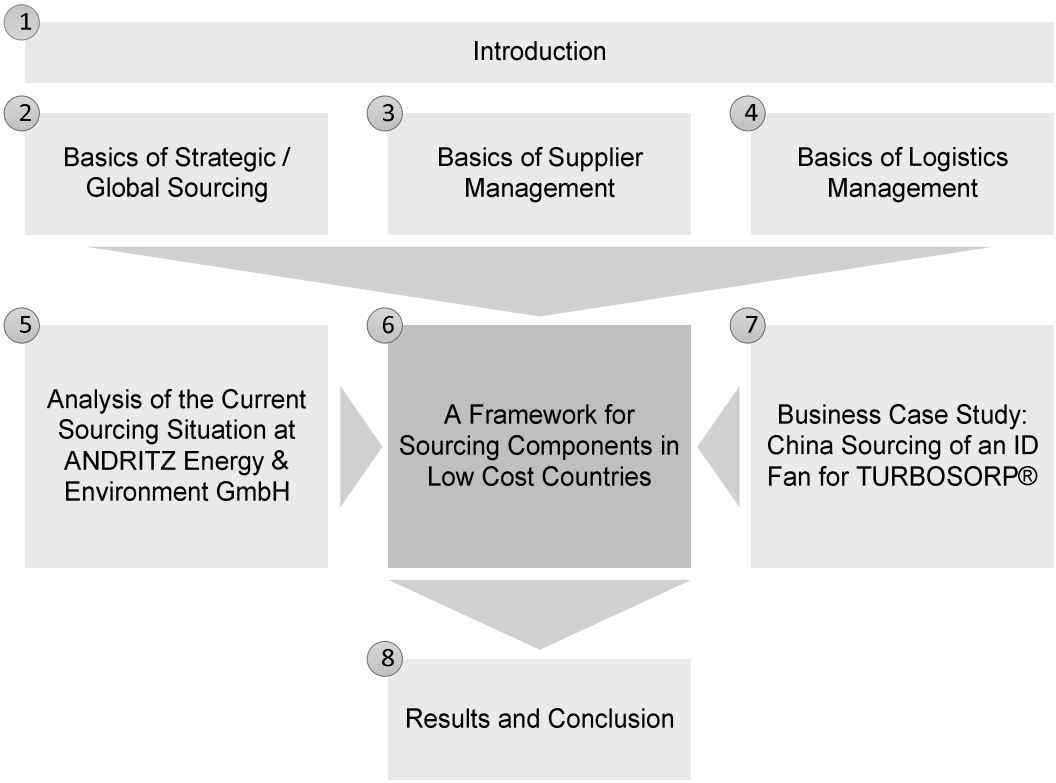

Figure 1.4: Structure of the thesis[11]

The numbers from 1 through to 8 reflect the order of the major sections. Starting with introduction, this section establishes the context for this thesis including the motivations, objectives and a brief overview of the relevant aspects of ANDRITZ Energy & Environment GmbH (AE&E).

The next three chapters focus on identifying and examining the literature and published data to highlight those aspects that have particular relevance to this thesis. Specifically chapter two covers the basic concepts of strategic and global sourcing. It gives special mention to the characteristics of low-cost

[11] Own illustration

countries and the implications of these when sourcing from these countries. Supplier management, which is covered in chapter three includes an overview of supplier management but again focuses on those aspects of supplier pre-selection, supplier evaluation and the selection of suppliers which have even greater significance in the context of sourcing from low-cost countries. This chapter continues with an overview of the methods and models of supplier evaluation and selection, with two models, the scoring model and the total landed costs, covered in greater detail. Logistics management covered in chapter four is a logical inclusion as getting products to the right place in the right time at the right price is a key measure of success.

While chapters two, three and four as previously explained provide the theoretical underpinning of global sourcing generally, chapter five reveals the particular strategies and business model currently at AE&E regarding their sourcing activities, particularly their experience in low-cost countries.

Chapter six, which addresses the key objective of this thesis, is focused on describing and explaining the proposed framework for sourcing components for plant constructions in low-cost countries. It draws on the theory as well as using the case study of a project of sourcing an induced draft (ID) fan for an air pollution control system in Chile. The details of this project are covered in chapter seven and includes an analysis of sourcing in China, and a technical description of the basics of a dry flue gas cleaning system, in which the sourced ID fan is a critical part.

While Figure 1.4 is an easy to see view of how the content of this thesis is structured, it also importantly shows how the proposed framework for sourcing components in low-cost countries was developed. The arrows indicate the relationships between the theory, current situation at AE&E and the lessons learned from the project undertaken to source an ID fan for TURBOSORP®.

The final chapter presents the results and conclusions drawn from the framework and its implementation in the business case study with the future outlook of China as a sourcing market discussed.

2 Basics of Global and Low Cost Country Sourcing

The intent of this chapter is to provide background and context for global sourcing. This includes an historical overview of the development of global sourcing, followed by a description of the different types of sourcing strategies. The section on opportunities and potential risks relates to global sourcing generally while the characteristics of low-cost countries and the specific aspects to be considered in these countries are described in the remaining of the chapter.

2.1 Development of Global Sourcing

International trading is not a new phenomenon, with history showing the trade of spices and silks between Asia and Europe as far back as 500BC. Figure 2.1 shows that there have been three key stages in the development of the global network of exchange that exists today.[12]

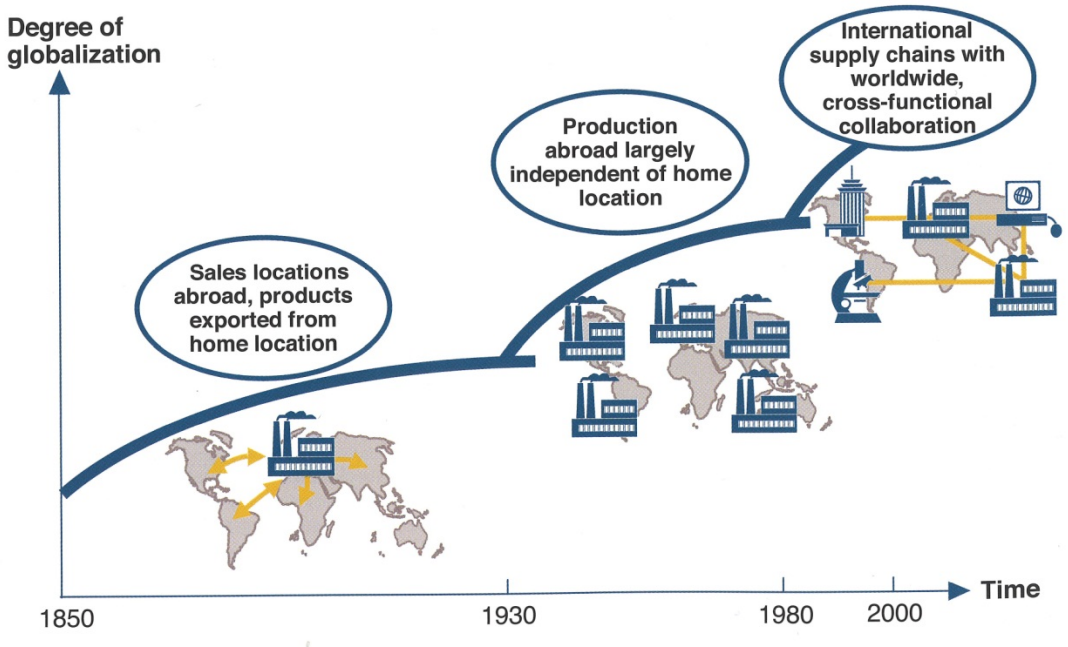

Figure 2.1: Development of globalisation[13]

[12] Cf. ABELE et al. (2008), p. 3f.
[13] MCKINSEY / PTW

Starting as mainly the import and export of goods in the 1930s, global trade steadily grew, resulting with companies creating independent offshore production facilities. Telecommunications has been one of the strongest influences on globalisation, with faster transfers of information directly correlated to the increased movement of goods and services.[14]

Trade agreements have been reducing barriers and encouraging global trade and purchasing since the early 1990s. While individual agreements between countries exist, the four major treaties are regional, including the European Union (EU), the North American Free Trade Area (NAFTA), the Common Market of the South (Mercosur) and the ASEAN Free Trade Area (AFTA). These agreements seek to promote both the import and export of goods and services between the contracting countries, in an effort to support regional growth.[15]

Within these trade groups, the ratio of intra-regional to extra-regional trade varies as illustrated in Figure 2.2. The EU in comparison with the other trade groups appears to fully utilize its regional free trade agreement, keeping 65% of its merchandise trade amongst its fellow countries.[16]

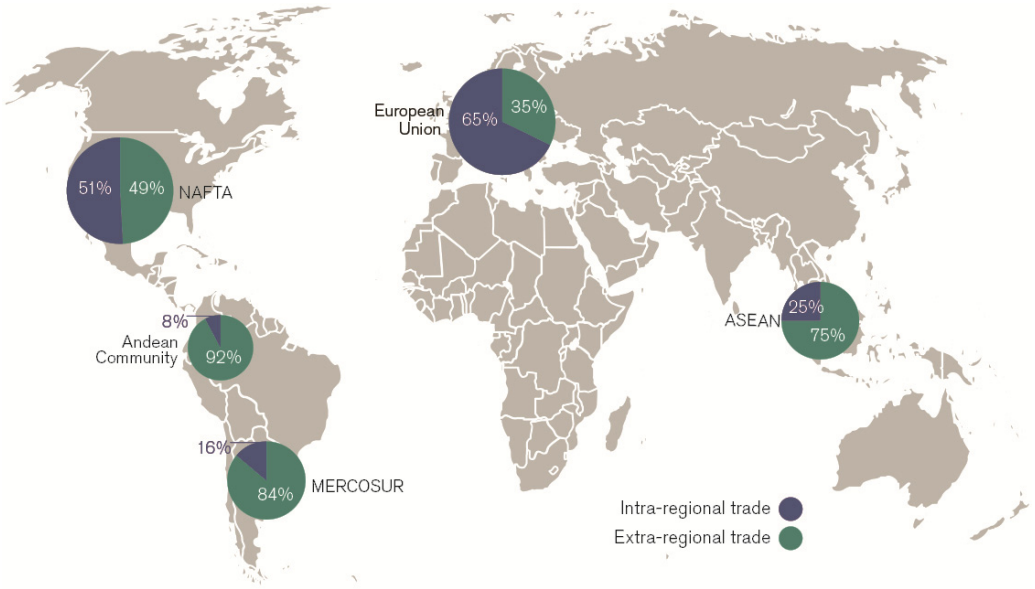

Figure 2.2: Merchandise exports of regional trade agreements 2010[17]

[14] Cf. ABELE et al. (2008), p. 3f.
[15] Cf. RAMSAUER (2009), p. 114f.
[16] Cf. WORLD TRADE ORGANIZATION (2011), p. 16
[17] Cf. WORLD TRADE ORGANIZATION (2011), p. 16, own illustration

NAFTA on the other hand has 49% extra regional trade[18], which would account for why household name American brands such as Nike and Adidas produce nearly all of their products in foreign countries - a fact that consumers are increasingly aware of. Trading outside their region also means, transferring significant parts of the added value to international suppliers. These big names in the clothing and textile industry are no exception, with companies from all industries sending their manufacturing processes offshore in order to gain cost advantages. In times of ever increasing price and competitive pressure, the worldwide procurement is one of the key elements of success for companies.[19]

2.2 Different Types of Sourcing Strategies

In sourcing processes, many different methods can be used. Which strategy is used depends on the particular requirements of the company and the complexity of those products to purchase. Sourcing strategies are divided into four main categories.[20]

- **Process-related Sourcing Strategy**

  The process-related sourcing strategy discerns between operational and advanced / strategic sourcing. Operational sourcing is the day-to-day supplier management. In advanced / strategic sourcing the supplier is involved in the product life cycle from the beginning, including research and development.[21] The goal is efficiency and effectiveness through the timely coordination of people and processes. This strategy tends towards purchasing entire systems and early supplier selection.[22]

[18] Cf. WORLD TRADE ORGANIZATION (2011), p. 16
[19] Cf. KERKHOFF (2005), p. 31
[20] Cf. KERKHOFF (2005), p. 48
[21] ibidem
[22] Cf. HOFBAUER / MASHHOUR / FISCHER (2009), p. 94

- **Supplier-related Sourcing Strategy**

  The supplier-related sourcing strategies differ with single, dual and multiple sourcing approaches. These concepts are distinguished by the number of suppliers from whom a specific procurement object is obtained. Single sourcing involves only one supplier and is characterized by a long-term relationship. The disadvantage is its high dependence on one supplier. Multiple sourcing means purchasing from several suppliers while trying to utilize the competition present between them. Increasing the security of supply without compromising long-term commitment to the supplier is also an aim. Dual sourcing is purchasing from two suppliers in an effort to maintain the benefits of single-sourcing while reducing the disadvantage of dependence. In a global context, single or dual sourcing often makes sense, because of the strategic, long-term supplier-customer relationship.[23]

- **Component-related Sourcing Strategy**

  Component-related sourcing varies from single unit sourcing to more complete products. In modular sourcing, the customer transfers more value-added levels of production to the supplier and procures ready to install modules and systems for final assembly.[24] An increase of value placed on suppliers shows a significant shift from single component procurement to the acquisition of total systems.[25]

- **Region-related Sourcing Strategy**

  The region-related sourcing strategy sees supply move from regionally limited and local procurement to international sources. This happens through the systematic expansion of procurement policies.[26] Increased competition and this trend towards global sourcing have resulted in a growing interest in low-cost country sourcing. This is the process of procuring products, parts and services from suppliers in countries with

[23] Cf. GRAF (2006), p. 12f.
[24] Cf. HOFBAUER / BAUER (2004), p. 27
[25] Cf. HOFBAUER / MASHHOUR / FISCHER (2009), p. 94
[26] Cf. HOFBAUER / BAUER (2004), p. 23

lower labor and material costs. These countries, also known as emerging markets, are often characterized by fast growth and are explained further in chapter 2.4. With manufacturing companies spending much more than half of their revenue on the purchase of parts and materials, it makes sense that companies are looking for cheaper alternatives.[27]

In practice, no strategy will be found that uses only one of these four approaches. To generate the maximum success in terms of quality, price, innovation, competition, flexibility and service, the company must execute overall strategies, which are a combination of these four areas.[28] Figure 2.3 shows the previously explained criteria at a glance, through which the different sourcing strategies can be distinguished.

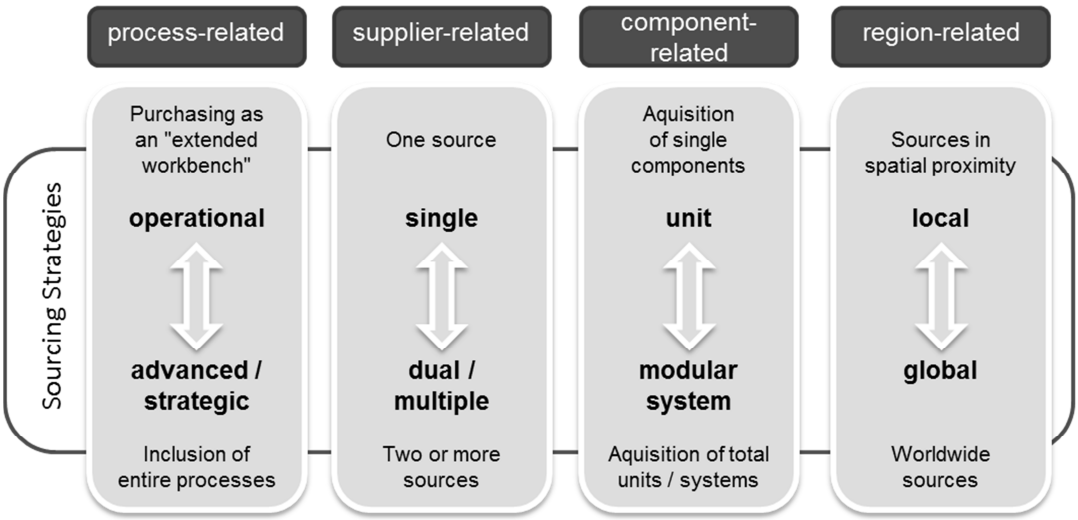

Figure 2.3: Sourcing strategies[29]

[27] Cf. TIMMERMANS (2005), p. 63f.
[28] Cf. HOFBAUER / MASHHOUR / FISCHER (2009), p. 94f.
[29] Cf. KROKOWSKI (2007), p. 444, own illustration

2.3 Opportunities and Potential Risks of Global Sourcing

By pursuing a global sourcing strategy, a company is offered a variety of opportunities that would otherwise not be available in a purely national oriented sourcing strategy.[30] The opportunities or goals of a global sourcing strategy, as shown in Table 2.1, are divided into cost, quality, technology, safety and sales targets.

Cost targets	• Exploiting lower wages, taxes, commodity prices, environmental costs, etc. abroad • Increasing competition among suppliers by increasing the number of suppliers
Quality targets	• Improving the (technical) product quality of procurement items • Increasing the congruence of their own products with the customer needs
Technology targets	• Procurement of technological goods, which are not available domestically • Connection to international know-how development
Security targets	• Increasing the security of supply by widening the supplier base • Compensation of exchange rate fluctuations • Distribution of site risks (e.g. strikes, political unrest)
Sales targets	• Reaction to trade restrictions imposed by perception of counter trades • Creation of an information base on potential export markets • Production for the local market

Table 2.1: Strategic objectives of global sourcing[31]

[30] Cf. GRAF (2006), p. 8

[31] Cf. BEDACHT (1995), p. 52, own illustration

Setting sourcing targets and goals in a global sourcing strategy are necessary, but risks that may occur in the pursuit of these must also be considered. Table 2.2 provides an overview of the different types of risks.[32]

Communication risks	• Differences in: language, culture, religious views, manners, customs, education and value systems • Varying communication technologies
Logistics risks	• Reduced reliability of delivery • Fluctuations in the duration and costs of transportation, including customs clearance
Quality risks	• Low technical level of development • Low expression of quality awareness • Other technical standards and codes • Availability of skilled workers
Currency risk	• Exchange rate fluctuations
Know-how risks	• Know-how theft • Abuse of intellectual property rights
Political risks	• Political instability in the sourcing country • Unpredictable development of regulations for international trade
Legal risks	• Lack of knowledge of foreign laws and their handling • Changes in legal regulations and licensing

Table 2.2: Risks of the global sourcing strategy[33]

Many of these risks can be minimized from the outset through an intensive and thorough supplier evaluation and selection.[34]

[32] Cf. GRAF (2006), p. 10
[33] Cf. GRAF (2006), p. 11; Cf. ABELE et al. (2008), p. 78ff., own illustration
[34] Cf. GRAF (2006), p. 12

Risks are about probabilities and consequences. Managing these is directly related to the extent to which these probabilities and consequences can be predicted and prevented. Those that can be quantified such as supplier performance and executional problems can to an extent be controlled, with historical data and monitoring systems the indicator of performance. Conversely, natural disasters, epidemics, and geopolitical risks are completely unknown and difficult to control.[35] An overview of sources of risks is given in Figure 2.4.

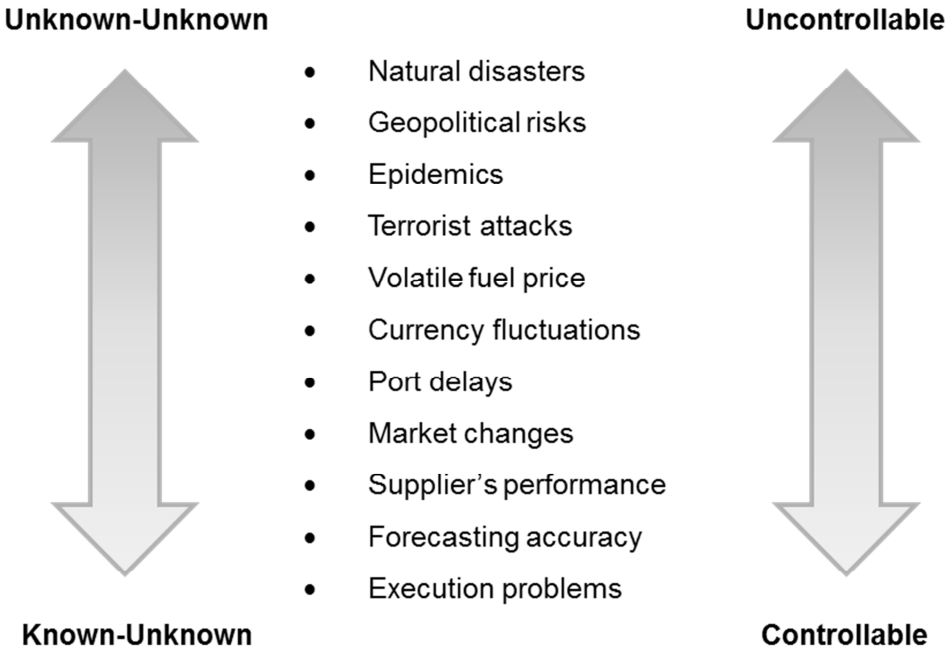

Figure 2.4: Risk sources and their characteristics[36]

[35] Cf. SIMCHI-LEVI / KAMINSKY / SIMCHI-LEVI (2008), p. 316

[36] SIMCHI-LEVI / KAMINSKY / SIMCHI-LEVI (2008), p. 316, own illustration

2.4 Characteristics of Low Cost Countries

Low cost countries as the name suggests, provide reduction in costs, particularly through employee wages and material costs. These countries are often also fast growing and the economic systems within them referred to as emerging markets.[37]

Countries can be categorised as 'low-cost' or emerging markets by key indicators and rankings, such as the Sovereign Risk, Global Competitive Index (GCI), Business Competitive Index (BCI), Human Development Index (HDI), Corruption Perception Index (CPI) or the Democracy Index (DI).[38]

As an example, the Global Competitive Index (GCI) is mainly based on the ability of countries to achieve sustainable positive economic growth and increase prosperity.[39] The GCI separates countries into three different stages as illustrated in Figure 2.5. The first, factor driven economies, have primarily unskilled labour and natural resources, competing on the basis of price. Secondly efficiency driven economies are at a stage where they compete, based on quality. At this stage countries usually fall within the emerging market category. The last is innovation driven economies and these are the countries that usually seek out low-cost countries in order to fulfil their high consumer demands.[40]

[37] Cf. RAMSAUER (2009), p. 108f.
[38] Cf. MUELLER / KNAUER (2009), p. 65ff.
[39] Cf. KEMP / HORBACH (2008), p. 21ff.; Cf. MUELLER / KNAUER (2009), p. 65ff.
[40] Cf. WORLD ECONOMIC FORUM (2011), p. 8f.

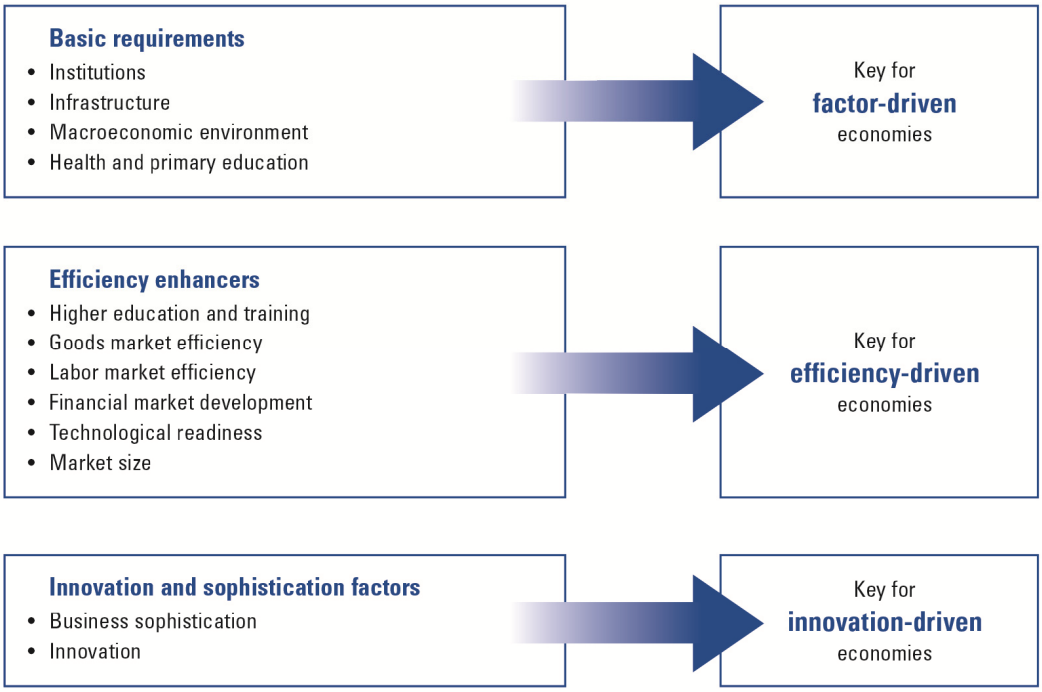

Figure 2.5: The 12 pillars of competitiveness[41]

While these indices are useful, they do not always provide accurate reflections of the actual market potential. This can be seen when well-known low-cost countries such as India and Vietnam still fall within the lowest stage. Many countries from Eastern Europe (Hungary, Poland, Slovak Republic, Russia) and South America (Argentina, Brazil, Chile, Mexico), who have in recent years been classified as low-cost production countries, are, in this index, transitioning to more innovation driven economies. This suggests that in coming years, with better education and higher salaries and standards of living, they will no longer be able to provide the cost savings once available. One of the countries that are accurately portrayed in the GCI is China, falling within the efficiency driven stage.[42] A detailed analysis of the characteristics of China as a sourcing country is given in chapter 7.1. The complete World Economic Forum table listing all countries and their relative stages is included in Appendix A.

[41] WORLD ECONOMIC FORUM (2011), p. 9
[42] Cf. WORLD ECONOMIC FORUM (2011), p. 8ff.

2.5 Specific aspects to consider in low-cost countries

Expenditure of Labour

Low-wage countries allow for more labour to be used in the production process. Thus, the need for automated machinery that requires a large initial financial outlay as well as specialists to set up, use and maintain them is not necessary. The simplification of machinery also results in the reduction of the skills and qualifications needed by the operators.[43]

Different Cultural, Specialist and Training Backgrounds

Language and cultural differences are usually cited as the most obvious differences when working across countries. An example of culturally sensitive interpretation is shown in Figure 2.6. Clear written, verbal and non-verbal communications are essential. Differences in assigned meaning to both the written word and spoken word can lead to at best embarrassing consequences and at worst be very costly errors. Every effort must be made to ensure that there is a shared understanding of the contents of documents such as contracts and technical drawings. Technical proficiency does not necessarily align with literacy. Problems may also arise through differences in quality standards and disparate levels of education and training in workers, particularly in low-cost countries.[44]

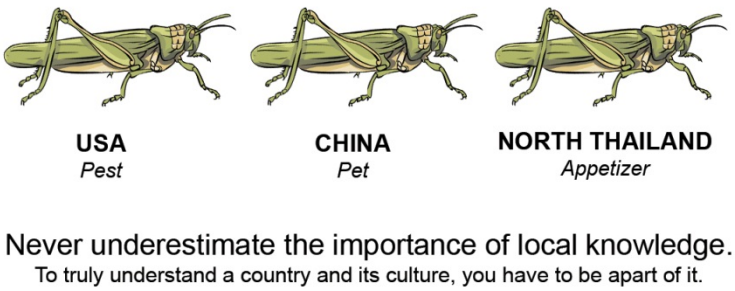

Figure 2.6: Importance of local knowledge[45]

[43] Cf. LANZA / WEILER / VOGT (2009), p. 229ff.
[44] ibidem
[45] Cf. HSBC, own illustration

Materials

In low-cost countries, material costs are proportionally higher than other costs of production such as labour. Significant reductions in total costs can be made through the economic use of materials. Sourcing materials locally should be addressed early to avoid expensive importing costs. Ensuring that the quality of these locally sourced materials is of an international quality standard is equally important.[46]

Requirements for Manufacturing Equipment

Accuracy and consistency are often lower if local equipment is used in low-cost countries.[47] Quality issues can be reduced by having less reliance on the manufacturing equipment. Substituting costly automated machinery with low-cost labour and designing to the strengths of the manufacturer are essential.[48]

Product Piracy and Knowledge Drain

While less of a concern in Western Europe with strict laws preventing piracy, low-cost countries are characterized by a high turnover of employees with a resultant low loyalty. Information about manufacturing processes, technology and products can easily be leaked and copied.[49]

Tariffs and Taxes

The different import and export regulations as well as tariffs between countries are important to take into consideration. When procuring individual parts for a product, a high percentage of elements sourced from foreign countries may deem the product to be non-EU, which would further increase the taxes placed on it.[50]

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[46] Cf. Interview with Mr Rainer Wurzinger (14.02.2012), CEO of WIR Techplan Zeichenbüro GesmbH & Co KG, responsible for sourcing in China for ANDRITZ

[47] Cf. FITZGERALD (2005), p. 16ff.

[48] Cf. LANZA / WEILER / VOGT (2009), p. 229ff.

[49] ibidem

[50] ibidem

Long Haul Distances

Many low-cost countries are geographically distant from the countries in which the products are used or required. With the exception of Eastern Europe, sea or airfreight is required to transport goods to Europe. The key differences between these modes is that sea freight is calculated mainly by volume and takes longer, adding time associated costs, whereas air freight is more influenced by weight, but is much quicker.[51]

Costs for Coordination and Support

Generally the cost of coordination and support is higher in low-cost countries. One reason for this is geographical distance, with the ability to work in close cooperation and face-to-face meetings requiring more time and money, particularly if an interpreter is needed to overcome language barriers.[52] In addition, the costs increase with the number of participants involved so ensuring a simple supply chain is imperative.[53]

Dynamics Conditions – Changing Taxes, Tariff Regulations, Labour Costs and Currency Fluctuations

Low-cost countries are experiencing rapid change and consequently all aspects of the sourcing process needs to constantly be monitored and re-evaluated. This can be costly, however not adapting to these fluctuations can have more severe repercussions.[54]

[51] Cf. LANZA / WEILER / VOGT (2009), p. 229ff.
[52] Cf. KASPERK / WOYWODE / KALMBACH (2008), p. 59ff.
[53] Cf. LANZA / WEILER / VOGT (2009), p. 229ff.
[54] ibidem

3 Basics of Supplier Management

Effective supplier management systems and processes are critical when reliant on third parties for products.[55] The first half of this chapter provides an overview of this process starting with the supplier search and identification. This is followed by a description of the processes and methods for assessing supplier limitations in order to arrive at a short list. The second half of this chapter deals with the processes involved leading up to the final selection of the supplier using the process steps of supplier management according to JANKER[56], which are shown in Figure 3.1.

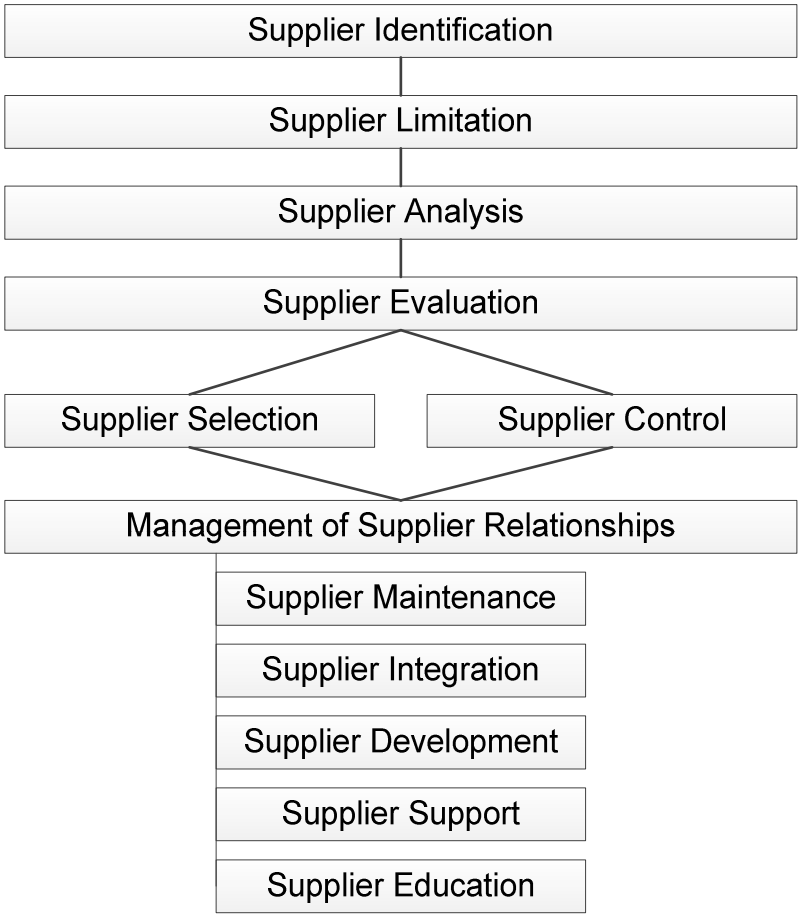


Figure 3.1: Process steps of supplier management according to JANKER[57]

[55] Cf. MONCZKA / PETERSEN (2012), p. 16
[56] Cf. JANKER (2004), p. 33ff.
[57] Cf. JANKER (2004), p. 33

Also in this chapter, supplier qualification, evaluation and selection will be considered, especially in the context of a global sourcing strategy. Aspects of controlling and managing the supplier relationships will not be discussed further in this context.

3.1 Supplier Pre-selection

Supplier pre-selection starts with supplier identification and supplier limitation. In order to limit the number of suppliers, further knock out – criteria can be established and is described in point 3.1.3.

3.1.1 Supplier Identification

Supplier identification can be referred to as the intersection of market research and supplier management as both have a similar detailed research process.[58] The analysis of market research is comprised of three main stages:[59]

1. **Demand analysis** – identification of the requirements regarding demand structure and quantity.
2. **Market analysis** – identification of the procurement markets in which the requirements of the demand analysis can be met.
3. **Supplier analysis** – identification of potential suppliers for the realisation of a possible purchase order.

Market and supplier analysis together constitutes a supplier screening.[60] Informative market research for global sourcing that aims to identify interesting suppliers includes the primary and secondary acquisition of information (shown in Figure 3.2). Following the analysis of the obtained data, a pool of potential suppliers is produced. Primary and secondary market research differs in terms of cost and time intensity with primary research requiring considerably more of both. The use of primary sources is

[58] Cf. SCHUMACHER et al. (2008), p. 49
[59] ibidem
[60] Cf. HOFBAUER / MASHHOUR / FISCHER (2009), p. 47

far more sophisticated than then the use of secondary sources in market research. It is advisable to carry out the secondary research first as this gives a good initial impression and overview.[61] Figure 3.2 lists a few of the many ways in which potential suppliers in the market can be identified.

Figure 3.2: International sourcing market research[62]

The Most Common Mistakes in Sourcing Market Research

Market research takes time and significant financial investment, especially in an unknown market. These factors can be amplified in low-cost countries, where situations change frequently. It is important to look at the actuality of the information gathered.[63]

[61] Cf. KERKHOFF (2005), p. 136f.
[62] Cf. KERKHOFF (2005), p. 136f.; Cf. CISEMA (2010), p. 28, own illustration
[63] Cf. KERKHOFF (2005), p. 144f.

While most are relatively easy to avoid, the same mistakes are often made when sourcing market research.[64] The following is a list of common failures which have the most serious repercussions:[65]

- The company selects the first available suppliers
- The search for additional potential suppliers is omitted
- Relying on the testimony of the supplier, without comparing the statements with relevant secondary sources
- No dialogue with the suppliers references

Despite the fact that all suppliers in the procurement market should initially be considered as potential suppliers, the evaluation process will result in many being disqualified as suitable. Because of this supplier limitation is essential and detailed information about the supplier is needed from the market research. Suitable methods of limitation are knock out - criteria, supplier self-disclosures and certificates and awards.[66]

3.1.2 Supplier Limitation

For the initial evaluation of a supplier there are management systems in place for verification.[67] Instruments can be used to narrow down the initial list of suppliers. Supplier self-disclosure and company led audits are two such instruments and are elaborated in this section.

Supplier Self-disclosure

The supplier completed checklist provides a quick overview of the supplier.[68]

A supplier self-disclosure should include the following information:[69]

1. Companies master data
    - Full name including entity and founding year
    - Address, phone, fax, e-mail, homepage, contact and function

[64] Cf. KERKHOFF (2005), p. 144f.
[65] ibidem
[66] Cf. GLANTSCHNIG (1994), p. 127
[67] Cf. HOFBAUER / MASHHOUR / FISCHER (2009), p. 51
[68] ibidem
[69] Cf. KERKHOFF (2005), p. 148

- Locations: domestic and foreign countries (development, production, sales)
- Private or public company

2. Business development
   - Group affiliation, size of company, business units
   - Economic development in recent years (turnover, profit)
   - Revenue per business unit
   - Number of employees per business unit
3. Product / service range
   - Product portfolio
   - Capacity
   - Additional services (such as development)
4. Export experience
   - Number of years
   - Export regions
   - Export share of total turnover
   - European references (companies including contact information, length of relationship)
5. Logistics
   - Warehouse (for example, location, capacity, equipment)
   - Consignment warehouse
   - Delivery conditions
6. Quality management
   - Existing quality management
   - Name of the testing company

The key issue with this method of information acquisition is that it is very one-sided, so evaluating the data should be done with caution. Information from suppliers should not be overvalued, because many suppliers often have difficulties and/or restrictions in relation to publishing information about their company. Especially those, who have little or no experience doing a disclosure.[70] The speed of response and the precision and completeness of the answers may also reveal a lot about the supplier.[71]

[70] Cf. LEMME (2005), p. 87
[71] Cf. KOPPELMANN (1995), p. 231

Supplier Audit

The audit is a systematic and independent examination by the purchaser of the respective supplier. It is used to compare the suppliers' capabilities and related results with the planned requirements. The audit is to be considered a management tool that aids the selection decision and contributes to the quality of advice. It also checks whether the requirements are implemented effectively and if the suppliers are capable of achieving the required goals.[72]

It is important that the supplier provides access to all premises and storage facilities and allows the inspection of all relevant documents. Production, development, purchasing and quality objectives, content, processes and areas of audit are determined in close cooperation.[73]

There are three types of audits:[74]

1. **System audit** – a system audit is product-independent. It focuses on the suppliers' compliance with standards, such as the quality management system DIN EN ISO 9001. Elements of corporate governance are also evaluated and checked for the presence of necessary organisational components.[75] The following elements can be considered:[76]
    - Quality policy, objectives and costs
    - Training of staff
    - Process Safety

    This process is simplified significantly if the supplier has documented its quality policy.[77]

2. **Process audit** – in a process audit, an assessment regarding the manufacturing process of products is carried out, whereby it is product-related. The main focus is on the security of the manufacturing processes.[78]

[72] Cf. PFEFFERLI (2002), p. 24
[73] Cf. ARNOLDS / HEEGE / TUSSING (1998), p. 386
[74] Cf. LORENZEN (2006), p. 91f.
[75] Cf. LORENZEN (2006), p. 91
[76] ibidem
[77] Cf. ARNOLDS / HEEGE / TUSSING (1998), p. 386
[78] Cf. LORENZEN (2006), p. 92

3. **Product audit** – the focus of a product audit is the product itself, which is randomly checked for compliance with the requirements. These may include: quality, performance, safety or appearance. There are usually several documents available for sourcing companies depending on which audit is completed. For example specifications, drawings, standards, data sheets and test plans. Classifications for possible errors can be made and divided into critical, major or additional errors.[79]

The figure below shows the different types of audits and that the supplier audit is a mixture of system, process and product audits, which can be both, system or product specific.

Figure 3.3: Types of audits[80]

[79] Cf. ARNOLDS / HEEGE / TUSSING (1998), p. 385f.

[80] Cf. HOFBAUER / MASHHOUR / FISCHER (2009), p. 52, own illustration

3.1.3 Knock Out – Criteria

An effective way of limiting the number of suppliers is to define knock out – criteria. These can narrow down a large pool of suppliers quickly and represent basic requirements, which the supplier has to fulfil from the company's perspective, to enter the supplier short list.[81]

Possible knock out (K.O.) – criteria can be:

Certificates	Certificates describe the production and condition of the products from one supplier in terms of quality, environmental standards or compliance with specific standards. They can be used as decision support.
Delivery performance in terms of quantity	If the supplier does not have the capacity to meet a required demand, then this is an exclusion criterion.
References	Any existing information of the supplier regarding international projects in the recent past is important to include in the supplier selection.
Production process	All production processes have to fulfil the accuracy requirements of the client.
Financial situation	If the potential supplier is in a difficult financial position, it does not make sense to build up a business relationship.
Employee qualification	Employees from the supplier, e.g. welding engineers, have to prove their qualification before selection.

Table 3.1: Knock Out - Criteria[82]

[81] Cf. LORENZEN (2006), p. 59

[82] Cf. JANKER (2004), p. 40f., own illustration

3.2 Supplier Analysis, Evaluation and Selection

The results gathered from the supplier pre-selection will be compiled and structured for the supplier analysis. This is a cross-sectional analysis of the economic, ecological and technical capability of potential suppliers. Hence, the entire scope of what the supplier offers and their means to realise this will be analysed. The potential future relationship between supplier and buyer are also considered in the evaluation for any resulting interdependencies, competitive deliveries, etc.[83]

The goals of the supplier evaluation are the selection of the best supplier, the management and development of supplier relationships, the design of objectives, transparent decision processes and the maintenance and strengthening of their own competitiveness. Based on the results of the supplier analysis, the performance of different suppliers will be evaluated systematically. To assess the performance of the supplier, procedures must be used that can deliver meaningful results for each decision situation. The maximum number of possible evaluation criteria should be processed. Both quantitative and qualitative criteria should be included in the evaluation.[84]

3.2.1 Methods of Supplier Evaluation

In both German and English language literature, a variety of methods and models for supplier evaluation and selection can be found. Depending on the specific requirements of an assessment, which are different from one company to another, each of the methods has its own strengths and weaknesses.[85]

Supplier evaluation methods can be classified into quantitative and qualitative groups. Quantitative methods can be expressed with numbers and are thus associated with arithmetic operations.[86] Qualitative methods are

[83] Cf. HARTMANN / PAHL / SPOHRER (1997), p. 18; Cf. GROCHLA / SCHOENBOHM (1980), p. 107

[84] Cf. MUSCHINSKI (1998), p. 85f.; Cf. MELZER-RIDINGER (1995), p. 96

[85] Cf. HOFBAUER / MASHHOUR / FISCHER (2009), p. 62

[86] Cf. JANKER (2004), p. 102

characterized by factors and assumptions that are not directly measurable from a system.[87]

Figure 3.4 shows the most common methods in an overview.

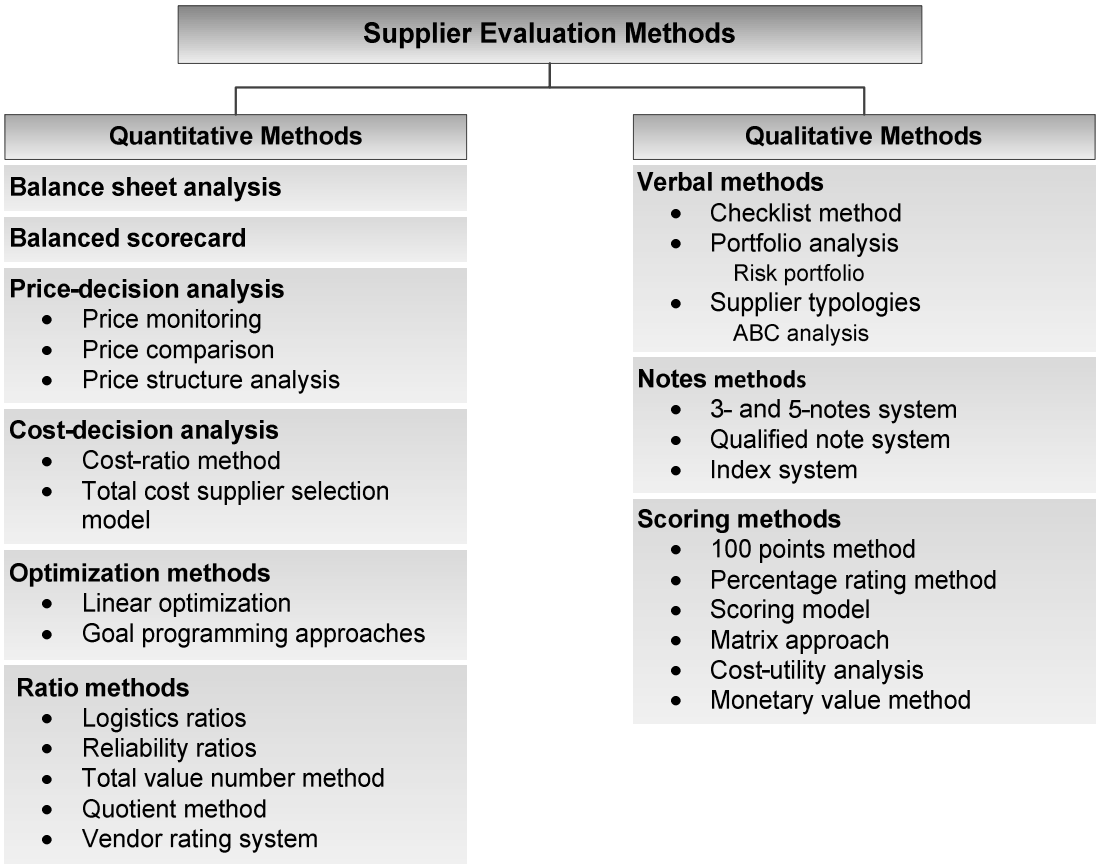


Figure 3.4: Overview - Supplier evaluation methods[88]

In the following sections, specific procedures for evaluation are illustrated. In practice, these are commonly applied tools that ensure a comprehensive evaluation.

[87] Cf. GLANTSCHNIG (1994), p. 32

[88] Cf. GLANTSCHNIG (1994), p. 23; Cf. JANKER (2004), p. 102ff., own illustration

3.2.2 Scoring Model

A scoring model is used to measure a supplier's suitability based on a set of criteria specified by the company. It is expressed in points, grades or percentages.[89]

To develop a scoring model, a set of criteria first needs to be selected. This will include all of the points by which the supplier will be evaluated. The second step is to weight the requirements. Once chosen, these need to be weighted to reflect their varying levels of importance. With the most critical points having a higher value to those less significant. Thereafter, the individual suppliers are evaluated according to these criteria, the characteristics multiplied by the weights and then added. Through the addition, the total score is determined.[90]

The model can be adapted to individual needs, other aspects can be supplemented or other criteria can be selected. The disadvantage of the scoring model is that it is quite difficult to weight the criteria correctly. It must be clear which characteristics of a supplier have the highest priority for the company. Only under this condition can a meaningful result be achieved.[91]

Table 3.2 is intended to represent the principle of the scoring model. The number 10 for example, is being used as the maximum number of points.

[89] Cf. HARTING (1994), p. 57
[90] Cf. JANKER (2004), p. 120
[91] Cf. LORENZEN (2006), p. 70

Main criteria Sub criteria	Weighting		Supplier 1		Supplier 2	
			Score	Score weighted	Score	Score weighted
I. Quality	**35%**					
1.1 Experience of the supplier		30%	5		8	
1.2 Consistent performance		30%	6		10	
1.3 Product quality		30%	6		8	
1.4 Employee qualification		10%	4		10	
Weighted part of scoring			5,5		8,8	
Weighted score				**1,93**		**3,08**
II. Logistics requirements	**15%**					
2.1 Reliability of delivery		15%	7		8	
2.2 Place of delivery flexibility		20%	5		10	
2.3 Reliability of deadline		20%	6		7	
2.4 Short time delivery		5%	7		8	
2.5 Distance to customer		10%	8		3	
2.6 Packaging		15%	9		8	
Weighted part of scoring			5,75		6,5	
Weighted score				**0,86**		**0,98**
III. Cost requirements	**15%**					
3.1 Quotation price		40%	5		8	
3.2 Terms and conditions		30%	7		10	
3.3 Cost analysis		15%	8		8	
3.4 Cost reduction activity		15%	8		6	
3.5 Currency risk management		20%	9		6	
Weighted part of scoring			8,3		9,5	
Weighted score				**1,25**		**1,43**
IV. Service requirements	**15%**					
4.1 Component guarantee		30%	8		10	
4.2 Availability guarantee		20%	10		8	
4.3 Fair dealing performance		20%	8		8	
4.4 Customer service		30%	6		8	
Weighted part of scoring			7,8		8,6	
Weighted score				**1,17**		**1,29**
V. Information requirements	**10%**					
5.1 Willingness to communicate		50%	10		10	
5.2 Information and communication technology		50%	6		10	
Weighted part of scoring			8		10	
Weighted score				**0,8**		**1**
VI. Know-how requirements	**10%**					
6.1 Technological know-how		75%	7		9	
6.2 Know-how protection		25%	5		10	
Weighted part of scoring			6,5		9,25	
Weighted score				**0,65**		**0,925**
∑ (Total Score)	**100%**		**6,65**		**8,70**	

Table 3.2: Example scoring model[92]

[92] Cf. JANKER (2004), p. 121; Cf. LORENZEN (2006), p. 66ff., own illustration

3.2.3 Total Landed Costs Analysis

Total landed costs are all the associated costs required to land a product ready for consumption in a destination different from its origin. This includes, but is not limited to, manufacturing costs, exchange rates, customs tariffs, value added taxes (VAT), transportation costs, agency fees and logistics service provider fees.[93]

Not all the costs associated with global sourcing are immediately evident. Illustrated in Table 3.3, HOLWEG et al. proposes that they are disguisable by and should be categorized into three basic types of costs: static, dynamic and hidden costs. Static costs, such as insurance premiums and purchase prices, can be easily quantified and have a fixed price. Dynamic costs are harder to predict and fluctuate. Hidden costs are even harder to account for, as they are not directly related to the supply chain. These hidden changes, such as an increase in oil prices, may impact transportation costs significantly, but are hard to attribute to a specific venture, instead being reflected in general overheads. Dynamic and hidden costs present significant problems if not incorporated into a total cost calculation.[94]

[93] Cf. INSTITUTE OF MANAGEMENT ACCOUNTANTS (2008), p. 6
[94] Cf. HOLWEG / REICHHART / HONG (2011), p. 335

Static costs	Dynamic costs	Hidden costs
• Purchase price ex-factory gate	• Increased pipeline and safety stock due, which is amplified by demand volatility and product variety	• Labour cost inflation due to rising standards of living and competition in the labour market
• Transportation costs per unit, assuming no unexpected delays or quality problems	• Inventory obsolescence due to long logistic lead-times, e.g. in case of quality problems	• Currency fluctuations, in particular for cases of artificially pegged currencies
• Customs and duties to clear a shipment for export	• Cost of lost sales and stock-outs, as the supply chain is unresponsive to shifts in demand	• Rise in transportation cost, e.g. due to higher oil price and carbon offset costs
• Search costs and agency fees to identify and interact with local suppliers	• Expedited shipments, e.g. air-freight, to ensure uninterrupted supply	• The loss of intellectual property to contract manufacturers
• Cost of quality control and compliance with safety and environmental standards		• Overheads for managing the international supply base, including costs for travel or local personnel in the supplying markets
• Insurance and transaction cost		• The risk of political and economic instability or change

Table 3.3: A framework for the financial assessment of global sourcing[95]

[95] HOLWEG / REICHHART / HONG (2011), p. 336

4 Basics of Logistics Management

Logistics management describes the effective and efficient movement of goods or supplies from one point to another. In the context of global sourcing, the vast distances across which products are to be transported adds another layer of complexity in managing this process. This chapter introduces the general concepts and principles underlying the logistics management process. It highlights those key elements that have particular application to the proposed framework for sourcing components. Considerations including duration, flexibility and reliability, as well as the cost of transport should be used for the decision of selecting the appropriate means of transport.[96]

Criteria for Selecting a Logistics Service Provider

Research by PricewaterhouseCooper (PwC) indicates that punctuality, flexibility, and capacity are the most deciding factors when selecting a logistics provider. In Figure 4.1 the relative importance of other characteristics are shown. Nine out of ten manufacturing companies believe punctuality is a key selection criterion. Smaller companies expressed an equal amount of importance on price.[97]

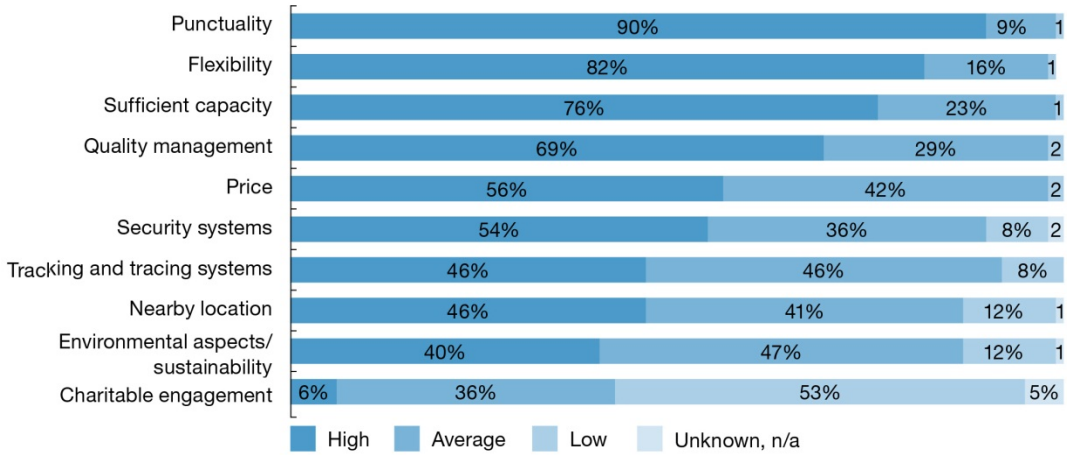


Figure 4.1: Criteria for selecting a logistics service provider[98]

[96] Cf. LORENZEN (2006), p. 99
[97] Cf. PRICEWATERHOUSECOOPER (2012b), p. 21
[98] ibidem

Diversity in Modes of Transport

In many companies, significant cost savings can be made by using alternative modes of transport. The three basic modes of transport by which goods move between places are land (road and rail), water (inland shipping, ocean freight or special service vessels) and air, which are very different in terms of costs. Often it is necessary for a combination of these to be used. One reason for this is in overseas transport, moving goods across water and over land requires two very different vehicles/vessels. Combined transport can also be used as an alternative to continuous road transport such as is available on continental Europe. In broad terms, the longer the transport section the more attractive and necessary combined transport becomes. With distance, the extra cost of handling the loading of units, and the expensive pre-and post on road costs become more insignificant.[99]

In the global procurement of large components and goods, sea freight provides one of the most economical options. There are two options within the mode of sea freight transport:[100]

- *Container freight* – this has restrictions, with maximum dimensions and weight specified for cargo. Standard containers come in either 20ft or 40ft sizes. They can be customised to include refrigeration, an open top or tanks for the transport of liquids. Surcharges are also common in container freight during peak times (PSS = Peak Season Surcharge), for fuel (BAF = Bunker Adjustment Factor) or for currency risk (CAF = Currency Adjustment Factor).
- *Break bulk freight* – these are specialised service vessels which are used for shipment of parts that do not fit into a standard container. Large components can be left in their original form and not disassembled. If the delivery date is more important than price, break bulk shipping is recommended. The disadvantages of this mode of transport are that they have no regular departure times and usually only service main ports. These limit flexibility and any changes are reflected in a higher quote price. The same surcharges apply as container transport.

[99] Cf. LORENZEN (2006), p. 99

[100] Cf. Interview with Mr Manfred Taferner (28.03.2012), logistics manager at AE&E

Terms of delivery – INCOTERMS

Incoterms (International Commercial Terms) are international trade terms published by the International Chamber of Commerce (ICC) and are of major importance to clarify who holds responsibility for imports and exports.[101] Basically, Incoterms describe the obligations, costs and risks associated with the delivery of goods from the seller to buyer such as:[102]

- Details about the transport of goods from seller to buyer
- Export and import procedures and paperwork
- Divisions of cost and risk between the participants

These terms do not deal with:[103]

- the transfer of ownership for the goods
- contract breaches and obligations or exemptions from liability
- third party relationships such as with a transport company

The terms of delivery are initially specified by the buyer, however they can be negotiated. This usually occurs during the award negotiations and is often also influenced by the capabilities of the supplier. These agreements are cemented in the contract and should always be defined with a location and year, such as “FCA Graz, acc. Incoterms®2010”. The commonly used FCA Incoterm code stands for “Free Carrier”. In this term the seller is obliged to deliver the goods at his expense to the buyer’s nominated carrier at an agreed location. From this point the buyer bears the transport costs and the risk of transport damage.[104]

[101] Cf. ALTMANN (2010), p. 1f.
[102] ibidem
[103] ibidem
[104] Cf. IHK (2010), p. 1

An overview of the trade terms is shown in Figure 4.2. Incoterms are divided into four groups.[105] The order of the groups indicates a rising responsibility for the seller:[106]

- E-clause: Pick-up clause, all transportation costs and risks are borne by the buyer.
- F-clause: The main transport costs and risks are borne by the buyer.
- C-clause: The main transport costs and a part of the cost of risk protection is by the seller, all other risks are borne by the buyer.
- D-clause: Arrival clause, all transportation costs and risks are borne by the seller.

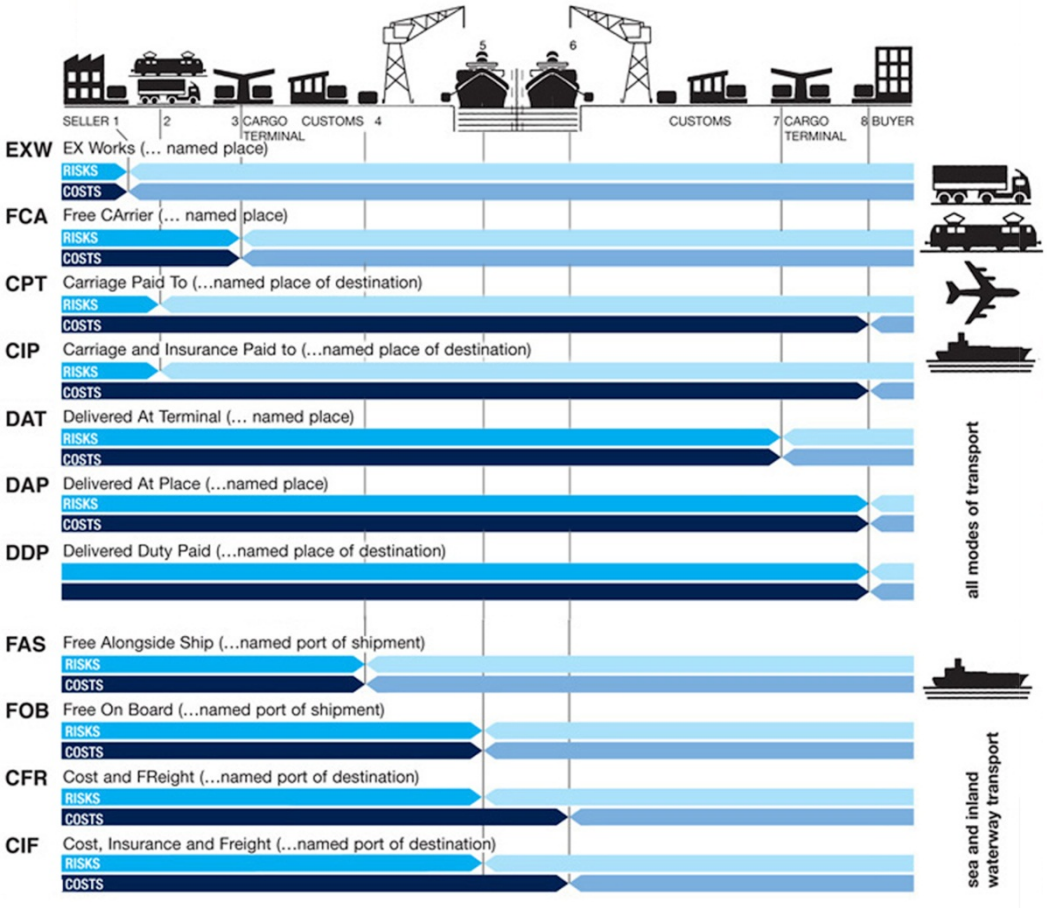


Figure 4.2: INCOTERMS 2010[107]

[105] Cf. PRICEWATERHOUSECOOPER (2008), p. 47

[106] ibidem

[107] Cf. ATLANTIS S.A. FREIGHT FORWARDING SERVICES (2012), p. 1

5 Analysis of the Current Sourcing Situation at ANDRITZ Energy and Environment GmbH

The purpose of this chapter is to create an understanding of the existing business models and motivations of ANDRITZ Energy and Environment GmbH (AE&E). It provides a context for how the company previously operated when sourcing in low-cost countries and the strategies which they implemented.

It is important to note that AE&E is an engineering and project management company. All production and also, part of the engineering of components is assigned to subcontractors. Therefore in this context, purchasing components is the only option, production is not possible.

AE&E first began procuring components from low-cost countries in August 2011. This was however, not their first venture into low-cost countries, having sourced structural steel from China for projects since the early 1990s.[108]

The components AE&E source are engineering products, and have high levels of complexity, such as fabric filters, induced draft fans or gypsum dewatering systems. At present, these components are mainly designed and manufactured in Western Europe or sent to Eastern Europe for production. The main problem with purchasing from low-cost countries, especially from China, is that clients of AE&E have concerns about the quality of the products being manufactured. For example, AE&E has had projects in Germany, Canada, the United Kingdom and even Japan where clients have chosen to exclude products or components from China in their scope of supply. The main question will always be: “Is the quality from China able to be sold?”. Nevertheless, new markets, such as South America and the United States of America may provide fresh opportunities by accepting components made in China.[109]

[108] Cf. Interview with Mr Josef-Peter Köck (14.02.2012), supervisor at AE&E

[109] Cf. Interview with Mr Peter Schreiber (08.02.2012), head of the department of supply management at AE&E

AE&E has guidelines and standards on how a procurement process should be executed. The supply management department at AE&E manages this process. It is a project oriented service department concerned with operational areas, including purchasing and transportation. An employee in procurement and transportation from this department is assigned temporarily for each project team and is responsible for the completion of the agendas of the procurement process. According to needs and outcomes, estimations gathered from supplier quotes are included in proposals given to clients by the sales department. For this reason, initial contact with suppliers is to obtain preliminary offers, to negotiate in advance and check the offers commercially.[110]

The Quotation Process

The quotation process at AE&E is shown in Figure 5.1. Information for the following process description was taken from an interview with Mr Peter Schreiber, head of the department of supply management at AE&E, as well as the AE&E manual for procurement and souring.

Firstly, the purchasing department searches for potential suppliers via secondary sources, including trade fairs, the internet, various contacts or others. When searching for suppliers in China, AE&E Shanghai (AESH) is responsible, as they have experience and knowledge in the Chinese market. To aid this initial search, the procurement department receives the purchase requisition from the lead engineer, together with all the project-specific standards and specifications.[111]

Each new supplier who is shortlisted by AE&E for main and/or critical components has to complete a supplier details questionnaire and a credit check. The supplier details questionnaire helps in assessing the capability of potential suppliers. It looks at their supply and service, certificates of quality and qualifications in terms of health, safety and environment (HSE).[112]

[110] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011a), p. 4

[111] Cf. Interview with Mr Peter Schreiber (08.02.2012), head of the department of supply management at AE&E

[112] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011a), p. 9

Any new suppliers with an extensive scope of supply and services, e.g. manufacturing of pressure parts, steelwork, tanks, sheet metal, etc., which pose a risk to quality, have to undergo an supplier audit.[113] If the audit discloses positive information about the supplier, a written request for quotation (RfQ) will be sent. An RfQ includes the following documents:[114]

- General commercial terms and conditions (GCC)
- Project-specific commercial terms and conditions (PCC)
- Technical specification
- Miscellaneous standard forms of guarantees
- Product requirement documents (PRD), e.g. quality assurance, corrosion protection, transportation, packing and marking, etc.
- Miscellaneous drawings

The lead engineer together with the procurement department select those vendors, which are considered for further contract negotiation due to technical, commercial as well as strategic points of view. The aim of the procurement department is to have a minimum of three alternative suppliers to choose from for each piece of equipment or component.[115]

[113] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011a), p. 11
[114] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011a), p. 8f.
[115] ibidem

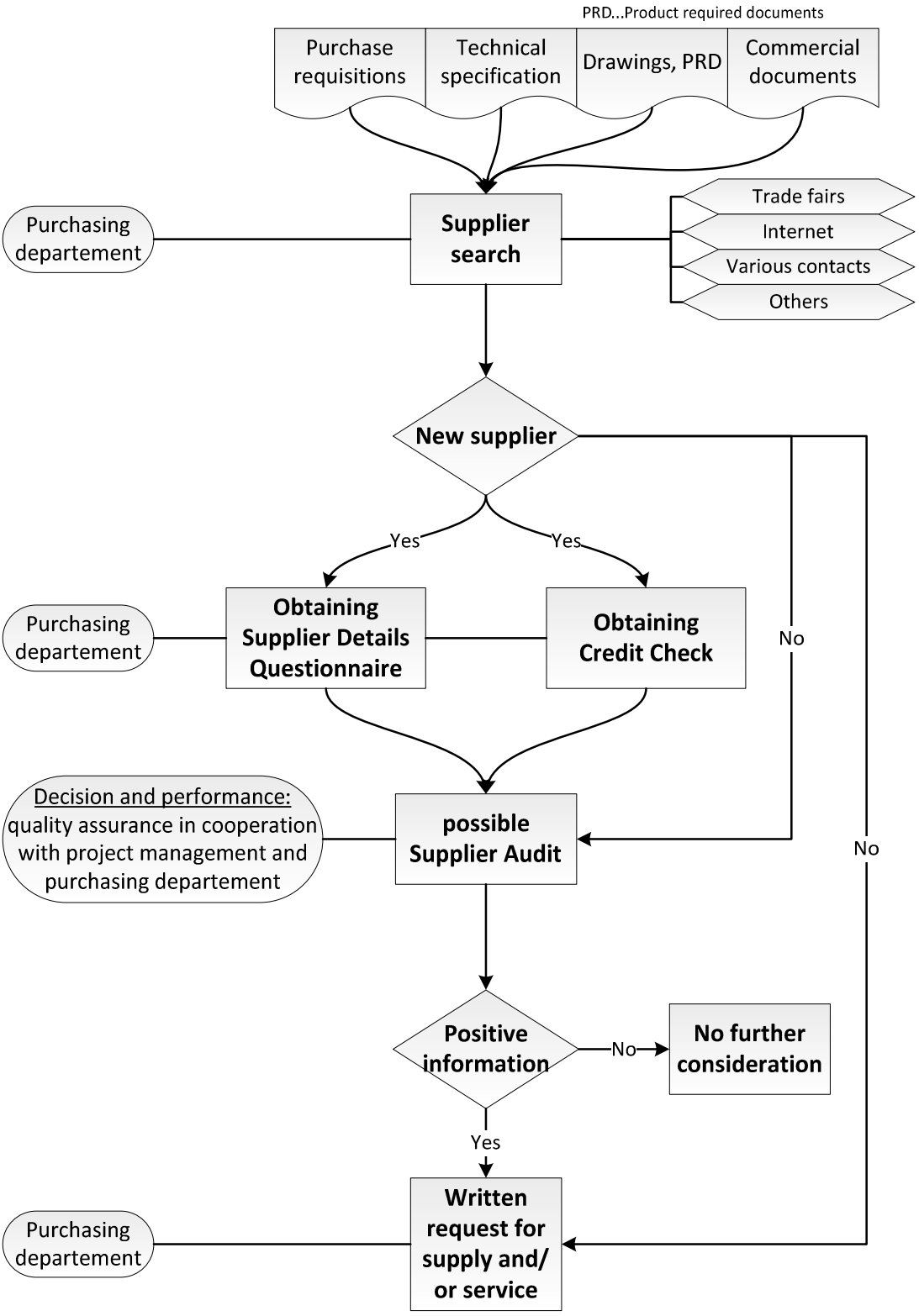


Figure 5.1: Quotation process at AE&E[116]

[116] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011a), p. 8, own illustration

Sourcing of Steel in China

As mentioned previously, AE&E has been using Chinese steelwork for selected power plant construction projects for many years. This section provides a context on why and how this process is conducted. Information in the following paragraphs was derived from interviews with the head of supply chain management department at AE&E, Mr Peter Schreiber, and the logistics manager at AE&E, Mr Manfred Taferner.

The costs associated with purchasing steel from China for European projects fluctuate to such a degree that at times it is not profitable. For this reason, AE&E cannot rely on one supplier for sourcing. For the procurement of a steel structure, AE&E has an existing group of bidders from both the Chinese and European market, which will be sent requests for new projects. New suppliers have to undergo a supplier audit from AE&E and can only bid provided they can offer the required quality on the required dates and at a competitive price. In China, this audit requires about two to three days. The quotation process is carried out as described earlier in this chapter.[117]

In China when sourcing for German projects, AE&E is bound to the supplier Matsuo Steel Structure Co., Ltd. This is because only steel which is approved by the German institute for civil engineering DIBt (Deutsches Institut für Bautechnik) is allowed on the German market.[118] Steel structures that are supplied to Europe have to meet the quality standard EN 1090 or DIN 18800. AE&E had Matsuo Steel Structure Co., Ltd in Shanghai certified by the DIBt which allows only them to supply steel for German projects. The company must ensure that it continues to satisfy all the requirements of the certification.[119] Under the precondition that Matsuo's offer is cheaper than the offer of a European competitor and the client agrees to use steel from China, Matsuo will be invited to an award negotiation. This award negotiation can last several days and occurs under personal attendance of the supply chain management and engineering department in China. It includes technical and commercial clarification. As a part of the technical clarification, project-

[117] Cf. Interview with Mr Peter Schreiber (08.02.2012), head of the department of supply management at AE&E

[118] Cf. SAUER (2011), p. 41

[119] Interview with Mr Peter Schreiber (08.02.2012), head of the department of supply management at AE&E

specific characteristics and details as well as deadlines are discussed with the Chinese production planners. The basic points of the scope of supply and services do not need to be discussed, because of the long-term relationship with Matsuo. After approval by the management and the subsequent purchase order, the shop drawings are sent to Matsuo.[120]

Matsuo could create and adapt the shop drawings by themselves, but the quality and speed that is required by AE&E can not be met. For this reason, the detailed planning is given to a European engineering office. Based on the shop drawings provided via internet, the fabrication of the steel structures starts after the arrival of raw materials. For quality control and supervision of fabrication, a separate employee is usually sent to China. The supervisor is responsible for the continuous monitoring of manufacturing during the production period. For some projects, customers have higher requirements than others, which lead to additional expenditure on supervision. After workshop manufacturing, the steel structures are sandblasted and coated. The manufacturing time from the ordering of material to the delivery of parts is approximately four to six months. Before shipment to the recipient country, the steel structures will be pre-assembled to check the part tolerances. This is also necessary for European steel companies.[121]

The loading of the transport and export customs clearance are the responsibility of the supplier.[122] A logistics service provider is responsible for the transport of the steel structures from China to the site in the recipient country. On average, about 15 tons of steel can be shipped in one container. The delivery time from the workshop in China to a European construction site, in this case to Germany is around five to six weeks. However, if the steel structures have to be transported by special vessels, also known as break-bulk ships, the transportation time can be up to three months.[123] The on-site assembly will be transferred by AE&E to an installation service provider.

The AE&E process for sourcing steel in China as explained previously is shown in Figure 5.2.

[120] Cf. SAUER (2011), p. 63ff.

[121] ibidem

[122] Cf. Interview with Mr Peter Schreiber (08.02.2012), head of the department of supply management at AE&E

[123] Cf. Interview with Mr Manfred Taferner (28.03.2012), logistics manager at AE&E

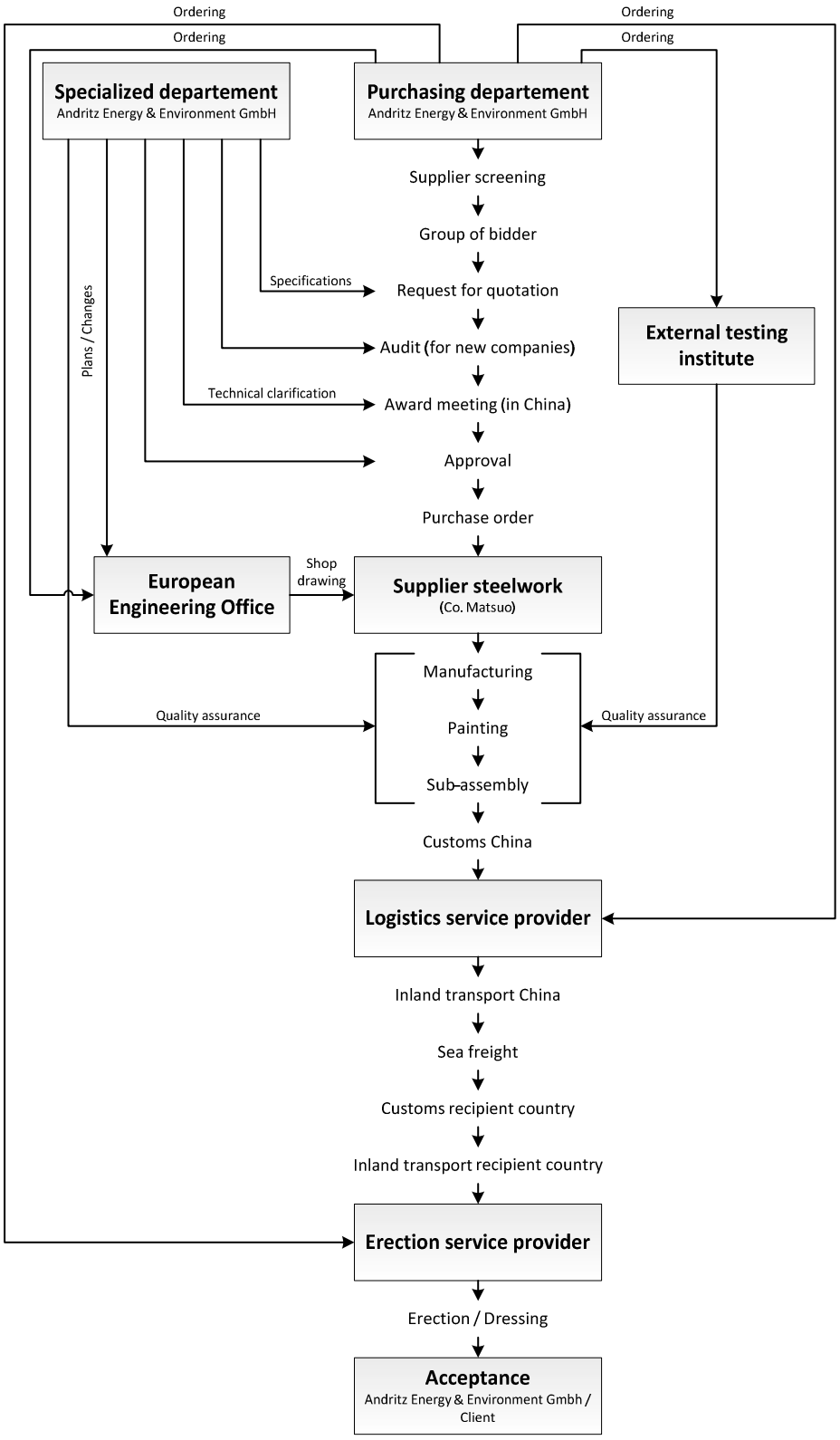


Figure 5.2: Sourcing process of steel in China – AE&E[124]

[124] Cf. SAUER (2011), p. 66, own illustration

6 A Framework for Sourcing Components in Low Cost Countries

The framework outlined in this chapter is limited to the procurement of components for plant construction, specifically for ANDRITZ Energy & Environment GmbH (AE&E). The aim of this framework is to provide management with a methodology to optimise the sourcing of components in low-cost countries, particularly China.

This framework is based on the existing sourcing processes and previous sourcing experience of AE&E and draws on the most current available relevant industry and business literature. It incorporates new information and additional steps, rearranging and streamlining the sourcing process. As a guideline, it can be applied or adapted to sourcing any components from any low-cost country within field of plant construction. It has been developed with a very clear focus on the sourcing market China.

AE&E does not have its own production facility, which means all production and most of the design of components are transferred to subcontractors. For this reason, the production and hence the decision on whether to "make or buy" is not an option. AE&E often only sources small numbers of components, which are mostly special orders.

Figure 6.1 is an overview of the framework. Each element is explored and explained in greater depth in this chapter. The arrows in the diagram depicting the framework show the sequence of steps to be followed in the process. The numbering in this same diagram indicates the order in which it is explained in this thesis. A colour code has been used to provide a more visual picture of the progress of each of the steps in the framework. The colour to the right indicates the completion status of this step in a similar way to a traffic signal. Red signifies an incomplete step, amber a step that is in progress, but requires more information and finally green represents a completed step. The responsible parties of the project team determine the status of a step.

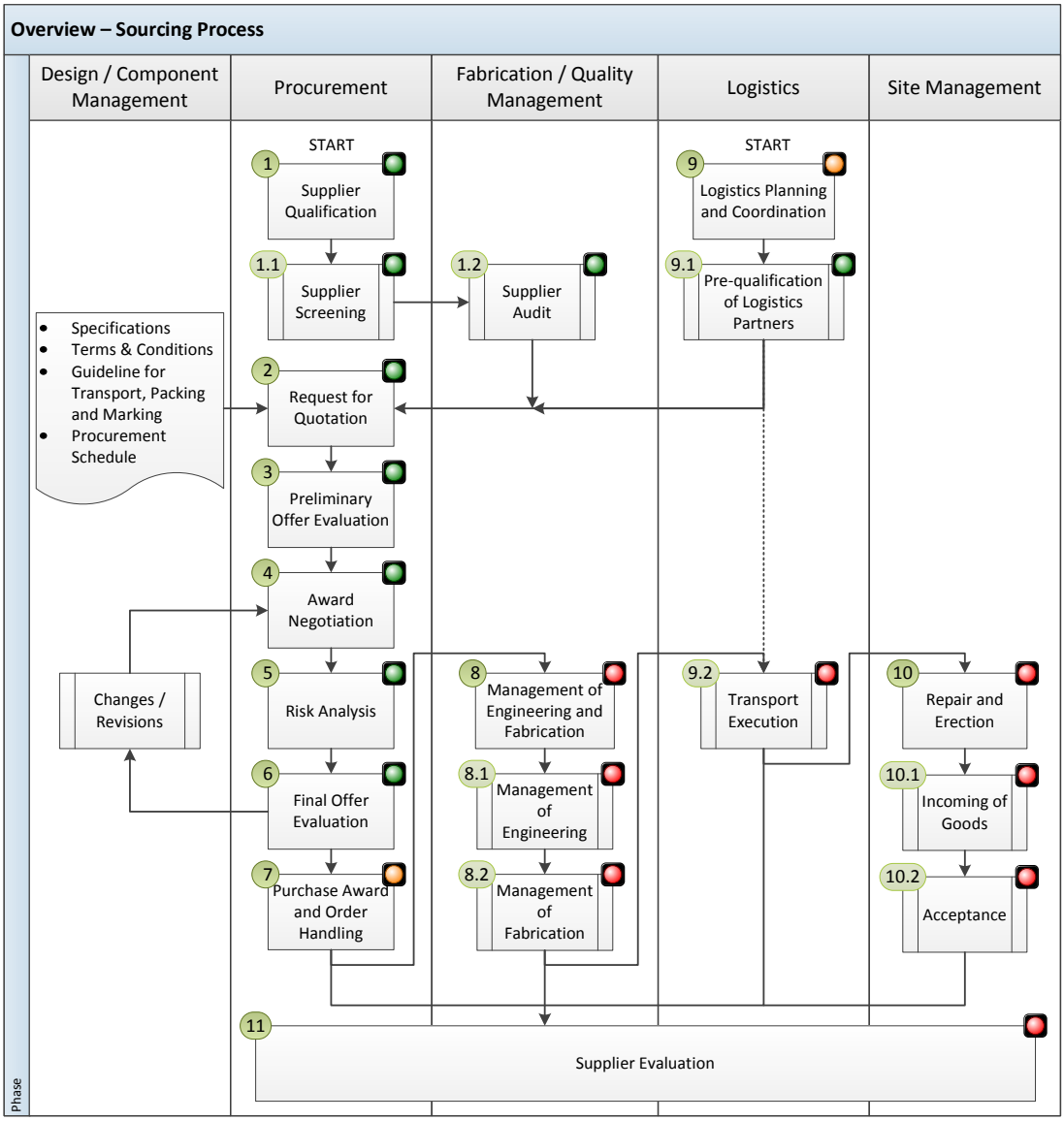


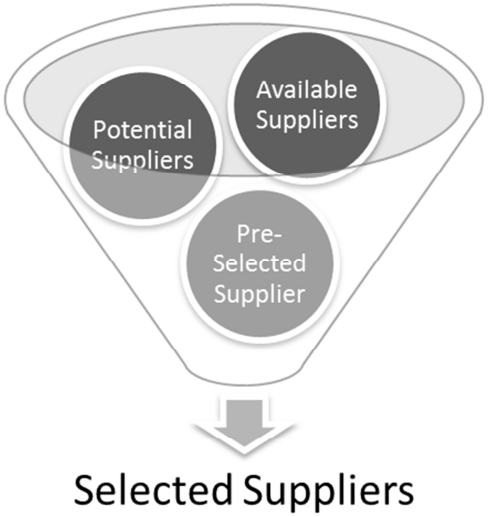
Figure 6.1: Overview of the sourcing process for components at AE&E[125]

[125] Own illustration

6.1 Supplier Qualification

At AE&E the supplier qualification process is about considering all the globally available suppliers in terms of cost, quality, delivery time and flexibility. In general, the procurement of equipment and components by AE&E is influenced by the AE&E manual for supply management.[126]

The following sections describe the main factors for choosing a supplier. At a global scale choosing a supplier is a complex process. The illustration in Figure 6.2 provides a simplified summary of the pre-selection of suppliers in the potential award of a contract.



1. **Long List - Identification**
   a) Research via trade fairs, internet, various contacts, etc.
   b) Elaborating a list with potential suppliers
2. **Short List - Analysis**
   a) Supplier screening
   b) First contact with the suppliers
3. **Pre-Selected Suppliers**
   a) Supplier audit
   b) Request for Quotation (RfQ)

Figure 6.2: Supplier selection process[127]

[126] Cf. Interview with Mr Peter Schreiber (08.02.2012), head of the department of supply management at AE&E

[127] Cf. BOGASCHEWSKY (2007), p. 21, own illustration

6.1.1 Supplier Screening

The supplier screening is the starting point of the supplier qualification process. It is necessary to actively seek potential new suppliers internationally in order to remain competitive.[128] As discussed in section 3.1.1, supplier identification is the process of casting a wide net to gather a list of suppliers using a variety of sources, such as the internet or recommendations from stakeholders.

In order to identify those manufacturers who offer the required sourcing object, it is important to use specific requirements in supplier identification. This will enable the eligible procurement market to be screened for potential suppliers that are able to produce the required sourcing object and meet these minimum requirements. Once supplier identification is undertaken not all suppliers in the procurement market will be considered as potential suppliers.

As explained in the supplier limitation chapter 3.1.2, to narrow down the number of suppliers, a supplier limitation should be executed. Having detailed information about the supplier from the sourcing market research is essential. In the case of AE&E, the methods of limiting suppliers are supplier details questionnaires, health, safety and environment (HSE) qualification, credit checks as well as the supplier qualification, including certificates and awards.

Supplier Details Questionnaire

The first step is to obtain details from the companies in the pool of potential suppliers, regarding their production program, manufacturing processes and current export successes. This can be done with a supplier details questionnaire which provides useful information early on. It assesses the supply and service performance of potential suppliers and their qualifications and authorisations. The information that a supplier should disclose is listed in section 3.1.2. The supplier details questionnaire from AE&E is a checklist, which serves as a basis for short-listing suppliers. The checklist includes general questions about the company, such as yearly turnover, export percentages and management systems (e.g. quality, environmental,

[128] Cf. HOFBAUER / MASHHOUR / FISCHER (2009), p. 36

occupational safety). Once completed the checklist provides a general overview of the supplier. Below are example questions taken from AE&E's questionnaire:[129]

- Can the company demonstrate records to show compliance with the applicable local occupational health and safety OHS and environment acts and regulations, with respect to the design and operation of its product(s)?
- Will the company be prepared to undergo formal on-premises systems audit?
- Which current certifications does the company have (ISO 9001, ISO 14001, OHSAS 18001, etc.)?
- List of machinery & capacities e.g. plate rollers, presses, welding, O/H cranes, heat treatment facility

The full supplier details questionnaire is provided in Appendix B. At AE&E, the returned supplier details questionnaire is evaluated by the supply management and quality management departments.

Credit Check

Another criterion for the qualification of a supplier is to obtain a credit check. The credit check provides information about the risks of a supplier defaulting on payment. It must be obtained before a contract is awarded to each new supplier or when an order volume is more than €100.000. If there are legitimate concerns for known suppliers, a credit check must also be obtained. The person responsible for purchasing analyses the credit check using at least the following criteria:[130]

- Actuality of the listed numbers / data in the information (e.g. last balance sheet)
- Rating
- Credit limit
- Ratio of potential contract value to the company's turnover

[129] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011b), p. 1ff.
[130] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011a), p. 10

Supplier References

Suitable references are mainly from European and North American companies, and reveal the export experience of the supplier. It is important to include any existing information about the supplier regarding recent international projects. It is essential to take time to thoroughly and meticulously examine the reference list. Chinese suppliers have been known to give incorrect information or cite references, which are not accepted in Europe. An example is given in award negotiation, chapter 7.3.2. References should be reviewed and verified further by telephone or a personal visit.

6.1.2 Supplier Audit

When the quality management and assurance department, together with the project management and procurement department consider an audit to be necessary, the audit objectives, audit participants and the audit appointment are jointly defined. As seen in section 3.1.2 there must be an audit result before a supplier is awarded the contract. In any case, new suppliers for extensive and complex goods must be audited. The audit has to be executed by an experienced audit team.[131]

Particularly in global sourcing where language differences may arise, it is crucial to have a translator at the supplier audit that has an in-depth knowledge of the technical terminology used in order to accurately convey information.[132]

Supplier audits can be segmented into three key categories: quality requirements, know-how requirements and information requirements.

Quality Requirements

This refers to the overall quality of the supplier's production processes including factors such as:

[131] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011a), p. 11

[132] Cf. Interview with Mr Simon Heber (23.04.2012), quality manager at AE&E

- *Experience of the supplier* – having previous experience in international projects is looked upon favourably. Suppliers with experience have more knowledge and will have a greater understanding of what is required of them.
- *Employee qualification* – ensuring that employees of the supplier are properly trained is integral to the successful execution of projects. In order to guarantee this, external trainers may be required to intervene, however this is costly and may disqualify the supplier from the pool.
- *Technical standard* – the existing layout, flexibility, quality and maintenance of the workshop and its machinery will influence supplier qualification as poor equipment results in reduced product quality.
- *Sample product quality* – being provided with samples of products made on the supplier's machinery at different stages of completion will give a good indication of overall quality. Nevertheless, one must ensure that the quality directly relates to the specific requirements of the project or component.
- *Consistent performance* – this relates to products being not only of a high quality for one sample, but for numerous samples as well as for different products.
- *Quality management (QM) system* – for the certification of quality management systems it is important to note that the certificate says nothing about the product quality. It tells you only that the certified company has an existing management system and has the ability to operate at a certain quality level. However, this quality management system may not always be in action.[133] For this reason, the supplier must provide evidence of the use of a quality management system. For example ISO 9000ff., which are international standards by which quality management systems are validated. If the supplier does not have a certified quality management system, they must establish and maintain a quality control (QC) programme which complies with AE&E's QC regulations. AE&E is entitled to check that the quality assurance and control programme (QA/QC) is being implemented and that the quality requirements are being satisfied at any time by means of audits and inspections.[134]

[133] Cf. KROKOWSKI (2009), p. 192

[134] Cf. Interview with Mr Simon Heber (23.04.2012), quality manager at AE&E

- *Sample documentation* – an example of a previous project's final documentation can reveal to the auditor details showing if the supplier is capable of providing a complete product package.
- *Clarification of technical details* – having a sound knowledge of the technical details of past and existing projects when questioned and being able to clarify and answer specific requirements and requests is important to auditors.

Know-how Requirements

- *Technical know-how* – the supplier should show that the breath of their knowledge regarding their products is vast and that they have the ability to adapt to new technologies and troubleshoot any future changes.
- *Potential of development* – being self-sufficient and showing a capacity for future research, innovation and development is an advantage.
- *Know-how protection* – although it is hard to monitor, ensuring knowledge security is essential. This can be done by segmenting products and never sharing all of the product and/or process know-how with one supplier.[135]

Information Requirements

- *Willingness to communicate* – being open and transparent in providing information and answering questions is necessary in the supplier qualification process.
- *Information and communication technology* – in global sourcing often geographical distance means that communication must be made using new technologies, such as video conferencing. It is essential that suppliers have access to the necessary technology to enable rapid communication.

[135] Cf. Interview with Mr Rainer Wurzinger (14.02.2012), CEO of WIR Techplan Zeichenbüro GesmbH & Co KG, responsible for sourcing in China for ANDRITZ

An overview of the previously mentioned requirements is given in Figure 6.3.

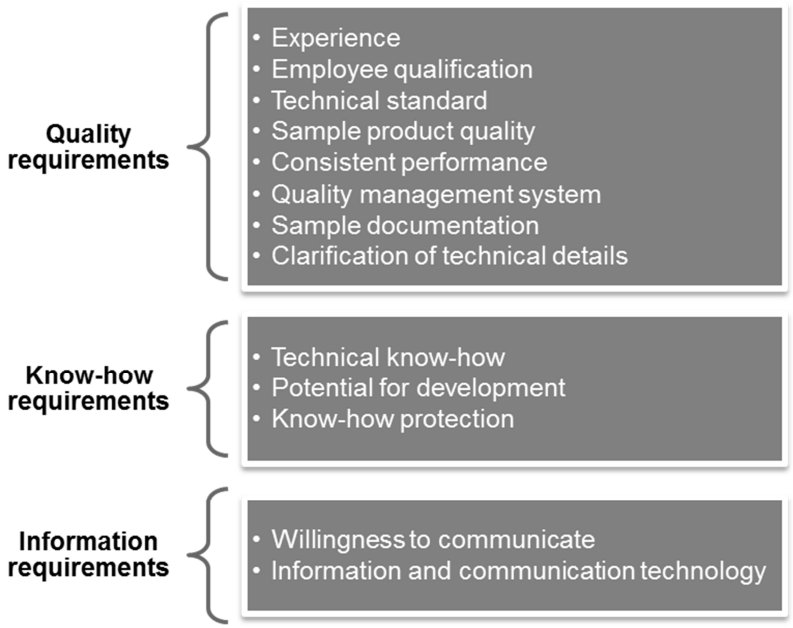


Figure 6.3: Supplier audit requirements[136]

At the end of the supplier qualification process, AE&E has a list of suppliers and ample information about each on which to base their further selection on. This information will include:

- Organisation and efficiency of the quality control system
- Level of technical skills
- Machinery and equipment
- Personnel qualification
- Certifications
- Reliability in meeting deadlines
- References

As explained in section 3.1.3, knock-out criteria are a useful way to quickly narrow down a short list of suppliers. Suppliers must meet the minimum criteria set by the purchasing company or they are removed from the potential supplier list.

[136] Own illustration

6.2 Request for Quotation

Following supplier qualification it is ideal to have least three potential suppliers to forward on a request for quotation (RfQ). A basic rule in an RfQ, particularly in a low-cost country, is to provide only the necessary and essential information. This is because larger documents are less likely to be read in full.[137]

Within the RfQ, the technical specifications for components are prepared under the direction of the project manager for all equipment. The specification generally needs to have the following data:[138]

- Component technical conditions (CTC) of supply and services
- Project specific general conditions (GTC), including standards, technical rules and specifications
- Technical guarantee conditions
- General and project commercial conditions (GCC & PCC)
- Various specifications and data (procurement schedule, documentation schedule, quality assurance, corrosion protection, inspection and testing plan and electrical, instrumentation and control field devices and equipment requirements)
- Necessary drawings, e.g. layout drawings

Purposely omitting a key piece of data in an RfQ package can be used as a way to check the supplier's product knowledge and attention to detail.[139]

Based on the specific locations of the qualified suppliers more detailed logistics estimates should begin to be compiled and RfQs given to potential logistics providers. Once received, these will give a more precise evaluation of the total landed costs.

[137] Cf. Interview with Mr Josef-Peter Köck (14.02.2012), supervisor at AE&E

[138] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011a), p. 8f.

[139] Cf. Interview with Mr Rainer Wurzinger (14.02.2012), CEO of WIR Techplan Zeichenbüro GesmbH & Co KG, responsible for sourcing in China for ANDRITZ

The following information should be sent to the logistics service provider:[140]

- Transportation specifications
  - Locations of potential suppliers and destinations
  - Description of modes of transport (road, rail, water)
  - Special transport items (e.g. hazardous materials, heavy and bulky transport)
  - Regulations regarding packaging
  - Transport labelling
  - Instructions for required individual shipping documents (such as customs invoice, packing list, shipping documents, source documentation, etc.)
- Material list
  - Volumes required
  - Declaration of unusual goods (e.g. based on a 40-foot shipping container: weight > 20 tons; dimension > 11900 x 2300 x 2400 mm (L x W x H))
  - Weight breakdown of all components
- Time schedule

Once the potential suppliers have been sent the RfQ packages, the company must wait for their response. This waiting process can itself play a role in the evaluation of the suppliers' initial offer and is explained further in the following section.

[140] Cf. Interview with Mr Manfred Taferner (28.03.2012), logistics manager at AE&E; Cf. ANDRITZ ENERGY & ENVIRONMENT (2011e), p. 3

6.3 Preliminary Offer Evaluation

Evaluating the return quote of a supplier is much more than just reviewing the data and price contained within it. There are other indicators both positive and negative that can be derived from the behaviour of the supplier during the process as well as the presentation of the offer.

- *Response time of quotation* – it is normal for a company to specify a time frame in the RfQ by which the supplier is encouraged to submit their quote. Unfortunately suppliers may not be able to meet this deadline and although usually granted, time extensions can result in set-backs to the whole project. Worse yet is when suppliers choose not to submit at all, which reduces the company's supplier selection options and may even require revisiting the supplier qualification process.
- *Quality of quotation* – the supplier is only expected to provide what was explicitly asked for in the RfQ, nothing more or less. Their conformance to the specific criteria requested is central to the final supplier selection. The quotation must be submitted in the English language with clear information and drawings.
- *Preliminary cost evaluation* – the initial quote price is merely a basis for further technical and commercial dialogues. Final contract award decisions are not made from this. Quotation prices at the extreme ends of the spectrum are usually an indication the supplier is incapable of providing the scope of supply and services or has understood the specifications incorrectly.[141] Any additional costs that may result from the selection of a certain supplier such as increases in logistics based on their location or training requirements, needs to also be taken into account.
- *Service* – service related benefits vary significantly between suppliers and often impact supplier selection considerably. The performance and product guarantees offered, potential contract longevity, customer service experience and general desire to accommodate requests should all be compared.

[141] Cf. Interview with Mr Rainer Wurzinger (14.02.2012), CEO of WIR Techplan Zeichenbüro GesmbH & Co KG, responsible for sourcing in China for ANDRITZ

These factors, derived from both the physical quote and also the supplier's behaviour give an initial indication of the suitability of the supplier to the company. The quote also acts as a tool to further narrow down the group of bidders. Once selected, the suppliers will be invited to meet for further negotiations.

6.4 Award Negotiation

Award negotiations must always be held in person as they involve demanding and detailed discussions. In low-cost countries it is paramount that all the people involved can converse in the English language or have a suitable translator present with adequate technical and business knowledge of the field. It is also important when negotiating in low-cost countries that the suppliers have someone in attendance with the authority to make decisions regarding the project. Negotiations aim to clarify and review all of the technical and commercial specifications that were outlined in the RfQ and the supplier submitted quote, ensuring a comprehensive understanding.

It is not unusual for negotiations to last for several days and it is recommended that the supplier and the company have experienced representatives from both their technical and purchasing departments present. Discussions should be continuously clarified and confirmed for understanding and intention, with key definitions and terms defined in writing to avoid subsequent confusion. A legal document is drafted and must be signed by the project manager of AE&E and a responsible party of the supplier as a record of what has being discussed in the negotiations.

This face-to-face meeting can give an indication how any future relationship will proceed. Suppliers that show flexibility and honesty are more likely to establish a good rapport. The additional details gathered in the award negotiations help to form a complete supplier package that can then be analysed for risks.

Parallel to these negotiations, the development of relations with the competent authorities in the suppliers' country is of vital importance to avoid blockages and delays.

6.5 Risk Analysis

Chapter 2.3 goes into detail about the various risks associated with global sourcing and what aspects need to be monitored and controlled.

AE&E holds a risk workshop for each project and utilises the process seen in Figure 6.4 to identify and analyse specific risks. The participants include all the AE&E employees that are involved in the project at all levels. As the workshop is for the entire project, not just for the sourcing of specific components, it reveals many other risks that may not have been apparent.

The aim and purpose of the risk assessment is:[142]

- Analysis of known risks
- Identification of new risks and setting priorities for risk management
- Capture the actual situation and work out corrective measures

Deviations or vagueness in the contract with regard to quality, costs, deadlines or other discrepancies will usually be exposed at this time.

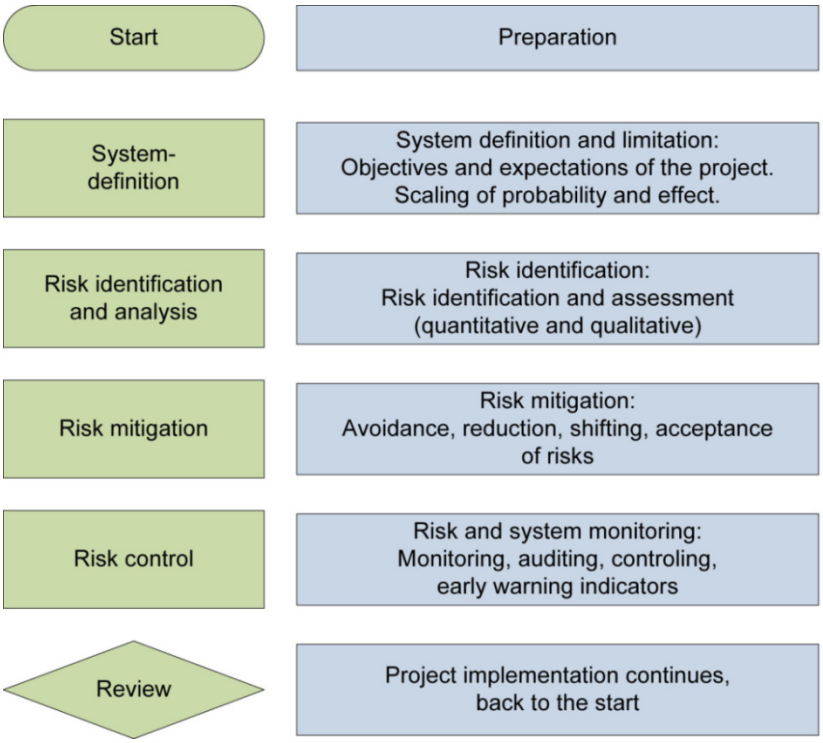


Figure 6.4: Risk analysis process at AE&E[143]

[142] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011d), p. 5
[143] ibidem

One of the key tools used to classify the risks in order of magnitude and urgency is the risk map / scenario analysis according to ONR 49000 / ISO 31000 as illustrated in Figure 6.5. The risks will generally be categorized into contracts risks, technical risks, project management risks and risks on the construction site. The vertical axis shows the qualitative assessment of the probability of occurrence and the horizontal shows the quantitative assessment of the maximum realistic effect.[144] Similarly to a traffic light system the risk map is divided into three levels. Red signifies risks that need to be acted upon immediately as they pose a real threat to the success of a project. Risks that fall within the yellow zone need to be monitored, however they, like the green zone risks, are usually tolerable.[145]

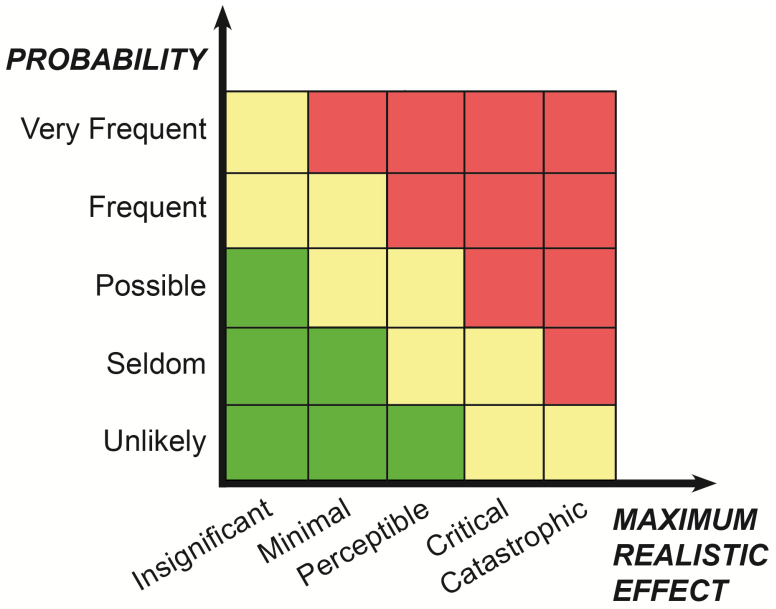


Figure 6.5: Risk map - AE&E[146]

[144] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011d), p. 3ff.
[145] Cf. FUCHS (2009), p. 142
[146] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011d), p. 8

6.6 Final Offer Evaluation

If the supplier pre-selection process has been successful, the company will have identified a number of suitable suppliers. Once initial impressions of the potential suppliers and their abilities are verified according to criteria, the challenge is to make the decision. Together with the project manager, this process should involve decision makers from all departments, including engineering, supply management, finance and quality management. In key decisions that have a strategic impact, top management should also be included.[147]

It is not unusual for the final selection to still be difficult and often many criteria must be carefully weighed again. Additional decision making instruments for selecting the contract awarded supplier are explained in detail in section 3.2. These are mainly comparative procedures and can be divided into quantitative and qualitative methods.

The most important aspects to compare between prospective suppliers are:

- *Technical terms and conditions* – the physical specifications of components, such as size, weight, performance, etc. are fundamental decision influencers.
- *Terms of payment* – this relates to the timeframes in which payments are to be made to the supplier. It is crucial to have terms that are fair to both parties and put neither in a high level of financial risk.
- *Total cost analysis* – it is essential when executing a total cost analysis that the quotes offer comparable parts and services. An in-depth look of total cost analysis is addressed in section 3.2.3.
- *Commitment to deadlines* – it is necessary for suppliers to meet the deadlines given to them so that the overall project time schedule is maintained.
- *Liquidated Damages (LDs)* – in order to ensure adherence to deadlines, performance guarantees and all other formal agreements, monetary penalties must be allocated. Liquidated damages are often the key to keeping projects on track. It is advisable to always calculate penalties as a percentage of a total cost in order to recuperate losses sufficiently.

[147] Cf. KERKHOFF (2005), p. 170

Throughout the entire supplier selection process, the behaviours and attitudes of the suppliers are also noted and taken into account during the final evaluation. These include issues such as:

- Response to problems and changes
- Accessibility of the contact person
- Willingness for cost transparency
- General conduct in negotiations
- Trustworthiness
- Speed of response

6.7 Purchase Award and Order Handling

Once a supplier has been selected, there are a few more steps before production can proceed. Firstly a purchase approval is required internally from the project manager and the supply management department. The supplier is notified and the contract awarded, before a formal placement of order is given to the supplier by the company. Contract awards in low-cost countries are best made in person, as at this point modifications and additions may arise. Having signed records of prior exchanges present will ensure there are no false claims made. Here, bank guarantees should also be administrated together with terms of delivery as explained in section 4.

Again, all contracts for international businesses should be in English. Where applicable, it is also valuable to have contracts governed by international laws, such as the United Nations Convention on Contracts for the International Sale of Goods (CISG).[148]

[148] Cf. CISEMA (2010), p. 24

6.8 Management of Engineering and Fabrication

In low-cost countries, engineering and fabrication processes require sound supervision from highly qualified and capable staff. It is necessary for all supervisors to be external to the supplier to avoid bias and objectively monitor and maintain quality, milestones and procedures. The amount of expenditure on supervision directly relates to the existing relationship with the supplier. During the first interactions with the supplier, especially in low-cost countries, a supervisor should be present for the entire production process. It is usual though, once a supplier's quality and reliability has been established and confirmed that supervision is only required at key points and milestones. For this reason, changing to a new supplier and developing them to the required quality standards is costly.[149]

6.8.1 Management of Engineering

The management of third party engineering services is an important part of ensuring the accurate execution of plans. The supplier's engineers are given time to detail their part of the engineering process after which their work is assessed and a formal progress check is made. At this point any required changes are made to their plans. It is common in low-cost countries for manufacturers to outsource their engineering services to an external company. These companies can be within the country or international. The collection, organisation and analysis of suppliers engineering deficiencies and weaknesses help to prevent failures, with corrective measures then being able to be formed and implemented.[150] Often the quantity of drawings provided by suppliers in low-cost countries is very high which initially gives a positive impression. When looked at closely though, it is likely that there is an absence of important information, such as weld strength, etc.[151] If all of the drawings and calculations provided are accurate, AE&E will then approve the documents for fabrication.

[149] Cf. Interview with Mr Peter Schreiber (08.02.2012), head of the department of supply management at AE&E

[150] Cf. Interview with Mr Josef-Peter Köck (14.02.2012), supervisor at AE&E

[151] Cf. Interview with Mr Christian Taucher (27.03.2012), project engineer at AE&E

6.8.2 Management of Fabrication

Here to, the qualification and experience of the supervisor is a key factor to quality and timely production. In low-cost countries when there is often a large geographical distance between the manufacturing workshop and the construction site, or when there is a short lead-time it is advisable, that a trial assembly occurs. It should be before transportation and it is vital when critical parts are concerned. This is because once off-site, the same machinery and tools are not available to make any large adjustments or changes. Precautions such as this reduce the risks and costs associated with schedule blowouts and the possible return and resupply of parts.

To inform the project manager of the fabrication processes progress, the supervisor of fabrication provides the following information for the assembly of each assembly lot:

- Availability of parts (status)
- Milestones (start and finish date)
- Work-related documents (work order, drawings, parts lists, assembly guidelines, assembly check list, if applicable)

A main feature of the fabrication process is the inspection and testing plan (ITP). The plan has a series of conditions that are checked at specific points during fabrication. Depending on the classification allocated to the criteria, repercussions vary. If not satisfied, production can be stopped or the entire component rejected by the client. Hence, the quality of the component can be directly influenced by the effective use of an inspection and testing plan. The plan should also act as a quality assurance to the client as its content and conditions are agreed upon and signed by all parties prior to commencement and it is legally binding.[152]

In low-cost countries with less experience in fabrication, country specific inspection and testing plans are often used. Internationally certified and component specific plans are preferable and should be given to, or developed with the supplier where possible. These should include standards, codes and regulations, such as the European or American standards, EN

[152] Cf. CISEMA (2010), p. 59

and ASME. Testing plans have to be approved by not only the supplier and AE&E, but also by their clients.[153]

While having tools for monitoring in place, it is also important to be involved in the manufacturing process to prevent and eliminate any fabrication deficiencies found, for example in defective and nonconforming parts. It is the supervisor's role to ensure that corrections are made as promptly as possible in order to maintain schedules and budgets.

6.9 Logistics Planning and Coordination

At ANDRITZ Energy and Environment GmbH (AE&E), external logistics service providers are required when sourcing components internationally. Logistics refers all of the transportation, documentation and costs, associated with moving the components from the place of fabrication to the installation location. The information in this chapter is the result of conversations with Mr Manfred Taferner, the logistics manager at AE&E.

6.9.1 Pre-qualification of Logistics Partners

The pre-qualification of logistics service providers begins during the supplier pre-selection stage. Requests for quotations (RfQs) are sent to logistics providers once the locations of potential suppliers have been determined. The specific contents of a logistics RfQ is detailed in section 6.2. The key point of this initial quote is to define terms of delivery as well as to get an estimation of costs for consideration in a total cost analysis.

Some enterprises place more emphasis on certain logistics factors than others, as can be seen in the research of PricewaterhouseCoopers (PwC) in section 4.

- *Employee qualification* – while it is important to have skilled and experienced staff on the logistics provider's team, it is hard to regulate and confirm. In low-cost countries it is preferable to use internationally recognised logistics companies as often they have standardised training for staff that is more reliable.

[153] Cf. Interview with Mr Simon Heber (23.04.2012), quality manager at AE&E

- *Reliability of delivery* – punctuality in the logistics industry is more than a primary business requirement, it is also the best quality indicator of a service provider. If a logistics service provider cannot keep to agreements and schedules in the tendering and pre-selection stage, they should not be considered further.
- *Locations* – having an office in the supplier's country is crucial as it signifies a thorough knowledge of local laws, restrictions, cultural customs, languages and communication. It is also fundamental that they have a similar familiarity with the destination country to ensure a smooth timely transfer.
- *Packing and transportation concept* – the appropriateness of the logistics providers plan for packing and transportation indicates a great deal about their experience and capabilities.

6.9.2 Transport Execution

The logistics manager at AE&E works closely with the logistics service provider throughout the supply and delivery stages. The monitoring and supervision of the supply chain is the internal responsibility of AE&E.

Control of Technical Approval, Readiness of Supply and Packing Lists

All parties involved in the project must make final technical approval in order for transport to proceed. This often occurs after the completion of a successful inspection and testing plan (ITP).

Prior to the movement of any goods, the availability of supply needs to be confirmed. The following verify readiness:[154]

- Delivery notification
    - Possible delivery date from the perspective of suppliers
    - Delivery location
    - Quantity, type, dimensions and weight of each package
    - Other necessary project-specific information
- Simplified quality and certification documents
- Preference certificates (proof of origin)

[154] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011e), p. 6

- Invoices from AE&E
- Wooden materials protection certificates

Package lists must be completed stating the exact content, weight and dimensions of the package. They are always to be issued in the English language and placed in waterproof envelopes. Copies are to be included within the package as well as attached to the outer surface.[155]

Delivery approval for the supplier

Once all documents are finalised and approvals received, the supplier is notified. Transportation of the components can then proceed via the selected logistics provider according to the terms of delivery as outlined in chapter 4.

Organisation and Supervision of Supply Performance and Administration of Transport and Custom Documents

In the AE&E business market, most of the parts required for their projects are large which limits the forms of transport available. International logistics processes can be divided into two key stages or sections, those relating to the port and country of origin and those relating to the destination country.

Below is a specific example of the many aspects of logistics that need to be addressed as seen when transporting components from China to Chile. These are taken from a business case study that is detailed in section 7.3.2.

Country of origin – CHINA:

- *Pre-shipment inspection* – it is advisable to check and approve the quantity and quality of goods prior to shipment as well as supervising and monitoring the loading and sealing of containers. This can avoid lengthy replacement deliveries for defective parts.[156]
- *Establishment of departure points* – the most suitable place of departure and appropriate type of travel within the country in relation to where the product was produced. Costs, restrictions, political instabilities and physical conditions are also influencers.

[155] Cf. ANDRITZ ENERGY & ENVIRONMENT (2011f), p. 6
[156] Cf. CISEMA (2010), p. 61

- *Provision of service package* – including all required certificates and documents as outlined previously in the readiness of supply. All documents must be in the contractual languages and follow formal regulations.
- *Selection of delivery routes* – as transportation routes become more lengthy and complex, uncertainties can arise. It is important to select delivery routes in terms of security, minimal distance and accessibility.
- *Time schedules* – design of time schedules along with their monitor and control.
- *Organisation of transport* – ensuring that modes of transport are coordinated in line with time schedules and/or amended to reflect changes that may arise. In addition to securing ship space within budget. In this case there are two possible modes of transport within the sea freight category. The differences are explained in chapter 4.
- *Timely export customs clearance* – this is a responsibility of the Chinese supplier or exporter and it is necessary that they have a valid export license to be able to export. The MOFCOM (Ministry of Commerce of the People's Republic of China) publishes an annual list of goods (www.gtai.com) for which an import and export license is necessary. Applications for these licenses must be submitted by the China-based importer or exporter.[157] Irrespective of this, when exporting to Chile, China operates under a Free Trade Agreement (FTA), explained further in section 7.1.1. This and other agreements with China promote exchange between the included countries and tend to worsen the position of exporters from other regions (see also section 2.1).[158] An "Export Processing Booklet" is also needed by customs to supervise and record the process.[159] If components are transported to the European Union, a EUR1 movement certificate is required. Particularly, when exporting from China, customs clearance must be made at least 24 hours prior to the loading of goods.[160] It is essential for AE&E's logistics manager to check the customs clearance and assist in obtaining one if the supplier cannot do so by themself.

[157] Cf. CISEMA (2012), p. 99
[158] Cf. CISEMA (2012), p. 32
[159] Cf. CISEMA (2012), p. 88
[160] Cf. THEUSNER / YUNLIN (2009), p. 254

- *Transport insurance* – the responsibility of AE&E, they have a blanket policy (Österreichische Kontrollbank AG - ÖKB) for all transportation, site installation and public liability insurance.

Destination country – CHILE:

- *Organisation of transfers* – handling the movement of goods from the sea freight carrier to onward inland transport, such as trucks or trains.
- *Import custom clearance* – the order and costs associated with receiving the goods in the destination country are the responsibility of AE&E. All documents need to be organised well in advance to prevent delays or rejection at the port.
- *Transport to site* – organising and ensuring parts reach the site on time and efficiently is paramount to keep to schedules and avoid added costs.

Figure 6.6 illustrates the flow of goods within international supply chains. It includes many of the stages and processes explained previously in this chapter.

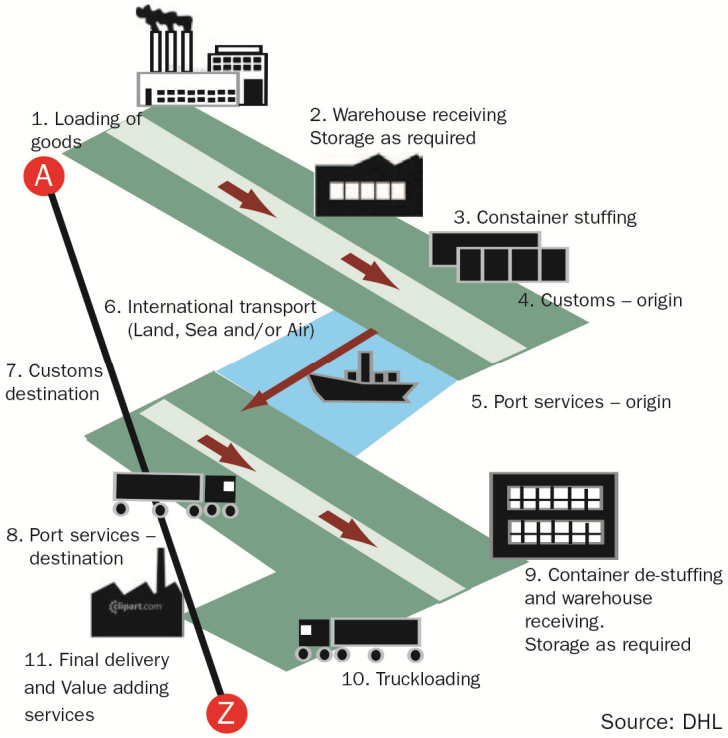


Figure 6.6: An example of the flow of goods in international supply chains[161]

[161] INSTITUTE OF MANAGEMENT ACCOUNTANTS (2008), p. 3

While in most projects a just-in-time (JIT) method of delivery for components is sought, it is difficult to obtain in AE&E projects as they often have varying installation and production schedules. This is amplified when sourcing components internationally as transportation times cannot always be guaranteed.[162]

6.10 Repair and Erection

With the incoming of goods including the receipt, unloading and posibble storage on site, the responsibility of the components fall to the installation provider. There is always the possibility for damage during transportation and/or problems with assembly with the sourced component. Documents, such as drawings, parts lists, installation work descriptions and any special tools that are required for the erection and/or repair of components must be included in the package of shipment. The commissioning of each plant is the responsibility of a commissioning manager who is a member of the project team. A successful trial on site results in the preliminary acceptance by the customer (PAC). Guidelines regarding the incoming of goods, installation and documentation as well as the acceptance declaration for components are all included in the AE&E manual for installation, commissioning and start up.

6.11 Supplier Evaluation

AE&E has an in-house document that is used for supplier evaluations. It assesses suppliers after all services requested have been provided. The evaluation is completed by the purchasing, technical, quality and all other departments that have been involved in the project. The quality, schedules and execution of the project are considered. It is vital that these evaluations be completed, as they benefit future projects where similar components may be required and can reduce expenditures on supplier pre-selection immensely. An example of AE&E's supplier evaluation form is presented in Appendix C.

[162] Cf. Interview with Mr Rainer Wurzinger (14.02.2012), CEO of WIR Techplan Zeichenbüro GesmbH & Co KG, responsible for sourcing in China for ANDRITZ

7 Business Case Study: Sourcing of an Induced Draft Fan from China

This chapter focuses on an existing project of ANDRITZ Energy & Environment GmbH (AE&E), in which an induced draft (ID) fan component of an air pollution control system was sought from China. This real business case is used to highlight the various aspects of sourcing in low-cost countries as well as specifics in relation to China. Supported by a description of the basics of dry flue gas cleaning, the framework outlined in chapter 6 is compared and reviewed in relation to the actual sourcing process that occurred in this project.

7.1 Analysis of Sourcing in China

The subsequent sections provide details about China and its current and future potential as an international destination of manufacturing and sourcing. This includes the development of foreign trade, changes in salaries, cultural characteristics, corruption and counterfeiting and the importance of China to AE&E as a sourcing location.

7.1.1 The Significance of China as a Sourcing Country

China is one of the most important production locations in the world. As one of the top three traders of merchandise, China along with the United States of America and Germany represent 28% of the total market.[163] High international investments show that more and more foreign companies want to take advantage of the benefits and savings China provides. Many companies are looking for new sources of supply to meet the increases in competitive pressure and low-cost procurement provides these opportunities.[164]

There are many countries globally that can provide cost savings for companies, but China's large ever-increasing production and manufacturing

[163] Cf. WORLD TRADE ORGANIZATION (2011), p. 8
[164] Cf. MAROHN (2009), p. 234f.

market is difficult to compete with. In 2007, for the first time, China surpassed the United States of America in export volume and was ranked second behind Germany.[165] With such a strong economy and market share, the question is how much longer will China continue to offer low-cost advantages and how can companies monitor its growth and still utilize the markets potential.

Figure 7.1 illustrates how the economy of China compares to other countries within the efficiency driven stage of development. Following on from section 2.4, this diagram is based on the Global Competitiveness Index (GCI), and shows that China is stretching well beyond the averages for most of the pillars in its stage. China's stable macroeconomic environment is ranked 11th in the world, and it still stands as one of the least indebted countries. This relative stability is one reason that foreign investment continues to stay strong.[166]

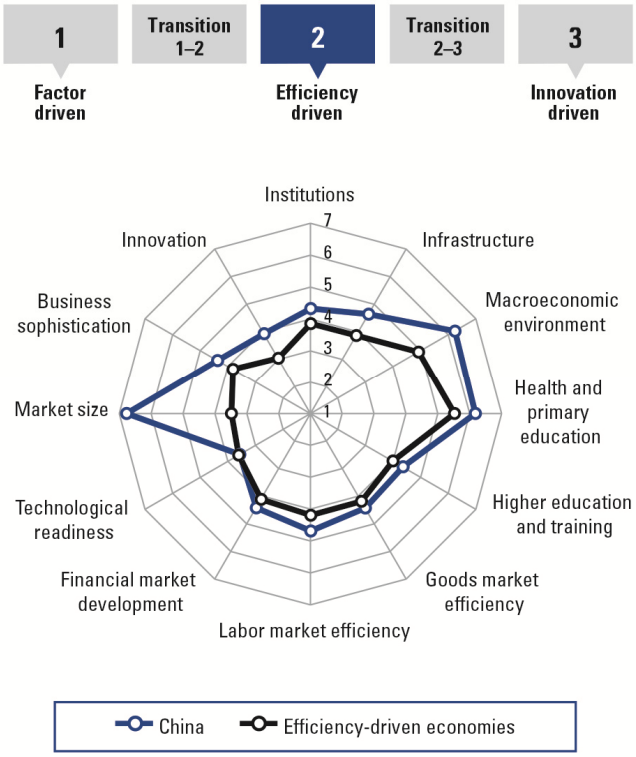


Figure 7.1: Stage of development[167]

[165] Cf. SCHMIDT / ZOLLENKOP (2009), p. 87
[166] Cf. WORLD ECONOMIC FORUM (2012), p. 8
[167] Cf. WORLD ECONOMIC FORUM (2011), p. 148

Foreign Trade

The People's Republic of China has been a member of the World Trade Organization (WTO) since December 2001. This has meant more openness and adaptation to internationally accepted trade rules, which has resulted in the introduction of the following:[168]

- International cooperation
- Participation in trading systems
- Adaptation of legislation
- Gradual reduction of tariffs
- Introduction of the most favoured nation (MFN) clause, all WTO countries (uniform tariff)
- Implementation of the General Agreement on Tariffs and Trade (GATT)
- Application of the WTO criteria for origin and customs valuation law
- Dismantling of quantitative restrictions
- Equal treatment of domestic and imported goods (TBT)
- Design of management fees to reflect actual expenditure
- Compulsory disclosure of export subsidies

Since China's accession to the WTO in 2001, their trade and current account surplus has been steadily increasing. As shown in Figure 7.2, a slight downward trend in 2009 can be attributed to the financial crisis. If the slowing trend in exports continues, this would be consistent with China's 12th five-year plan, which has a stronger focuses on domestic consumption.[169]

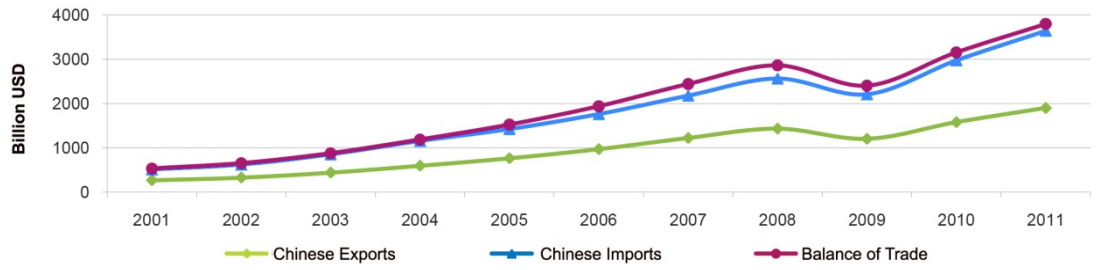


Figure 7.2: Foreign trade statistic China 2001-2011[170]

[168] Cf. CISEMA (2012), p. 33
[169] Cf. BOTSCHAFT DER REPUBLIK DEUTSCHLAND PEKING (2012), p. 2
[170] ibidem

China wants to expand its service sector and continue to push forward through the modernisation of industry. At present, the main attention is on infrastructure projects, with goals including increasing domestic demand and reducing the economy's dependence on foreign trade.[171]

Salaries in China

Due to these changes in the Chinese market, other factors, such as salaries will also change. Salary minimums increased by an average of 20 to 25% in 2010. These rises were much higher in coastal regions than inland. The current minimum salaries in Shanghai and Zhejiang are above RMB 1100, while in Shaanxi and Ningxia they are 40% lower (shown in Figure 7.3). This shows that coastal regions are becoming increasingly more expensive in terms of labour costs, however the transportation from inland regions to ports is still significantly higher.[172]

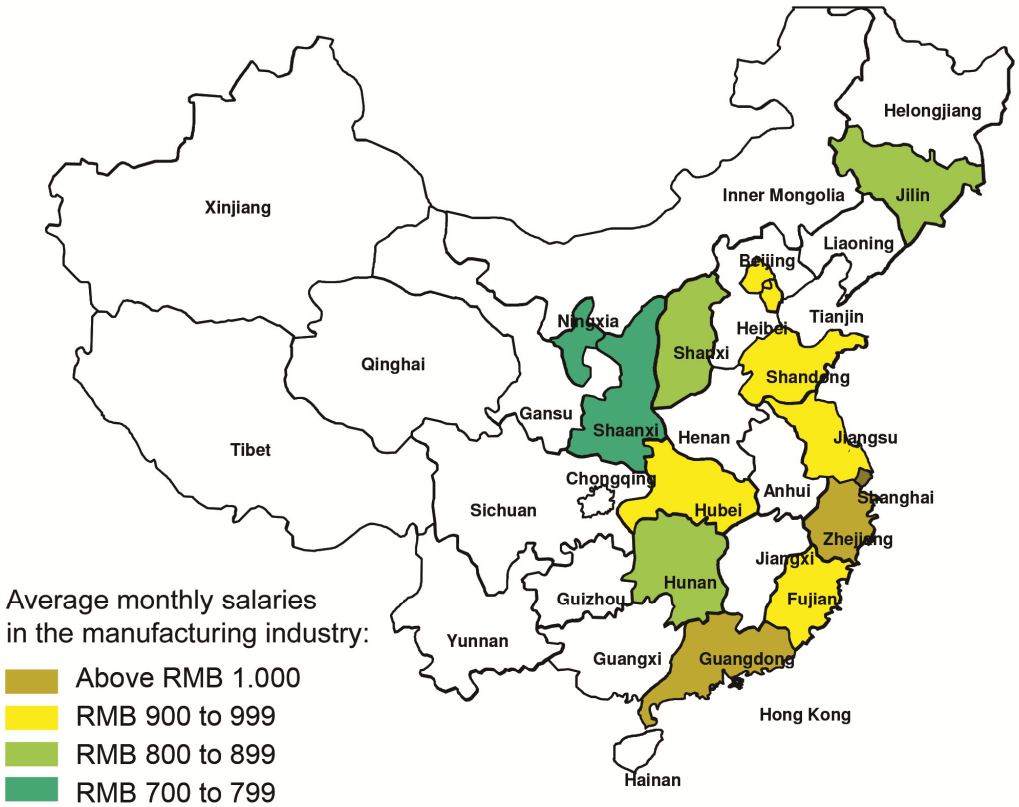


Figure 7.3: Monthly average salaries in China - Manufacturing industry[173]

[171] Cf. PRICEWATERHOUSECOOPER (2011), p. 10
[172] Cf. CISEMA (2010), p. 34
[173] Cf. ODM GROUP (2010), p. 1

Culturally specific characteristics of the Chinese market

Cultural differences within business relationships can often cause problems (see also section 2.5). China looks back with pride and respect to more than 5000 years of history and therefore it is even more important to understand the culture of potential business partners and to accept and adhere to certain rules of engagement. To assist in managing the differences there are two important Chinese cultural concepts for interrelationships in international businesses:[174]

- 面子 *Mianzi (face)* – a loss of face, even unintentionally, can destroy the business relationships foundation. The admission of failure means a "loss of face" to Chinese people, they find it difficult to admit an error and a direct rejection or a clear “No” is often avoided. Simply, mianzi is the reputation and the social status of a person.
- 关系 *Guanxi (personal network)* – Guanxi does not mean "cronyism", but rather the need for connectedness to family, relatives, friends and colleagues. This is not necessarily extended to a loyalty towards the company for which they work. However, this often means successful business is only made between friends and social interaction should occur before a business exchange.

Summarized tips for intercultural bridging in China:[175]

- Tread lightly
- Respect the local culture
- Pay attention to hierarchies
- Contact the chief operating decision maker
- Do not push for decisions
- Use local intermediaries
- Develop long-term goals
- Not too many words - but keep your word!

Large parts of China are dominated by traditional cultures that date back thousands of years. With globalisation, these cultures now need to coexist with the dynamic business world that in many cases has brought with it a corrupt cadre across regions and institutions.[176]

[174] Cf. CISEMA (2010), p. 71ff.; Cf. GOERRES / WANG (2009), p. 384ff.
[175] Cf. CHU (1996), p. 106ff.
[176] Cf. GOERRES / WANG (2009), p. 383

Corruption and Counterfeiting in China

Corruption and other economic crimes are also a serious problem in China. China ranks 79 among the world's 180 nations in the Corruption Perception Index (CPI). Transparency International determines this index annually. Its position shows that the Chinese government still has a long way to go in its fight against corruption. The State has recently reaffirmed to strengthening the fight against corruption through preventive measures and establishing a stronger system of control and monitoring.[177]

In the People's Republic of China, there are deficiencies in many areas of the enforcement and implementation of national guidelines at provincial and district levels. Furthermore, in some provinces of China plagiarism production is a highly profitable industry that provides jobs for entire regions. A few of the reasons for this situation are listed:[178]

- Local governments benefit from the counterfeiting through tax revenues, and often have a stake in companies that produce fakes
- Law enforcement personnel are corruptible
- In Chinese tradition, learning means, first imitating the teacher

Importance of China for AE&E

Like many other international companies, AE&E operates in China for the benefits it presents. In addition to those facts above, China is significant, particularly to AE&E as they have already an established office in Shanghai with local employees. Cultural and language differences can be addressed and dealt with effectively by having employees with local knowledge. It also helps facilitate initial contact, negotiation and communication with Chinese manufacturers and suppliers when they are addressed in their local language. AE&E Shanghai is responsible for market research such as what components and parts are available in the Chinese market and which suppliers would be suitable. AE&E Shanghai also supports project execution and progress reporting in China. It is essential that AE&E enforces standards

[177] Cf. PRICEWATERHOUSECOOPER (2012b), p. 30
[178] Cf. MAROHN (2009), p. 228f.

of practice and quality at their branch in Shanghai while accommodating the local culture.[179]

Also a member of the ANDRITZ Group, ANDRITZ Technologies China Ltd. (ATC) is based in Foshan and has the largest quality assurance department in the group. AE&E can use ATC's experience and knowledge in China, including their quality managers for current and future projects. This utilizes the existing capacities of the ANDRITZ Group to which it belongs.[180]

7.1.2 Savings Potential vs. Risks of China

While the general aspects associated with global sourcing processes are explained in chapter 2.3 and those special to low-cost countries are detailed further in chapter 2.5, there are additional opportunities and threats specific to China. Figure 7.4 shows a SWOT (Strengths-Weaknesses-Opportunities-Threats) analysis of the potential savings and risks associated with China.

Figure 7.4: SWOT Analysis – China's savings potential vs. risks[181]

[179] Cf. Interview with Mr Josef-Peter Köck (12.04.2012), supervisor at AE&E
[180] ibidem
[181] Cf. CISEMA (2010), p. 15

Strengths

- *Cost structure* – undoubtedly the most important reason for global sourcing is the opportunity to reduce material and overhead costs.[182] Likewise, the costs of energy and land are usually lower than in Western Europe. Moreover, other countries may have to pay less tax or have lower ecological related costs due to lower or no environmental regulations.[183] While China's wages have increased quickly, their rates are still more competitive than those in the developed world with the overall gap in wages continuing to widen.[184]
- *Motivation of employees* - in comparison to Germany, people in China work an average of 40% more, due to less holidays, sick leave etc.. Employees are also motivated by non-monetary benefits in their contracts, including in some cases housing and the education of their children.[185]
- *Speed of building up capacities* – with such a large workforce at their disposal increasing capacity through the employment of staff is a viable option for suppliers. The capital from overseas buyers can also be used to expand factories and production volumes.[186]

Opportunities

- *Reduction of trade barriers* – explained further in the foreign trade section in 7.1.1, China's international trade agreements have allowed greater access to their market for imports, exports and investment.
- *Participation in China's growing market* – with the sheer size of the Chinese market, huge opportunities can arise particularly with its rapid growth. Overseas companies can take advantage of this through either selling goods to the market or investing in Chinese production facilities.[187]

[182] Cf. KERKHOFF (2005), p. 37; Cf. MELZER-RIDINGER (2004), p. 83
[183] Cf. GRAF (2006), p. 8f.
[184] Cf. ACCENTURE (2011), p. 4
[185] Cf. International Chamber of Commerce Austria seminar by Mr Stefan Fischer (15.05.2012), CEO of CISEMA GmbH
[186] Cf. AMINPOUR / WOETZEL (2006), p. 114
[187] Cf. VESTRING (2005), p. 4

- *Best price through China's internal competition* – in international procurement activities, the potential number of suppliers' increases, putting pressure on existing domestic suppliers and hence intensifying competition. This may contribute to a reduction in costs with domestic suppliers adjusting prices to remain competitive.[188]
- *Internationalisation* – China's ever increasing drive to meet international standards for trade, confirms to overseas companies the possibility of increased quality and reliability.

Weaknesses

- *Expenditure on communication* – time and costs associated with communication and translation in China are comparatively high as there is a low level of business English. Translation mistakes, incorrect interpretations and time differences that impede workflow can all be seen as expenditures.[189]
- *Supervision and representatives' expenses* – as discussed previously like other low-cost countries, China requires additional supervision to execute projects, especially in new business ventures. In their culture, a personal visit is valued highly, with a larger entourage suggesting a more genuine interest from the company in the relationship. Though, this can be costly.[190]
- *Level of influence on quality* – "Trust, but verify." This Russian proverb aptly describes how the approach to quality assurance should be in China. Sample products shown by the supplier should be checked for consistency with the actual fabrication quality. Drawings and specifications need to be explicit and frequent quality inspections carried out. Having capable and experienced staff present or using third party services in China to conduct these inspections is paramount.[191]

[188] Cf. GRAF (2006), p. 8f.

[189] Cf. CISEMA (2010), p. 16

[190] Cf. Interview with Mr Rainer Wurzinger (14.02.2012), CEO of WIR Techplan Zeichenbüro GesmbH & Co KG, responsible for sourcing in China for ANDRITZ

[191] Cf. KROKOWSKI (2009), p. 187f.

- *Employee fluctuation* – wages and working conditions have been blamed for increasing employee turnover in China. In some industries numbers as high at 50% have been recorded.[192] In response, Foxconn (in the Guangdong Province), for example, raised the salary of their factory workers from 900 RMB to 2,000 RMB a month.[193] This indicates that companies need to spend more, to ensure employee satisfaction and retention and also avoid loss of invested time and money on training new staff.

Threats

- *Reliability of delivery* – keeping to dates of completion often requires external drivers in Chinese factories. If there are other clients' components being made in the factory, the quantity of supply might favour the client providing the supplier with more revenue. Constantly stressing and reminding the supplier of the importance and significance of the part to the project helps to maintain supply. In China the customs office is often in a position of power and customs clearance times vary, also impacting reliability.[194]
- *Legal uncertainty* – many Chinese laws are ambiguous and having access to lawyers with knowledge of the rules and regulations are key. China has an insufficient number of independent courts with not enough tough sentences against offenders. Local governments are often more interested in local interests and do not implement or enforce all national legislation.[195]
- *Corruption and product piracy* – a detailed explanation of counterfeiting in China can be found in chapter 7.1.1.
- *Currency fluctuations* – because the Chinese currency Renminbi (RMB) is pegged to the USD, it is more predictable than RMB to EUR. The People's Bank of China decides on an exchange rate that remains fixed relative to the USD.[196] In long term contracts between

[192] Cf. SCHMIDT / ZOLLENKOP (2009), p. 99

[193] Cf. ACCENTURE (2011), p. 4

[194] Cf. Interview with Mr Rainer Wurzinger (14.02.2012), CEO of WIR Techplan Zeichenbüro GesmbH & Co KG, responsible for sourcing in China for ANDRITZ

[195] Cf. SCHUELLER (2008), p. 13

[196] Cf. VON DER WETH (2009), p. 257

European and Chinese business partners, currency fluctuations represent large financial risks. These can be mitigated through methods, such as Non-Deliverable Forward (NDF).[197]

- *Chinese standards, codes and regulations* – the national Chinese standards, called GUOBIAOs (GBs), are mainly based on Japanese standards, but also American and German. Depending on their internationalism, not all suppliers follow ore are able to follow international standards. Suggesting GBs to suppliers that are similar to international standards is often easier for them to understand.[198]

7.1.3 Comparison of China with other Low Cost Sourcing Markets

Before entering the Chinese procurement market, an in-depth analysis of China's situation in relation to the purchasing strategy of the company should be completed. In the event China is not compatible, other low-cost countries may be an option including Eastern Europe and India, which are characterised below.[199]

Eastern Europe

Since the early 1990s, Eastern European countries have been the focus of purchasing for West European companies. This was solidified with the creation of the European Union and large numbers of established production facilities in the area.[200]

Besides regional proximity, Eastern European countries have many other advantages over China as a sourcing market, including already conforming to many standards and administrative and legal systems in the European Union. With few exceptions, the countries are politically stable and have rather minor climatic and transport-related risks, unlike China. The level of foreign language for younger, well-educated staff is very good. The difficulties of Eastern Europe exist in its heterogeneity and the languages and cultures of their respective countries. Eastern Europe also tends to lag in the

[197] Cf. SCHROEDER (2009), p. 238
[198] Cf. VINCK (2009), p. 184f.
[199] Cf. SCHMIDT / ZOLLENKOP (2009), p. 97ff.
[200] ibidem

high-tech sector currently still behind China as a sourcing market. Traditional industries such as metallurgy, chemicals and electronics, are still relatively wide spread.[201]

India

India is one of the most innovative and powerful nations in information technology, pharmaceuticals and biotechnology.[202]

India offers a number of advantages over China, with Western European companies continuing to find their feet more easily in the country. Partly due to India's long history of British colonisation, the workforce has a consistently good knowledge of the English language, as well as the advantage of being exposed to Western management methods. In general, India is still seen as the centre for software and China for hardware – colloquially known as the global service centre and the "factory of the world".[203]

[201] Cf. SCHMIDT / ZOLLENKOP (2009), p. 97ff.
[202] Cf. KERKHOFF (2005), p. 129
[203] Cf. SCHMIDT / ZOLLENKOP (2009), p. 97ff.

7.2 Basics of Dry Flue Gas Cleaning / TURBOSORP®

The business case study described in the following chapter focuses on the sourcing of an induced draft (ID) fan from China. This chapter provides an overview of the TURBOSORP® air pollution control system from which this component is a critical part.

TURBOSORP® from AE&E is a dry flue gas cleaning process for pollutant removal in which the high chemical-physical mass and heat transfers of a circulating fluidized bed (CFB) are utilized. The concept is shown in Figure 7.5. This method can separate many harmful acidic components, such as sulphur dioxide (SO_2), hydrogen chloride (HCl), hydrogen fluoride (HF), sulphur trioxide (SO_3), dust, mercury, other heavy metals, and dioxins / furans.[204]

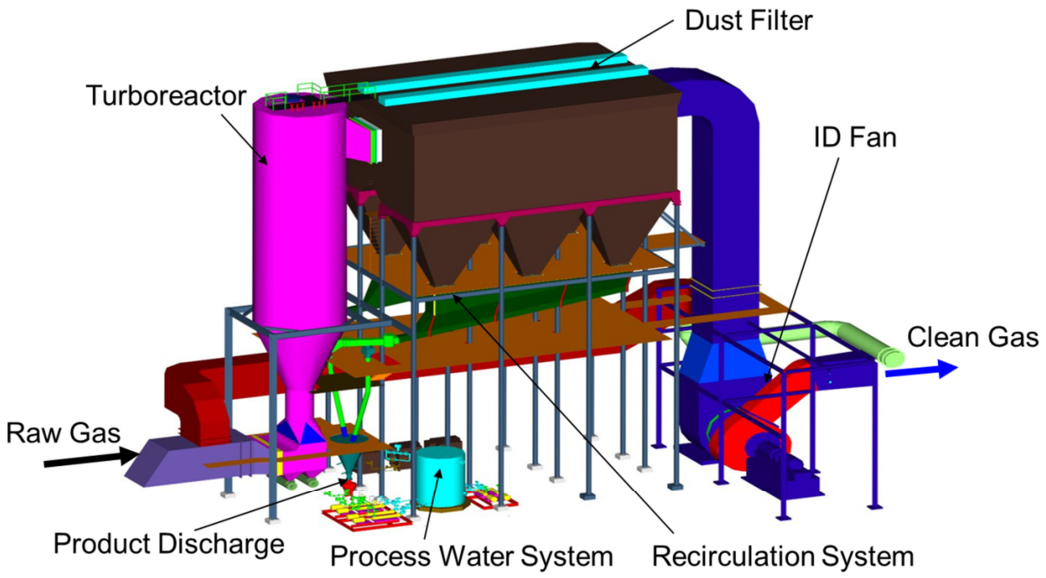


Figure 7.5: TURBOSORP® - Concept[205]

TURBOSORP® falls into two categories, flue gas desulphurisation (FGD) and flue gas dechlorination (FGC). The FDG application mainly removes sulphur dioxide and trioxide (SO_x), whereas the FGC focuses on the removal of hydrogen chloride and hydrogen fluoride. An important aspect of dry flue gas

[204] Cf. ANDRITZ ENERGY & ENVIRONMENT (2008), p. 5
[205] ANDRITZ ENERGY & ENVIRONMENT (2010a), p. 4

cleaning is that it is a wastewater free process. Activated lignite or hydrated lime can be used as a sorbent.[206]

Figure 7.6 illustrates the process flow of a TURBOSORP®. In the turboreactor, a turbulent contact between the flue gas, fresh sorbent and the recirculated product occurs. The flue gas is cooled by water injected at the optimum operating temperature. Some of the solid particles leave the turboreactor with the flue gas and are separated in the downstream fabric filters. Separation efficiency is impacted by the cooling, the increase of water fraction and the interim formation of a liquid phase on the surface of dust particles. The pollutants, sulphur dioxide, sulphur trioxide, hydrogen chloride and hydrogen fluoride are highly bound in this process. If required, fresh sorbent fed with a lignite coke provides high separation of heavy metals and dioxins / furans through adsorption. The bound sulphur trioxide reacts further to sulphuric acid (H_2SO_4) on the surface of the lignite coke and provides a chemical binding of mercury (Hg) as mercury sulphate ($HgSO_4$).[207]

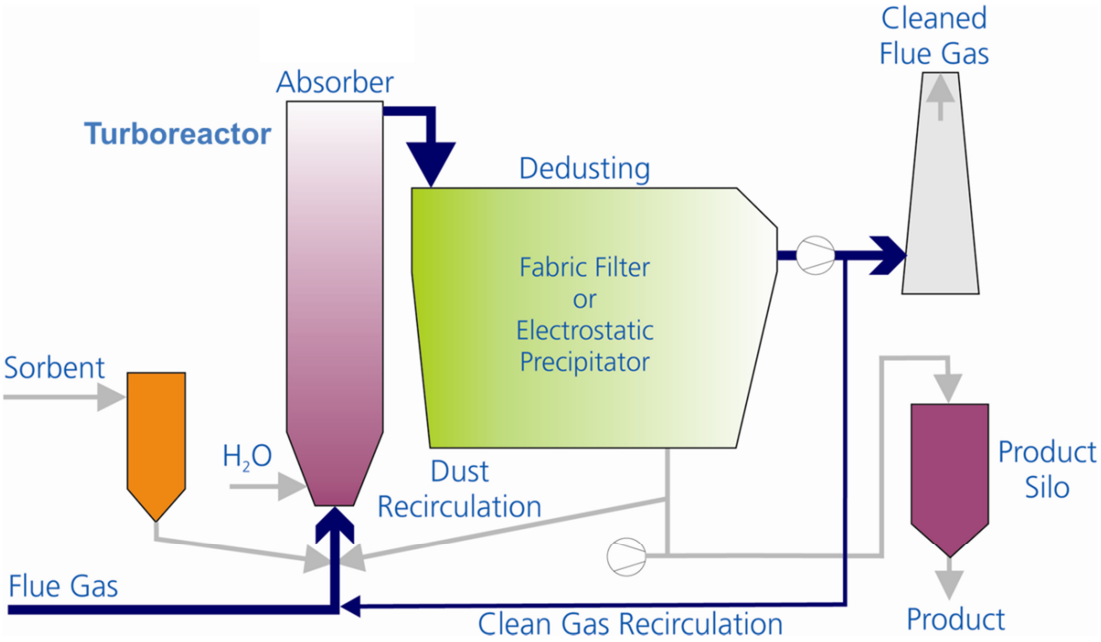


Figure 7.6: TURBOSORP® - Process flow diagram[208]

[206] Cf. ANDRITZ ENERGY & ENVIRONMENT (2008), p. 5f.
[207] ibidem
[208] ANDRITZ ENERGY & ENVIRONMENT (2010a), p. 6

Figure 7.7 shows a schematic diagram of the solids recirculation of a dry flue gas cleaning system / TURBOSORP®.

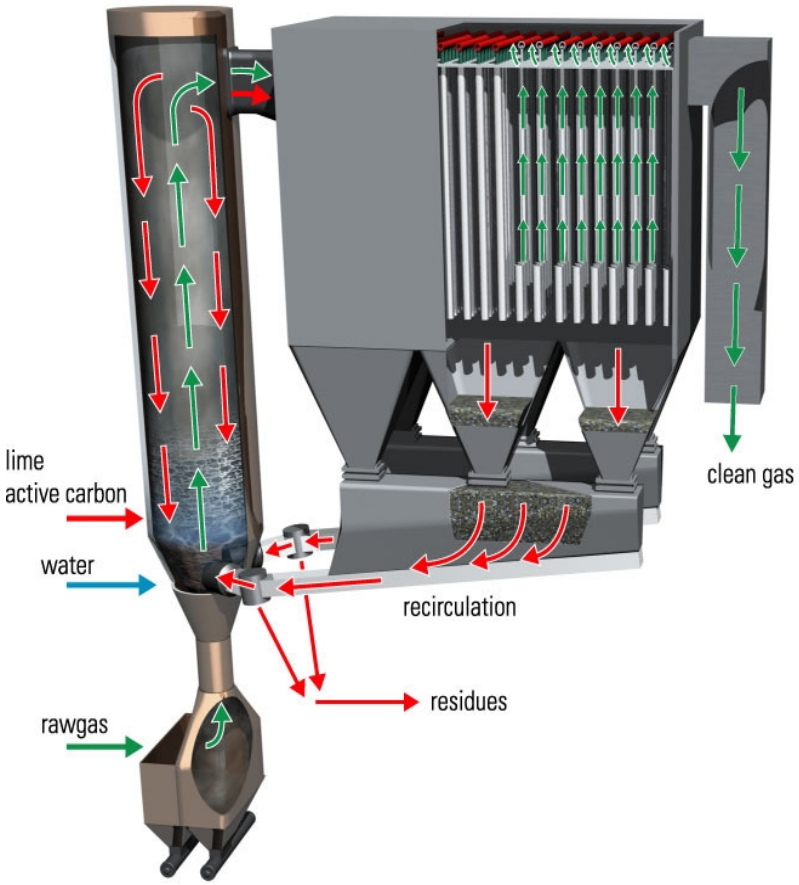


Figure 7.7: Schematic diagram of the solids recirculation[209]

The dust filter is the second stage of flue gas purification. Similar chemical reactions to that in the turboreactor occur in the accumulating residue. The exhaust gas, which has to be cleaned, enters the filter via a centrally located channel, before being passed through the filter chambers. The raw gas flows through the filter medium from outside to inside, while the solids adhere to the outer sides of the filter hose (shown in Figure 7.8). This forms an auxiliary layer and supports the filtration.[210]

[209] ANDRITZ ENERGY & ENVIRONMENT (2010a), p. 4
[210] Cf. ANDRITZ ENERGY & ENVIRONMENT (2008), p. 6

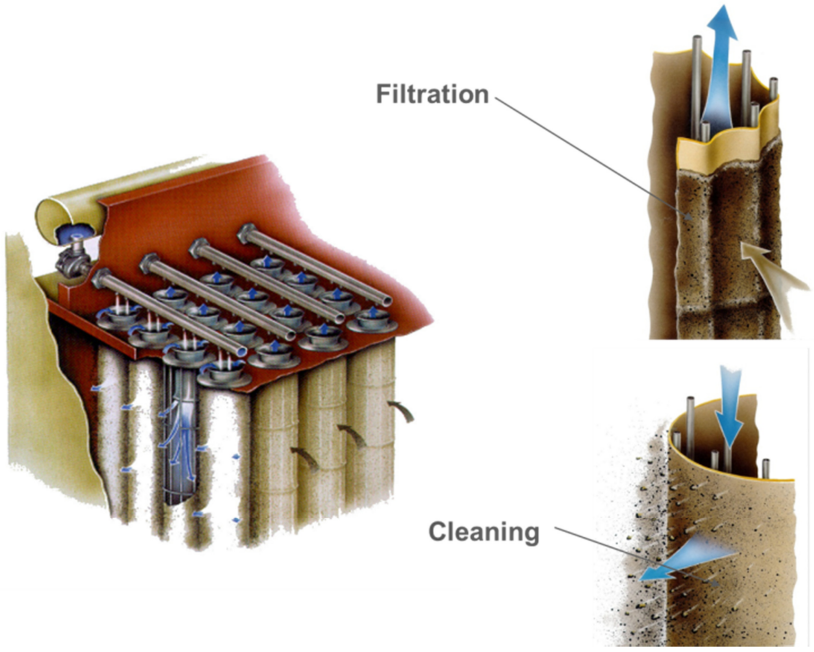


Figure 7.8: Fabric filter / Pulse jet filter[211]

The majority of the deposited material from the filter recirculates in the reactor with a solid recirculation system, consisting of two pneumatic fluidized bed channels, each with a metering roller. This leads to long residence times and high utilization of the raw material, which is characteristic of the method. In addition to saving fresh sorbent, the resulting residue quantity is also minimized. Only a small part of the solid material from the fabric filter is removed as product.[212]

[211] ANDRITZ ENERGY & ENVIRONMENT (2010a), p. 33
[212] Cf. ANDRITZ ENERGY & ENVIRONMENT (2008), p. 6

7.3 Sourcing of the Induced Draft Fan

In this business case the international sourcing of components is for two large on-going AE&E projects in Chile. This is a very significant endeavour for AE&E as it is the first time they have attempted to source components from China having previously only sourced steel (see chapter 5). It also represents their first venture into the South American market. Because of the tight schedule and short lead times (the procurement schedule for the ID fan is shown in Appendix D), elements of the framework were completed out of order or not at all. This is reflective of many projects where external influences demand changes in the planned structure.

Each gas cleaning system is fitted with one induced draft (ID) fan. The fan has the task of compensating the flue gas pressure drop throughout the whole system and is located between the fabric filter and the chimney (also shown in chapter 7.2.

As part of the project team, the first-hand experience and knowledge gained was used to further develop and complete the proposed framework herein. The AE&E project team, including Mr Klaus Glawogger the project manager and person responsible for sourcing components for this project, provided the information used in this section.

7.3.1 Project Specific Details

For the offshore portion of the project, including the ID fan, the contract currency is in USD. Two currency conversion rates are required as payment is also divided between AE&E Graz and AE&E Shanghai. The rates of conversion from EUR / USD and RMB / USD are hedged at the time of contract signing.

VAT, customs and import duties are all borne by the customer. The client is the registered importer, but AE&E is responsible for the entire import process and to ensure minimal import duties for the customer.[213]

[213] Cf. Interview with Mr Manfred Taferner (26.06.2012), logistics manager at AE&E

7.3.2 Execution of Sourcing for the Induced Draft Fan

As this is an on-going project, the sourcing process of the ID fan is analysed only up until the final supplier selection stage. Like many real world projects, time and funding limitations among other things mean that often not everything is completed as anticipated.

Supplier Qualification

For the projects in Chile there was a preliminary search for suppliers which used valuable time in a project with not much to spare. This was due to the cost intensive nature of supplier auditing, especially that required for the Chinese suppliers.

In the case of sourcing in China, screening of the supplier is the task of the office of AE&E Shanghai. The reason for this is their existing experience with Chinese suppliers and ability to know the circumstances around finding the right supplier for the requested component.

It was the responsibility of AE&E Shanghai to distribute the supplier details questionnaire to potential suppliers and obtain as much additional information as possible regarding their component specific experience, financial standing, present workload, and exporting experience. As mentioned in section 7.1.1 it is also their task to establish on-going relationships and complete scheduled audits with the suppliers. Supplier audits are conducted in conjunction with the quality assurance and control department (QA/QC) of AE&E Graz.

Even if the supplier has all the required certificates, it is essential, especially in China, to execute a full supplier audit. It is important to note that in China quality management certificates are often only available in Chinese and thus need to be translated or verified by other means.[214]

[214] Cf. Interview with Mr Simon Heber (23.04.2012), quality manager at AE&E

Request for Quotation

Following supplier qualification five requests for quotation were dispatched to the selected potential Chinese suppliers. Unfortunately, while AE&E intended to source the ID fan from China, only three quotes were received and thus quotes were requested from two existing Western European suppliers for comparison. The contents of and procedures regarding requests for quotation are defined in detail in section 6.2.

No obligation quotes were collected from the potential logistics providers, in which the key was to determine the terms of delivery. In this project the reasons for choosing either the FCA (Free Carrier) or FOB (Free on Board) Incoterms are (terms of delivery are explained further in chapter 4):[215]

- A small time frame window
- Import customs
- That the logistics provider assume full responsibility of transportation
- To manage the process more effectively
- Flexibility with port of export and delivery times

In the award of transportation services, the contracted company must have an A license for Chinese domestic transport. The A license also covers the entire sea and air freight forwarding services to and from China and the project business within China including storage and handling of goods as well as the issue of Renminbi (RMB) receipts. With the permit, which is granted very restrictively, the company can operate throughout the entire Chinese market.[216]

Preliminary Offer Evaluation

After receiving initial quotes from suppliers, it could be seen that the Chinese quotes where not of a high quality. This was because the Chinese suppliers first sent AE&E Shanghai their proposal packages, which were partly in the Chinese language and needed to be translated. This was time consuming, left room for errors and reduced overall quality through translation.

[215] Cf. Interview with Mr Manfred Taferner (26.06.2012), logistics manager at AE&E
[216] Cf. CISEMA (2012), p. 28

A preliminary cost comparison revealed unexpected results, with the difference in price between all the suppliers much smaller than anticipated. Surprisingly one of the Chinese quotes was higher than that of one from Western Europe. While this gave a general indication of costs, AE&E found that there were many more aspects to clarify and questions in relation to the suppliers bids.

After discussing with AE&E possible ways to reduce costs, one of the European suppliers also provided alternative locations to Germany for the manufacturing of parts of the ID fan. With a sister company in Brazil and contacts in Chile, the supplier thought costs could be reduced by having these parts made closer to the construction site in one of these low-cost countries. After looking at total costs more closely, the amount of expenditure required for external supervision from Europe would void any costs savings made, thus disqualifying it as an option. This was despite the fact, that time and money would have been saved in logistics.

Award Negotiation

Because substantial changes occurred to the project after the supplier audits, all five of the quoted suppliers were invited to award negotiations. This was even though two of the Chinese suppliers did not satisfy the minimum requirements of the audit.

Negotiations where held with the three eligible Chinese suppliers at the office of AE&E Shanghai. Lasting a week, the project team in Shanghai was supported by the project manager, head of supply management and the project engineer responsible for the ID fan from AE&E Graz. An issue that arose in China was that none of the representatives from the Chinese suppliers were proficient in the English language and all conversations needed to be interpreted to the AE&E Graz team.

It is important to question and confirm all of the elements offered in the suppliers quote and any supplementary documents provided. An example where a supplier failed at this questioning occurred in China when a reference list provided was almost entirely fabricated. Sufficient verifiable information could not be provided regarding export projects and was requested to be submitted at a later date.

A positive seen in the negotiations with Chinese suppliers is that they had a strong desire to build future relationships with international companies. Due to this they were very accommodating and keen to raise their quality and technology standards to the appropriate levels.

Supplier negotiations with the two Western European suppliers were held at AE&E Graz, where all technical and commercial clarifications were made. Because AE&E had existing business relationships with these suppliers, technical details specific to the project could be examined in more depth.

Risk Analysis

A formal AE&E risk analysis workshop (see section 6.5) was conducted for the entire project in which the following problems both specific and more generally about China where identified:[217]

- Chinese suppliers must be controlled and monitored precisely by the terms outlined in the agreement, such as schedules and quality. Periodic progress reports are therefore a necessity.
- In China, suppliers prefer to operate at capacity. If not satisfied they may seek other contracts, neglecting the project with less revenue.
- For time critical components it is important to send reminders in order to stress how important their role in the project is.
- Unforeseeable changes and repairs required during the installation process of projects with a tight time schedule can result in increasing costs, such as penalty payments.
- Exchanging information between AE&E Graz, AE&E Shanghai and then the supplier is time consuming and creates opportunities for mistakes through handling, translation and cultural differences.
- As this was AE&E first venture sourcing components in China, there was not a sufficient knowledge of the market.

These risks for sourcing the ID fan in China were likely to have jeopardised the overall project schedule. By producing sub-quality parts, delays could arise in the workshop as well as during installation, the latter also creating claim potential for the installation provider.

[217] Cf. Results of the risk management workshop for the Chile projects of AE&E on the 14./15.06.2012

Final Offer Evaluation

In projects, even more so for those with a short lead time such as this, it is not unusual for changes to arise after requests for quotation have been received. New data or changes to processes and specifications can be sent and quick responses are needed from the supplier in order to progress. Because of the language difficulties explained previously and a comparative lack of experience, the Chinese suppliers were not capable of executing these changes efficiently. The Western European suppliers actually provided suggestions and alternative solutions for issues and changes raised, showing a superior knowledge and level of experience that was highly desirable.

Following the supplier analysis before mentioned, only two emerged as suitable candidates for the contract award, an existing German supplier of AE&E and a new supplier from China. AE&E Shanghai completed a bid evaluation report similar to the scoring model explained in section 3.2.2 to recommend the final Chinese supplier. The other two Chinese suppliers were disqualified from consideration due to insufficient quality standards. The remaining European supplier was not selected due to a large increase in quoted cost following the inclusion of the late changes to the project.

Initially, when comparing offers from the Chinese supplier and the European supplier, the former appeared to provide a better quote in terms of pricing. However, after closer analysis, a number of problems were discovered with the Chinese proposal and supplier:

- Could only supply two radial fans, the other two would be axial fan. This would have technical implications and impact on the already strained layout
- Did not provide a valid reference list of export projects
- Would require significant additional supervision of fabrication
- Gave unsatisfactory technical clarification during negotiations
- An additional liaison engineer would need to be supplied from AE&E in Austria for the component execution, increasing costs substantially

The available information showed a tendency to award the contract outside of China. A total cost analysis would be used to determine who would receive the contract award.

When preparing the final cost analysis for the ID fan it was important to include all relevant cost variables, as listed in section 3.2.3.

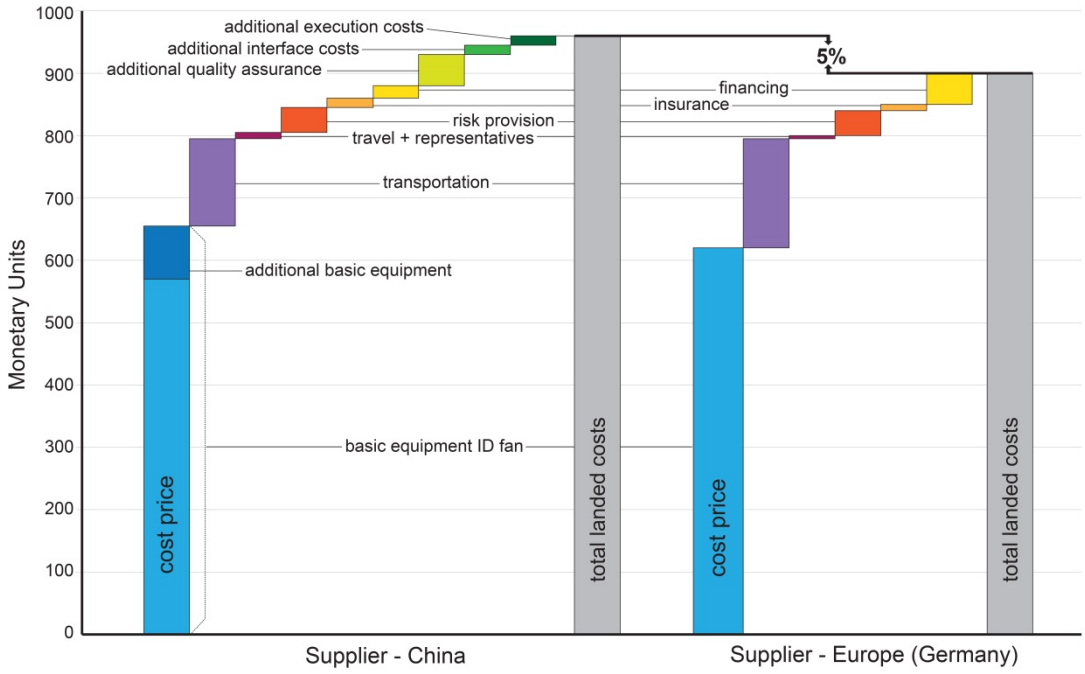


Figure 7.9: Total Landed Costs ID fan - Supplier comparison[218]

Appendix E shows the total cost breakdown of the two final suppliers. Figure 7.9 visually represents this data. When comparing basic equipment, the Chinese supplier accrued costs associated with workshop layout changes and the need for additional equipment. The Chinese total cost evaluation was also increased because of quality assurance variables and the need for extra support staff from AE&E Graz and Shanghai.

The transport rates were assumed by Mr Manfred Taferner, logistics manager at AE&E, for costs incurred after leaving the suppliers quoted port up until the point of installation. It is important to note that the Chinese quote for seaworth packaging and transportation to port was much lower than that of the German supplier and may be questioned for accuracy. Data relating to supplementary costs were provided by Ms Elisabeth Pozar, commercial project manager at AE&E.

[218] Own illustration, all data is not reflective of actual project costs

8 Results and Conclusion

While under optimum conditions the framework proposed would ideally be executed in full for all international sourcing, companies often cannot achieve this due to short lead times and inadequate resources. It is vital however, particularly in the process of sourcing in low-cost countries that adequate time schedules and funding are allocated and decisions made with a long term outlook instead of short term, project specific solutions.

For the business case study in section 7.3, because of the short timetable it was not possible to find the right supplier from a low-cost country. For the induced draft (ID) fan, the Chinese suppliers could not provide the required quality standards, international experience and cost savings desired and after completing the evaluation process, the contract was awarded to the European supplier. In spite of this, other parts of the project were still purchased from China. It is projected that 10% of the overall budget for the project will be allocated to goods from China, indicating that the results from the ID fan procurement are not applicable across the board. The ID fan example revealed that European suppliers can certainly compete with Chinese suppliers from an expected technical standpoint but also in terms of pricing.

The ID fan plays a major part in the calculations and functioning of the system it is within and therefore is a critical component. In future, which parts or components are qualified for sourcing in countries with a probable lower quality standard or high expenditures in quality development should be weighed carefully against the potential cost savings. Moving forward, ANDRITZ Energy & Environment GmbH should use facilities and experience from international purchasing offices (IPO's) within the ANDRITZ Group to help to develop and establish long term relationships with new suppliers.

Mr Stefan Fischer, CEO of Cisema GmbH, an experienced service and consultant company for China revealed in a seminar[219], that as a general rule of thumb, the cost price (acquisition price) of a Chinese supplier must be on average 30% lower than that of the European supplier in order to be profitable. As the saying goes "you get what you pay for!" and quality in low-

[219] Cf. International Chamber of Commerce Austria seminar by Mr Stefan Fischer (15.05.2012), CEO of CISEMA GmbH

cost countries comes at a price. Primarily, decisions should be based on the ratio of price to quality, however the know-how and efficiency of the supplier should also be taken into account.

Outlook for China

The 12th five-year plan for China was announced in 2011 by the residing government. One of the fundamental differences with this plan from previous ones is that instead of encouraging exports and investment, stronger domestic consumption is recommended to drive growth. The five-year plan also provides manufacturers with new challenges. Rising wages, stricter compliance requirements and higher taxes will lead to higher costs in an already competitive market. The intense competition for qualified personnel has already lead big international companies to rethink staff recruitment and development.[220]

The government also aims to reduce carbon dioxide emissions by 40 - 45% by 2020. Key goals to achieve this include the development of gas-fired power plants and the improved efficiency, safety and implementation of environmental regulations for coal-fired power plants. This, in conjunction with predictions that China will have 220 cities with over a million people by 2030[221], creates huge consumer market potential for AE&E in China, particularly with their focus on air pollution reduction and clean energy. With many other countries in the Asia Pacific region implementing significant carbon dioxide reduction policies, including Australia and Japan, it seems fit that China will follow, however experts anticipate it to be considerably further in the future.[222]

China, in the medium to long term, still remains a highly attractive procurement market. Many top managers agree, with one from Germany quoted saying: "It may be a mistake to get involved in the Chinese economy. But not being active in China is a much bigger mistake."[223]

[220] Cf. PRICEWATERHOUSECOOPER (2012b), p. 49
[221] Cf. PRICEWATERHOUSECOOPER (2012b), p. 38
[222] Cf. PRICEWATERHOUSECOOPER (2012a), p. 20
[223] Cf. SCHMIDT / ZOLLENKOP (2009), p. 99

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Abbreviations

acc.	according
AE&E	ANDRITZ Energy & Environment GmbH
AESH	ANDRITZ Energy & Environment Shanghai
APC	Air Pollution Control
ASME	American Society of Mechanical Engineers
BANF	Bestellanforderung (purchase requisition)
BC	Before Christ
CTC	Component Technical Conditions
DIBt	Deutsches Institut für Bautechnik
DIN	Deutsche Industrie Norm
e.g.	for example
EN	Europäische Norm (European standards)
EU	European Union
FGC	Flue Gas Dechlorination
FGD	Flue Gas Desulphurisation
FCA	Free Carrier
FOB	Free On Board
GB	Guojia Biaozhun (national Chinese standards)
GCC	General Commercial Conditions
GTC	General Technical Conditions
GmbH	Gesellschaft mit beschränkter Haftung (company with limited liability)
HSE	Health, Safety and Environment
i.e.	id est
ICC	International Chamber of Commerce
ID	Induced Draft
ISO	International Organization for Standardization

K.O.	Knock Out
LCC	Low Cost Country
LCCs	Low Cost Countries
LCCS	Low Cost Country Sourcing
MOFCOM	Ministry of Commerce of the People's Republic of China
NDF	Non-Deliverable Forward
ONR	Rules of the Austrian Standards Institute
PAC	Preliminary Acceptance Certificate
PBoC	People’s Bank of China
PCC	Project specific Commercial Conditions
PRD	Product Requirement Documents
QA	Quality Assurance
QC	Quality Control
QM	Quality Management
RfQ	Request for Quotation
RMB	Renminbi (Currency of the People’s Republic of China)
SGU	Sicherheit, Gesundheit und Umwelt
TLC	Total Landed Costs
USD	United States Dollar
VAT	Value Added Tax
vs.	versus
WTO	World Trade Organisation

Appendix A Countries/economies at each stage of development

Stage 1: Factor-driven (37 economies)	Transition from stage 1 to stage 2 (24 economies)	Stage 2: Efficiency-driven (28 economies)	Transition from stage 2 to stage 3 (18 economies)	Stage 3: Innovation-driven (35 economies)
Bangladesh	Algeria	Albania	Argentina	Australia
Benin	Angola	Belize	Barbados	Austria
Bolivia	Armenia	Bosnia and Herzegovina	Brazil	Bahrain
Burkina Faso	Azerbaijan	Bulgaria	Chile	Belgium
Burundi	Botswana	Cape Verde	Croatia	Canada
Cambodia	Brunei Darussalam	China	Estonia	Cyprus
Cameroon	Egypt	Colombia	Hungary	Czech Republic
Chad	Georgia	Costa Rica	Latvia	Denmark
Côte d'Ivoire	Guatemala	Dominican Republic	Lebanon	Finland
Ethiopia	Guyana	Ecuador	Lithuania	France
Gambia, The	Honduras	El Salvador	Mexico	Germany
Ghana	Iran, Islamic Rep.	Indonesia	Oman	Greece
Haiti	Jamaica	Jordan	Poland	Hong Kong SAR
India	Kazakhstan	Macedonia, FYR	Russian Federation	Iceland
Kenya	Kuwait	Malaysia	Slovak Republic	Ireland
Kyrgyz Republic	Mongolia	Mauritius	Trinidad and Tobago	Israel
Lesotho	Paraguay	Montenegro	Turkey	Italy
Madagascar	Philippines	Morocco	Uruguay	Japan
Malawi	Qatar	Namibia		Korea, Rep.
Mali	Saudi Arabia	Panama		Luxembourg
Mauritania	Sri Lanka	Peru		Malta
Moldova	Syria	Romania		Netherlands
Mozambique	Ukraine	Serbia		New Zealand
Nepal	Venezuela	South Africa		Norway
Nicaragua		Suriname		Portugal
Nigeria		Swaziland		Puerto Rico
Pakistan		Thailand		Singapore
Rwanda		Tunisia		Slovenia
Senegal				Spain
Tajikistan				Sweden
Tanzania				Switzerland
Timor-Leste				Taiwan, China
Uganda				United Arab Emirates
Vietnam				United Kingdom
Yemen				United States
Zambia				
Zimbabwe				

Figure A.1: Countries/economies at each stage of development[224]

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Appendix B Supplier details questionnaire AE&E

	Initiator (Andritz)	Name:	E-mail:

1.	**COMPANY** *(Please provide all required details)* ***Unternehmen*** *(Bitte alle erforderlichen Angaben machen)*			
	General / *Allgemeines*	Office / *Büro*	Workshops / *Werkstätten*	
	Name	"CompanyName"		
	Address / *Anschrift*			
	Phone / *Tel.*			
	Fax			
	E-mail			
	Website			
	Commercial Register / *Firmenbuch*			
	Legal form of company *Rechtsform*	Identification no. *Eintragungsnummer*	Court of Registry *Registergericht*	D-U-N-S-No. "www.upic.de"
				123456789
	Supplier Bank Details *(For payment of invoice purposes)* *Details der Bank des Lieferanten (für Zahlungszwecke)*			
	Account Name / *Kontobezeichnung*			
	Swift			
	Bank Name & Branch Address *Name der Bank und Anschrift der Filiale*			
	IBAN			
	Key Figures / *Wichtigste Kennzahlen*			
	Yearly Turnover / *Jahresumsatz*		m EUR / *Mio. EUR*	
	Export Percentage / *Exportanteil*		%	

2.	**CLASSIFICATION** *(Please indicate classification by **X**) /* ***Klassifizierung*** *(Zutreffendes mit **X** ankreuzen)*			
	Standard Line Products *(go to ch. 6, 7, 8)* *Standardprodukte (zu Kap. 6, 7, 8, 9 gehen)*		Engineering Design Services *(go to ch. 6, 7, 8, 9)* *Engineeringleistungen (zu Kap. 6, 7, 8, 9 gehen)*	
	System Supplier (Engineering, Manufacturing, Erection & Commissioning) / *Systemlieferant (Engineering, Fertigung, Montage & IBS)*		Consultant *(go to ch. 3, 6, 7, 8, 9)* *Consulting (zu Kap. 3, 6, 7, 8, 9 gehen)*	

	Component Supplier / *Komponentenlieferant*		Inspection Services *(go to ch. 3, 8, 9)* *Inspektionsleistungen (zu Kap. 3, 8, 9 gehen)*		
	Steel Fabricator / *Stahlproduzent*		Transport / Shipping *(go to ch. 8, 9)* *Transport / Versand (zu Kap. 8, 9 gehen)*		
	Site Construction / Installation *(skip ch. 5 only) Baustellenfertigung / Montage (nicht Kap. 5)*		Other *(specify) Sonstiges (angeben):*		

3. INSURANCES (Certificates of Currency) *(See ch. 2 for applicability)*
VERSICHERUNGEN (laufende Polizzen) (Siehe Kap. 2 zur Anwendbarkeit)

		Policy No. / *Polizze Nr.*	Expiry date *Ablauf-datum*		Policy No. / *Polizze Nr.*	Expiry date *Ablauf-datum*
	Public Liability *Allgemeine Haftpflicht*			Professional Indemnity *Berufshaftpflicht*		
	Motor Vehicle & Equipment Kfz & Ausrüstungen			Workers Compensation Arbeiterun-fallversicherung		
	Other (specify) Sonstige (angeben)					

4. ORGANISATION *(See ch. 2 for applicability)* / *ORGANISATION (Siehe Kap. 2 zur Anwendbarkeit)*

	Management Board / *Vorstand*				
	Technical / *Technisch*				
	Commercial / *Kaufmännisch*				
	Responsible persons for / ***Verantwortliche Personen*** *für*				
	Design Department / *Auslegung*				
	Procurement / *Beschaffung*				
	Production / *Fertigung*				
	Sales / *Verkauf*				
	Shipment / *Versand*				
	Quality Department / *Qualitätsabteilung*				
	Staff / *Personalstand*	2010	2009	2008	2007
	Total / *Gesamt*				
	Thereof / *davon* (if applicable/ *falls zutreffend)*				
	Design Department / *Auslegung*				
	Procurement / Beschaffung				
	Production / *Fertigung*				

	Construction Site Work Force / *Baustellenpersonal*				
	Quality Department / *Qualitätsabteilung*				

5. WORKSHOP / *WERKSTÄTTE*

	Total / ***Gesamt***	m^2		
	Thereof / davon			
	Under Cover Work Area *Arbeitsfläche in Hallen*	m^2	Open Area / *offene Flächen*	m^2
	Roofed in Area *Überdachte Flächen*	m^2	Storage Yard / *Lagerflächen*	m^2
	Type of Heavy Fabrication Work *Art der Fertigung schwerer Teile*			
	Type of Light Fabrication Work *Art der Fertigung leichter Teile*			

6. SCOPE OF CAPABILITIES *(Please briefly describe capabilities, if applicable)*

LEISTUNGSUMFANG *(Bitte kurze Beschreibung der Leistungsmöglichkeiten, falls zutreffend)*

	Products / *Produkte*	
	Services / *Leistungen*	
	Fabrication / *Fertigung*	
	Special Capabilities *Besondere Fähigkeiten*	
	Hardware / Software	

7. CAPABILITY CERTIFICATIONS AND MANAGEMENT CONTROLS *(See ch. 2 for applicability)* / ***NACHWEISE UND STEUERUNGSHANDBÜCHER*** *(Siehe Kap. 2 zur Anwendbarkeit)*

7.1 Current Company Certification(s) *(Please indicate by X - then go to ch. 7.2, 7.3)*

Laufende Firmenzulassungen *(Bitte mit X ankreuzen, dann zu Kap. 7.2, 7.3 gehen)*

	ISO 9001		DIN 18800-7		ON M 7812	
	ISO 14001		PED 97/23/EC		Manufacturers Competency Declaration EN 12952-2 Annex F-2 / *Herstellererklärung EN 12952-2*	
	OHSAS 18001		AD HP0		Others / *Sonstige*:	
	AS/NZS 4801:2001 Safety		AD W0			
	SCC		EN ISO 3834, (EN 729)			

	ASME (A, E, M, S, PP, U, U2, V)		TRD 100		No System Certifications - *(Go to ch. 7.2, 7.3) / Keine Systemzulassungen (zu Kap. 7.2, 7.3 gehen)*	

7.2 System Manuals / *Systemhandbücher*

	Quality Management System Manual *Qualitätssicherungshandbuch*	Revision		Date *Datum*	
	Occupational Health and Safety (OHS) Management System Manual *Handbuch für Arbeitssicherheit und Gesundheit*	Revision		Date *Datum*	
	Environment Management System Manual *Umweltmanagementhandbuch*	Revision		Date *Datum*	

7.3 System Compliance Records / *Unterlagen zur Einhaltung von Systemanforderungen*

	Can the Company demonstrate records to show compliance with the applicable local OHS and Environment Acts and Regulations, with respect to the design and operation of its product(s)? *Kann das Unternehmen Unterlagen zum Nachweis der Einhaltung der lokalen Bestimmungen zu Arbeitssicherheit, Gesundheit, Umweltschutz und der anderen Vorschriften für die Auslegung und den Betrieb ihrer Produkte vorlegen?*		*Yes or No* *Ja oder Nein*
	Does the Company maintain OHS and Environment Performance Statistics for its operations? *(applicable to Site Construction / Installation)* *Führt das Unternehmen Statistiken zu Arbeitssicherheit, Gesundheit und Umweltschutz im Zusammenhang mit dem Betrieb des Werkes? (betreffend Baustellenarbeit und Montage)*		
	Will the Company be prepared to undergo formal on-premises Systems Audit? *(applicable to Steel Fabrication, Construction, Engineering Services)* *Ist das Unternehmen bereit einen formellen Systemaudit direkt am Werksgelände durchführen zu lassen? (geltend für Stahlbau, Fertigung, Engineeringleistungen)*		
	Will the Company be prepared to undergo on-premises inspection and assessment? *(applicable to Steel Fabricator classification)* Ist das Unternehmen bereit Inspektionen und Beurteilungen direkt am Werksgelände durchführen zu lassen? *(geltend für die Beurteilung als Stahlbaufertiger)*		
	Does the Company have Management Representative(s) for the Quality / OHS / Environment management of any of these functions? *Hat das Unternehmen auf Managementebene Verantwortliche für Qualität / HSE / Umweltmanagement für eine dieser Funktionen?*	QM / *QM*	
		OHS / *HSE*	
		Environment *Umwelt*	
	Contact Person as Representative(s) for Quality / OHS / Environment Management *Kontaktperson als Vertreter für Qualität / HSE / Umwelt-management*		
	Contact Person e-mail for Product / Service enquiries *Kontaktperson mit e-mail für Produkt- / Leistungsanfragen*		

8.	**ATTACHMENTS** *(Indicate by **X** and include the attachments (as applicable) to this questionnaire)* ***ANHÄNGE*** *(Bitte mit **X** ankreuzen und die Anhänge (falls zutreffend) diesem Fragebogen beilegen)*	
	Company profile / Scope of capability / *Firmenprofil / Leistungsmöglichkeiten*	
	Company organisation chart / *Firmenorganigramm*	
	Customer / Project reference list / *Kundenliste / Projektreferenzliste*	
	List of machinery & capacities e.g. plate rollers, presses, welding, O/H cranes, heat treatment facility *Maschinelle Ausstattung und Leistungen, z.B. Blecheinroller, Pressen, Schweissgeräte, Hallenkräne, Wärmebehandlungsanlagen*	
	OHS frequency rates: Medical Treat Injury, Lost Time Injury *(over last 1 year) (applicable to Site Construction / Installation classification)* *Häufigkeit von Zwischenfällen betreffend Gesundheit und Sicherheit: medizinische Behandlung nach Verletzungen, durch Verletzungen verlorene Arbeitszeiten (im letzten Jahr) (betreffend Baustellenarbeit und Montage)*	
	Incidents reportable to local Environmental Authority *(over last 1 year) (applicable to Site Construction / Installation classification)* *An Umweltschutzbehörden zu meldende Zwischenfälle (im letzten Jahr) (betreffend Baustellenarbeit und Montage)*	
	Certificates *(see ch. 7.1) / Zeugnisse (siehe Kap. 7.1)*	

9.	**QUESTIONNAIRE COMPLETED BY SUPPLIER** *(Details of person authorised to complete Questionnaire)* ***FRAGEBOGEN AUSGEFÜLLT DURCH DEN LIEFERANTEN*** *(Angaben über die zur Ausfüllung bevollmächtigte Person)*					
	Name		Position *Funktion*		Date *Datum*	"Datum"

Sign / *Unterschrift*: _____ Date / *Datum*: _____

Please return fully completed questionnaire, <u>with</u> nominated attachments in 8!

Bitte den vollständig ausgefüllten Fragebogen <u>mit</u> den in Kap. 8 angeführten Anhängen zurücksenden!

10.	***Beurteilung durch Andritz Energy & Environment (auszufüllen von Andritz)*** ***Estimation from Andtritz Energy & Environment (to fill from Andritz)***	
	Beurteilung durch Einkauf / *Estimation from purchasing*	Name:
	Sign / *Unterschrift*: _____ Date / *Datum*: _____	
	Beurteilung durch QMS / *Estimation from QMS department*	Name
	Sign / *Unterschrift*: _____ Date / *Datum*: _____	

Table B.1: Supplier details questionnaire AE&E[225]

[225] ANDRITZ ENERGY & ENVIRONMENT (2011b), p. 1ff.

Appendix C Supplier evaluation AE&E

ANDRITZ Energy & Environment GmbH

LIEFERANTENBEWERTUNG

Projekt:					**Lieferant:**		
Projekt Nr.					**Kreditor Nr.**		
Bestellnr.:							
Bestellgegenst.:					**BEWERTUNGSPUNKTE**		
BEURTEILUNGSKRITERIEN	**EINKAUF**	**BEDARFSTRÄGER**	**QUALITÄT**	**SONSTIGE**			
TQ/QUALITÄT							**0**
ANFORDERUNGEN ERFÜLLT					0,0		
TECHNISCHER STANDARD					0,0		
VORHAND.QUAL.SYSTEM					0,0		
PERSONALQUALIFIKATION					0,0		
VORHAND. ZULASSUNGEN					0,0		
QUALITÄT ZULIEFERANT					0,0		
HÄUFIGK. TECHN./QUALT.MÄNGEL					0,0		
QUAL.AUSSAGEN AUS ABNAHMEN					0,0		
GESAMTDURCHSCHNITT/SUMME					0,0		
TE/ TERMIN							**0**
ENDTERMINE					0,0		
ZWISCHENTERMINE					0,0		
DOKUMENTATIONSTERMINE					0,0		
ANGEBOTSTERMINE					0,0		
SONSTIGE TERMINZUSAGEN					0,0		
GESAMTDURCHSCHNITT/SUMME					0,0		
AW / ABWICKLUNG							**0**
QUALIT. DER DOKUMENTATION					0,0		
VERHALTEN BEI PROBLEMEN					0,0		
VERHALTEN BEI ÄNDERUNGEN					0,0		
REAKTIONSZEITEN					0,0		
GESAMTDURCHSCHNITT/SUMME					0,0		
GESAMTBEWERTUNG							

EINKAUF DATUM UNTERSCHRIFT	BEDARFSTRÄGER DATUM UNTERSCHRIFT
QUALITÄT DATUM UNTERSCHRIFT	SONSTIGE DATUM UNTERSCHRIFT
EINKAUFSLEITUNG DATUM UNTERSCHRIFT	BEMERKUNG

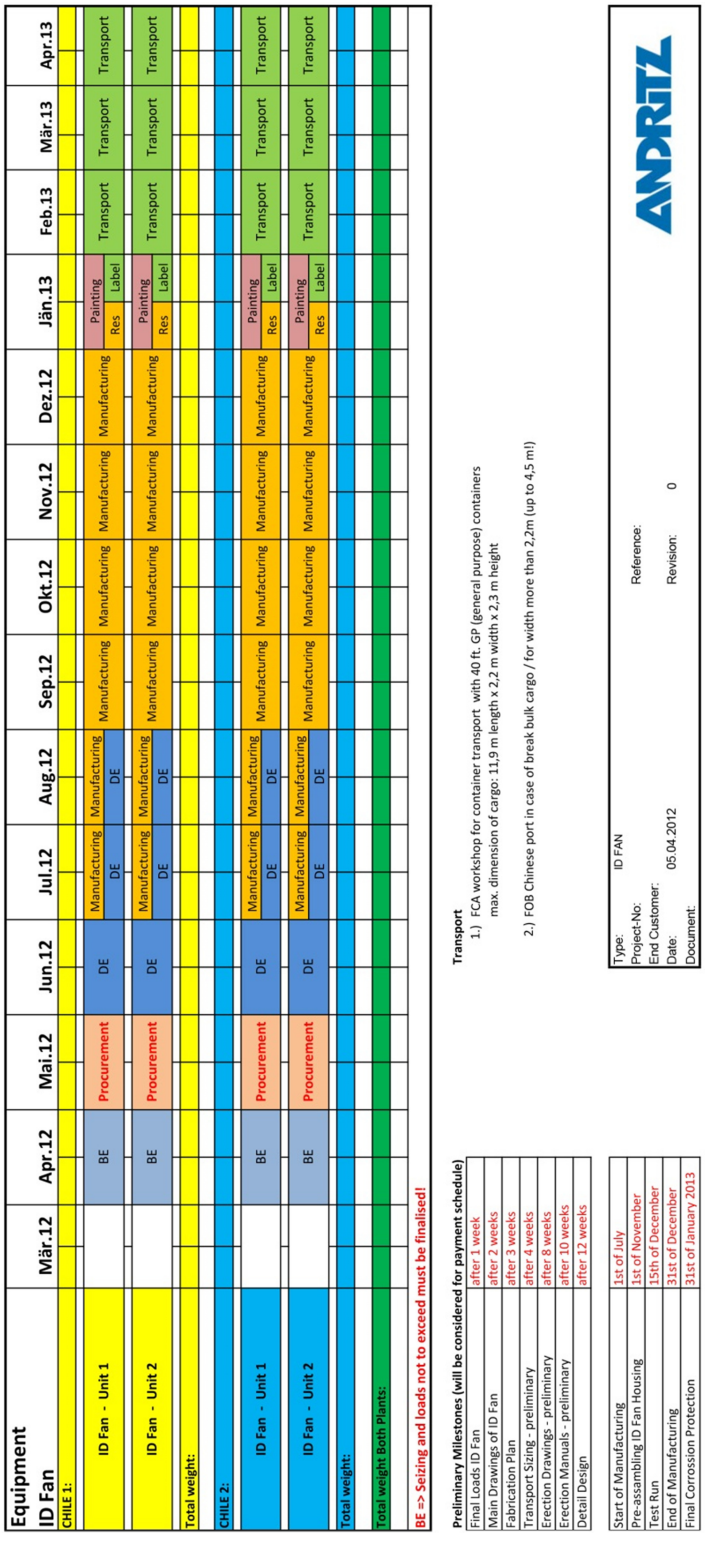
1)	TQ	TE	AW
10 =	SEHR GUT	EXAKTE EINHALTUNG	Sehr gut
20 =	GUT	Keine TE-Probleme	Gut
30 =	AUSREICHEND	Fallw. TE-Probleme	normal
40 =	SCHLECHT	öfter TE-Probleme	normal
50 =	SEHR SCHLECHT	LFD. TE-Probleme	sehr schlecht

2) ES MÜSSEN NICHT ALLE EINZELKRITERIEN BEWERTET WERDEN.
3) EINE ZWISCHENBEWERTUNG AUF ZWISCHENSTUFE 5 (z.B. 15) IST ZULÄSSIG.
4) A/B/C BEWERTUNG
A = 10 bis 16 PUNKTE
B = 17 bis 26 PUNKTE
C = 27 bis 40 PUNKTE
5) SPERRE DES LIEFERANTEN: ab 35 PUNKTEN (GESAMTBEWERTUNG)

Table C.2: Supplier evaluation AE&E[226]

[226] ANDRITZ ENERGY & ENVIRONMENT (2011f), p. 1

Appendix D Procurement schedule - Induced draft (ID) fan



Equipment ID Fan	Mär.12	Apr.12	Mai.12	Jun.12	Jul.12	Aug.12	Sep.12	Okt.12	Nov.12	Dez.12	Jän.13	Feb.13	Mär.13	Apr.13
CHILE 1:														
ID Fan - Unit 1		BE	Procurement	DE	Manufacturing DE	Manufacturing DE	Manufacturing	Manufacturing	Manufacturing	Manufacturing	Painting Res / Label	Transport	Transport	Transport
ID Fan - Unit 2		BE	Procurement	DE	Manufacturing DE	Manufacturing DE	Manufacturing	Manufacturing	Manufacturing	Manufacturing	Painting Res / Label	Transport	Transport	Transport
Total weight:														
CHILE 2:														
ID Fan - Unit 1		BE	Procurement	DE	Manufacturing DE	Manufacturing DE	Manufacturing	Manufacturing	Manufacturing	Manufacturing	Painting Res / Label	Transport	Transport	Transport
ID Fan - Unit 2		BE	Procurement	DE	Manufacturing DE	Manufacturing DE	Manufacturing	Manufacturing	Manufacturing	Manufacturing	Painting Res / Label	Transport	Transport	Transport
Total weight:														
Total weight Both Plants:														

BE => Seizing and loads not to exceed must be finalised!

Transport
1.) FCA workshop for container transport with 40 ft. GP (general purpose) containers max. dimension of cargo: 11,9 m length x 2,2 m width x 2,3 m height
2.) FOB Chinese port in case of break bulk cargo / for width more than 2,2m (up to 4,5 m!)

Type:	ID FAN
Project-No:	
End Customer:	
Date:	05.04.2012
Document:	
Reference:	
Revision:	0

ANDRITZ

Preliminary Milestones (will be considered for payment schedule)	
Final Loads ID Fan	after 1 week
Main Drawings of ID Fan	after 2 weeks
Fabrication Plan	after 3 weeks
Transport Sizing - preliminary	after 4 weeks
Erection Drawings - preliminary	after 8 weeks
Erection Manuals - preliminary	after 10 weeks
Detail Design	after 12 weeks

Start of Manufacturing	1st of July
Pre-assambling ID Fan Housing	1st of November
Test Run	15th of December
End of Manufacturing	31st of December
Final Corrossion Protection	31st of January 2013

BE...Basic Engineering
DE...Detail Engineering
Res...Reserve

Table D.3: Procurement schedule - Induced draft (ID) fan[227]

[227] Internal data for on-going project in Chile – AE&E

Appendix E Price evaluation – Induced draft (ID) fan

PRICE EVALUATION ID FAN	China			Europe (Germany)		
Unit	CHILE 1 - I&II	CHILE 2 - I	CHILE 2 - II	CHILE 1 - I&II	CHILE 2 - I	CHILE 2 - II
Pieces	2	1	1	2	1	1
ID Fan						
Engineering	€ 9.341,32	€ 9.341,32	€ 9.341,32	incl.	incl.	incl.
Foundation Plates	incl.	incl.	incl.	incl.	incl.	incl.
Sound Insulation Device	excl.	excl.	excl.	incl.	incl.	incl.
Expansion Joint	€ 2.802,40	€ 1.868,26		incl.	incl.	incl.
Painting	excl.	excl.	excl.	incl.	incl.	incl.
Vibration Damper	€ 1.868,26	€ 1.868,26	€ -	incl.	incl.	incl.
Special Tools	€ 116,77	€ 116,77	€ -	incl.	incl.	incl.
Temperature Monitoring	€ 747,31	€ 373,65	€ 1.681,44	€ 2.340,00	€ 1.170,00	€ 1.170,00
Vibration Monitoring		€ 3.736,53	€ 3.736,53		€ 1.092,00	€ 1.092,00
Junction Box	€ 934,13	€ 934,13	€ 934,13	incl.	incl.	incl.
Startup Spares	€ -	€ -	€ 1.120,96	€ 2.340,00	€ 2.340,00	€ 2.340,00
Recommended Spares						
Wear Spares	€ -	€ -	€ -	incl.	incl.	incl.
Total / Unit		€ 135.939,52	€ 126.574,85		€ 144.066,00	€ 178.854,00
						14%
				Discount		4,2%
Cost price			-8%			

Preliminary Additional Costs for Basic Equipment	China			Europe (Germany)		
Foundation extra costs						
Necessary for axial fan			€ 33.150,00	not necessary		
		€ 33.150,00			**€ -**	
Pumps and piping for oil cooling						
3 x for radial fan ca. 2m³/h			€ 50.310,00	not necessary		
		€ 50.310,00			**€ -**	
Additonal costs for basic equipment		**€ 83.460,00**			**€ -**	

Basis Equipment ID Fan	China	Europe (Germany)

Additional Costs	China			Europe (Germany)		
Preliminary transportation costs						
Seaworth packing	€ 3.276,00	€ 3.315,00	€ 3.276,00		€ 39.000,00	
Transport to port	€ 3.510,00	€ 3.276,00	€ 3.510,00		€ 15.600,00	
	Shanghai	€ 20.163,00	177 to	Hamburg	€ 54.600,00	117 to
Transport to site FCA to Chile	Casing + Impeller			Casing + Impeller		100%
	Local			Local		
Transportation costs						
Travel and representative costs						
Additional inspections	2 men	€ 10.000,00	€ 5.000,00	2 men	€ 6.000,00	€ 3.000,00
		€ 10.000,00			**€ 6.000,00**	
Imputed costs of risk provision						
acc. Commercial Project Management	6%			6%		
Insurance						
acc. Commercial Project Management	2%			2%		
Financing costs						
acc. Commercial Project Management	3%			3%		
Possible hedge costs		€ -				
					€ 48.603,00	
Additional QA costs						
QA support 1 man from Andritz	2 mon	€ 30.000,00	€ 15.000,00	not necessary		
1 man from ATC Foshan, China	5 mon	€ 18.000,00	€ 3.600,00	not necessary		
		€ 48.000,00			**€ -**	
Additional interface costs						
Execution support Graz - China	10 mon	€ 15.000,00	€ 1.500,00	not necessary		
		€ 15.000,00			**€ -**	
Additional execution costs Graz	3 x Radial & 1 x Axial			4 x Radial		
Layout redesign	1 mon	€ 15.000,00	€ 15.000,00	not necessary		
		€ 15.000,00			**€ -**	
Total Landed Costs ID Fan						-5%

Table E.4: Price evaluation – Induced draft (ID) fan[228]

[228] Internal data for on-going project in Chile – AE&E