Jyväskylä University School of Business and Economics

MIGRATING SHIP WASTE MANAGEMENT FROM INDIA TO FINLAND

Analysis of opportunities and risks in an industrial symbiosis of sustainable ship recycling

Katalin Talas

Corporate Environmental Management
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Supervisor: Tiina Onkila
External supervisor: Matti Pettay

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ABSTRACT

Author
Katalin Talas

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Environmental protection and social wellbeing are significant segments of economic development. Market demand, legal directives, competitor existence and NGO interest together influence to manufacture in a cleaner and safer way and to abandon the traditional, often lethal working processes. Ship breaking is one of the most perilous industries where powerful states subordinate those countries where regulations can be bypassed for profit maximization. The unfavorable dependence arises from economic and technological arrears, and it results in environmental pollution, human rights violation and non-conformity with environmental, health and safety regulations.

To improve environmental, health and safety issues in ship breaking sequential international legislation was required that controls the supply of vessels. Revolution develops as ship recycling is becoming strictly controlled in South-Asia under the flag of the European Union. This restriction gives opportunities for developed countries to establish collaborations for sustainable ship recycling. Such little understood business favors the combination of expertise from different fields. Technical interaction, joint logistic systems and collective operational processes can be perceived as industrial symbiosis. Developing synergy between different industrial partners requires managerial dedication as well. Besides the so-called hard tools for such engagement, questions remain around the level of commitment, preparedness and willingness for collaboration in an industrial symbiosis.

This study seeks to answer the research question, whether it is possible to establish an industrial symbiosis for environmentally friendly ship recycling in Finland. Perception and attitude towards a systemized cooperation and the current understanding of ship recycling is analyzed.

Keywords
ship recycling, industrial symbiosis, green supply chain management, environmental, health and safety issues

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3R's	Reduction, Reuse and Recycling
B2B	Business-to-business
CFC	Chlorofluorocarbons
CHP	Combined Heat and Power
CSR	Corporate Social Responsibility
EIP	Eco-Industrial Park
EU	European Union
EHS	Environmental, Health and Safety
ESM	Environmentally Sound Management
GMB	Gujarat Maritime Board
GSCM	Green Supply Chain Management
HKC	Hong Kong Convention
HSSEQ	Health, Safety, Security, Environment and Quality
ILO	International Labour Organization
IMO	International Maritime Organization
ISO	International Organization for Standardization
JIT	Just-in-time
LDT	Light Displacement
NGO	Non-governmental Organization

OECD	Organization for Economic Co-operation and Development
OHSAS	Occupational Health and Safety Assessment Series
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated biphenyl
PPE	Personal Protective Equipment
PR	Public Relations
PVC	Polyvinyl Chloride
R&D	Research and Development
RL	Reverse Logistics
RRM	Re-rolling mills
SME	Small-and-medium sized enterprise
TBT	Tributyltin
UN	United Nations
UNEP	United Nations Environmental Programme
US	The United States
USD	United States dollar

CONTENTS

1 INTRODUCTION

Organizations, businesses and governments nowadays show increasing interest in global sustainability issues, thus environmental and social performance is also considered besides economic progression. It is both an opportunity and a challenge to embed environmental and social performance in long-term strategic decisions (Epstein, 2008). Organizations either realize inherently to involve environmentally considerate practices, or external drivers influence their business strategy to act in a more sustainable way. Fortunately, environmental issues are continuously becoming more relevant in organizational decision-making (Deloitte & Touche, 1992). Traditional business entities generally slower engage with environmentally conscious business ethics, mainly because of financial reasons. However, companies started to realize that it is more costly to ignore environmental impacts and pay for clean ups after an accident. Another explanation for this revolution can be originated from external sources, such as market demand, legal restrictedness or the chance of competition. Legal requirements are one of the main external forces that can result in overall organizational changes (Lozano, 2013). This research work attempts to study how sustainability can be integrated into the strategic business model of a changing industry that has been restricted by legal enforcement. Different approaches exist for such alteration that are briefly elaborated in the thesis. Embracing sustainability issues in a whole business sector, however, is highly industry specific and it depends on multiple aspects and actors, therefore there are no general principles and practices for executing such process. Strategic alternatives, such as green supply chain management (Brockett & Rezaee, 2013) and industrial symbiosis (Chertow, 2000) can ease the integration of sustainability by providing a solid platform for integrating environmental thinking into strategy without compromising on the economic viability.

In this research thesis sustainability implementation will be investigated in the environment of the shipbreaking industry. Although this phenomenon has been little studied in Europe so far, because the whole industry takes place in those locations where legislation is less restricted. The greatest shipbreaking countries, like India, Bangladesh and Pakistan used to dismantle ships without applying environmental management on the lowest level. These locations struggle with typical problems, such as ignoring social security and daily accidents at the work places. (Puthucherril, 2010)

Ship breaking industry is foreseen to enter into new operational and economic circumstances. Traditional shipbreaking countries like India are exposed to operational difficulties, because since 2013 unsafe and unsound ship disposal is prohibited by the European Union (The European Parliament and The Council of the European Union, 2013). Therefore, the whole industry is expected to migrate from hazardous work places to those geographical locations where corporate environmental and social responsibility plays an essential role. Another significant aspect will be the change of the term; from shipbreaking to ship recycling. The new concept embraces safe and environmentally sound ship disposal. Consequently, the thesis attempts to discover business development directions for ship recycling industry. The EU legal framework for ship recycling is rather new, thus many scenarios can be developed from the current situation of ship breaking. It is important to note that the entire industry has to apply new business strategies. Thus the thesis attempts to describe possibilities for implementing green strategy in heavy industrial environment. Redesign and rethinking of ship recycling has started due to the Directive of the European Union (The European Parliament and The Council of the European Union, 2013). The thesis analyzes whether it is possible that ship recycling business (partly) migrates to Finland for instance from India, because of the more favorable work conditions and technological advantages. Undoubtedly, establishing ship recycling in Finland requires strong consideration and thorough planning beforehand. The thesis work strives to contribute to these preparation processes with researching on possible business partners who are willing to invest in founding such business in Finland. Ship recycling industry involves several different players who could naturally find collaboration, because there is a high interdependence in the sector. Material, energy and information flows are presented in the whole process, therefore ship recycling industry is investigated in the context of green supply chain management and industrial symbiosis. All in all, the overall aim of the research work is to discover opportunities for ship recycling in a Finnish industrial symbiosis.

1.1 Background of the research

One of the most challenging missions of corporate environmental management is to improve sustainability performance in heavy industries. Such development

is aimed to achieve by EVAK Ry. the European Water, Lake and River System Development Association. In 2014 summer, the non-profit organization provided opportunity for a three month-long traineeship to research on the industry of ship recycling. The internship was conducted in Helsinki with the supervision of Matti Pettay who is the chairman of EVAK Ry. The organization participates in water development projects considering environmental protection, hazardous waste and hazardous water treatment (www.evak.fi). The internship was striving to clarify certain directions in ship recycling industry, thus a short research was conducted about the economic meaning of ship breaking, the current changes the industry faces and the environmental and health and safety problems occurring in Asia. There have been some attempts to roughly discover environmentally friendly ship recycling possibilities in Europe, especially in Finland. The internship also contributed to form the main topic of the thesis work, thus a future scenario of shipbreaking industry.

1.2 Objective of the research

The main objective of the study is to discover how the changing industry of ship recycling is perceived and understood among different actors such as shipping companies, ship builders, ship repairing yards and material recycling companies in Finland. It is important to identify interests and willingness for cooperation in a supply chain network and/or industrial symbiosis, where interdependence is intense. The theoretical research of the thesis explains ship recycling industry in the concept of an industrial symbiosis, while the second part of the study will focus on a possible scenario that investigates opportunities for establishing an industrial symbiosis in Finland. During the qualitative research different business partners were interviewed in order to get an insight about their understanding and attitude of ship recycling. It is crucial to emphasize that for ship recycling no clear future path is drawn yet, the research only attempts to investigate how ship recycling continues to work after EU legal restrictions.

Due to the fact that ship recycling is changing, embedding more environmental friendly operational circumstances, the thesis first endeavors to identify drivers and forces that define an industrial shift in general. The list of green approaches is extensive, but considering the most suitable ones for industrial changes in shipbreaking, two strategic solutions are chosen. One is elaborating the material and energy flows in a systemized structure, thus in green supply chain management. The other framework attempts to incorporate supply chain stakeholders to industrial symbiosis. These strategic frameworks will be further analyzed in the environment of ship breaking and recycling. In order to scope down the whole topic of ship recycling industry, the study will focus on identifying an environmentally conscious industrial symbiosis where green supply chain network is incorporated.

Ship breaking became the center of attention of environmental research, especially after the European Parliament introduced Regulation No (1013/2006) and the Directive 2009/16/EC in 2013 that prohibit the export of hazardous wastes to non-OECD countries. As ships are considered to be hazardous wastes, banning is applicable for all vessels sailing under the EU-flag (The European Parliament and The Council of the European Union, 2013). Due to legal changes, traditional ship breaking countries might lose market without implementing green ship recycling (Pakistan Shipbreaking Outlook, 2014). Even though, it is avoidable to state one clear future direction the business turns into, the thesis work attempts to elaborate a possible scenario with the focus point on business opportunities in Finland. This scenario will be investigated to discover possibilities for collaborative industrial system. Three research questions will be answered based on the empirical research analysis:

1. What are the opportunities and risks of establishing ship recycling facilities in Finland?
2. What kinds of possibilities exist for a future collaboration in ship recycling?
3. How can a strong and effective cooperation be created and who would be the considerate business partners of a Finnish industrial symbiosis for ship recycling?

1.3 Structure of the research

The thesis is based on a theoretical research and an empirical research. The theoretical research is divided into two main topics discussing green supply chain management and industrial symbiosis. These concepts are reviewed in order to underline opportunities for the phenomenon of ship breaking industry drawn in the second part of the theoretical research. The theoretical research studies relevant literature from scientific articles and books and industry specific journals. Due to the high sensitivity of ship breaking industry, it is challenging to obtain reliable sources. In the second part of the thesis an empirical research was conducted through personal interviews, and the interviews were complemented with field observations and questionnaires. The qualitative research questions were based on the theoretical research analysis.

2 GREEN SUPPLY CHAIN MANAGEMENT AND INDUSTRIAL SYMBIOSIS EVOLVEMENT

2.1 Introduction to organizational sustainability issues

Economic growth is an essential aim of any industries. Profit generation, cost reduction and investment acquisition are main drivers for enhancing overall competitiveness (Milgate, 2004). However, constant growth in productivity and trading has compromising effects on the natural environment and human welfare. Economic development often ignores resource depletion, environmental degradation, social inequality and human welfare, however, as it was discussed in the introduction, sustainability driven societies discovered that good environmental and social performance can be achieved in parallel with economic growth (Lozano, 2013). Incorporating environmental and social aspects implies commitment and responsibility towards sustainable business development (Milgate, 2004). It is risky and challenging to dedicate to all areas of sustainability, especially because additional strategic consideration might be necessary (Eweje & Perry, 2011). For sustainability achievements the organizational business strategy has to be well designed and opportunist to quick changes (Welford, 2014). On the other hand, various approaches exist where sustainability can contribute to profit growth:

- By being the first-mover business advantages and benefits can be gained
- Addressing social and environmental issues fosters investment and inspire employees
- Dedication to CSR demonstrates a good image of the company
- Sustainable development encourages innovation that stimulates new market opportunities (Forum for the Future, 2002).

To improve profitability through sustainability, an organization can consider reducing environmental impacts of their products and production, optimizing

natural resource consumption, upgrading waste management systems and investing in innovations. These sustainable strategic approaches can contribute to a trustworthy and transparent organizational image in long term (Bhamra & Lofthouse, 2007).

2.2 Sustainable business strategy

In traditional business management environmental issues were regarded with little enthusiasm, because economical and commercial benefits were not clearly understood. Though recently organizations see environmental management as one of the most effective strategic tools for obtaining competitive edge and reducing business risk (Reinhardt, 2000). In practice it usually means striving for the most complete integration of environmental management into the business strategy. According to Taylor's (1992) forerunner companies begin to use environmental instruments (FIGURE 1) to acquire operational efficiency, better corporate image and innovative products and services that altogether contribute to gain competitive advantage (as cited in Welford, 2014). This switch also brings changes in the organizational culture, objectives, procedures and operational processes. Environmental management system could endorse commitment towards environmental issues at any level of the organization from top management to the employees (D'Amato, Henderson & Florence, 2009).

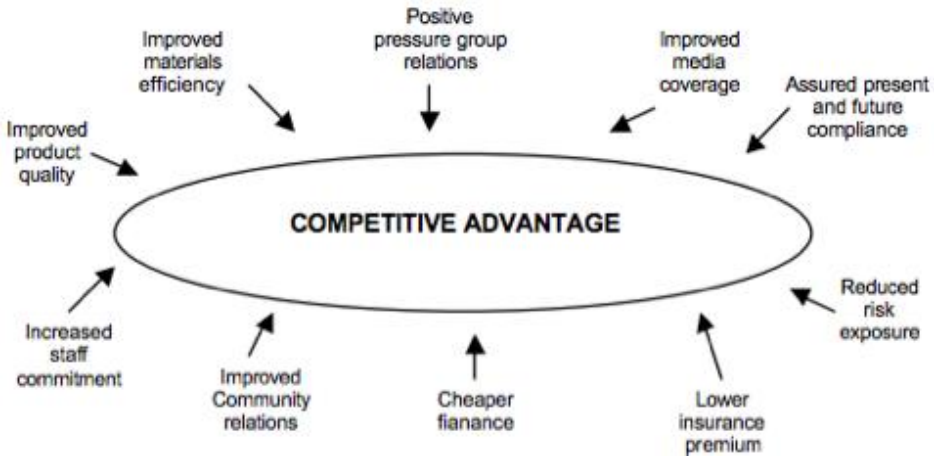

FIGURE 1 Environmental related tools for competitive advantage.

Practical possibilities for improving sustainability performance are immersed and pioneer firms constantly strive to develop innovative programs to achieve reductions in environmental risks and simultaneously to exploit opportunities of implementing sustainability (Shrivastava & Hart, 1995). Shrivastava and Hart (1995) examined three approaches for implementing environmental management: waste and emission reduction, reduction in material and energy consumption and green investments. According to Pietilainen, it is possible to

apply more strategic options concurrently for example to enhance market communication by placing the environmentally favorable characteristics of a product or service into marketing focus point (as cited in Welford, 2014). Environmental impacts can be reduced by applying cleaner and more efficient technology in the existing manufacturing processes (Shrivastava & Hart, 1995). Pioneer companies engage in manufacturing processes and machinery investments that focus on conserving raw materials and energy savings, waste reduction, recycling etc. (Thomas, 2005)

Environmental awareness also appears among supply chain actors, so that companies are willing to engage in partnerships with stakeholders for better decision-making and broader sustainability implementation (Thomas, 2005). Enhanced communication with different stakeholder groups is often regarded as sustainable marketing strategy (Obermiller, Burke & Atwood, 2008; D'Amato et al. 2009). Reduced material consumption is most effectively achieved by the integration of stakeholders (Shrivastava & Hart, 1995). On the other hand alliances between firms are often only born when sustainability is proven with certifications. More and more companies require international verification from suppliers and vendors, because they are concerned about product traceability and environmentally friendly production processes in procurement. Correspondingly some industries face new levels of competition. (Thomas, 2005)

To summarize the environmental strategic tools that can contribute to economic viability, there are five main dimensions a corporation could consider to apply:

1. `Excellence' and `leading edge' entails moving beyond legal compliance and presuming environmental management as an essential part of overall management, but also utilizing environmental opportunities and endeavoring to achieve state-of-the-art environmental management (Roome, 1992; as cited in Thomas, 2005; Tinsley & Pillai, 2006).
2. Incorporation of environmental management implies ensuring focus and significance for environmental issues in preparation processes before the actual processes come into operation. Environmental policy, programs and practices are recommended to fully incorporate into the company activities. Furthermore, all environmental impacts relating to different organizational aspects should be taken into account (Welford, 2014)
3. Line driven: Environmental management is considered to be a line function instead of a staff function. Some examples of rigid organizational structures showed that line managers ignored environmental performance, however it is the responsibility of all staff members (Welford, 2014; Shrivastava & Hart, 1995)
4. "Effective communication" or constant dialogue plays key role in public relations with external stakeholders, therefore organizations should have an enhanced green image (Shrivastava & Hart, 1995)
5. Short- vs. long-term strategy: Altering from short-term goals to long-term ones forms an essential part of environmental management,

because in general investments in environmental matters return in the long run (Welford, 2014).

As it seems ideas, tools and strategies already exist for obtaining corporate environmental and social achievements. Questions remain in what sort of conditions an organization can obtain economic opportunities as well, that allow them to integrate pioneering ideas into their business operations. Interestingly, increasing number of innovative strategies encourage inter-firm cooperation. By nature, changing from competition to cooperation depends on for example geographical location, business operation and legal structure etc. (D' Amato et al, 2009). The next chapter elaborates two methods supporting organizational change; green supply chain management and industrial symbiosis. After discussing the main segments of these strategies, the thesis work attempts to interconnect them by highlighting their common approaches and schemes.

2.3 Strategic approach of green supply chain management

The following section discusses the development of green supply chain strategy that primarily engages with sustainability and environmental management in traditional supply chain system.

In order to preserve competitive advantage, it is crucial to support business partners in engaging with sustainability principles. In fact, pioneer businesses not only consider environmental and social impacts of their production, but also supply chain performance is seen as a contributing factor to economic viability (Bhool & Narwal, 2013). With other words, profit maximization is influenced by operational and environmental improvements in the entire supply chain. Savings can also be identified from re-planning material and energy flows in the entire supply chain (Emmett & Sood, 2010). Green supply chain management (GSCM) has been examined according to different aspects, such as geographical location, industry specific attributes and operational scope. In general the following phases can be distinguished in GSCM (FIGURE 2):

FIGURE 2 Main stages of Green Supply Chain Management.

2.3.1 Green Procurement

Resource procurement disciplines are highly sensitive for the 3R's, thus for Reduction, Reuse, and Recycling of materials and packaging components in certain cases. Besides conscious material use, environmentally concerned businesses also purchase products and services that carry minimized environmental impact (Salam, 2008; as cited in Ninlawan et al, 2010). Simpson and Power (2005) also promote the reuse of materials and products forming a closed loop in the supply chain (as cited in Pak, 2013). According to Ninlawan et al. (2010), the essence of green procurement is to identify supplier that can verify environmental quality standards and obtain green certificates. Reliable partners follow the regulations regarding environment-related substances and acquire e.g. ISO 14001[1], OHSAS 18001[2] and/or other directives that control hazardous substances in production processes. Besides international standards, environmental auditing of the suppliers also helps to identify trustworthy green procurement channels. Gilbert (2001) emphasizes the importance of stable, long-term connection with the supplier in order to make systematic decisions for environmental performance (as cited in Pak, 2013).

2.3.2 Green Manufacturing

Production function in general is a significant factor of responsible management, because it affects the environment in a wide scale. Green manufacturing processes utilize efficient inputs that exerts low impact on the

[1] ISO 14001: refers to the environmental management systems specified by the International Organization for Standardization (ISO 14001:2004(E))

[2] ISO 18001: refers to the occupational health and safety management systems specified by the International Organization for Standardization (ISO 18001:2007)

environment and generate reduced waste and pollution (Pak, 2013). Green manufacturing contributes to further diminish raw material costs and environmental and occupational safety expenses, it also helps to increase production efficiency and to enhance corporate image (Atlas & Florida, 1998; as cited in Ninlawan et al, 2010). Additionally, it entitles a closed loop in the internal process that strives for zero emissions. Besides green production, sustainable or green design contributes to corporate social responsibility[3] as well, by impacting the environment as little as possible, while the expected quality is ensured (Emmett & Sood, 2010). Life cycle assessment is one technique to improve product attributes by considering resource acquisition, product design, production strategies, distribution and the end of life use (Pak, 2013). One of the central segments of GSCM is altering the product lifecycle, thus changing from cradle-to-grave to cradle-to-cradle design. Product life cycle assessment is reasonable to conduct before the actual manufacturing starts; in product planning phase it is often regarded as phase 0.

2.3.3 Green Distribution

Green distribution involves packaging and logistics. Green packaging considers physical measures such as size and shape, but also packaging materials affect their transport characteristics. Smart packaging and loading patterns promote decreased resource use, transportation extension, warehouse space expansion, and reduced warehouse management (Ho, Shalishali, Tseng & Ang, 2009; as cited in Ninlawan et al, 2010). As Pak (2013) explains just-in-time (JIT) logistics reduces warehouse-storing time that saves energy and costs. Unfortunately, problem remains in the unavoidable environmental impacts of transport. Any mode of transport uses energy and causes some sort of emissions.

2.3.4 Reverse Logistics

The two main targets of reverse logistics (RL) are reverse distribution and resource decrease. Efficient distribution can be conducted with minimized waste and disposal and maximized reuse and recycling (Carter & Ellram, 1998; as cited in Pak, 2013). The end of life product still carries value, therefore it is retrieved from the end consumer and taken to e.g. to inspection, selection, re-processing or direct recovery, redistribution, and disposal (Ninlawan et al, 2010).

[3] According to Business for Social Responsibility (2003) socially responsible businesses ensure natural value preservation, consider stakeholder interests and ethical values (as cited in Dahlsrud, 2006)

2.4 Drivers and approaches of green supply chain management

Motivation for adopting green supply chain practices can be distinguished between external and internal factors. Main external forces, such as business clients, regulatory bodies and competitors influence the organizations to consider their environmental performance (Bhool & Narwal, 2013). It is vital to fulfill customer demand for instance by providing environmentally friendly products, considering ecological footprint or the impacts on climate change. Regulatory stakeholders determine standards and policies that production needs to follow. Competitive business strategy also necessitates green image in global marketing, while in long term it is expected to acquire economic benefits and cost reduction as well (Yusuf, Gunasekaran, Adeleye & Sivayoganathan, 2003). Internal drivers like top management dedication form a basic condition for successful GSCM and motivate employee participation. Innovative practices only work effectively, if the organizational capabilities are ensured for applying them. Self-learning and job training can enhance the implementation of new approaches. Other stakeholders like suppliers, investors and shareholders also mean a great pressure. It is often seen that materials and energy flow between business-to-business partners is jammed without having verified environmentally sound operations. With other words, business engagement favors environmentally conscious manufacturing ensured through management systems (Amit and Pratik 2012; Bhool & Narwal, 2013).

Green supply chain management incorporates environmental matters regarding "product design, material sourcing and selection, manufacturing process, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life" (Seman, Zakuan, Jusoh, Arif & Saman, 2012, 2). Considering environmental issues, thus applying environmental management is recently seen one of the most effective strategic tools contributing to gain a competitive advantage and improve the corporate image in long term (Shrivastava et al. 1992; as cited in Welford, 2014). Even though environmental management is integrated in the whole supply chain, uncertainties can occur due to the degree of heterogeneity and competition among the actors. Interconnection in the supply chain can face conflicting interests, mistrust and problems with aligning managerial decisions (Pak, 2013). Pak (2013) also highlights that besides technical advancement, the so-called "intellectual workers'" role is important. They probably see and solve communication problems that cannot be remedy with physical interaction. For strategic planning some technical instruments and approaches from relevant research of Ninlawan, et al. (2010)[4] are important to consider before implementing green supply chain management:

[4] Ninlawan C., Seksan P., Tossapol K., & Pilada W. 2010, The Implementation of Green Supply Chain Management Practices in Electronics Industry

1. Promoting eco-design: by using technological innovation the product design and development already integrates environmental characteristics that consecutively improve the environmental performance of the product. Environmentally friendly product development encompasses two principles: (1) designing extended product lifetime, so that it can be upgraded, repaired and reused
(2) designing products for recycling, thus the end of life products can still be recovered.
2. Monitoring hazardous constituents: compliance with legislation
3. Establishing policies for waste disposal and investing in recycling facilities
4. Communicating GSCM knowledge and endorsing the use of eco-friendly products and services
5. Committing to use only those equipment and substances that can increase reverse logistics
6. Encouraging recycling processes through campaigns to create reuse / recycle awareness
7. Prolong product lifespan by designing for disassembly or upgrading, investing in quality machinery that can be reused at the end-of-life stage.
8. Maintaining administration systems unit for recording and tracing data. (Ninlawan et. al, 2010)

All in all, comprehensive strategic and financial planning usually precedes any green supply chain management execution. Expected financial benefits of GSCM are cost reduction, increased market share and profit growth. Financial achievements also occur by preventing environmental and occupational health and safety accidents. Environmental performance can be and should be assessed in a GCSM in order to identify the capability of environmental management. Generally, measures provide information about resource and energy consumption and on waste generation (Pak, 2013).

2.5 Creating green supply chain management in an industrial symbiosis

Green supply chain management is one alternative solution for involving multiple business operators (e.g. suppliers) into concourse where strong interaction exists in order to achieve collective sustainable performance. In practice, such network usually develops naturally. Regarding other forms of collaboration – structurally and spatially different ones - there have been debates on the implementation of sustainable development into local and regional processes. As it has been a quite demanding procedure, only a few practical examples could prove that economic, social and environmental aims can be attained simultaneously.

Luckily, a paradigm shift is noticed to arise, when numerous project developments applied the ideology of sustainable industrial collaboration (Thomas, 2005). There have been four generally accepted definitions developed for such alliance: industrial ecology, industrial ecosystem, industrial symbiosis and Eco-Industrial Park (Patala, Hämäläinen, Jalkala and Pesonen, 2012). However, until now it has not been clear where to draw a strict line between these concepts, because they all incorporate the purpose and goals of sustainability. Each concept defines a certain level of interactions between individuals, communities or systems strive to achieve environmental performance, while economic goals are fulfilled as well. Lowe (2001) described Eco-Industrial Park as "a community of manufacturing and service businesses located together on a common property. Member businesses seek enhanced environmental, economic and social performance through collaboration in managing environmental and resource issues…" (as cited in Kronenberg 2007, 115). Eco-Industrial Park focuses on achieving environmental and economic performance improvements in a network based collaboration. "Industrial Ecosystem" or "Industrial Ecology" emphasizes the establishment of a mature cooperation where public policies and management systems provide a framework for environmental achievements and economic viability. These collaborations also involve material and energy cascade in order to reduce natural resource use and waste generation. Technologies and processes support economic and environmental efficiency (Butnariu & Avasilcai, 2013). Gertler (1995) believes that an industrial ecosystem creates a cluster, or network, where organizations with different industrial portfolio interact and exchange materials and energy. According to the researcher, the collaborative production model has two main targets:

(1) Facilitate overall energy efficiency
(2) Achieve higher market value through process outputs (as cited in Gondkar, Sriramagiri & Zondervan, 2012).

Chertow (2000, 314) described "Industrial symbiosis" as "it consists of place-based exchanges among different entities that yield a collective benefit greater than the sum of individual benefits that could be achieved by acting alone. Such collaboration can also increase social capital among the participants". The main difference between industrial symbiosis and eco-industrial development or industrial development relies in their business profile. The central matter of an industrial symbiosis is the materials, water and energy exchange, while Eco-Industrial Park mainly engages in agricultural activities rather than in industrial and commercial (Butnariu & Avasilcai, 2013). Chertow (2000) classifies these terms in a different way and defines industrial symbiosis as such type of industrial ecology that arises at inter-firm level between different organizations, while industrial ecology itself is more facility-based term (FIGURE 3). Industrial symbiosis also encourages the development of social relationships among collaborating partners. All of the above mentioned concepts relate to green strategy where collective exchanges are ensured in order to preserve natural resources and promote social welfare.

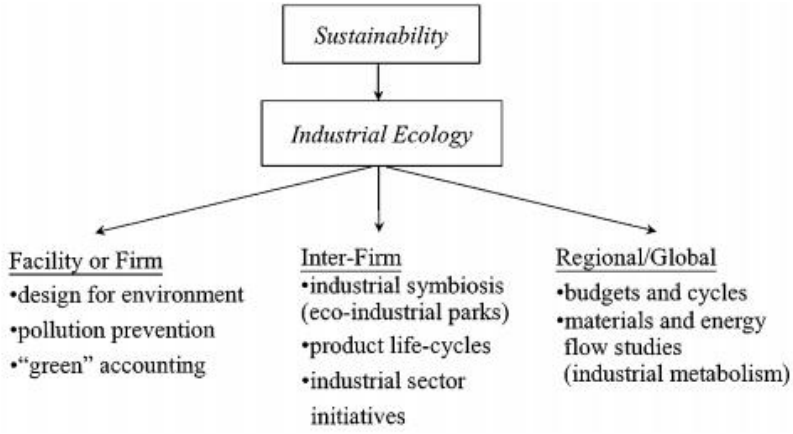

FIGURE 3 Level of Industrial Ecology.

This research chose to use the concept of an industrial symbiosis that represents a structural switch from linear to circular systems. Such remodeling means a solid platform for traditional heavy industries, for instance for ship breaking where the traditional, linear profile of the industry is reshaped through innovation. Gibbs (2008) believes that any industry can shift to a circular economy, where natural resource inputs are lessened, wastes are converted into inputs and energy cascaded in the entire industrial symbiosis (FIGURE 4) (Butnariu & Avasilcai, 2013; Gibbs, 2008).

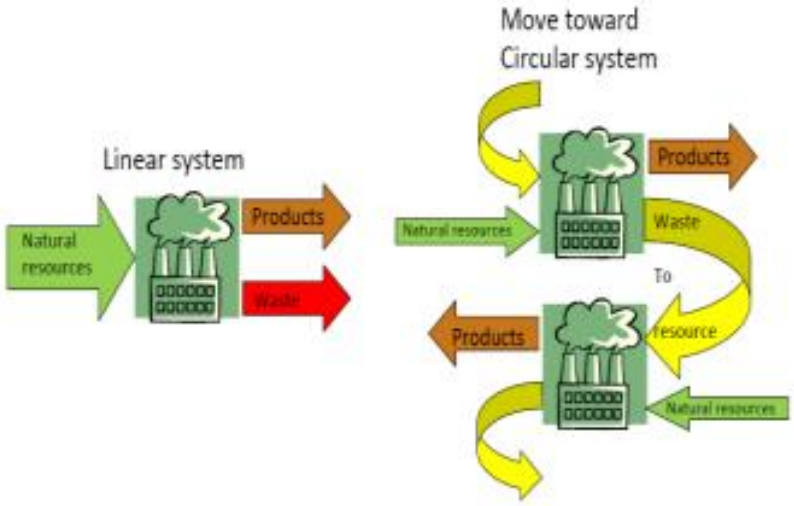

FIGURE 4 The concept of an industrial symbiosis, moving from linear to circular system.

Besides resource exchange, an industrial symbiosis also privileges geographical proximity, common logistic systems, trust and cooperating attitude among different industries (Patala et al. 2012). The ideal system of an industrial ecosystem can bring economic, social and environmental advantages to regional development, since waste products of one industry mean resources for another. An industrial symbiosis entitles waste with economic value that contributes to profit acquisition, input costs reduction and waste disposal costs

decrease. Additional costs can be saved from compliance with legislation or even moving beyond it. As a result of reduced emission, fewer separate industrial and residential lands are required to be maintained (Dunn & Steinemann (1998); as cited in Gibbs, 2008). The common use of certain utilities e.g. energy, water or wastewater plants can be beneficial, moreover services for instance transportation, landscape planning and waste management systems can be shared in the symbiosis (Ashton, 2008). A growing need is acknowledged for developing industrial symbiosis, so in many cases European governments politically and financially support such development projects. The necessity of creating a balanced economic growth without compromising the natural environment existence was proclaimed in numerous regions, moreover several guidelines were published for encouraging alliances among public and private sectors (Gondkar et. al, 2012).

An industrial ecology in the form of symbiosis strives to achieve environmental impact reduction, improvements in competitiveness and enrichment in labor market. It is able to enhance the social dimensions of sustainable development as well, because local investments and job establishment naturally increases profitability for the firms (Schlarb 2001; as cited in Gibbs, 2008). Allenby and Richards (1994) explain that such alliances involve various actors from suppliers, through manufacturers and consumers, till waste managers, or recyclers (as cited in Gondkar et. al, 2012). Stakeholder interests are taken into account in planning and decision-making processes, which embraces certain dimensions of corporate social responsibility. In traditional industrial systems independence and competitiveness appear inherently, while industrial symbiosis encompasses a cluster where first the physical infrastructure is developed, and the so-called “soft tools” are expected to emerge continuously in the future. What is more, since strong interactions and interdependence describe these co-operations, it is rather challenging to predict soft-infrastructure evolvement (Gibbs, 2008; Gibbs, 2009). One of the greatest challenges of such industrial networks is that the level of engagement cannot be physically assessed. It strongly depends on the culture of the firms and on the willingness to share tacit knowledge with each other to develop mutual trust (Paquin & Howard-Grenville, 2012). Gibbs (2003) presumes that trust and interdependence between the participants arise naturally. Paquin & Howard-Grenville (2012) on the other hand, explains that trust grows when partners are working together in common projects. Ashton and Bain (2012) explain that the behavior and attitude of the participants is influenced by constant interaction when shared norms can be formed (as cited in Patala et al. 2014). According to the practical experience of Schwarz and Steininger (1997), informational and organizational relations are enabled to grow in smaller neighborhoods more easily where natural trust and reliability exist among the personally known actors. Expanding the network beyond regional boundaries fosters waste supply and recycling progressions. Lowe (2002) considers the interactions critical between the corporations and local communities and the local inhabitants and natural environment. The author also emphasizes that

industrial ecologies exceed simple by-product exchange in a network that focuses on resource recovery and recycling. Instead of building a “green infrastructure”, the end-product is the most essential (as cited in Gibbs, 2009). According to the author, such cluster is not only a cluster of environmental technology or recycling companies where the main goal is to manufacture so-called ‘green’ products. No stable profit acquisition is guaranteed, if the system is designed around one particular environmental methodology. Lowe also highlights the need for diversity with industrial, commercial and residential segments, but he rejects to simply engage in environmentally friendly infrastructure (as cited in Gibbs, 2009). Besides materials and energy cascade, Korhonen (2001) also agrees that an industrial ecology considers the diversity of the economic actors and relies on local resource and small-scale activities. (as cited in Gibbs, 2008)

Industrial ecology incorporates a self-organized system, as it was happened in the case of Kalundborg Park, Denmark. It was the first industrial synergy realized completely in the form of an Eco-Industrial Park. In 1961, Danish firms from the oil industry, such as a coal-fired power station, an oil refinery, a biotechnology or pharmaceutical firm (producing enzymes), a plasterboard manufacturer, a soil remediation company and a waste management enterprise decided to build an industrial alliance. The main target of the cluster was to minimize ground water usage for oil refining where the partners exchange different materials, for instance steam, water, gas, gypsum, fly ash, sludge, liquid fertilizer, etc. (Yang 2006, as cited in Gondkar et. al, 2012). Instead of primary raw material resort, optimized by-products use and minimized waste and energy generation contributed to considerable savings. Excess heat was utilized in the power plant and other plants (pharmaceuticals plant, fish farms and a CHP, thus combined heat and power system) that improved the fuel utilization by approximately 30 percent. The power plant also used recycled wastewater that decreased the water usage by 60 percent, therefore groundwater consumption has also significantly decreased (Gondkar et. al, 2012). The other target of the complex was to minimize costs that occurred in compliance with additional environmental regulations. Kalundborg is claimed to be an idyllic symbol of sustainable economic development, because environmental issues are fully integrated into economic development strategies (Gregson, Crang, Ahamed, Akter, Ferdous, Foisal & Hudson, 2011).

The policy concept of an industrial symbiosis encompasses the enhancement of business competitiveness, achieved through shared infrastructure, joint services and by-product exchange. Even though the main principles are accurately defined in theory, it is challenging to align these issues in practice. Waste generation is unceasingly restricted in the industrial synergies by environmental regulations, that leads to limitations in the actual amount of waste can be reused. Consequently, the interaction of markets and the governmental decisions significantly influence the industrial eco-park establishments (as cited in Gregson et. al, 2011). Gregson et al. (2011) argue that until now the most significant recycling and material-recovery technology

complexes were not developed in the industrialized world, but mostly in South and East Asia. It arises from waste flows in the globalization, remanufacturing within the local economies and the favorable regulatory conditions that shape these economies. The emergence of a systemized collaboration in South Asia rises from global flows containing hazardous wastes. It must be admitted that complete materials and energy recycling is unlikely to be achieved regardless of geographical location, however it is a purposeful goal to reach 'zero discharges' (as cited in Gibbs, 2008). Korhonen (2004) gives a more pessimistic opinion by claiming that constructing a perfect industrial ecosystem can never be conducted, because most of the theoretical approaches in business strategy are challenging to implement, but it is often sufficient, if the practices are approximate to the theories.

Collaborative behavior is fundamental in industrial symbiosis development that requires trust and cooperation to understand complex processes that affect economic viability. Policy establishment has a key role in identifying business opportunities and setting adequate circumstances for inter-firm networking. To harmonize different interests, third-party engagement can be involved (Gibbs, 2008). Numerous industrial complexes worldwide were designed with external encouragement of local governments, non-governmental organizations, educational institutes, etc. (Gondkar et. al, 2012). These organizations are important actors in knowledge sharing and in facilitating political support, informational advices and educational services (Korhonen et. al, 2004; as cited in Gibbs, 2003).

A theoretical approach developed by Scharb (2001,1) highlights green strategies that can be adapted to such a unique combination of firms. He also agrees that the ultimate goal of an industrial symbiosis is material and energy interchanges that require medium or long-term targets, instead of immediate results. Long-term visions also reflect deep and severe networking, not only superficial, self-actualizing, temporary business strategies (as cited in Gibbs, 2003). Chertow (2000) questions the correlation between input/output savings in B2B connections and traditional waste recycling or exchanges. The author promotes to establish bilateral exchanges in place of creating a complex network (Gibbs, 2008). Attuning different business operations can result in difficulties, but as it was discussed before, local firms are statistically more willing to take part in collaboration than subsidiary firms that tend be less powerful in decision-making powers or inactive in materials linkages. Based on the previous examples, better performance can be achieved by designing collaboration in an already existing industrial region than investing in initial networks (as cited in Gibbs, 2008).

Coˆte´ (1998) notes that whereas by-product based production saves resources and diminishes waste, the interconnection can continue to shape the environment during transporting materials or in the end of the life cycle (as cited in Gibbs, 2003). It is one of the greatest questions of industrial ecology and industrial symbiosis implementation, however Gibbs (2003) enlists several other obstacles that can occur during such development:

- Technical difficulties imply the likelihood that local firms are unable to unite because of the lack of conformity and similarity.
- Informational barriers relate to poor informational channels on waste potentials, market opportunities and supply.
- Economic walls may prevent the willingness to utilize waste streams as raw material without interested and reliable buyers.
- Regulatory barriers may hinder to interconnect industries or industrial processes.
- Motivational problems can occur because inter-firm projects rely on strong dependence between the partners, however it is challenging to predict willingness for cooperation and commitment. (Gibbs, 2003)

2.6 Comparison between green supply chain management and industrial symbiosis

Based on the previous discussions on GSCM and industrial symbiosis, this section attempts to find arguments for and against the theoretical integration of GSCM with / into industrial symbiosis. Available scientific literature in the topic is very limited. The main characteristics of the two systems are defined in TABLE 1.

	Industrial symbiosis networks	Sustainable supply networks
Operational logic		
Focus of environmental action	Improving eco- efficiency of production through by-product and waste reuse, utility and service sharing, information exchanges.	Decreasing environmental footprints of products through life-cycle thinking.
Drivers	Economic and environmental benefits; legislation; personal values.	Consumer demands; stakeholder pressures; legislation; personal values.
Network architecture		
Actors	Complementary industrial firms from various industries; authorities; NGOs.	Industrial firms, typically from the same supply chain; vertical connections.
Commons	Shared knowledge, and tangible resources and/or energy.	Shared GSCM information and product life-cycle knowledge.
Protocols, processes, infrastructures	Formal exchange of resources, shared norms, social embeddedness.	Formal mechanisms for flows of information and materials; standard operating practices; cooperative green actions.
Stratification of decision making	Ranges from hierarchical (i.e. planned) to heterarchical (i.e. self-organising)	Mostly hierarchical with formal supply chain relations.
Permeability of boundaries	Regionally constrained.	Supply chain constrained.

TABLE 1 Network based approach of industrial symbiosis and green supply chain.

Industrial symbiosis and sustainable or green supply chain appear as two separate systems in the above mentioned brief summary, however the network of sustainable supply already assumes the integration of GSCM into some sort of industrial ecosystems (e.g. eco-industrial parks, industrial symbiosis etc.). Hypothetically, such integration is highly dependent on the industry itself, its participants and the purpose of the collaboration. Both GSCM and industrial symbiosis elaborate closed loop processing where environmental practices embrace material reuse and recycle, and waste exchange. Eco-efficiency is an essential part of the systems, enhanced by knowledge sharing and cooperative sustainability actions. Decision-making connects to some sort of hierarchical system. (Patala et al. 2014)

Although both strategies are based on inter-organizational material and energy flows, their physical structure firmly contrasts from each other. According to Bansal and McKnight (2009), enterprises forming one supply chain are strongly focused on the product sold for end customer, but they are also motivated to minimize waste and emissions in the entire supply chain. Thus such external drivers as consumer demand and stakeholder requirements motivate GSCM to improve environmental performance. Supply chain network

identifies environmental improvements through product lifecycle assessment. Industrial symbiosis represents a more entrepreneurial approach, and its participants strive to find solutions for utilizing waste and by-products that can even be entirely different from the original production profile (as cited in Patala et al. 2014). Industrial symbiosis is organized regionally with the participation of firms from various industries, regulatory institutions and NGOs, while GSCM mostly involves the actual members of the supply chain. Due to the fact that Eco-Industrial Park closely related to industrial symbiosis, the research of Zhu and Cote (2004) is partly applicable for the relation of GSCM and industrial symbiosis. The integration of sustainability driver supplier operating in the same region is a relatively new innovative idea. It can bring several opportunities for the involved firms by utilizing the available technologies, expertise and open-minded management, but risks rely in difficulties to prepare for unpredictable cases. (as cited in Patala et al. 2014)

3 SHIP BREAKING INDUSTRY – PROBLEMS AND LEGISLATIVE SOLUTIONS

The previous chapter explored two different methods considering material and energy flows in network based collaboration. GSCM and industrial symbiosis approach sustainable production from different angles, and their successful application is in strong relation with industry specific attributes. It has been previously cogitated whether these approaches are potential contributors to greening heavy industries, such as ship breaking.

The following chapter investigates traditional shipbreaking operations from the viewpoint of environmental management. There has been an ongoing debate on the determination of ship disposal among international organizations, therefore it is essential to first clarify the relevant concepts. The thesis thoroughly discusses business factors and environmental, health and safety issues in ship breaking industry. The industry is more and more restricted by international and European legislation in EHS matters, but the current business processes and changes are relatively unknown for Europe. The thesis also attempts to give an overview of the current situation of shipbreaking in South Asia through the example of India and possible development strategy (strategies) regarding cooperation with European experts. Three international conventions and guidelines define the frameworks of shipbreaking procedures. The Regulation and Directive on Ship Recycling of the European Parliament become the most significant legislative frameworks influencing global shipbreaking and ship recycling.

3.1 Debate on the terminology

The terms of 'shipbreaking', 'ship demolition', 'ship scrapping', 'ship wrecking', 'ship decommissioning' all mean dismantling a ship and recovering materials for re-processing when the exterior structure of the ship, thus the hull is taken apart for steel components and other valuable recycled parts. Officially, ILO calls the process as "shipbreaking", the Basel Convention defines it as "ship dismantling" and according to IMO the official term is "ship recycling" (Puthucherril, 2010). The European Commission distinguishes the following concepts (TABLE 2):

Word	Definition
Decommission	Taking an end-of-life ship out of service
Dismantle	The physical process of taking the ship apart, not including beaching
Demolition	The process of taking a ship apart, including beaching
Ship breaking	The process of taking a ship apart, including beaching
Recycling	The process of taking a ship apart, when procedures with respect for the environment and workers health and safety are applied, "green recycling"
Scrapping	"Neutral" word for the process of taking a ship apart without considering the procedures used

TABLE 2 Definitions related to ship disposal.

The generally accepted term is "ship recycling" entailing the most significant sustainability criteria. The Ship Recycling Convention defines "ship recycling" as the following:
"the activity of complete or partial dismantling of a ship at a Ship Recycling Facility in order to recover components and materials for reprocessing and re-use, whilst taking care of hazardous and other materials, and includes associated operations such as storage and treatment of components and materials on site, but not their further processing or disposal in separate facilities." (Puthucherril, 2010, 8). The definition refers to a limited range of resource utilization and the necessity for safe hazardous material management.

3.2 Supply chain management in ship breaking

There are four stages in the life cycle of a ship: ship building, transport or freight, sale and recycling. Constructing a merchant vessel is typically based on customer requirements and specifications. Over time ship retains less favorable

industrial characteristics due to wear, and it can reach to phase-out. During the active life, ships often obtain new owner, flag registry, classification and liability insurer. When the ship maintenance, operation, insurance are uneconomical or it becomes unsuitable for trading, the ship is considered to take for scrapping (Yujuico, 2014). The demand for ship recycling strongly depends on different global and regional economic aspects, and it interconnects to supply. The supply of end-of-life vessels is mainly influenced by the global economic performance, hence during economic expansion sea transport is demanded that increases the freight costs and the scrap or demolition market prices. In this case the number of ships sold for scrapping decreases that extends the gap between demand and supply, thus market instability increases (Puthucherril, 2010). FIGURE 5 describes the expected demand for scrapping tankers and other vessels based on two scenarios. The background of the scenarios are not relevant in the research, therefore they are not discussed in details. It can be acknowledged that in year 2015 demand for scrapping will significantly increase, while in the oncoming years it is taking a more modest direction, but the need for scrapped metal is expected to reach the same level as before 2015 (European Commission, 2004).

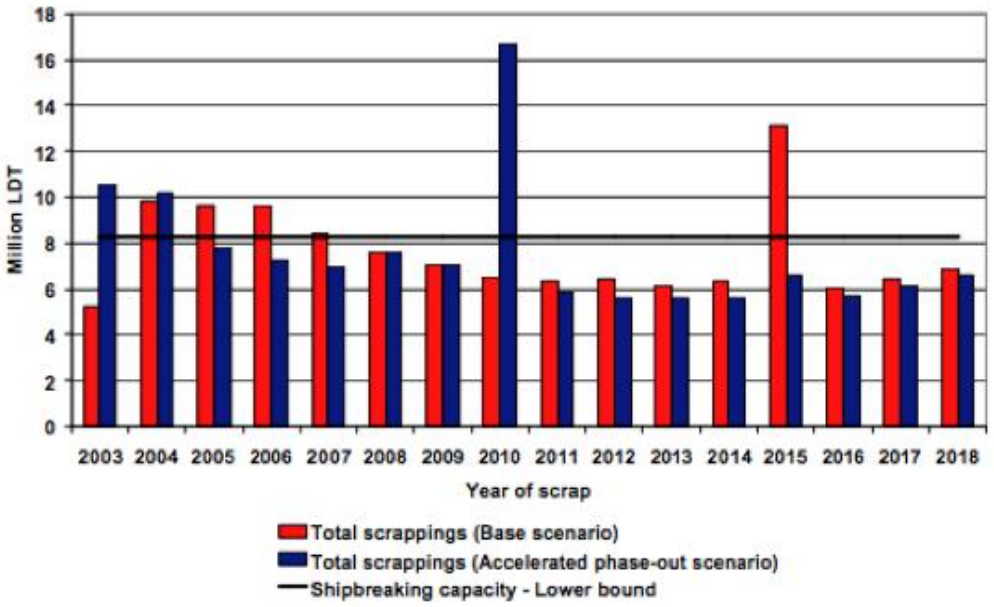

FIGURE 5 Demand for scrapping between 2003-2018.

On average ships were sent for scrapping after 19 years of useful life in 2000, and by 2007 the useful life was extended to 30-35 years. In recession, trading stagnates that results in surplus in freight market and ships are taken for scrapping in higher quantity (Puthucherril, 2010). Ship purchasing is a serious investment for the recycler who expects maximum return on it. The recyclers are mostly concentrated in their own associations as they protect their interests. The scrap steel recovered from outdated vessels is sold at local markets in India, Bangladesh and Pakistan, but the valuable steel is often re-

exported to the European Union. The main stakeholders in the supply chain of ship recycling are the ship owners, cash buyers and the ship recycling yards. Basically they control the recycling industry and market developments. In practice recycling process starts when the ship owner decides about the time and price of selling and his decision determines whether the expected revenue from continual trading or the scrap price is higher. To maximize profit, the ship owner decides the scrapping location that offers the highest scrap price for the ship. Ship owner can obtain greatest profit, if his vessels are sold to the yard with low standards. Hence, the ship owner himself sets the standards for recycling processes, while cash buyers determine the ship recycling location for the ship owner (in some cases with the advice of the brokers). The cash buyers purchase the ship before its last journey, and they often also rename and re-flag it, and eventually the ship is transported to the yard for scrapping. Cash buyers are the main advisors of ship owners on ship recycling, thus they have a key role in prompting the most reasonable shipbreaking place. Cash buyers also acquire profit from scrapping, thus it is their direct interest to enhance profit acquisition by sending the vessels for economical dismantling (Pakistan Shipbreaking Outlook, 2014) (FIGURE 6).

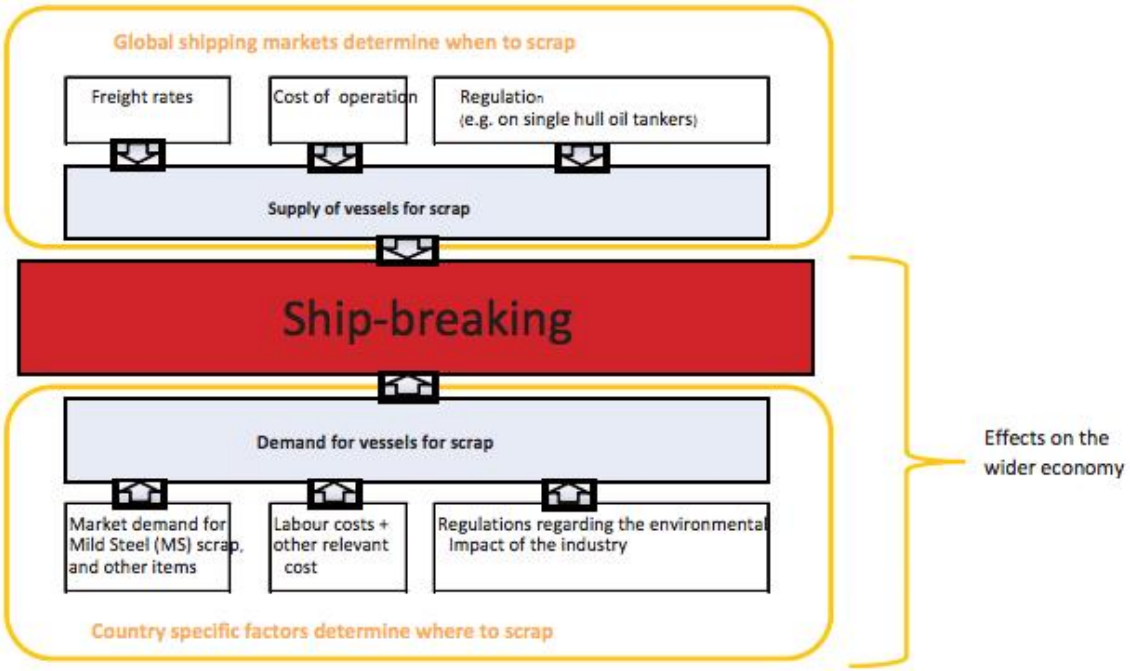

FIGURE 6 The supply chain of ship breaking.

The ship recycler purchases a ship when there are good market possibilities for selling the recovered steel and other reusable materials and with the lowest probable costs can be incurred during shipbreaking. Cost reduction can be achieved by not complying with occupational safety and environmental legislation. Due to the fact that the industry has considerable political and economic power, ship scrappers attempt to minimize governmental regulative forces. Usually ship selling happens in United States

dollars per light displacement tonnage (LDT). The actual shipbreaking is estimated to last for four to five months depending on the ship size. Approximately 70% of the scrap is more economical re-rollable steel and 20-30% is melting scrap (Puthucherril, 2010). Ship breaking is conducted in four sites: dry docks, piers, slipways and beaches. Compliance with EHS regulations decreases from dry docks to piers and slipways and to beaches. Meanwhile marine pollution and labor hazards become more severe by getting closer to a body of water. Beaching means grounding the ships on the shore when the sea tide is increasing and material recycling is carried out at low tide. Due to these intertidal zones the accumulated pollutants can enter into seawater when the tides retreat by causing hazardous threat on a larger area (Yujuico 2014). Providentially, in the developed countries ship recycling is conducted entirely in piers or slipways in almost any case. Ship breaking yards are required to implement certain standards, but in general ship owners are not concerned with clean and safe processes. The ship owners, cash buyers and the ship recycling yards all contribute to revenue acquisition from the recycling business, thus they are jointly responsible for improving the environmental and social performance of the industry. (Pakistan Shipbreaking Outlook, 2014)

3.3 EHS hazards in shipyards

Ship recycling is an essential part of sustainable development strategy that enhances workplace establishments, raw materials acquisition and economic benefits. It does contribute to energy saving, because high quality steel is produced from re-processed scrap. The list of the recyclable ship items is extensive: the hull, machinery, fittings, generators, batteries, hydrocarbons, and interior furniture can all be reused by other industrial sectors. Unfortunately, besides the main constructing materials, ships contain large quantities of hazardous materials, as well (Secretariat of the Basel Convention, 2003). Hazardous waste management was little known both in shipbuilding and in ship recycling. Asbestos, different chemicals and hazardous materials were fundamental constructing elements of vessels built between the 1960-1980 (Puthucherril, 2010). Asbestos, as one of the most lethal materials is used for thermal and fire insulation in gaskets, pipes, bulkheads and walls. It is an excellent noise and vibration dampener and it can be found in the engine room. Ship vibration and mending of asbestos-containing materials can cause asbestos fiber emission into the air exposing health risks for workers. The increasing concern about lethal asbestos exposure redounded that IMO guidelines were released in order to provide comprehensive analysis of the on-board materials containing asbestos. Besides asbestos, polychlorinated biphenyls (PCBs) are also predominant industrial applications, because PCBs resist high temperature, it has effective insulating and fire-retardant features, and it is also able to physically appear as oily fluids and waxy solids. Direct contact with PCBs intensifies the risk of cancer and it can also damage the immune, reproductive,

nervous, and endocrine systems. PCBs are one of the major building materials of wires and electric products. Ships contain organotin compounds based on tin such as Tributyltin (TBT), used for painting the ships outwardly, because it can prevent the growth of algae and other organisms on ship hulls. It is one of the most toxic chemicals, because it is extremely resistant to natural degradation. TBTs cause the hormonal behavior change of the marine fauna and human health can also be jeopardized when consuming sea animals. Highly toxic lead and mercury are important heavy metals in shipbreaking. Lead is used in batteries, paints, and as basic components of motors, generators, piping and cables. Lead has poisoning effects on the nervous system, and it damages hearing, vision and muscle coordination (Puthucherril, 2010). Mercury is building up thermometers, electrical switches, level switches and light fittings. It is also a non-degradable pollutant impairing the nervous system. It is a more and more concerning problem to combine bilge and ballast water. Bilge water contains potentially polluting fluids such as oil, cargo residues, inorganic salts, arsenic, copper, chromium, lead and mercury (www.shipbreakingplatform.org). Typically, the bilge water leaks directly into the ocean during recycling processes, thus it endangers aquatic ecosystems. Additionally, there are other dangerous by-products of the shipbreaking process for instance oil sludge, ozone depleting f-gases, polyvinyl chloride (PVC), polycyclic aromatic hydrocarbons (PAHs), radioactive materials, etc. Almost 5,5 million tons of substances are estimated to enter seawaters between 2006 and 2015, that carry potential environmental concern, and it emphasizes the necessity and urgency for sustainable ship recycling operations (Puthucherril, 2010). All these previously mentioned hazardous substances are present in vessels and they expose significant risks for workers and the local society in long term.

Due to the constant expansion of the shipbreaking areas, environmental impacts become more severe in the local environment and society. Emissions and discharges can affect large scope of seawater, ground and air with acute and long-term pollution. The lack or absence of preliminary cautions jeopardize safe work environment. The lack of guidance and coordination of working processes result in constant and potential risks for workers. Health related concerns are the exposure of dangerous substances and the method of work operations. Indirect risks include insufficient housing and sanitary facilities located directly at the scrapping area that exposes significant danger resulting from hazardous emissions. (Secretariat of the Basel Convention, 2003)

3.4 International legislation in ship breaking

This chapter reviews the main international and EU legal obligations for shipbreaking industry. International law under the United Nations Environment Programme (UNEP) - in particular the Secretariat of the Basel Convention (SBC),

International Labour Organization (ILO), and the International Maritime Organization (IMO) have provided regulation and guidance for environmental and labor issues in shipbreaking (UNEP).

3.4.1 The Basel Convention

The Basel Convention on the Control of Transboundary Movements of hazardous Wastes and Their Disposal came into force in 1992 by the approval of UNEP. Besides the European Union, 179 countries ratified the Convention in order to create a framework for protecting human health and the environment against hazardous waste risks. Possible options for preserving social and ecological values can be reached by diminishing hazardous waste, restraining hazardous waste transitions and applying environmentally sound waste management. The Convention considers end-of-life vessels with their possible hazardous materials contained, but environmentally sound shipbreaking is seldom implemented. Problems also occur around uncertainties with the exporting state if no port state is mentioned, and the principle of flag states is not determined by the Basel Convention either (UNEP). In 1995, Basel Ban Amendment was ratified that prohibits hazardous wastes shipping from OECD to non-OECD states. The EU member states (except Croatia) have all ratified the Amendment, and its principles are also stated in EU law. Later on a decision classified vessels as ‘waste’ that defines end-of-life ships intended for scrapping as waste, because it carries hazardous materials on board including heavy metals, oil residues, and sludge. Expectedly, despite being the members of the Basel Convention, Bangladesh, India and Pakistan have not ratified the Ban Amendment. (Yujuico, 2014). In 2002, the Basel Convention was extended with the Technical Guidelines for the Environmentally Sound Management (ESM). It provides technical information on procedures, processes and practices in order to ensure safe and environmentally sound ship waste management (UNEP). The Guidelines recommend constant monitoring and certification of environmental performance. (Pakistan Shipbreaking Outlook, 2014)

3.4.2 Hong Kong Convention

The Hong Kong Convention (HKC) for Safe and Environmentally Sound Recycling of Ships was developed by IMO and adopted in Hong Kong in 2009. The Convention is ratified only by Norway, France and Democratic Republic of Congo, but none of the great shipbreaking South Asian nations have signed it until now. The Hong Kong Convention alone is not adequate enough to prevent hazardous waste export from industrialized countries to developing countries, because important issues are omitted from it e.g. the ‘polluter pays’ principle, waste prevention, and requirements for downstream waste management. The Hong Kong Convention prohibits constructing ships from any hazardous materials (e.g., asbestos, PCB, TBT and ozone depleting substances). It claims an inventory of the hazardous ship materials that is regularly updated and it specifies quantity and the location of the ships. It also states other provisions for

ship recycling facilities and for reporting. Ship recycling facilities are required to be officially certified and maintain a recycling plan that includes occupational safety issues and trainings, human health and the environmental protection, employee roles and responsibilities, emergency plans and monitoring, reporting and data-recording systems (Pakistan Shipbreaking Outlook, 2014; Lloyd's Register, 2014).

The Hong Kong Convention considers the entire life cycle of the commercial vessels based on official standards fostering safe recycling. Dissimilarly to the Basel Convention, it only concerns the EHS issues during end-of-life ship dismantling. Besides that, the Hong Kong Convention rules out vessels that are less than 500 gross tons, or ships that only operates in local waters of their flag states. Before the actual recycling is launched, the flag state or a national authority has to certify that the ship complies with the EHS standards regarding design, construction and operation. The Convention strongly influences the ship recycling market where the recycling facilities must comply with the IMO regulations and they also must gain approval from the Flag State and the Ship Recycling State for their operations. These obligations transform the commercial environment where the ships are sold and the roles of the main stakeholders (Maritime International Secretariat, 2009). Certainties cannot be predicted about the commercial direction yet, especially because the European Union also restricted the ship recycling procedures for both the seller and recyclers.

3.4.3 ILO recommendations

In 2004, ILO defined a set of criteria to control ship recycling and disposal in "Safety and Health in Shipbreaking: Guidelines for Asian Countries and Turkey". The Guidelines proposes to establish a national framework where responsibilities and rights for employers, workers and other stakeholders are described accurately. ILO also recommends conducting safe shipbreaking operations with hazardous waste management, risk assessment, continuous monitoring and health surveillance. Occupational health and safety policy should ensure the identification of any hazards and complete the necessary preventive and protective measures. It is also important to maintain accurate records of work-related injuries, diseases and accidents. Any incidents should be reported to the relevant authorities. Finally, the guideline also highlights to provide appropriate personal protective equipment (PPE) on sites and competence-based trainings for shipyard workers. The main target of the guideline is to ensure minimum level of social welfare on sites. (ILO, 2004)

3.4.4 The EU regulation on ship recycling

On 30th of December, 2013 the European Ship Recycling Regulation entered into force, and it will be completely authorized between 2016 and 2019 (Pastorelli, 2014). European ship-owners are only permitted to recycle their vessels if they are listed in 'European List' among those compliant facilities that meet the

requirements, are certified and inspected. It does not exclude non-EU facilities from free application for inclusion (Yujuico, 2014). The Regulation aims to diminish the undesirable impacts of ship recycling under the flag of EU, particularly in South Asia. In practice, it means abolishing accidents and unfavorable effects on human health and environment by ensuring hazardous waste treatment through environmentally sound management. The Regulation will be applicable to commercial vessels over 500 gross tonnages. These vessels are eliminated from the EU Ship Recycling Regulation, which Regulation so far did not allow the export of end-of-life vessels to developing countries. It is prohibited to construct asbestos, ozone-depleting and anti-fouling substances into the EU-flagged ships (Webb & Warder, 2014). The Regulation determines numerous provisions for the facilities in order to recycle European-flagged ships. The requirements are more severe than in other regulations, and the South Asian facilities will not be able to fulfill them by applying traditional beaching method. By 2015, the European Commission intends creating a list of compliant ship recycling facilities where EU-flagged ships are allowed to demolish. Ship owners will be requested to prepare the end-of-life ships for recycling according to certain standards (Pakistan Shipbreaking Outlook, 2014). Before the actual recycling – similarly to the HKC - compulsory information has to be provided about the recycling facility and the inventory of hazardous materials, the recycling intention has to be reported to relevant administration, the amount of cargo residues has to be minimized, residual fuel oil and wastes have to be remained on board (The European Parliament and The Council of the European Union, 2013). Finally, a so-called "ready for recycling" certificate has to be submitted. Before recycling a European ship in a third country port, the recycling facility is required to present a ship recycling plan that describes safe and sound dismantling and ensures that the facility protects the laborers and the environment (Pakistan Shipbreaking Outlook, 2014). Similarly to the HKC, according to the European Ship Recycling Regulation, surveys are completed that verify compliance with the requirements of the Regulation on the inventory of hazardous materials. For being enlisted in the European List, ship recycling facilities - regardless of the location - have to conform to different requirements (The European Parliament and The Council of the European Union, 2013). The European Commission evaluates the submissions sent by the ship recycling facilities from developing countries including South Asia (Pakistan Shipbreaking Outlook, 2014). Mikelis (2013) explains that additional requirements are elaborated to the HKC: "to 'operate from built structures'; facilitate 'the control of any leakage, in particular in intertidal zones'; and ensure 'the handling of hazardous materials, and of waste generated during the ship recycling process, only on impermeable floors with effective drainage systems'." (The European Parliament and The Council of the European Union, 2013). There are different scenarios developed for predicting the impact of the EU law. It is estimated that the – anyhow advisable- HKC ratification will be accelerated, before it is replaced by the European regulation. It may urge South Asian countries to ratify HKC in fear of losing European business. The

European regulation is expected to undermine HKC's prospects because of the new requirements targeted South Asian ship recyclers. By leaving no choice but only the ratification of HKC, these developing countries may experience a prejudicial discrimination (Yujuico, 2014). Concerns arise about the regulation, because penalties are not determined for ship owners who recycle in facilities excluded from the European List. In addition to this, the European Council does not ban beaching completely, mainly because the South Asian governments has a strong legal power and the European ship owners acquire high amounts of steel from beaching yards. Finally, registration changes to non-EU flags before recycling is not restrained by the Regulation (Webb & Warder, 2014).

3.5 Ship breaking perspective in South Asia

Since India, Bangladesh, and Pakistan execute approximately 75 percent of the global end-of-life vessel dismantling (Pakistan Shipbreaking Outlook, 2014), these nations are also responsible for the ultimate industrial waste emissions. The greatest ship-breaking yards are located in Alang, India, in Chittagong, Bangladesh, and in Gadani, Pakistan. These yards complete shipbreaking on a few kilometers long beaches, while two smaller scope recyclers, China and Turkey use alternative methods, like piers and slipways. These developing countries are highly dependent on accepting transported waste from developed countries, but their operations neglect work conditions and environmental risks. Ship recycling industry in South Asia is also impeached with being responsible for avoidable accidents, work-related diseases and the loss of human lives (Gregson et al. 2011). Shipbreaking industry is globally affirmed to be one of the most hazardous activities without applying adequate dismantling and waste management technologies, and with compromise on labor rights. According to the international environmental law, end-of-life vessels are hazardous waste containing toxic materials for instance asbestos, heavy metals, and toxic chemical compounds that are structural part of the vessels. The current market situations show growing demand for constructing "green" ships that exclude hazardous materials (Pakistan Shipbreaking Outlook, 2014).

Historically, ship scrapping was mostly completed in Europe and North America. As the labor costs were increasing and environmental regulations became stricter in the 1970s, East Asian shipyards took over dismantling processes, particularly in Taiwan and South Korea. In the last few decades, the entire business of ship scrapping was relocated to South Asia. According to the World Bank, it can be explained as the following (Pakistan Shipbreaking Outlook, 2014): "A large labour supply, low labour costs, and a relative lack of environmental and occupational health regulation have all been vital. Also important is the fact that Bangladesh and Pakistan feature some of the largest current and pent-up future global demand for the Ship Breaking and Recycling

Industry's (SBRI) outputs—notably, relatively low-grade mild steel bars and rods for use in construction". (Pakistan Shipbreaking Outlook, 2014, 16)

Almost 90% of the global recycling tonnage annually is concentrated in the following developing countries: India (34%), Bangladesh (23.3%), Pakistan (12.1%), China (23.9%) and Turkey (4.3%) (FIGURE 7). (Yujuico, 2014)

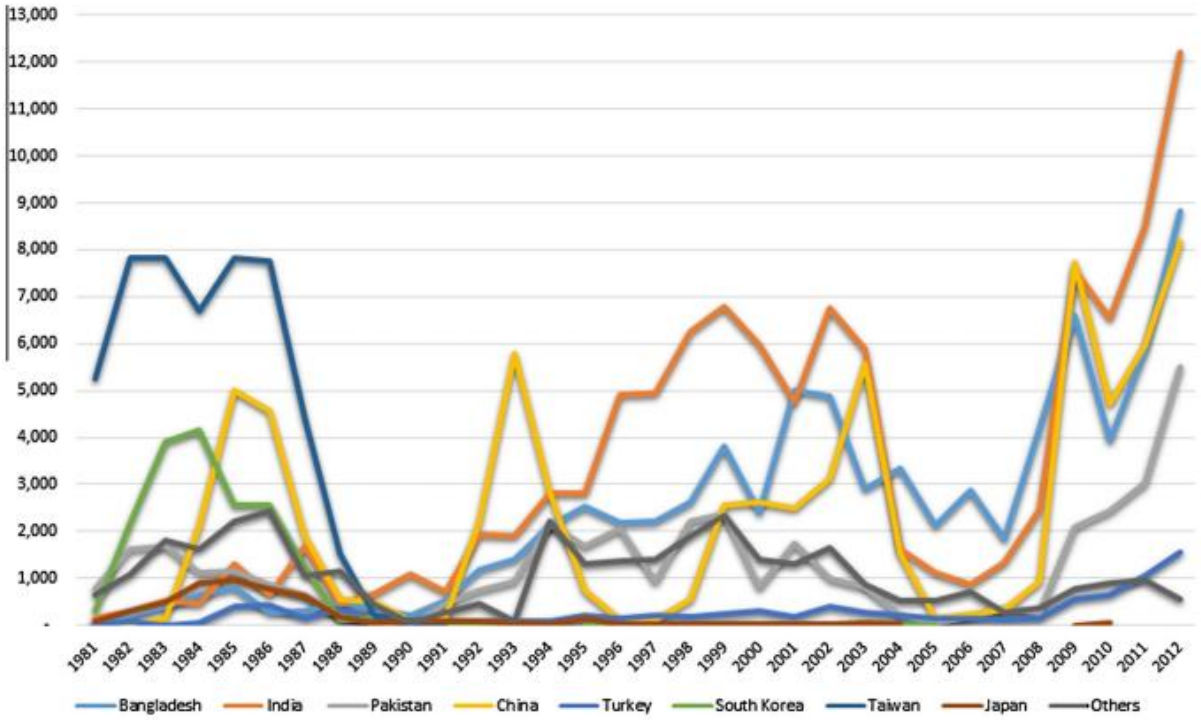

FIGURE 7 World ship recycling market (in '000 of gross tons).

The major shipbreaking countries, India, Pakistan and Bangladesh also embrace similar socio-economic circumstances, such as high population, increasing poverty, uneducated workforce, illiteracy, unemployment, environmental degradation and pollution, and non-existing/weak legislations. For being competitive, these countries often only focus on short-term economic goals with negative compromise on the environment and human health. Shipbreaking industry is partly seen as a sustainable business, because it employs unskilled workforce, supplies high quality steel that reduces the demand for ore mining, and provides revenue to governments (Puthucherril, 2010; Hiremath et al. 2014).

One of the most significant problems of these ship-scrapping nations is the insufficient manpower and investment capital. Mechanized facilities and lifting capacities are missing from the ship breaking yards and they operate under comparable environmental protection, health and safety provisions (Secretariat of the Basel Convention, 2003). The currently used beaching method for ship dismantling makes it impossible to fully exclude pollutants. Hazardous waste is not properly documented and managed. In Alang, India the Treatment, Storage and Disposal Facility has been set up for the industry, however, waste burning on beaches and the imported amounts of hazardous waste are not documented

in a transparent way. Additionally, emergency response, such as ambulances and fire fighters, are often unable to reach the scrapping area on the beach. Ultimately, even although lifting equipment, like small cranes can be set up on a beach, adequate heavy machinery can only be installed on stable land for instance on a pier or in a port area. Therefore, the greatest shipbreaking locations must utilize gravity method, thus large steel units are dismantled by using their own weight and crashed onto the beach or into the sea. (Pakistan Shipbreaking Outlook, 2014)

The ship breaking countries ultimately imply the failure of compliance to western requirements. In order to change the traditional standards and norms, these nations should invest in adequate facilities, process control, and working conditions are required to be altered. Additionally, a legal and cultural framework should be introduced that ensures the application of new measures and actions taken. All in all, the environmental and health and safety impacts of these countries are substantial that encourages the immediate development of new operational methods. Any improvements taken in the future cannot be fully similar in these countries, and they are influenced by the different regulatory structures, political conditions and the local economies. (Secretariat of the Basel Convention, 2003)

In the following chapter the thesis will demonstrate business and environmental management related segments of shipbreaking in India that also represent EHS conditions in other South Asian countries. Finally, this chapter will discuss important legal improvements regarding ship breaking in India.

3.6 Shipbreaking in India

Originally, India was focusing on dismantling small weight of barges and coastal wrecks, although it already had a greater economic potential in the business. In 1978, the Indian Union Government introduced a policy considering imported vessels for scrapping and established a development fund that sponsors the industry. Therefore shipbreaking quickly became a significant part of the economy facilitating continuous growth (Puthucherril, 2010). The entire industry is concentrated to Alang-Sosiya, in the State of Gujarat, and this area is the focal point of the Indian shipbreaking since 1983 (FIGURE 8). Some shipyards can also be found in Mumbai, Sachana, Azhikkal and Kolkata. The Alang beaches are often reached by rather high tides, when ships are pulled to the shore. The 10-12 kilometres long yard accommodates 160-169 plots where annually 200 ships are dismantled, and nearly 3,5 million tonnes of steel is gained. Alang is responsible for recycling 70% of the global vessels which provides 60 000 workplaces in the shipyard. One company can own more plots, but the shore of Alang is owned by the state by Gujarat Maritime Board (GMB). Hundreds of second-hand shops established around the yards selling valuable reusable and recyclable materials from ship dismantling. (Puthucherril, 2010; Hiremath et al. 2014)

FIGURE 8 The location of Alang-Sosiya, Gujarat, India.

3.7 EHS conditions in Alang, India

Unfortunately, the workforce is easily exploited in the shipyards. Most of the workforce involves migrant workers from less prosperous regions of the country. Laborers are mainly illiterate and lacking proper training of hazardous material handling. Severe or even fatal accidents are common like falls from height, fires and explosions, and workers are daily exposed to hazardous materials such as asbestos or toxic fumes (Rousmaniere & Raj, 2007). The unacceptable conditions also entitle that there is negligible or non-existing provision of minimum protective equipment, while job security or redress of grievances does not exist. Additionally, workers are daily exposed to fatal work conditions, although 80% of them does not receive more than 1-3 USD salary daily (Puthucherril, 2010; Demaria, 2010). In Alang the informal sector of workers are invisible to the law. The employer-employee relationship is unclear, thus allocating rights and responsibilities is difficult by law, and it is also problematic to provide social security system for employees. Scrap yards are poorly organized, and without trade unions they have incompetent bargaining power. Besides lacking appropriate work conditions and enforcement of human rights, workers are mostly entitled for accommodation with no sanitary or safe drinking water, but prostitution. Therefore sexually transmitted diseases are common phenomenon in shipyards. Consequently, average life expectancy of a shipyard worker is around 40-50 years. (Puthucherril, 2010)

The Indian subcontinent is accounted for having one of the most dangerous workplaces worldwide (Puthucherril, 2010). The Indian Supreme Court was reported about 2.0 per 1,000 annual incident rates of fatalities between 1995 and

2005 in Alang, India. Workers appear as little appreciated services, one can be replaced by thousands of willing, unprotected, illiterate applicants. Besides that, the marine environment in Alang is seriously affected by flourishing heavy industries, tightening other forms of livelihood (Hiremath et al. 2014). Alang is also responsible for high-degree of contamination caused by heavy metals, plastic debris and asbestos. Water quality on the coastal areas is unreliable due to leachate that increases salinity percentage of the seawater. Air pollution is severe, because wastes are burnt without filtering, thus harmful chemicals are released directly into the air. The steel re-rolling mills emit toxins when steel boards are taken to furnace without previous cleaning. One of the greatest challenges in India is hazardous waste management. (Puthucherril, 2010)

3.8 National regulations in India on ship recycling

Regulations derive locally in the industry of shipbreaking. Implementing any labor and environmental standards can be hindered by the overall economic performance. Due to multiple external forces, India has always been concerned about legal frameworks and regulations. One of the most significant legislative instruments is the “Gujarat Maritime Board Ship Recycling Regulations 2003” defined by the Gujarat Maritime Board. The Regulation was issued in order to strengthen legislation on occupational health and safety, and environmental protection in the shipyards of the State of Gujarat. Employers are mandatory to provide appropriate trainings and safety instructions displaying precautions. They have to manage an attendance register and provide identity cards, safety devices and compulsory insurance. Work processes must be documented in a daily logbook, and certain level of automation and adequate equipment are ensured. According to the above-mentioned regulation, it is mandatory to report on emergency and accident and to pay compensation in case of injury or fatality. Shipyard owners are obliged to dispose the hazardous materials and organic waste separately and to launch a solid waste management system. The regulation expresses a pressure on the recycler to engage with safety supervision and inspection on accidents in order to develop a permanent safety culture in the shipyards. When a regulatory decision is enforced, costs start to increase, and therefore the recycler struggles to offer attractive prices for the obsolete tonnage, and trading can migrate to other locations with more favorable market conditions. A municipal legal system could offer a challenging path for the sustainable growth in the global shipbreaking industry. This happened in the case of Alang, when the Supreme Court of India was insisting on obtaining higher standards by 2003, but great volume of the industry exited India and migrated to Bangladesh. (Puthucherril, 2010).

Due to continuous criticism on EHS practices, the GMB assured medical assistance by establishing a hospital close to the yards and building adequate accommodation for some of the workers. However, the yards are still

inaccessible for public inspection and there is no publicly available documentation about the processes. Even though the yards conducted some certification procedure and they use standards – such as ISO 30000[5], the reporting processes and the certificates are acquired in a doubtful way. India has introduced a set of sector-specific legislation in the shipbreaking industry for external drivers and internal motives. In 2003 the Supreme Court Monitoring Committee was established to inspect compliance with legislation and especially compliance with court decisions. India is concerned about international legislation, but the problem relies in practical enforcement. Authorities are engaged and certificates are demanded, although administrative liabilities could not achieve significant changes accepted by human and labor rights and environmental parties (Pakistan Shipbreaking Outlook, 2014).

3.9 Summary of ship breaking industry

The previous chapters investigated the current situation of global ship breaking. It has been highlighted that ship breaking industry needs to be altered into a more sustainable and safer business. The first two chapters of the thesis attempted to describe applicable methods for developing a greener ship recycling industry.

The subchapters on international legislation discussed that due to non-compliance with the Hond Kong Convention and the Regulation and Directive on Ship Recycling of the EU, traditional South Asian ship recycling will possibly come to an end. It has been emphasized that other locations could also be attractive for the industry where environmental, health and safety issues are essential part of the business. The subsequent chapter attempts to investigate attitudes and perceptions of a possible ship recycling industry establishment in Finland with the interaction of various suppliers and business partners.

[5] Ship recycling management systems that contain specifications for safe and environmentally sound ship recycling facilities (iso.org)

4 RESEARCH METHODOLOGY

4.1 Qualitative study approach

According to Weiss (1994, 9), “Research aims should dictate research method.” One of the most common research aims is to understand the studied phenomenon in a holistic view. Qualitative research method gives a holistic description by aligning perspectives of interrelated actors. In order to gain a comprehensive understanding it is recommended to study the topic from different perspectives. Instead of standardized questions, each interview can be formed with the consideration of specific company profile (Saunders, Lewis & Thornhill, 2009). Qualitative interviewing also enables to investigate perceptions and reactions of an interconnected group that helps to define the structure of the system. Theories and hypothesizes can be applied that can support future quantitative researches. Qualitative research does not only aim to describe a topic from different perspectives, but also describes how different actors work together in a complex entity (Weiss, 1994). The qualitative research consists of the following main steps (FIGURE 9):

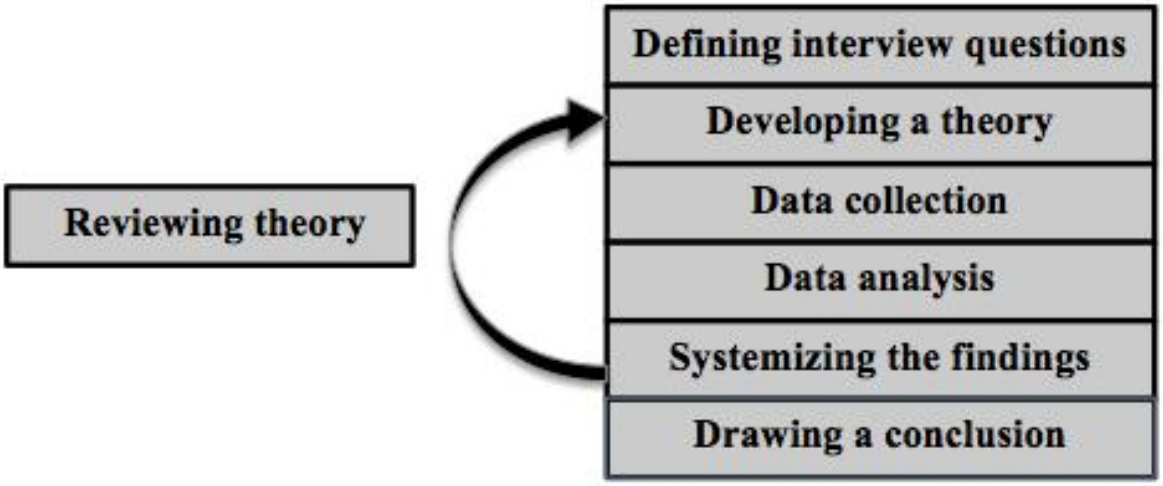

FIGURE 9 Qualitative research procedure.

4.2 Data collection

The research analyzed the understanding and attitude of public and private companies in Finnish ship recycling possibilities. For data collection two different types of interviews were conducted with altogether five interviewees. Open-ended semi-structured interviews are prepared for private companies to make sure that interview obtain the necessary information. Every interview was specific in some extents, thus the conversation included additional questions (Saunders et al. 2009). The qualitative research also analyzed data collected from field observation and electronic questionnaires were sent out. The main aim of the qualitative research was to conduct interviews, but unfortunately not all the participants could schedule sufficient time for it, therefore some companies requested interviewing in electronic way. According to Meho (2006), e-mail interviewing is more and more popular tool to conduct qualitative research. It is significantly less costly than telephone or face-to-face interviews, independent from time and geographical location, and it can be conducted in large groups. The main drawbacks are the uncertainty of response rate and the probability of misinterpretation of both the questions and the answers. First face-to-face interviews were conducted, and then questionnaires were sent to the interviewees afterwards in order to obtain information for all the questions not being discussed at the interview. The quality of the answers was not adequate enough, therefore further research was needed to complement the responses. The main reason for it is the lack of face-to-face interaction that leads to less opportunity for observations and perceptions.

Data was collected from the following types of private organizations:

- ship repairing firms
- shipbuilding company

- shipping company
- waste recycling company

More detailed information about the interviews are available in APPENDIX 2. Records were gathered from a relatively small number of sample sources for two reasons. First, shipping industry is fairly small in Finland with a very few organizations, and currently no company is executing ship recycling that could have been interviewed. Therefore general data availability is restricted. Secondly, those firms that show any interest in new business opportunities, are still very skeptical, therefore they cannot perfectly respond the questions related to their willingness for cooperation. Luckily, there was also a workshop organized for interested companies that was probably the first significant step towards ship recycling experts in order to benchmark, share best practices and network. The workshop also enable to acquire information for this thesis research, even though these information was mostly based notes from the discussion panel and own observations of the researcher.

4.3 Data analysis

The open-ended questions recorded a large number of data for transcription that has been studied in qualitative content analysis approach. Due to the complex nature of the records, the data needed to be simplified by summarizing, reconstructing and classifying (Saunders et al. 2009). Basic requirements of the content analysis are to define the unit of the research (1) – in the current research it is an organization - and to create categories (2) for the data that can be further assessed in a conceptual framework (Saunders et al. 2009). According to Zhang & Wildemuth (2009, 2), "Qualitative content analysis involves a process designed to condense raw data into categories or themes based on valid inference and interpretation". Qualitative content analysis can be divided into two approaches: inductive and deductive. Both approaches aim to connect theory and research (Brymall & Bell, 2007). By applying inductive coding scheme, concepts and variables usually evolve from data analysis. The challenge of this approach is that data collection foregoes theory explanation, thus after the records were taken, the researcher attempts to develop a hypothesis corresponding with the data. On the other hand, deductive approach means that research questions and objectives are derived from existing theory and it can be even used for data analysis (Saunders et al. 2009). This thesis research has combined the two types of approaches, because even though there is clear theoretical framework in the research, the applicability of it was uncertain until conducting the empirical research.

The chosen research method of this thesis is content analysis. Hsieh & Shannon (2005, 1278) state that "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (as cited in Zhang &

Wildemuth, 2009). Content analysis is an increasingly used quantitative research technique, but it is also considered to be an effective method for testing hypothesizes in qualitative research. It summarizes the reported data into a core message without deeply discussing details. As Neuendorf (2002, 13) explained "Measurements are made for each of the variables, and relationships among them are examined statistically to see if the predicted relationship holds true." With other words, if the research proves that the findings support the hypothesis, the theory is applicable. In case the research results can fail to support the hypothesis, the theory is only applicable in some extent.

The current research chose to apply deductive content analysis method, meaning that the hypothesis and the research questions were developed before data collection and transcription. The unit of data collection was defined on which variables are evaluated (Neuendorf, 2002). The unit of the data is any words or sentences of the transcript that demonstrates the research phenomenon. It also means the words or sentences that are interconnected through their content (Graneheim & Lundman, 2004). According to Zhang & Wildemuth (2009, 3), "The unit of analysis refers to the basic unit of text to be classified during content analysis." The unit of analysis is "organization". The main aim is to reduce the text size without quality decrease. Shortening the text means abstraction when codes, categories and themes are produced on different levels.

Deductive content analysis requires categorization that is a form of criterion derived from the theoretical research and research questions (Mayring, 2000). The interview responses are classified in three matrix's, each includes different categories that assess the interview responses in an analytic framework. A group of content, belonging to the same category is homogenous, while heterogeneity between the different categories is noticeable and manifest. The meaning of the categorization is to provide a descriptive understanding of the interview contents (Graneheim & Lundman, 2004).

Subsequent to the data categorization coding schemes were developed. Coding interprets the data according to category definitions. After each interview theme a coding agenda concludes the acquired data in a simplified and consistent method (Brymall & Bell, 2007; Mayring 2000).

The coding logic of the research is to first define aspects and assess the answers of the organizations (1-5.) according to the relating category. If the aspect is more than 50% applicable for the firm, the evaluation is marked with green, while in any other cases there is no mark. The level of applicability is not provided, due to the fact that the entire assessment is based on the researcher's own perceptions and evaluation. The assessment strives to transform the textual information into analytical data that can be measured in Chapter 6. Discussion. After all, one of the greatest weaknesses of qualitative content analysis is that is relatively subjective.

4.4 Data reliability and validity

Reliability and validity are different indexes to assess the quality, accuracy and broader prospects of the research (Bryman & Bell, 2007). Reliability describes the scope within the data collection, and analysis discovers findings analogous without significant deviation (Saunders et al. 2009). Validity refers to correlation of the research theory and observations. It also means whether the findings can be generalized in a broader scientific scale (Bryman & Bell, 2007). This thesis recorded the interviews only on paper notes due to the fact that a significant part of the interviews were conducted at the same time with the facility visits. Shipyard production line usually involves high level of noise disturbance. To enhance data reliability questionnaires were given to the interviewees. Additionally, all interviews were conducted with the presence of the external supervisor, Matti Pettay. More than one observer contributes to the accuracy of gathered information (Bryman & Bell, 2007). Validity of the thesis was conveyed by explaining the changing legal requirements of ship recycling. Furthermore, at the beginning of each interviews a comprehensive explanation of industrial symbiosis helped the interviewees to familiarize with the research topic.

5 EMPIRICAL RESULTS

The interview topics are discussed in three main groups as it was explained in the objective of the paper. Besides that, the companies first were requested to provide general data about their business operations. This information is not published in the research due to irrelevance and identity protection. Any information this chapter handles is interview related transcriptions of the data collection. The entire empirical research was focusing on applying a scenario or hypothesis of establishing ship recycling business in Finland. The first research question group attempted to discover opportunities and risks of developing recycling industry in Finland. Mapping the possible negative effects helps to prepare for handling them. The second question group assumed that the theory can be applied and the firms are willing to engage in business with each other. In such a small industry, firms already know each other, therefore the next section aims to find out how they could work together in the most effective way. The last group of questions elaborated internal stakeholder point of view for enhancing commitment, and reliability by applying soft management tools. Interview responses are grouped according to the corresponding question and summed up at the end of the section.

The background of hypothetical question (RQ1) assumes that ship recycling migrates from South Asian countries that show non-compliance to EU legislation to other locations for example Europe, where technical preparedness and know-how could provide business opportunities for investors. The research question examines whether the interviewees are willing to participate in developing ship recycling. Their decision is in strong correlations with the predictable opportunities and risks.

RQ1: What are the opportunities and risks of establishing ship recycling facilities in Finland?

Historically Finland is not a typical ship recycling nation. Small-scale ship repairing and recycling was executed a few decades ago, but nowadays it is irrelevant compared to other countries. However, many shipping and repairing companies have know-how in the technical processes of ship dismantling and material recycling:

> "Currently we are only dealing with ship repair, but a few years ago we had some demolition projects. Two small LDT vessels were fully recycled with the cooperation of a material recycling company from Finland. In case Finland starts environmentally sound ship recycling, we are one participants who consider to contribute with our know-how." (3)

> "We have had experience in ship recycling in 1997. We specialized in small wreck tonnage recycling, including lifting from sea bottom and dismantling of hazardous wastes. However, this project already ended long time ago. At the moment we still ship and handle about 100-200 000 tons of scrap metals yearly. Currently this part of the company is not active. But we still have the infrastructure and the equipment for ship recycling." (4)

Ship repairing and shipping companies possess relevant knowledge in ship recycling, because they used to execute such processes in the past. Safe and environmentally sound operations were always taken into account. International certificates are still required from the ships that arrive for repair. The ship repairing yard is in a good geographical position, main advantage is that processes are machined, however the facilities need to be extended and upgraded for recycling business.

In addition to technical knowledge, another factor that could favor ship recycling in Finland the small business cooperation of one material recycling company and the ship building firm. Based on the interview responses, it can be mentioned that at least two of the interviewed firms maintain strong cooperation in waste metal recycling:

> "We purchase metal waste from manufacturing companies and the recycled metal is sold back as raw material for manufacturing. It is important to consider ship recycling opportunities here in Finland for different reasons. As the raw material prices - especially steel and copper - constantly increase, at some point Finland has to consider recycling more metal for the supply of local manufacturing industries." (1)

> "Our metal waste is handled and recycled by the recycling company. We require certificates and standards from our suppliers

> to ensure quality in building blocks and equipment. However, we often have to provide information about our products from raw material acquisition for our customers. We could enhance our competitiveness, if we were also able to assess the entire product life cycle." (2)

The supply chain participants thoroughly considered the opportunity of ship recycling business in Finland. Most of them agreed that their competitiveness is enhanced with locally procured materials and energy supply. One of the shipbuilding companies gave two reasons for their interest:

> "Currently our ship building processes rely on import resources mainly from Russia, but we would prefer to procure more materials from locally recycled steel and other valuable materials. It could enhance traceability of the products that provide better data for our customers as well." (2)

Based on the assessment of technical preparedness, it can be claimed that several companies have had experience in ship recycling even though none of them dismantles ships currently. Technical know-how is one crucial element of ship recycling besides legal and supply chain issues. Interestingly, several interviewees are concerned about the same problems in terms of environmental licensing.

> "…our environmental permit does not include ship recycling in total. To be able to launch full scale recycling the company needs a new environmental permit. Acquiring an extended environmental permission brings financial expenses and the application processes lasts for an undefined time." (3)

The same problem plays an even greater role in the operations of one ship repairing firm:

> "We don't have environmental permit for ship recycling. Acquiring an environmental permit is already required in the testing processes. The application period often takes several years and unexpected expenses could occur. Therefore it has to be deeply considered to obtain." (5)

Besides the above-mentioned challenges, supply chain management is also a crucial aspect in ship recycling. In many cases it can mean great uncertainty, thus companies see it as a potential risk.

> "One of the biggest challenges of the ship recycling is logistics, therefore a reliable and trustworthy supply chain is needed with the best specialists from the industry." (3)

> "I am not sure if we are taking part in an actual scrapping business anymore. Mainly because of the transportation and monitoring of the business show the biggest risks." (4)

Many organizations considered that managing such a long supply chain is also a great challenge whether it should be remained to one actor or more and for internal or external. The most probable is that the head-managing actor should have experience from all the different business segments and advisory teams should support the leaders work.

The material recycling firm showed great interest in ship recycling, and the company could also offer supply chain management expertise based on the already existing networks and connections with local specialists from the entire industry.

Ship recycling can only be executed in certified and inspected dry-docks in Europe according to Regulation and Directive on Ship Recycling of the EU (The European Parliament and The Council of the European Union, 2013), however no Finnish shipyard has adequate size to recycling in large scale. Building dry-docks means a great investment that no organization is willing to conduct without cooperation.

The interviewees also acknowledged the lack of competence in evaluating the end-of-life ships. Besides the initial investments made for ship dismantling facilities, ship purchase brings further expenses, however pay-back-time is unknown. The ship recycling firms could gain knowledge e.g. from Indian shipbrokers in order to be able to estimate the ship prices based on tonnage, age, materials and size.

> "We don't know how to estimate a wreck taken for recycling, but we could learn these processes from Indian experts. Besides the main investment costs, we also need to carry out a full analysis of other related costs." (5)

The main discouragement is the relatively little knowledge of financial planning. Currently known areas where costs can occur: personnel related cost such as wages, PPE and equipment, technological costs, scrapping cost for the shipyard and other facility related costs. These are altogether significant costs, therefore probably no single organization will invest in building a recycling shipyard. As a recycling company with deep knowledge of prices related to material flows, profit-loss analysis can be estimated related to material flows. However many firms stated that very few companies have knowledge of the

costs of buying and breaking ships. Quality management should also be applied on materials arriving to recycling factories.

The sample participants acknowledged that ship recycling is the most reasonable to combine with ship repairing in the same shipyard. Due to the business volatility occurring in both industries, the shipyard can constantly acquire new orders based on the actual market demand whether for scrapping or repair.

Examined factors that influence the establishment of ship recycling in Finland	1.	2.	3.	4.	5.
Availability of technology, (recycling) equipment and dismantling spaces	✔	✔	✔		
Sufficient knowledge in legal requirements			✔		
Sufficiency in infrastructure and logistics	✔	✔	✔	✔	✔
Understanding the market trends of ship recycling			✔		
Knowledge of investing in ship recycling facilities	✔	✔	✔	✔	✔
Believing that unexpected costs can occur			✔	✔	✔
Aspiration to share business and technical knowledge	✔		✔	✔	
Co-joint ship repair and recycling yard idea supported	✔		✔		✔

TABLE 3Aspects that concern organizations (1-5.) in ship recycling.

After assessing the perceptions on establishing ship recycling business in Finland, the research focuses on determining whether the motivation increases if organizations start to work together, perhaps in an industrial symbiosis. The hypothesis of establishing an industrial symbiosis was made, because the interview participants already explained that such business opportunity attracts simultaneous consideration of multiple firms.

RQ2: What kind of possibilities exists for a future collaboration in ship recycling?

Ship production is a typical business where decision-makers always have to follow global trends. The business strongly connects to ship repair and ship recycling. Any changes occurring in shipbuilding have an impact on the other two businesses. Finland has a long history in shipbuilding and the country is also known as “one of the world’s biggest cruise ship builders” (Czinkota & Ronkainen, 2012). Finland has a prestigious place in shipbuilding worldwide, moreover one ship building company and another repairing firm noticed sales order increase in long term. They consider extending their businesses such as investing in new facilities or increasing the capacity of the current ones. Ship recycling is perceived as a local traceable raw material supplier that could support shipbuilding and repairing.

> "Shipbuilding demand is worldwide increasing. Finnish builders have a good reputation and we also get several new orders yearly. We need to consider cooperating with more economic and sustainable suppliers, especially with local firms" (2)

Other firms also deliberate ship recycling developments. One ship repairing firm emphasized that ship recycling requires a bigger dismantling pool in their shipyard. However, such investments are rather risky, for example collaboration could help to reduces predictable risks:

> "Increasing our capacities is a reasonable idea, however it is more reasonable to invest in with other business partners. We could also apply for financial aid from public sectors." (3)

> "The most beneficial and less risky to start recycling ships, if R&D and facility investments are already conducted in a collaboration. We also believe that private and public organizations should work together." (4)

Interest for establishing ship recycling business can be acknowledged. In many cases the interviewed firms referred to each other in terms of maintaining a strong cooperation. Cooperation means that shipbuilding and ship repairing organizations form a closely related network in Finland where SMEs work together for decades and mutual reliability and trust develops among them.

> "We believe that ship recycling can develop among SMEs as shipbuilding and repairing also exist among SMEs. They are also open for new ideas and willing to promote collaborations." (1) (4)

Industrial symbiosis, as a "label" or a physical phenomenon with quantifiable segments is a known term for Finnish shipbuilding and ship repairing industry. Very many Finnish firms already joint some sort of an industrial collaboration. Based on their experience, they evaluate ship recycling industrial symbiosis in Finland:

> "If any ship recycling business will be launched in Finland that can only be imagined in the form of a strong and committed collaboration. However we believe that concrete collaboration cannot be planned at the moment due to the lack of R&D." (4)

> "Finnish heavy industry companies have great know-how in engineering and technology of material recycling, but they need

> to work together in a common location. On the other hand, their individualism must be taken into account as well." (5)

During the interviews several companies claimed to be participated in green supply chain management and/or an industrial collaboration. Waste is one of the most valuable resources of the chain, since it is separately collected and sold for recycling companies.

> "After sorting metal waste by different quality requirements, the material is sold to the suitable company. One of our business partner, a recycling company melt the metal waste and produce building elements for the ship such as metal blocks." (2) (3)

> "We could purchase scrapped electrical equipment and furniture from a dismantled ship. We recycle these wastes in a safe and environmentally friendly way, then we sell it as a raw material for manufacturing firms. We also recycle hazardous waste safely." (1)

It is commonly perceived that an efficient collaboration also considers partners outside of the system. A common business plan should be defined by understanding customer relations and expectations, because achievements in sales relate to good customer management.
Good basis can be found for a future collaboration, since some of the interviewed firms already have business connections in steel block supply that are recycled from metal waste. However it is important to consider to engage in business with the small and medium sized enterprises that are more willing to collaborate, as it was stated by Schwarz and Steininger (1997) as well.

Factors related to the attitude and perceptions of a collaboration e.g. an industrial symbiosis	1.	2.	3.	4.	5.
Theoretically ship recycling is needed in Finland	✔	✔	✔	✔	✔
Theoretically Finnish ship recycling can be established in collaboration most easily	✔	✔	✔		✔
Currently actively participating in an industrial collaboration	✔	✔	✔	✔	✔
Seeing opportunities to include ship recycling in the current collaboration					
Willingness to actively participate in ship recycling initiative					
State as a financial supporter is seen as a key contributor			✔	✔	
Cooperating with SMEs from shipping industry	✔		✔		

TABLE 4 Factors that describe the attitude of organizations (1-5.) to establish ship recycling in an industrial symbiosis.

RQ3: How can a strong and effective cooperation be created and who would be the considerate business partners of a Finnish industrial symbiosis for ship recycling?

The last section of empirical research results (RQ3) is based on the recorded interview responses and the perceptions of the interviewer. The evaluation matrix contains observations on behavior and non-verbal communication, as well. Most of the interviewees think shipping businesses can only be executed in collaborations whether in a supply chain system or in an industrial symbiosis. They also seemed to pay attention to stakeholder expectations.

> "We could cooperate with recycling company/companies in ship recycling. But probably a linking connection is needed to discover the potential business partners. An agency could find suitable recycling projects and handle the sales of used ship equipment and materials with profitable prices." (3)

> "As a leading material recycling company in Finland, we already manage a supply chain with shipbuilding and repairing waste suppliers. We could also offer such services for managing ship recycling collaborations with suppliers and customers." (1)

> "We believe that sharing knowledge and providing expertise in certain topics can be performed easily in a small and interrelated community. It is probably also an efficient tool to enhance trust and willingness for cooperation." (1)

Inter-firm connections are perceived as a prosperous idea in ship recycling. On the other hand organizations need to take into account the requirements of external stakeholders as well. Shipping industries are strictly controlled by legislation, and any non-compliance can bring great costs. One of the shipbuilding companies explained that cost calculation needs to be carried out in any case, especially if the estimated work time is expected to extend due to internal on-site inspections. Any non-compliance can be a critical issue for suppliers/ customers or legal inspectors. Best practices could also be considered regarding environmental legislation:

> "In order to comply with the quality requirements it is advisable to supervise the work and production processes by internal and external inspectors." (1) (2)

> "Transparency is one of the most significant targets that is supported by the official authorities' verification both in environmental and health and safety matters." (5)

Many of the interviewed companies have already engaged in social responsibility issues. They have learnt through practical experience that different actors influence business operations, therefore their wellbeing and opinion need to be considered in strategic questions. CSR is one of their basic elements in the code of conduct. Compliance with the law is often a minimum obligation, but many go beyond it by setting strict internal requirements. No compromise is allowed in human health and safety and environmental protection:

> "Social challenges can be reduced, if the recycling process follows the requirements and complies with the legislation." (3)

As the part of social responsibility practices, most of the bigger companies maintain ISO 18001 Management System. Additionally, heavy industrial companies in general are striving to improve work conditions both at shipyards and in the factories.

In order to better cope with social challenges, firms understood that the Finnish legislation and stakeholder requirements about ship recycling should be thoroughly comprehend. Common environmental and health and safety management systems could enhance the possibilities of acquiring environmental licenses.

The following coding implies those aspects that are essential to consider in strategic planning phase of ship recycling business project. It is important to note that each company is marked with the most relevant aspects based on their interview responses.

Influencing factors in a future ship recycling symbiosis	1.	2.	3.	4.	5.
Importance of transparency of the whole business	✔	✔	✔	✔	✔
Establishing – possibly common - management systems	✔	✔			
Considering CSR – establishing a socially responsible business	✔	✔	✔	✔	✔
Willingness to Invest in R&D			✔	✔	
Willingness to engaging with foreign business partners		✔			
Seeing a need for external support from PR experts			✔		✔
Requiring support from market experts			✔	✔	
Financial support from the Finnish state			✔		✔

TABLE 5 Factors supporting ship recycling symbiosis.

6 DISCUSSION

Subsequently to data analysis, this chapter attempts to interpret the research findings and answer the research problems. The discussion is divided into three main topics correlated to the research questions.

6.1 Perceptions and beliefs in Finnish ship recycling

The interviews discovered that internationally recognized shipbuilding companies can be found in Finland that are manufacturing for global markets. Ship repairing is also a significant industry in the country, but relatively little experience can be acknowledged in ship recycling, especially compared to South Asian recycling countries. Finland has terminated ship recycling business decades ago, and even though there was ship recycling in the country it was a small scale business. During interviewing, the companies agreed in having sufficient knowledge in material recycling that is one crucial element of ship recycling. However, the entire ship recycling business process seemed to be an unfamiliar topic for them. Due to the lack of business expertise, Finnish companies consider establishing ship recycling as a risky business with many uncertainties. Long-term investments with long payback time does not favor high rate of uncertainty. Obviously the EU Regulation on Ship Recycling opens up debates for discussion whether Finland can benefit from the new legal requirements. International media claims that ship recycling is expected to emerge in the EU shipyards, while South Asian shipbreaking will decline (http://maritimenewstoday.com). As a matter of fact environmental standards are very high in Finland, and the country also holds some dry-docks, but they are too small for large LDT vessel dismantling. Thus from one side business

prospects exist however without any new investments on shipyard extension these opportunities cannot be exploited. Considering other risks Finnish companies believe that they know little about the market structure and economic processes in ship recycling that further challenges the investments. Expertise is missing from vessel price evaluation, competition and end-of-life vessel purchase. So far the thesis research could not identify such potential key actors in the industry who possess these missing skills and knowledge. Despite the Finnish companies show interest in ship recycling, they are not willing to manage an entire industry without national/international support. They highlighted the need for experts from different fields to work together already in R&D phase.

Comprehensive market analysis needs to be carried out in order to invest in Finnish ship recycling with reduced risks. It is a never-ending debate whether there is enough ship recycling capacity (NGO Shipbreaking Platform, 2013). Demand for shipbuilding delivery is rather volatile, but as the European Commission (2004) predicted the same degree of demand is expected to rise for ship recycling in the next few years as it was in the last five years. The only difference is that ship recycling is more dependent on the decision of ship owners than before. Those ship owners that are concerned about sustainable ship dismantling will probably refuse to sell their vessels to South Asia (http://maritimenewstoday.com). However the greatest driving force in such decisions is still profit acquisition. Other influences like legal changes inevitably determinate market conditions and cause a market gap. Currently only a very few green shipyards are verified by the recent EU Directive, perhaps more shipyards are needed to join safe and environmentally friendly recycling. Organizations that first enter a new market consider obtaining long-term competitive advantages by accruing higher market share than the followers. Entry could also bring higher profits due to the lack of competition. There are several advantages of being a pioneer, however firms often have to face the challenges of regulatory approvals, customer acquisition, supplier support and sufficiency in infrastructure (Roger, Kerin, Varadarajan & Peterson, 1992). The interviewed Finnish companies seemed to have low belief in the business idea and none of them would fully commit to ship recycling development at the moment.

Regarding Finnish opportunities, one seemingly convincing reason found for establishing ship recycling, as it could complement ship repairing business. Ship repairing business is highly dependent on ship demand, thus it is also a volatile business. It has been stated that ship repairing and recycling are closely related, thus similar technical knowledge is required. When no demand can be found for ship repair, ship recycling could provide jobs for the shipyard. Moreover, the European Commission (2004) encourages to apply a so-called “take-back” approach in shipbuilding yard that is also a good opportunity to obtain work when demand is decreasing for ship construction.

All in all, industrial waste and hazardous waste recovery are important segments of the Finnish industry. In 2013 more than 90 percent of the metal and

electrical waste was recycled in Finland (www.stat.fi). The country has know-how and experience is material recycling. According to Schwarz and Steininger (1997), during recycling the ultimate amount of waste is considerably diminished, alongside with the demand of raw materials. From the economic point of view it reduces raw material and waste disposal costs, furthermore the supply and disposal risks lessen, that are important economic drivers. By using recycled materials, energy costs can be reduced in manufacturing processes. It is applicable for example for utilizing scrap iron. Economic and ecological changes in a certain area emerges the establishment of a regional industrial recycling network. The development of recycling networks strongly relate to the changes occurring in the region. Increasing restriction in legislation and ecological shortages influence the establishment of waste recycling (Schwarz & Steininger, 1997). The interviewed firms operate in an in an environment with high environmental and health and safety standards. However they believe that in order to recycle large LDT vessels rigorous environmental permission is required that is very expensive to acquire.

6.2 Attitude towards an industrial collaboration in ship recycling

Forming an industrial symbiosis for ship recycling could give good opportunities to work for common goals, and at the same time trust and willingness for cooperation could be enhanced. Findings of the empirical research show that engaging in collaborative business is a favored idea, especially because the firms have positive experience in such cooperation. Many of the interviewed companies already operate in strong alliance with each other that allowed to affirm trust and reliability. On the other hand, the interviews also pointed out that these firms restrict their operations to national level. In the century of globalization national borders theoretically disappear and collaborations born between organizations regardless of their background. Finland is in the need for more foreign investments as well. Industrial symbiosis could also attract them by showing cooperative alliances and opportunities for innovative businesses. Regional collaboration is needed that can attract foreign firms to the country because presumably not all the know-how can be found locally.

As is has been mentioned, the already existing strong cooperation could support new business developments in ship recycling. However, one main drawback of their interconnection is that the motivation to engage in business with new or unknown business partners is relatively low. Another negative effect of the strong alliance is that most of the firms are not willing to open up for ship recycling without co-joining partnership that can be interpreted as high interdependence. The companies also trust their current business partners and suppliers regarding environmental performance and social responsibility. In a

small business society like in Finland, organizations know each other for decades and they have information of acquired standards and certificates that further increases trustworthiness. However the interviewed firms have doubts about the success factor of the whole Finnish ship recycling possibilities. It results from the lack of knowledge about business opportunities in the industry and from unpredictability regarding the market trends. The other problem is that the interviewed companies are little aware of any business partners who could be interested in Finnish ship recycling. They perceive ship recycling as a highly risky business where no firm is willing to invest without the contribution of their current business partners. Already in R&D phase they require the attendance of public companies, moreover ship recycling facility and infrastructural investments are mostly favored business approach with public financial instruments. Research findings show that the companies are not particularly willing to initiate ship recycling investments without collaboration. They also mentioned that it would mean such a large-scale business that certainly requires financial support from governmental side. However detailed discussion about it was failed to carry out. All in all, industrial symbiosis is perceived as a prosperous development idea, while ship recycling is assumed to be an unpredictable and uncertain business field that needs to be researched more.

The qualitative research analysis showed that shipbuilding and ship repairing companies are motivated to start researching and planning how ship recycling could be executed in Finland. Due to the tightening legal requirements, shipbreaking can be and needs to be redesigned in Europe and in Finland. Inevitably, it has been recognized that Finland needs industrial changes, meaning traditional Finnish businesses are not competitive enough anymore, therefore new opportunities need to be utilized such as ship recycling. Industrial symbiosis is one possible approach for ship recycling that was introduced for instance in Bangladesh. These types of initiatives strive to better comply with regulations and slowly introduce a greener ship dismantling business in the developing world. The case study of Bangladesh gives an excellent example on cooperation for the Asian industries, and it highlights the crucial points of developing a future alliance for instance in Finland.

The Bangladeshi industrial symbiosis represents how the recycling processes are managed in collaboration. Chittagong area, Sitakunda-Bhatiary is a traditional shipbreaking region in Bangladesh where mainly oil tankers and container ships are dismantled. Some economic entities established a strong network where materials exchanges were accomplished, while wastes and by-products of disposed ships were reconditioned, reused, and remanufactured for producing secondary items. Sitakunda-Bhatiary businesses mostly decompose ships and the scrap ferrous is transferred from the beach to the local re-rolling mills (RRMs). Almost every shipbreaking yard includes a RRM, therefore materials exchange is separately negotiated based on the bargain of items and materials of the beached vessel. The supply of scrap ships can be easily predicted according to the independent sale of the arriving ships. The scrap

supply is gained from breaking large discrete units into smaller items and sold as recovered materials in the local economy of Bhatiary and Chittagong. Bangladesh has discovered a market gap by remanufacturing high-quality items rather than purchasing new inferior-quality ones that entitle expensive technological imports. South-Asia is typically selling for the domestic markets, but if international technical and labor standards are also applied, the companies can engage with global markets. The collaboration mainly constructs low-technology decomposing goods for local consumption and for SMEs in the domestic manufacturing sector. The domestic market consists of selling for middle-class consumers, who mainly purchase power generators for ensuring their own personal energy supply living in areas with frequent power outages. One group of customers is the business startups, especially from garment and shoe sectors. Start-ups or SMEs, producing inexpensive garments and shoes for the expanding market, rely on power-related equipment taken from scrapped ships; e.g. generators, cabling and other reconditioned engineered products. The growing market extends the business of these SMEs, hence their power capacity demand urges to purchase already available, cheap reconditioned power equipment. (Gregson et al. 2011)

For similar future intention some specifications could be used from the case of Sitakunda-Bhatiary:

1. Wastes and potential by-products are also generated during secondary materials recovery, because it is a natural segment of material recovery, just like of any manufacturing process. On the other hand recovery wastes can become inputs and exchanges for other industries by offering primary raw material for available price or by contributing waste management cost reduction.
2. Based on the already existing industrial symbiosis in South Asia, more sophisticated conceptualization is needed in order to understand the symbiosis in spatiality of globalization. Industrial symbiosis stands in close relation with geographic proximity, island economies, industrial districts and the policy concept of EIP. It ignores large-scale global symbiosis and their materials flow and processes.
3. Symbiosis can develop from different pioneer entrepreneurial businesses regardless of any territorial specifications. Even entire sectors can form collaborative initiatives based on initial inter-firm waste and by-product exchanges from the recovery of ferrous metals.
4. The different industrial sectors are strongly dependent on the supply of the end-of-life ships, thus the more complex a ship structure is, the more varied potential it means for recycling.
5. Symbiosis is considered to be environmentally clean manufacturing cluster in order to minimize waste in the closing loops. It is important to note that the symbiosis is far from green issues understood in Europe, but it is a huge step forward in South Asian conditions of negligible or absent environmental regulations. Establishing a symbiosis in South Asia implies enormous amount of environmental and labor costs. (Gregson et al. 2011)

The case study of Bangladeshi industrial symbiosis demonstrated how ship recycling could be utilized in an industrial symbiosis. The success story could be partly applicable for a Finnish initiative, as a matter of fact technical procedures are similar, only higher EHS standards are required in Finland. It is important to keep in mind that business possibilities arise with the EU Ship Recycling Regulation, because even though health and safety performance are constantly improved in South Asian ship recycling, the environmental issues still mean a significant problem due to beaching method.

6.3 Merging theory and practice

Currently the interested organizations are attempting to discover opportunities in ship recycling, thus the industry is in the phase of research and development. The interviewed companies admitted that there is a great need for R&D in the economic, market and financial issues. As Vandermerwe and Oliff (1990) were investigating the early stages of business opportunities, they defined three main tools that are important to consider before a sustainable business development is launched: research and development, market communication and manufacturing process improvements (as cited in Welford, 2004). Barisal (1993) describes these sub-categorize in more details; before any concrete business investments, investments are needed in R&D that supports environmental issues and the reduction of environmental impacts. It is crucial to highlight that suppliers should operate and manufacture in an environmentally sound way. Environmental management in manufacturing helps to ensure supplier claim for ecological friendliness and to commit to other environmental targets (as cited in Welford, 2014). At the early stage of business planning cooperation is one significant contributor to innovation and responsiveness. (Yusuf, Gunasekaran, Adeleye & Sivayoganathan, 2003)

Many of the above mentioned instruments are often more applicable with the cooperation of external partners. The sample companies are constantly seeking for opportunities for their current and new businesses. Presently, the companies are lacking opportunities for networking and knowledge sharing about ship recycling, but there is also a great need for those “head-hunting” organizations that support the matching of business partners. One of the major steps in ship recycling development was the Helsinki Conference on Ship Recycling arranged by a Finnish non-profit organization in March 2015. The main aim of the Conference was to encourage collaboration and planning in Finnish ship recycling. The meeting provided good opportunity to discover whether the invited partners are interested in establishing collaboration. The networking event was organized in the form of a seminar where the specialists from different ship industries could discuss their perceptions and strategies in ship recycling industry.

Key question was to understand the consequences of the EU Ship Recycling Regulation. As it was mentioned in the theoretical research, after the

EU Regulation becomes enforced, third world countries will not be able to recycle if they are not certified and inspected. It is important to know if the Regulation determines and restricts the business even more after authorization. During the seminar it became clear that the Finnish companies are not fully aware of the requirements of the Directive. They agreed that from the technical point of view recycling is not perceived as a challenging industry, but concern remains in prediction of scenarios, strategic planning, financial planning and in cost-efficiency achieved through ship recycling cooperation. The participating firms claimed that the greatest competitor of Finland would probably be Denmark with recently upgraded ship system. The country in cooperation with Sweden recycles end-of-life vessels from all over the world and dismantles them according to the highest European EHS standards (www.shipbreakingplatform.org). Other competitors are currently unknown, but Belgium could be assumed an emerging ship recycling nation in Europe as well (www.shipbreakingbd.info). Considering international markets China is also a notable ship recycler with increasing number of safely dismantled ships. The unpredictability of the industry further increases by mentioning that ship owners often change the flag registration of the vessels. Thus if the ship is not registered under EU flag, but the owner is still European, the EU Regulation is not applicable. On the other hand the European Commission (2004) aims to support environmentally friendly ship recycling by providing subsidies and tax benefits for ship owners.

Interestingly, at the Helsinki Ship Recycling Conference an Indian business representative revealed that there is a growing business interest from India in Finnish ship yards. As the country is the greatest recycler worldwide, it is seeking for solutions to engage in greener ship recycling. According to the representative, the Gujarat Shipbreaking Board considered two methods, either being certified by the EU and applying for environmental licenses for all the 169 ship breaking spots, or developing ship recycling with the cooperation of a partnering country where EHS standards are higher, such as in Finland. One assumption is to collaborate with Finland in building dry-docks and transferring the business to Finnish shipyards. Both options are investment intensive, thus the decision requires deep analysis, especially for better seeing the investment possibilities of the Indian-Finnish ship recycling collaboration.

All in all, the entire industry is perceived to be difficult to reform, because the highest financial benefits are still achieved by recycling in third world countries where no environmental permissions and EHS standards exist, and worker rights is neglected. The Hong Kong Convention strives to achieve improvements in shipbreaking with strict requirements. Even though the Convention requires that the ratifying countries must own at least 40% of the global ship capacity, 55% of the capacity currently belongs to countries that are unlikely to ratify (Pakistan Shipbreaking Outlook, 2014). Political and legal frameworks are observed to have deficiency in transforming ship recycling processes. It is still questionable whether ship owners are willing to recycle

their vessels in more costly but environmentally friendly yards in order to preserve good image and reputation.

Based on the observation made at the conference, similar findings were concluded as during the interviews. All in all, ship recycling business is very little understood, and the opportunities are mostly unknown in Finland. Economic and financial planning needs to be conducted before launching any business. Finland should be more open for foreign expertise and collaboration with other countries in ship recycling. As a last observation ship building and ship repairing companies are not aware of the positive effects of obtaining materials provided directly from recycled ship waste. It is a significant deficit in their perceptions, and probably their understanding in ship recycling cannot be altered until a market gap is not clearly visible. Their conviction probably relates to the actual practical application of waste circulation.

7 CONCLUSION

Meanwhile the global economy is constantly being reconstructed, a growing demand has been acknowledged for new business strategies that promote more efficient resource utilization. Material and energy efficiency and cleaner productions, as a part of sustainability are main targets of any heavy industries. Sustainability is one co-joint option for industrial progression that also supports social welfare and environmental protection. Sustainable production enhances environmental impact reduction and contributes to shape transparent businesses where credibility based trust develops naturally. Transparency and credibility are increasingly important to ensure, especially in heavily pollution industries such as ship breaking. Ship dismantling industry is known as one of the most lethal business worldwide. Due to the fact that traditional shipbreaking involves dangerous work conditions and intensive environmental degradation, the whole industry is perceived to require more legal restrictions. Several international initiatives were introduced without achieving significant improvements. In 2013, the European Union - the European Parliament and the Council of the European Union – issued the Regulation and Directive of Ship Recycling in order to restrict unsafe and unsound disposal of EU-flagged vessels. As one of the most important steps in ship regulations, the European Union demands safe recycling facilities and work conditions, environmentally sound hazardous waste management and appropriate documentation (The European Parliament and The Council of the European Union, 2013). Question rises whether South Asian ship breaking nations could comply where EHS standards are not required on a basic level. Previous researches presume that the EU legislation will force the industry to transfer to other locations where corporate environmental and social responsibility is considered more thoroughly. Various scenarios could develop regarding the future of South

Asian ship breaking, mostly meaning Indian ship breaking, while it is certain that ship recycling in general has to be redesigned based on the EU legislation.

The main purpose of the thesis was to find solutions for current ship breaking problems including business opportunities in Finland. It has been assumed that shipbreaking business evolves into a cleaner industry in order to comply with international regulations. It could enter Finland because Finnish legislation already includes compliance with EHS requirements. This research also attempted to find practical frameworks for improving sustainability in ship recycling industry. First the theoretical structure of green supply chain management was analyzed, that was also understood in a greater scope of business model, in industrial symbiosis. In the current research the purpose of the hypothetical industrial symbiosis strived to embed green supply chain elements and actors from ship recycling industry. Based on these concepts an innovative investment idea was elaborated with the goal of constructing Finnish ship recycling. The thesis presumed that experts and investors from shipping industry could cooperate in Finnish ship recycling. Therefore five interviews were conducted personally and some of them where complemented with questionnaires and field observations. The interviews aimed to assess technical experience, legal knowledge, attitude and perception of ship recycling investments in an industrial symbiosis. The empirical research also investigated opportunities and risks in ship recycling perceived by the firms and their business ideas were evaluated. The research results showed that ship recycling is considered to be a potential business opportunity in Finland if local SMEs are willing to participate in collaboration. As it happened in the case of Sitakunda-Bhatiary, Bangladesh, SMEs are generally more motivated to interact in materials linkages among them than in highly centralized subsidiary firms. However the interviewed firms seemed to be strongly dependent on each other that further challenged to predict enthusiasm in cooperation. The main expectation of the firms is to understand legal requirements and the application process for environmental permission better for what they expect contribution of professional expertise. Although there is a growing interest in ship recycling possibilities in developed countries, the research discovered that currently there is weak significance of integrating new business opportunities into Finnish shipping and waste management industries.

As Neuendorf (2002) elaborated, a research theory is only applicable if the findings support the hypothesis defined in the research. In this research work the results failed to support the hypothesis, thus the theory is only applicable in some extent. Currently there is a relatively low level of interest in investing in large-scale ship recycling in Finland, and the interviewed firms agreed that comprehensive research has to be conducted regarding financial expectations, legal requirements and cooperation possibilities.

On the other hand ship recycling business can only improve if ship builders also engage in better environmental performance and commit to improve the technical attributes of their vessels already on product design

stage. Different sources recommend to design ships initially for recycling that includes reduced or replaced hazardous substances, accurate inventory of hazardous materials and to design ships for easy dismantling (Lloyd's Register, 2014). Another approach could be to design products for recycling, thus the end of life products can still be recovered. European Commission (2004) also considered how shipbuilders could contribute to greener recycling, and a take-back approach was suggested to apply at the shipbuilding yards. In order to achieve higher technical awareness of shipbuilding efficient interaction is required. One key element of ship recycling business is to actively communicate common environmental goals at all levels of the industry.
Eventually it is still the mission of ship recycling industry to execute environmentally sound and safe ship recovery projects. However, the process of sustainable ship recycling, itself is only one fragment of the termination of lethal ship breaking. Environmentally safe and sound ship recycling also means "off the beach" dismantling, fully applying "polluter pays" principle, the respect of human rights and committing to social responsibility (NGO Shipbreaking Platform, 2013).

This thesis research concludes that the universal saying is applicable: "theory is far from practice" regarding sustainability, especially in heavy industrial environment. It is much easier to construct sustainable business ideas in theory, but it requires several years of research and development before the practical developments could start. All in all, the market gap is understood in ship recycling; more recycling facilities are needed that ensure environmentally safe and sound waste management. However challenge remains in interconnecting investors and investment possibilities. Consideration needs to be thoroughly executed, because long-term investments are always great financial decisions.

7.1 Limitations of the research

This thesis is one of the earliest researches attempted to investigate Finnish ship recycling possibilities in collaboration such as industrial symbiosis. Ship recycling is a very extensive industry, therefore certain research demarcations were defined. The thesis introduced ship recycling from the perspective of environmental, health and safety related problems investigated in India. Due to beaching method applied in South Asian ship yards, an assumption was made whether ship breaking would cease and European countries could develop a greener version of the business. The focus of the thesis was on the future market perspectives in Finland for establishing conjoint collaboration between companies with different industrial profile. However the study excluded the evaluation of the already existing green ship recycling countries that are / can be competitors for Finland. Any ship recycling case study could be beneficial for Finnish initiatives in the future. One of the greatest challenges of the study was to draw a strict line between the analysis of technical environment the business

requires and the actual economic significance. Technical side of ship breaking needs to be analyzed, because sustainable ship recycling requires to conduct in a scientifically advanced way. Although the thesis discussed the main international and EU legislations, there have been several other legal frameworks design in order to restrict hazardous ship dismantling. There was no possibility to investigate public sector participants regarding their perceptions in Finnish ship recycling formation. The research results were affected by time limits, that only allow to conduct empirical research with a limited number of interviewees.

7.2 Further research recommendation

The primary focus point of the thesis was to investigate ship recycling development in Finland with the contribution of internal stakeholders. The interviews and questionnaires were focusing on a relatively small group of interested parties by allowing to further research perceptions and opinions of other stakeholders such as local citizens, activist groups and the media. Especially the belief of investors would be interesting to understand. Five participants of waste recycling, shipping, ship building and repairing industry were interviewed and obviously further research could examine the topic with more interviewee samples. The interview participants varied significantly in terms of their business profile and organizational background. More waste recycling companies could be assessed, because they probably have knowledge about the prices of recycled materials. It is recommended to further analyze the strategic planning and perceptions of other Finnish organizations. In case Indian decision-maker dedicate to Finnish ship recycling, comprehensive analysis is needed to understand the possibilities for collaboration in the industry. Further research could analyze how the industry is changing if ship owners also demand high standards for ship recycling. Acquiring knowledge about recycling from benchmarking could enhance technical preparedness and economic increments. Expertise from safe oil tower and airplane recycling could provide appropriate information for recycling vessels. Finally, a more extensive research could be conducted on the current sustainable ship recycling economies and business in order to understand the potentials of competitors. Before an actual environmentally sound ship recycling establishment a comprehensive research work is required that elaborates possible scenarios.

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APPENDIX 1.

Interview questions for the thesis of ship recycling in Finland

Katalin Talas
Jyväskylä University, Corporate Environmental Management MSc

Thesis supervisor: Matti Pettay, Tiina Onkila
Thesis title: Migrating ship waste management from Alang, India to Finland. Analysis of opportunities and risks in an industrial symbiosis of sustainable ship recycling

If any answers can be found from public source (webpage etc.) please mark it.
Note: not all the questions are compulsory to answer, only the relevant ones for your company

Introduction in order to get familiar with the company profile and understanding about green supply chain

1. Please introduce your business and operational processes.
2. How do you manage your environmental and social issues in your company at the moment?
3. What experiences do you have in green supply chain or in any sort of business collaboration?

Self-assessment relating to ship breaking

4. Please explain your knowledge and experience in great amount of material recycling such as ship recycling.
5. What sort of strategic decisions would you prepare before launching ship recycling projects?
   - 5.a. Internal preparation in own business
   - 5.b. External preparation with relevant business partners

Implementing scenario. Establishing an Industrial Symbiosis for Green ship recycling, discussing strategic planning

6. What kind of collaboration do you see in a future ship recycling network in Finland?
7. Would you consider working with others in this business sector?
8. What could be the greatest opportunities of ship recycling in a Finnish collaboration?
9. What sort of risks/threats do you identify already or expect in a collaboration?

9.a. regarding the industrial symbiosis itself
9.b. regarding EHS issues in the industry
10. What could be the role and responsibility of your organization in such collaboration?
11. Do you need to alter your business strategy or organizational processes to best fulfill the collaborative needs?
12. How would you alter your long-term strategic plans?

Soft instruments needed for managing the ship recycling industrial symbiosis
13. What EHS practices would you use to make this business collaboration successful / profitable / attractive for investors?
14. How do you see to achieve commitment and dedication to manage the network together with multiple local stakeholders?
15. How could you deepen the cooperation further in order to achieve collaborative targets?
16. How can you contribute to social challenges in Finland when you enter such business?
17. What knowledge and skills are needed to manage the logistics of ship recycling? And what ideas do you have to execute it?

Thank you for answering the questions. Your company will be provided with the empirical research results after analyzing your answers.

APPENDIX 2.

	Waste Recycling company	Ship Building company	Ship repairing firm 1.	Shipping company	Ship repairing firm 2.
Company profile	• Large company employs over 5000 people in Finland, Sweden and Russia. • specialized in waste management, recycling and cleaning	• It specialized in shipbuilding technology (ice breakers and special vessels) between Finland and Russia • employs about 500 workers	• mostly ship building and ship repairing • hires 40 people	• marine transportation and associated services • 250 people are employed	• ship repairing, maintenance and cleaning • employs 100-200 people depending on the workload
Interviewee	Business Director, Environmental Services	Risk Manager	Managing Director	Company founder, Managing director	HSSEQ Manager
Date	17.10.2014	5.12.2014	23.1.2015	23.1.2015	23.1.2015
Place	Vantaa	Helsinki	Teijo	Turku	Naantali
Length	1 hour	2,5 hours	1,5 hours	0,5 hour	1,5 hours
Type of interview	Interview	Interview and field observation	Interview and questionnaire	Mostly emailed questionnaire	Interview