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The Role of Sustainability in Strategic Thinking in Norwegian Shipbuilding Industry

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Project Management

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Task Description

Thesis Title

The Role of Sustainability in Strategic Thinking in Norwegian Shipbuilding Industry

Task Description

The thesis will study the strategic thinking process in Norwegian shipbuilding industry and how the focus on sustainability has impacted the strategic thinking in the industry. The research work also analyses the applicability of certain production methods that can improve the sustainability features of the shipbuilding industry in Norway.

Preface

This Master Thesis has been written to fulfill the requirements of the Master of Science (MSc) programme in Project Management at the Department of Industrial Economics and Technology Management (IØT) at the Norwegian University of Science and Technology (NTNU), Trondheim, Norway. This research work has been carried out under the aegis of a 4 year competence building project titled SUSPRO - Decision support for sustainable ship production in Global fluctuating markets, of which NTNU is a partner institute.

On this occasion, I would like to express my sincere gratitude to my supervisor **Annik Magerholm Fet**, Professor at Department of IØT, NTNU for her constant support and guidance in realizing the goals of this research project.

I would also like to sincerely thank **Dina Margrethe Aspen**, PhD at Department of IØT, for ideas and comments that have immensely helped in formulating the scope and structure of this thesis. My special thanks to **Michael** and **Sigurd**, members of our Green Value Creation (GVC) research group, for their valuable inputs at different stages of this project work. My vote of thanks also goes to my **parents** and my **siblings** for their whole-hearted support in all phases of my life. Their love and prayers have been the driving force in everything that I have achieved in life.

I also express my gratitude to all the **interview participants** and the **co-authors** in the conference paper we authored as part of this thesis. Their contributions have greatly helped in improving the scientific temper of this work.

I am greatly indebted to **Sulalit** (PhD at Dept of Chemical Engineering, NTNU), my friend, guide and motivator, for everything he has done to improve the quality of this work. On this note, I would also like to thank all my friends, both in India and Norway, who have extended their support in various forms at different stages of this research work.

Trondheim, June 11th, 2015.

Faheem Ali

Abstract

The Norwegian shipbuilding industry is one of the most well integrated and well developed shipbuilding industries in the world. It has established its supremacy as the strategic leader in product offerings and technical expertise required to meet the needs of challenging vessel operation environments. However, stiff competition from shipbuilding industries based in low cost countries such as China and South Korea has turned out to be a great challenge to this vital industry. In addition to this, the growing concern about environmental pollution and stringent emission control regulations coming in to force in various parts of the world. This has made sustainability issues a prime focus of the industry.

These two factors have made the topic of strategic thinking and sustainability focus in activities, a hot topic of discussion both in the academic circle and the industry alike. There have been a good number of studies and research projects aimed at helping the industry overcome these challenges. But most of these research projects have restricted itself to studying just the technical challenges or business issues plaguing the industry. Even though a few of them have successfully studied and analysed the role of sustainability issues in the strategies of the industry, the topic still seems to lack a clear focus in the industry.

This thesis aims at closing this gap between strategic thinking process of the industry and the role of sustainability issues in it. This research work strives at achieving this goal by studying the existing strategic thinking process in the industry and the practical steps it has taken to improve performance related to sustainability issues through a case study method. Further, the thesis analyses these findings in the light of existing literature on strategic thinking and sustainability strategies. The findings from the interviews carried out as part of the case study point towards the industry's need for innovative production methods to improve both financial and environmental performance of the industry.

The report focuses on two innovative production concepts that have potential applicability in the industry, namely, lean production and remanufacturing. These concepts are analysed and correlated to sustainable strategies put forward by the Natural Resource Based View (NRBV) proposed by Hart. As the lean production concept has been already introduced in the system to some extent, the thesis focusses on the second concept of remanufacturing. This research work further endeavours to develop a strategic decision making framework that would assist the shipbuilding companies in making a well calculated strategic decision on remanufacturing a vessel.

This five stage strategic decision making framework is illustrated and discussed in detail in the thesis. This will help in bridging the gap between existing studies on industrial strategies and environmental challenges. Further work could include testing the frame-

work in a real industrial setting. The author believes that a well framed decision making model that incorporates sustainability solution will be a great contribution to the academic discourse on the aforementioned topics.

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Abbreviations

IMO	=	International Maritime Organisation
ECA	=	Emission Control Areas
ROE	=	Return on Equity
OEM	=	Original Equipment Manufacturer
LNG	=	Liquefied Natural Gas
SE	=	Systems Engineering
ISO	=	International Organization for Standardization
PPE	=	Personal Protective Equipment
NRBV	=	Natural Resource Based View
RBV	=	Resource Based View
PESTEL	=	Political, Environmental, Social, Technological, Economic and Legal
ER	=	Environmental Regulations
PH	=	Porter's Hypothesis
NO _x	=	Nitrogen oxides (includes nitric oxide, NO, and nitrogen dioxide, NO ₂)
SWOT	=	Strength, Weakness, Opportunities and Threats

Chapter 1

Introduction

The introductory chapter of this report shall present an overview of the Norwegian maritime industry in general and the major challenges that the shipbuilding segment of the industry is currently facing. The later half of the chapter also describes the goal, scope and research questions of this thesis. The chapter concludes by explaining the structure of the whole report.

1.1 Norwegian Maritime Industry

The Norwegian maritime industry has been evolving over the last few decades and this evolution has been characterized by the changing market conditions, product offerings and entry of new low cost competitors among other factors. The shipbuilding industry has not been immune to these changes and subsequently has witnessed a major shift in strategies and product offerings. Recent research in the maritime industry shows that the intensification of globalization has played a decisive role in the strategies of many Norwegian shipbuilding companies. They tend to focus more on their core competencies while outsourcing other activities to shipyards worldwide (Mello and Strandhagen, 2011; Rialland et al., 2009).

Norway has been a major player in shipbuilding for more than 100 years and the industry has been a pioneer in many technological innovations and still continues to enjoy a leading position in international markets. This has been mainly due to the presence of well-developed maritime clusters which distinguishes it from the rest of the world (Reve, 2012). The vessels manufactured in Norwegian shipyards have been characterized by the high level of customization and flexibility. Most of these vessels are capable of incorporating changes even later in the production phase (Semini et al., 2014).

However as mentioned in the first part of this chapter, the industry has been experiencing stiff competition and depleting orders primarily due to the entry of low cost shipyards. The presence of overcapacity in the industry has also added to the cause (Rialland et al., 2009). All these factors have encouraged the industry to evolve into a provider of specialised vessels and high technology services. This distinctive role has made strategies and strategic thinking all the more important in the industry. In addition to this, green technology and sustainability issues have been hogging the limelight in discussions and academic research in the industry. In this thesis, the author argues that there is need for a clearer and deeper connection between sustainability issues and strategies in the shipbuilding industry.

This research work aims at contributing to the goals of the 4 year (2013-2017) competence building project titled SUSPRO (Sustainable Ship Production) “Decision support for sustainable ship production in global fluctuating markets”. The project aims at achieving a sustainable and life-cycle-oriented ship production in an uncertain, fluctuating market. It is a joint project between Norwegian University of Science and Technology (NTNU), SINTEF, and three industrial partners, namely, Fiskerstrand, Ulstein International and Pon-CAT.

1.2 Goals and Scope of study

The primary goal of this research is to study and analyse the strategic thinking process and the role of sustainability in that process in Norwegian shipbuilding industries. The thesis aims at achieving this goal by taking a case study approach involving two Norwegian shipbuilding companies.

The secondary goal of the project is to analyse and suggest an innovative production concept that would be able to improve the sustainability performance of the company.

The scope of this research is limited to the Norwegian shipbuilding industry and three major sustainability issues which are further described in Chapter 2. Since the principal focus of this research work is to find the role of sustainability in strategic thinking in the industry, it was important to find alternatives that will provide an answer to the first goal of the thesis. Thus as explained in the secondary goal, the concept of remanufacturing is identified as a feasible alternative and a decision framework for the same is presented. However the scope of the thesis limits itself to proposing such a framework and does not test it in a real industrial setting.

1.3 Research questions

The research aims at reaching the aforementioned goals by answering the following questions:

1. What is the strategic thinking process in the Norwegian shipbuilding industry?
2. How has the focus on sustainability issues affected the strategic thinking in the industry?
3. What practical step can augment the sustainability efforts of the Norwegian shipbuilding industry?

1.4 Structure of the report

For a lucid reading experience and easy comprehension of ideas presented, this report has been divided into seven chapters. The initial chapters present the background for this thesis work and the research questions that drive the arguments presented in this report. It also elucidates the existing literature on the topic of discussion. The latter half the thesis consists of empirical findings and discussions and analysis based on these findings. This complies with the linear-analytic structure as proposed by Yin (2009). The overall structure of the report is illustrated in Figure 1.1.

Chapter 1 presents a brief overview of the Norwegian maritime industry and the characteristics of the shipbuilding industry. Further, the chapter describes the goal, scope and research questions of this thesis report. Chapter 2 outlines the need for this thesis by describing the current scenario of the shipbuilding industry. The latter half of the chapter describes the sustainability issues that the thesis focusses on. The concept of systems engineering that drives the discussions in Chapters 5 and 6 is also explained towards the end of Chapter 2.

The third chapter explains the theory and existing literature on the research topics. Meanwhile, Chapter 4 describes various case study methods that have been applied during the course of this research work.

The empirical findings from interviews carried out as part of the case study is presented in Chapter 5. Further, Chapter 6 discusses and analyses these findings in the light of literature presented in Chapter 3. The penultimate chapter also illustrates and explains one of the major findings of this thesis, the strategic decision making framework.

The concluding chapter of this thesis summarizes the major findings of the thesis and evaluates it by comparing the research questions stated in Chapter 1.

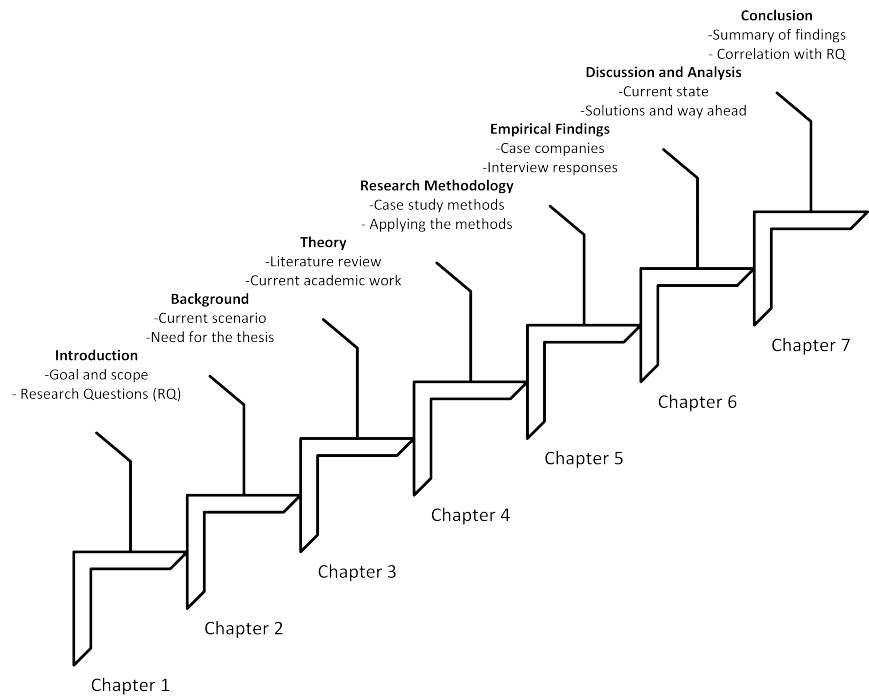


Figure 1.1: Structure of the report

There are three appendices attached to this report for the reader’s reference. Appendix A presents a short definition of terms that are widely used in this report, while Appendix B presents the interview guides that were used to collect the information presented in Chapter 5. The final appendix is the conference paper that was written as part of this thesis work.

Chapter 2

Background

The background chapter of the report explains the relevance of this thesis in the current market scenario of the Norwegian shipbuilding industry. Further, the second section of the chapter describes the three sustainability issues that form the main focus of analysis in this thesis. While the latter half of the thesis illustrates and describes the systems engineering approach which forms the underlying theme of all analyses presented in Chapters 5 and 6.

2.1 Current Scenario

The shipbuilding industry has witnessed a significant number of changes both in strategy and operational methods, primarily due to the changing market situation and customer base. As seen in Figure 2.1, offshore vessels form a major share of the new buildings in Norwegian shipyards these days, replacing fishing and cargo vessels (Association, 2015). This has made the industry very much reliant on the oil market. The recent fall in oil prices has adversely affected the prospects of the industry. Further, as mentioned in Chapter 1, stiffer competition from countries such as South Korea, China and emerging markets such as India and Vietnam have made the market tougher for Norwegian shipyards (Rialland et al., 2009).

Environmental friendliness and sustainability initiatives have become a prime focus in all Norwegian industries including shipbuilding. The industry has witnessed a number of strategic changes to incorporate these initiatives, such as life-cycle focused ship building, cleaner production methods, less polluting fuel and so on. (Dugnas and Oterhals, 2008; Kumar et al., 2011). In addition to this, increasing ship trade and subsequent emissions have forced International Maritime Organisation (IMO) to impose stringent emission regulations on ships in certain areas (Ali, 2014; ICS-Shipping, 2013; IMO, 2014). All these

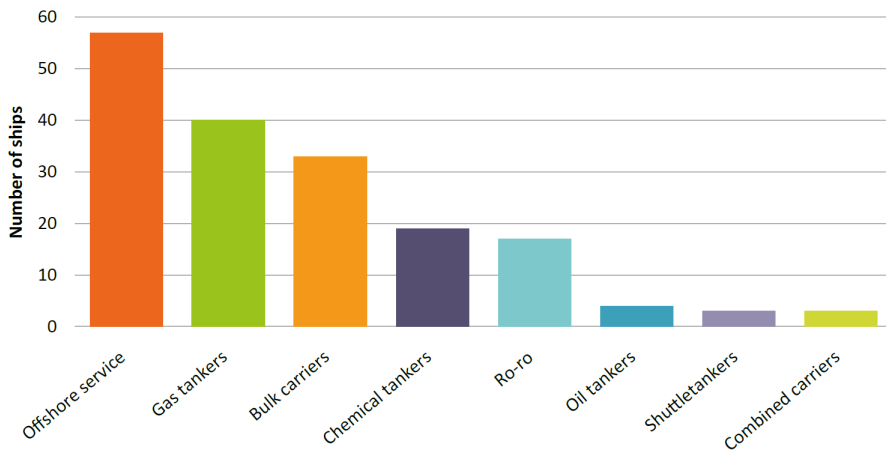


Figure 2.1: Norwegian controlled order book by type - number of ships as of January 2015 (Association, 2015)

factors make environmental performance an important part of strategic thinking in the shipbuilding industry.

However, despite a growing concern about being green in shipbuilding, investing in such solutions has been considered to be less profitable from the strategic viewpoint of a company, and the original focus on environment friendliness gets reduced to complying with the regulations (Gehin et al., 2008). It is in this premise that this research work endeavours to discuss and analyse the research questions mentioned in Chapter 1.3.

2.2 Sustainability Issues

One of the most widely accepted definitions of sustainable development is from the Brundtland report, which defines it as the *'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'* (Brundtland, 1989). Sustainable development has three dimensions, namely, economic development, social development and environmental protection. As the scope of sustainability is very broad and diverse, this research work restricts itself to certain areas of sustainability issues in the shipbuilding activity which is illustrated in Figure 2.2.

The identified issues and their definitions are:

- **Environmental sustainability** is defined as the activities of the company that takes into consideration the protection of the natural environment that are directly or indirectly affected by their actions (Goodland, 1995).

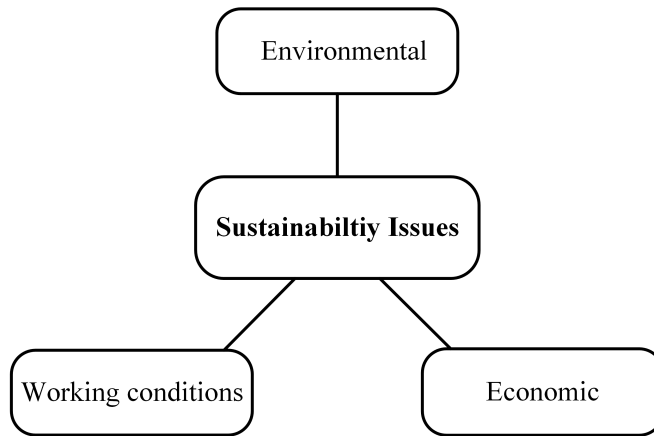


Figure 2.2: Selected sustainability issues in shipbuilding for the research - an illustration

- **Economic sustainability** is defined as capability of the company to sustain its activities with a certain amount of profit for an indefinite period.
- Sustainable **working conditions** relates to activities that will ensure greater social and ethical responsibility among the employees while at the same time giving them a safe and healthy workplace (Flynn, 2014).

2.3 Systems Engineering Approach

In simple terms, a system is defined as *“a complex whole, the functioning of which depends on its parts and interactions between those parts”* (Jackson, 2003). A system constitutes of a subject and its surrounding, and system elements which interacts with each other. The structure of the system is defined by the relationship between the elements and subsystems (Magerholm Fet, 1997). Organizational theorists and strategists have come to accept this view of emphasis on parts mainly because of raising complexity in the current organisations and externalities affecting its decisions (Narayanan et al., 1993).

As explained in the preceding sections, this thesis deals with three major themes, namely, strategic thinking in the Norwegian shipbuilding industry, sustainability focus in strategic thinking in the shipyards and innovative production concepts that would improve the sustainability performance of the industry. It is clearly evident that all these three themes are diverse and to analyse the interrelations between these themes, they need to be considered in totality. As the topic of research forms a subject and with the three themes forming the subsystems within it, it is imperative that the thesis take a systems engineering approach to the analyses.

The systems engineering process involves a series of steps accomplished in a logical

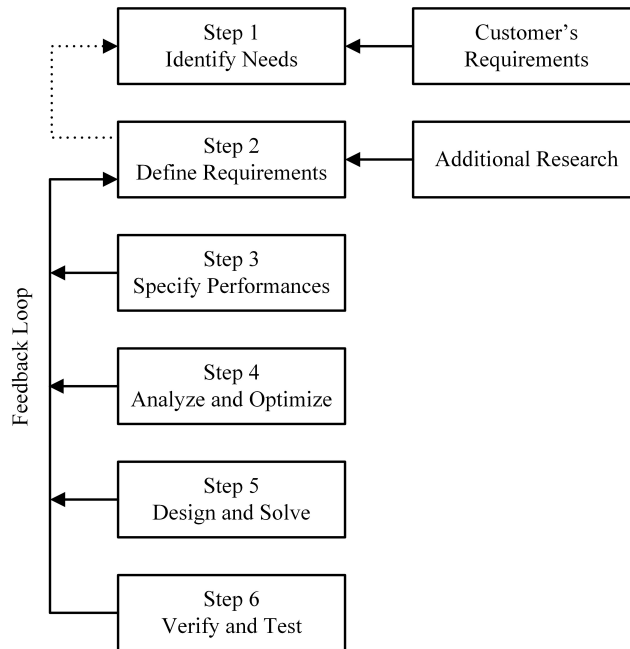


Figure 2.3: The Systems Engineering Process (Adapted from (Magerholm Fet, 1997))

manner and directed towards achieving the goals. These six steps are illustrated in Figure 2.3, where, the first step is *Need identification* from the clients. This step is realised by answering the questions such as ‘What is needed?’, ‘Why is it needed?’ and ‘How can the need be satisfied?’. The second step is to *Define Requirements* needed to meet the needs identified in step 1. These can be functional, operational or physical requirements. The third step involves *specifying performance*, i.e to define the system requirements in measurable and definable performance criteria based on an iterative process. Step 4 *analyse and optimize* configurations selected based on the specified performance criteria iteratively until the desired solution or description is obtained. The penultimate step in the process involves developing a system design that will meet the identified needs. The final state involve *verifying and testing* the system concept according to the requirements set in stage 1 (Magerholm Fet, 1997).

This six stage process is applied to carry out the mind mapping activity to be described in Chapter 6.1.3.

2.4 Summary of Background chapter

The background chapter presented the current market scenario for the Norwegian ship-building industry, the challenges it is currently facing and the relevance of this thesis topic

in the present market condition. Further, the chapter also illustrated and defined three sustainability issues that forms the main focus of analysis in this thesis. And towards the end, the chapter explained the six step systems engineering process model by Magerholm Fet (1997) that forms the basic framework of analyses carried out in subsequent chapters of this thesis report.

Chapter 3

Theory

The importance of theory in research cannot be underestimated as any research requires a sound theoretical basis and strong methodology. Wacker (1998) identifies four basic criteria that theory must meet: conceptual definitions, domain limitations, relationship-building, and predictions. Academic literature on theory also states that theory should have the following virtues; uniqueness, parsimony, conservatism, generalizability, fecundity, internal consistency, empirical riskiness, and abstraction (Wacker, 1998). Wacker further states that a theory becomes a good theory only when it meets the four criteria and addresses all the virtues to some extent.

This chapter describes the set of theories that formed the basis of problem formulation and research questions presented in Chapter 1.3. Further, the theoretical background has also been used to formulate the arguments presented in Chapters 6 and 7.

3.1 Strategy and Strategic Thinking

The term strategy has varying dimensions according to various academicians, making it difficult to provide strategy an all-encompassing and comprehensive definition. Subsequently, the literature review on strategy as part of this thesis work tried to analyse and understand the concept in a more holistic perspective, rather than restricting it to one single definition.

Strategy is most commonly defined as a method or plan designed in order to achieve a desired future, goal or objective. The word strategy derives from the ancient Athenian position of *strategos*. The title was coined in conjunction with the democratic reforms of Kleisthenes (508-7 BC), who developed a new socio-political structure in Athens after

leading a popular revolution against a Spartan-supported oligarchy (Cummings, 1993). Wit and Meyer (2010) identify three dimensions of strategy that can be recognized in every real-life strategic problem situation. They can be generally defined as follows (Wit and Meyer, 2010):

- **Strategy Process:** The manner in which strategies come about is referred to as the strategy process.
- **Strategy Content:** The product of a strategy process is referred to as the strategy content.
- **Strategy Context:** The set of circumstances under which both the strategy process and the strategy content are determined is referred to as the strategy context.

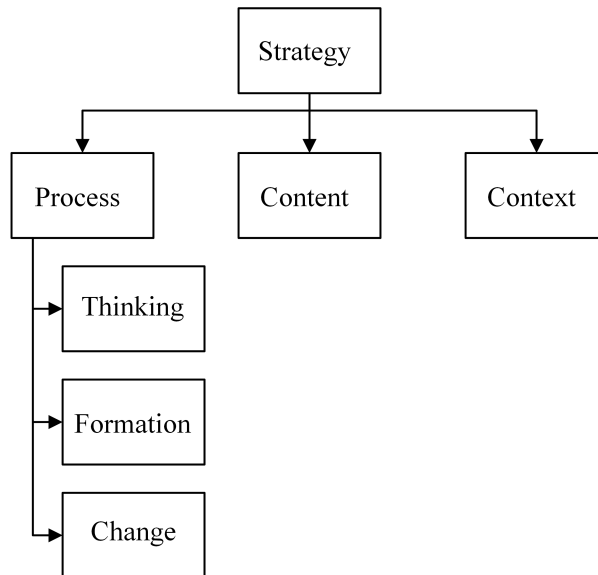


Figure 3.1: Strategy: Process, Content and Context (Adapted from Wit and Meyer (2010))

In order to further narrow down the process, the thesis restricts itself to the strategic thinking area within the strategy process dimension (see Figure 3.1), which is concerned with the how, who and when of strategy.

3.1.1 Strategic Thinking

As mentioned earlier, definitions on strategy and strategic thinking vary to a great extent in academic literature. For the purpose of this research we present two widely accepted views

on strategic thinking. According to Heracleous (1998), strategic thinking is a specific management activity whose aim is *'to discover novel, imaginative strategies which can rewrite the rules of the competitive game; and to envision potential futures significantly different from the present'*.

The two major views on strategic thinking are proposed by Henry Mintzberg and Michael E Porter. Mintzberg (1994) distinguishes strategic thinking from strategic planning, as the latter being more analytical in approach, while the former is about synthesis. According to him an efficient planner would make his/her contribution around the strategy making process, rather than inside it. The strategic thinking process requires intuition and creativity in order to be effective and rewarding. The outcome of such a process would be an integrated perspective of the enterprise rather than a *'precisely articulated vision of direction'* (Mintzberg, 1994).

Based on Mintzbergs view on strategic thinking, Liedtka (1998) proposes strategic thinking as a particular way of thinking with a set of attributes. The model (see Figure 3.2) put forward by Liedtka consists of five elements;

- **A systems perspective:** Strategic thinking is built on the foundations of systems perspective, which encourages the strategic thinker to have an end-to-end perspective over the firms operations and the interdependencies within it.
- **Intent-focused:** Strategic intent is necessary for the individuals in an organisation to leverage their energy and avoid distractions. A clear intent would help them give in the maximum effort required to achieve a goal.
- **Intelligent Opportunism:** In addition to being intent focussed, strategies should also provide the leeway to accommodate emerging strategies that may not be within the scope of the intended strategy.
- **Thinking in Time:** This element of strategic thinking emphasises on the importance of time, as the future of any company comes from its past performance, thus making past a basis for predicting the future. Therefore the strategic thinking process always warrants a swing between the past, present and future of the firm.
- **Hypothesis-driven:** Liedtka identifies that strategic thinking is both creative and critical in nature. Therefore the strategic thinking process involve iterative cycles of hypotheses generating and testing, such as a creative question of *"what if..?"* which generates the hypothesis, followed by a critical question of *"If...,then..?"* that tests the hypothesis.

While on the other hand, researchers of the like of Porter, favour a set of analytical techniques for developing strategy (Porter, 1987; Mintzberg, 1994). According to Porter strategic thinking involves asking two critical questions, firstly on the structure of the industry and its likely direction of evolution in the future. The second question pertains to the companys relative position in the industry (Porter, 1991). Further, Porter observes that

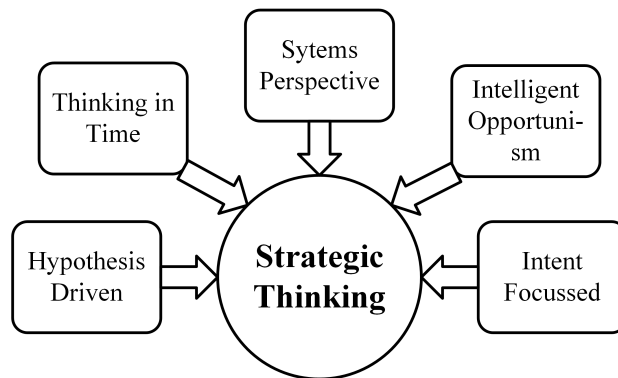


Figure 3.2: Elements of Strategic Thinking (Adapted from Liedtka (1998))

these two questions can be answered with the aid of analytical tools. Unlike Mintzberg, Porter focusses on the unique configurations of the value chains that evolve from analytical strategic thinking. He opines that such a configuration would make it difficult for the competitors to copy the strategies of the company. His contributions have been more on the cross-sectional problems of strategy, which was the cause of superior performance of a company at a given time. While Mintzberg on the other hand attended to the longitudinal problems that focussed on the dynamic processes by which strategies are arrived at (Heracleous, 1998).

Thus, both Mintzberg and Porter focus on two different aspects of strategy, the former being process focused and the latter emphasizing on the position of the firm (Heracleous, 1998). For this particular research we restrict ourselves to the view that both are strongly interrelated, however would analyse the research questions in the light of Mintzberg's views on strategic thinking.

3.2 Sustainability in Strategy

The literature review (see Table 4.1) carried out as part of this thesis revealed that the depth of academic literature exclusively on the importance of sustainability in strategies is still shallow and has a clear void. Nevertheless, there have been two major views in strategy that emphasize on the importance of environment factors and societal needs in strategy. Namely, shared value creation model proposed by Porter and the Natural Resource Based View (NRBV) on strategies by Hart. This section of the chapter presents a brief overview of both these theories.

3.2.1 The shared value creation

The concept of shared value creation can be defined as the operating procedures and practices that improve the competitiveness of a company simultaneously advancing the economic and social conditions in the communities in which it operates (Porter and Kramer, 2011). The article also opines that companies indirectly strengthen the public opinion that most companies prosper at the expense of the broader community in which it operates, by just embracing corporate social responsibility initiatives and restricting themselves just to such initiatives. The shared value creation view on the other hand proposes a different approach from the traditional view on environmental commitment of firms. While highlighting the dangers of being trapped in conventional methods of value creation, the article encourages firms to focus on environment friendliness in their strategies more than ever.

Earlier, Porter and Linde (1995b) observes that environmental regulations will help companies to offset the cost of pollution and wastage as the innovation driven by regulations will help firms pursue better and improved technologies. The article also establishes a positive correlation between environmental regulations and competitive advantages of the firm. Known as the 'Porter's Hypothesis' these observations prepared the ground for further research in this area.

In a post 20 year review of the Porter's hypothesis (PH) on the role of environmental regulations (ER) in enhancing competitiveness, Ambec et al. (2013) observes that theoretical arguments that can support the PH theory are more stronger. On the empirical side, the version that stricter environmental regulations will lead to more innovation is also quite well established, while on the other hand the claims by the hypothesis that ER would improve business performance is mixed, with more recent results supporting the view.

3.2.2 The Natural Resource Based View

The natural resource based view (NRBV) introduced by Hart (1995) is relevant for any company that operates in close interaction with the environment, such as the shipping industry. Hart argues that in the long run, business strategy will be '*constrained by the ecosystems*' and companies' capabilities to tackle the environmental challenges would determine its competitive advantage. This is clearly drawn from the understanding that most of our past and existing business models are not environmentally friendly and cannot be used for a longer period of time.

According to Hart (1995) the NRBV would remain relevant only if the strategists in companies and organisational theorists make efforts to understand the potential of environmentally oriented resources and capabilities in creating competitive advantage for the companies. In order to aid this, he presents the NRBV with three interconnected strategies, namely, *pollution prevention*, *product stewardship* and *sustainable development*.

The validity of the NRBV has been tested in various industries, Menguc and Ozanne

Table 3.1: A Natural Resource Based View Conceptual Framework (Adapted from (Hart, 1995))

Strategic Capability	Environmental Force	Driving	Key sources	Re-	Competitive Advantage
Pollution Prevention	Minimize emissions, effluents, & waste		Continuous Improvement		Lower costs
Product Stewardship	Minimize life-cycle cost of products		Stakeholder integration		Pre-empt competitors
Sustainable Development	Minimize environmental burden of firm growth and development		Shared vision		Future Position

(2005) were the first to explicitly test the NRBV. They studied the impacts of natural environment orientation on the firm's performance and success by collecting data from 140 Australian manufacturing industries. The results supported Hart (1995)'s views that valuable resources can have a positive impact on firms' performance and the ones capable of developing resources to reap the benefits from the environment will exhibit higher performance.

A review carried out by Hart and Dowell (2011) fifteen years later studied the evolution of the concept and in its relevance in the present world. The article observes that the arguments contained in the original piece by Hart (1995) has only grown stronger and more relevant. They observe that companies and management scholars are continuously challenged to shift focus from incremental sustainable strategies and develop strategies that would actually resolve the social and environmental problems the industries face. The review also draws out certain empirical evidence on the correlation between product stewardship, pollution prevention and competitive advantage of the firm. Hart and Dowell (2011) opines that while the effectiveness of the first two strategies have been established by empirical results from industries, research on the third strategy is still in nascent stage.

The shipbuilding industry has been characterized by innovation and new solutions to solve both operational and business challenges (Rialland et al., 2009). The concepts of product stewardship and pollution prevention have played an important role in these strategic changes in the shipbuilding industry. Since there is also empirical evidence from the industry to establish the benefits from such actions, these two concepts are further discussed in the following sub chapters.

Product Stewardship as a strategy

Product stewardship involves the integration of external stakeholder perspectives into the product design and development process (Hart, 1995). This attempts to reduce the life cycle environmental costs of the products by either redesigning the existing products to reduce liability or by developing new products with lower life cycle cost. The product

stewardship strategy may also encourage firms to quit environmentally hazardous businesses (Hart, 1995).

Empirical evidences provided by researchers who studied the impact of environmental friendly products and strategies on the business of the firms show that product stewardship strategies have improved the firms' performance. Eiadat et al. (2008) who studied the impact of environmental innovation strategy in Jordanian industries observed that an environmental innovation strategy and firms' positive business performance are positively linked, and that managers should consequently continue to search for win-win solutions to their environmental problems. In another quantitative study of North America based manufacturers and product developers, Pujari (2006) also observes a strong correlation between environmental new product development and performance of the firm.

The shipbuilding industry has also documented considerable improvement in performance and business by being innovative in design and propulsion technology. The concept of product stewardship is therefore has great level of applicability in our case study approach. However, the success of product stewardship in achieving the goals set by environmental regulations is highly dependent on specific projects.

Pollution prevention as a strategy

According to Hart (1995), pollution prevention can be achieved primarily through two main methods, control and prevention. The latter approach emphasises on the reduction of pollution during the manufacturing phase while producing saleable goods. The former according to Hart (1995) is a more expensive and non-productive pollution control equipment. In the initial phases of implementing pollution reduction, Hart (1995) opines that the presence of many *low hanging fruits* make the efforts less costly and more effective, however, further reduction in pollution becomes more cumbersome as the firm's environmental performance improves.

Porter and Linde (1995a) observe that environmental regulations that control pollution and improve the product quality actually are the greatest stimulators of innovation. Such innovations also bring offsets that improve the productivity of the firm. An empirical study carried out by Nishitani et al. (2011) further establishes that firms reducing pollution emissions through prevention approach can achieve competitive advantage not only through an increase in demand for their products, but also through improved productivity.

Thus the above empirical results show the importance of pollution prevention strategies in the firm's activities and the benefits it offers both to the company and the environment. These factors are also very much evident in shipbuilding industry.

3.2.3 Reflections on literature discussed

Both NRBV and Porter's views linking environment focus and business performance have been grouped as the 'Pay-to-be-green' strategies (Berchicci and King, 2007) as firms, including shipyards, have found to make profit by investing in activities to protect the environment. These strategic concepts have also influenced most companies who emphasize on sustainability or environment friendly solutions in their strategies. The following reflection tries to analyse the theory presented here from a shipyard context and why it is relevant for our research analysis.

The shared value creation shifts the focus of the firms to its geographical and environmental setting. It brings into analysis, the region and people affected by the firm's activities. This understanding and concern for the surrounding communities is very relevant in Norwegian shipbuilding industries too as they operate in regional clusters and are in close collaboration with the local communities.

The NRBV on the other hand is based on the Resource Based View (RBV) in strategic thinking which provides a challenging situation to firms while defining their strategies. This is mainly because, the critical aspect of resource based view is to identify the key resources the company possess and the ones it needs to develop in order to achieve competitive advantage. In order to successfully execute projects the shipbuilding industry makes use of a lot of resources from project initiation to project handover. These include human resource, production facilities, raw materials and energy among others. However given the dynamic nature of the industry and the changing customer demands, companies will have to acquire additional resources or outsource their work to competent ones. As a derivative of RBV, NRBV establishes the capability of environmental friendly strategies in achieving competitive advantage, which could be improved fuel efficiency in ships as a result of innovation strategies in ships.

The above reflections show that NRBV has a greater relevance in this thesis than the shared value creation view. Therefore, the ideas conceived in the NRBV and the two strategies, namely, pollution prevention and product stewardship are further used in Chapter 6.

3.3 Sustainability in Shipbuilding

Over the years industries have enacted many steps to improve their environmental performances and to tackle many environmental issues. Innovative production concepts such as lean manufacturing have been one of those. Studies show that lean construction methods which focus on areas such as wastage reduction and lesser inventory has aided firms in being more sustainable (Flidner, 2008; Marhani et al., 2013). Remanufacturing is another such initiative which has garnered attention among industrial experts. It takes a different approach on the end-of-life treatment of products and unlike recycling, it maintains the added value in the product and avoids second manufacturing (Gehin et al., 2008). This

research would focus on the potential of these two production methods in the Norwegian shipyards mainly due to its aforementioned benefits and its applicability in the industry. The following sections present an overview of these two concepts. As the concept of lean production is already in practice in the shipbuilding industry (Hassan and Kajiware, 2013; Koenig et al., 2002; Dugnas and Oterhals, 2008), the discussion on the same is limited to a very brief overview of the concept and its benefits. The major focus is on the concept of remanufacturing and the process involved in it.

3.3.1 Lean Production

Lean is a manufacturing philosophy that aims at reducing or avoiding unnecessary production times, materials and resources in the production processes (Hassan and Kajiware, 2013). Academic research has revealed that an effective lean production system is a sustainable competitive advantage over the competitor (Lewis, 2000) and also an environment friendly solution in terms of waste reduction and reduced inventory.

Academic research and case studies in the shipyard context (Hassan and Kajiware, 2013; Koenig et al., 2002) has established the importance and clear applicability of lean manufacturing in the shipyards. The concept of lean has been adapted to meet the specific needs of the shipbuilding industry. Most shipbuilding companies have developed their own systems based on the original concept of lean (Dugnas and Oterhals, 2008). This has proven to be effective in streamlining the operations in the facility and also expediting the delivery process of projects (Moura and Botter, 2012; Koenig et al., 2002).

3.3.2 Remanufacturing

For the purpose of our analysis this research work restricts itself to Ijomah (2002)'s definition of remanufacturing according to which it is *'the process of returning a used product to at least Original Equipment Manufacturer (OEM) original performance specification from the customers perspective and giving the resultant product a warranty that is at least equal to that of a newly manufactured equivalent'*. As evident from the remanufacturing concept illustrated in Figure 3.3, the concept is distinct from recycling, reconditioning or repairing of products or goods in the final stages of operability. It is often confused with recycling as both concepts tend to mean the same. While the latter involves the collection, extraction and processing of component materials into the same product or a useful degraded material, remanufacturing modifies the existing product into a newer one with same features of a brand new product or even better functionality (Ijomah et al., 2004).

The first known application of the remanufacturing process was in the shipbuilding industry in the year 1861, where a steam frigate was transformed into an ironclad ship (Ilgin and Gupta, 2012) thus making it an interesting point of departure to study the applicability of remanufacturing in the shipbuilding industry.

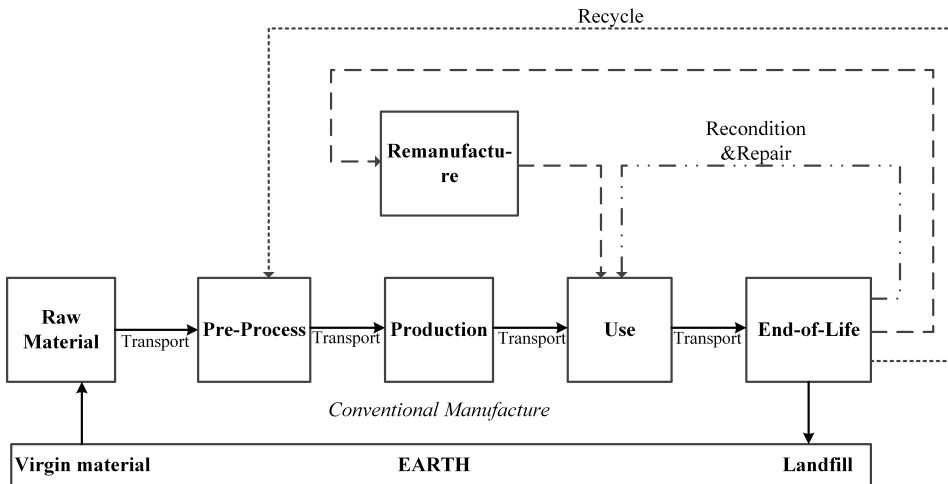


Figure 3.3: Remanufacture concept and significance (Adapted from Ijomah et al. (2007))

Remanufacturing is already in practice in a number of industries such as the automotive and aerospace industries (Gray and Charter, 2007). Further in contrast to other secondary market or used products, remanufactured products are characterized by better reliability and quality because the remanufacturing process involves the complete disassembly of all the components in the product and restoration and replacement where needed (King et al., 2006). The following subsection identifies certain benefits and challenges of the remanufacturing concept.

Benefits and challenges of Remanufacturing

The concept of remanufacturing has been proved to be an environment friendly alternative to end of life treatment of products. Empirical studies carried out on the environmental performances of remanufactured products have shown significant reductions in energy and materials consumption, air emissions and solid waste generations (Goldey et al., 2010; Schau et al., 2012; Smith and Keoleian, 2004; Sharma et al., 2010). These benefits are mainly due to the fact that virgin materials involved in remanufactured product is the least compared to other materials, thus reducing the raw material extraction cost, the energy required and also the emissions associated with it. It also does not hamper innovation associated with the product, job creation or lifetime of final product (Gehin et al., 2008).

But remanufacturing also has its own challenges and disadvantages that need to be overcome in order to be successful. The complete social benefits accruing from remanufacturing can be achieved only if the remanufacturing concept is well thought of and integrated into the design stage and strategy of product development (Nasr and Thurston, 2006). The other challenges include the cost of transporting the product to specific remanufacturing facilities, which could be very limited in number. The final dis-assembly of the

product can also be expensive and time consuming. Besides these barriers, the most basic challenge is the lack of a credible and stable demand for remanufactured products (King et al., 2006). In case of ship building industry the concept is yet to be explored in detail, making it a business challenge for shipyards planning to implement the concept.

The Remanufacturing process

The various stages involved in the remanufacturing process of a product is illustrated in Figure 3.4. The process begins with field evaluation stage by the customer and the remanufacturing facility. This stage looks into existing needs of the products and improvements needed. The second stage that follows is the reverse logistics phase. Reverse logistics “*encompasses the logistics activities all the way from used products no longer required by the user to products again usable in a market*” (Fleischmann et al., 1997). As the product to be remanufactured reaches the facility, stage three begins with disassembly of the product or core that is being remanufactured.

The disassembled core is then cleaned and inspected for defects and faulty parts. The remaining components are tested to ensure proper functionality. The disassembly, cleaning and testing stages are supported by the inventory at the facility, which replaces faulty components with new or compatible ones from the inventory. Results from the testing phase is used to decide upon the next stage. Repairable components are sent to the remediation or re-engineering stages, and the irreparable ones are replaced completely. This is followed by the final assembly of the remanufactured core, which is then tested to ensure the product operability and performance. The final stage involves logistics to the end customer, where the product is put into service.

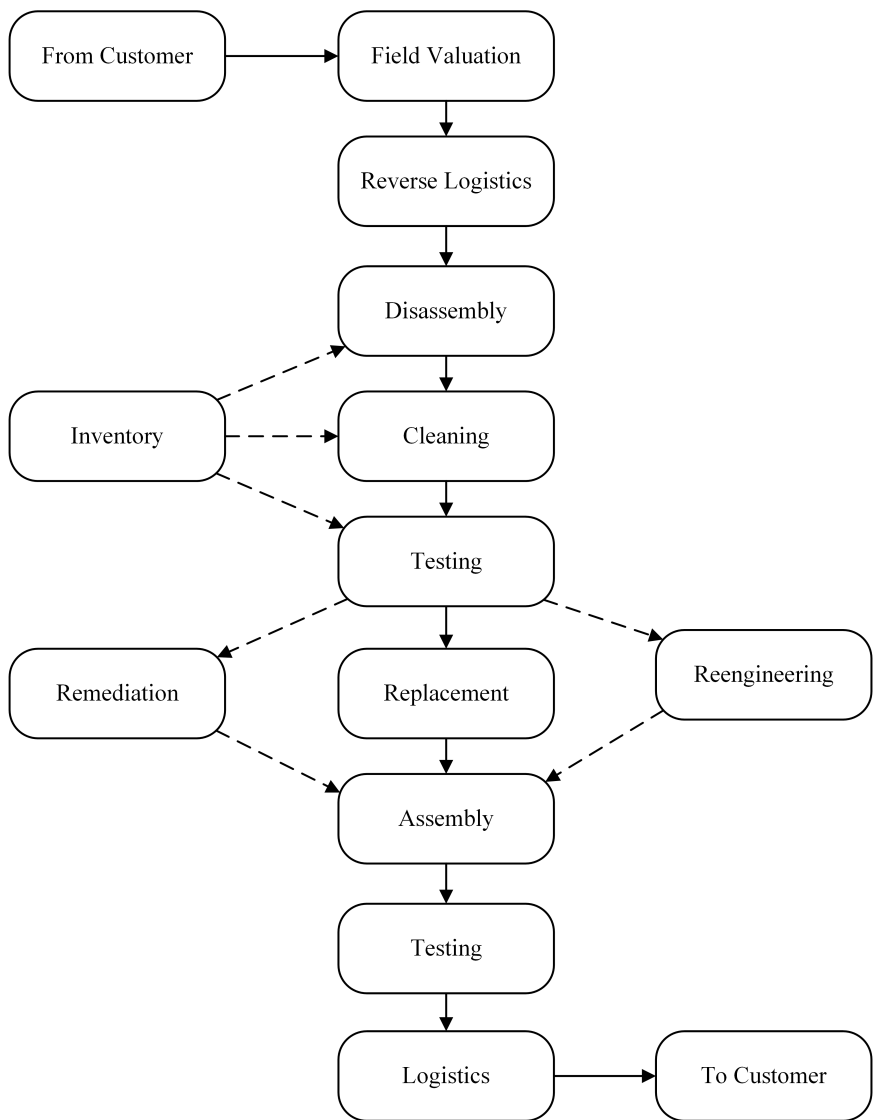


Figure 3.4: The remanufacturing process (Adapted from Parker and Butler (2007))

Focus area of analysis

In order to provide a strong theoretical support to our analysis, the research has adapted the remanufacturing decision making framework proposed by Subramoniam et al. (2009), which consists of three major parts, namely, results, process and factors in a pyramid structure 3.5. As illustrated in Figure 3.5, this thesis focusses on the three areas at the

bottom of the pyramid. This includes the factors that affect strategic thinking regarding a remanufacturing decision, the strategic thinking process for the same, followed by the decision making framework itself. All these factors shall be discussed and illustrated in detail in Chapter 6.2 of this report.

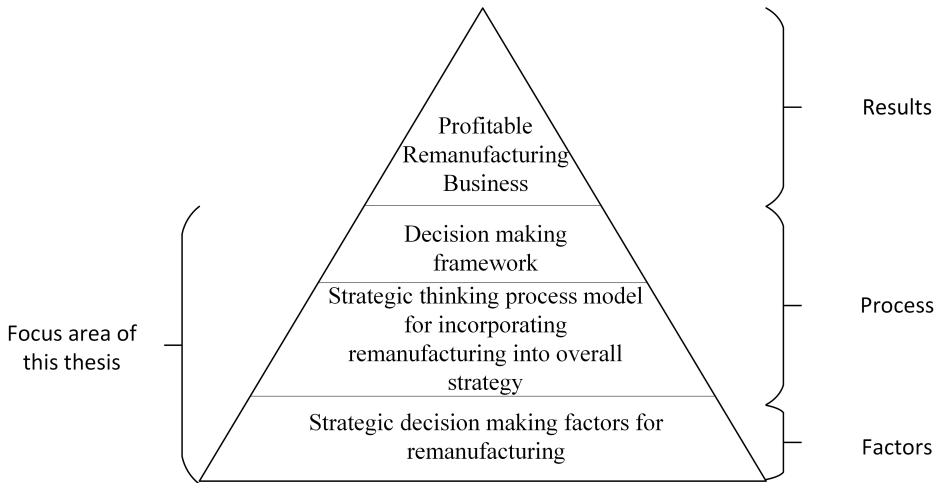


Figure 3.5: Remanufacturing decision making framework and focus area of the thesis (Adapted from Subramoniam et al. (2009))

3.3.3 NRBV and the production concepts

As mentioned in Chapter 3.2.2, with the aid of appropriate strategies both environmentally sustainable facilities and successful businesses can be established and sustained in any company. The product stewardship and pollution prevention strategies were two component strategies of NRBV that were discussed in detail. This literature review chapter finds that there is an evident linkage between these two strategies and the two production concepts presented in the preceding paragraphs, namely, lean production and remanufacturing.

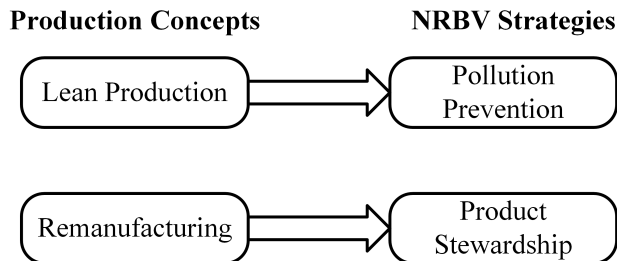


Figure 3.6: Correlation between the production concepts and NRBV strategies - an illustration

A close reading of the benefits and characteristics of these production concepts show that while the lean production concept aligns with pollution prevention strategy, remanufacturing is in line with the product stewardship strategy. This correlation between remanufacturing and product stewardship, illustrated in Figure 3.6, shall be further discussed in Chapter 6.1.3.

3.4 Summary of theory chapter

This chapter presented the theoretical concepts that shall be used for formulating the arguments and discussions to be presented in the subsequent chapters of this report. The initial half of the chapter discussed the origin of strategy and its different components and narrowed down the focus to the concept of strategic thinking. The following section of the chapter explained the two major views on strategic thinking and various attributes that define the strategic thinking process.

The second major topic discussed in the chapter was on the role of sustainability in strategy. As part of which, two major theories, namely, shared value creation and Natural Resource Based View (NRBV) were elucidated. The section concluded by selecting the NRBV for further analysis and application in the following chapters of the report. The final section of the chapter presented relevant literature on lean production and remanufacturing concepts both of which were found to be relevant to the shipbuilding industry. The section concluded by establishing the correlation between the production concepts and the strategies presented under NRBV.

Chapter 4

Research Methodology

This chapter elaborates on the research methodology that has been used in this research work. The following paragraph provides a brief overview and theoretical background of various methods that have been used to collect information and to drive the discussions in various chapters of this report.

The two general objectives of research are theory-building and fact-finding. The difference between these two objectives is grounded in the purpose of the research. A ‘good’ theory-building research’s purpose is to build an integrated body of knowledge to be applied to many instances by explaining who, what, when, where, how and why certain phenomena will occur. On the other hand, a ‘good’ fact-finding research’s purpose is to build a lexicon of facts that are gathered under specified conditions (Wacker, 1998). This report focusses more on the former part of research as explained by Wacker (1998) than the latter. The literature reviewed and findings included in this report aim at providing a short yet comprehensive overview of various dimensions of strategic thinking in Norwegian shipbuilding industry and sustainable production methods; and do not restrict itself to just a fact finding endeavour.

Any work of research gains credibility and relevance only when backed by strong evidences and hard facts. Yin (2009) identifies six areas from where evidences for case studies can be collected, namely, documents, archival records, interviews, direct observation, participation-observation and physical artefact.

A similar approach has been used in this report too. The basic source of information for this research work has been the following (see illustration in Figure 4.1):

- Research articles published on strategic thinking, sustainability and innovative production methods

- Newspaper articles on the regulations and recent developments
- Responses to interviews and email questionnaires from industry experts and academicians
- Third party market survey and prediction reports (Eg: Rederings Forbundet, DNV GL etc.)

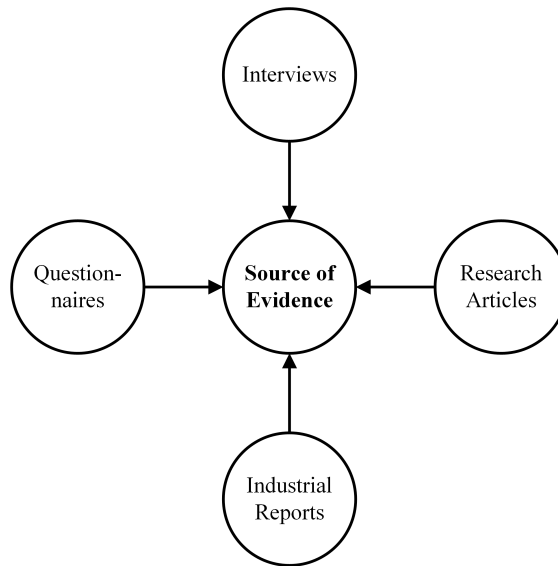


Figure 4.1: Source of Evidences (Adapted from (Yin, 2009))

These multiple sources of evidences further compliment Yin's three principles of research data collection. Yin (2009) observes that the benefits from the aforementioned six sources can be maximized if the researcher follows the following principles:

- Use multiple sources of evidences
- Create a case study database
- Maintain a chain of evidence

The evidence collection methodology as outlined by Yin further emphasizes on the importance of triangulation of the evidences collected. By triangulation, he means that the researcher must strive to strike a balance between these information collected from various sources, such as surveys, articles, interviews etc. The author of this project report has also endeavoured to bring in this approach in the report by relying on multiple sources to present the case and analyse the results (Yin, 2009).

Further as this project report aims at being a reference material for further research work in the SUSPRO project, all research materials have been categorized and made into a case study database. Moreover as the topic of research is relatively new and growing, all the evidences have been tried to be presented in a progressive and interconnecting manner.

4.1 Literature Review

Using the existing literature on a topic is a means of developing an argument about the significance of ones research and where it leads. A competent review of the literature is at least in part, a means of affirming one's credibility as someone who is knowledgeable in one's chosen area. This is not simply a matter of reproducing the theories and opinions of other scholars, but also being able to interpret what they have written, possibly by using their ideas to support a particular viewpoint or argument (Bryman, 2012).

Literature review may include research articles, journals, conference papers or even newspaper articles. However as Yin observes in his book, each piece of literature might have been written for a different set of audience or for a specific purpose. In this sense, the author must act as a vicarious observer, and the documentary evidence reflects a communication among other parties attempting to achieve some other objectives (Yin, 2009). Journals on the other hand are regular publications that are closely associated with a particular area of scientific domain and comprising a collection of articles, reports and research papers reflecting current works in the particular field (McQueen and Knussen, 2002). Thus journals represent a great source of preliminary information for someone starting their research on a particular topic.

In addition to these, textbooks - the classic source of information, too form a single comprehensive and systematized source of background information on topics of research. Textbooks provide a more generalized overview of the topic and thus can be a point of departure for readers who are new to a topic. However it is most often likely that the textbooks havent been revised over the years or may have been written in a very general nature. It should also be kept in mind that books always provide a secondary source of data, as they are interpretations by an author and may not often reflect the original ideas (McQueen and Knussen, 2002).

Industrial reports and publications from governmental agencies that focus on the topic have also aided the research work carried as part of this thesis. The benefit of industrial reports over the scientific articles are that, most often they may provide a better overview of the topic from an industrial perspective than a researcher studying the industry from outside. These reports are also periodic and thus provide a good source of information on the progress and ongoing changes in the industry.

4.2 Interviews

The second most widely relied method for information collection in this research has been interviews, both with industrial experts and academicians researching on the topic. Interviews are an attractive proposition for any researcher as it goes beyond the normal casual conversation and is based on a certain set of assumptions (Denscombe, 2014). Interview was chosen as the suitable method for data collection based on the understanding that the research topic required *detailed information* and *in-depth insights* into the topic from a select few respondents, as highlighted by Denscombe (2014).

For the purpose of this particular research, two major modes of interviews were used, telephonic interview and face-to-face semi-structured interviews. Yin (2009) defines these types of interviews as focussed interviews, as even though the time is limited or fixed, the interviewer has the freedom to be flexible with his/her questions. Semi-structured interviews were carried out as it gave both the interviewee and interviewer freedom to deviate from the main topic and also develop ideas and speak more widely on the issues raised (Denscombe, 2014). But this demanded the interviewer to be attentive and to have constant check on the list of issues that needed to be addressed.

Interviews provided in depth information and insights to the topic of research. The research also experienced a high response rate and easy validation of results from interviews compared to questionnaires. However, as observed by Denscombe (2014) interviews are time consuming and data analysis is harder as it generates non-standard responses especially in semi-structured interviews. Further, the responses from interviews are also driven by inhibitions and interviewer effect. Yin (2009) recommends to corroborate interview data with information from other sources to overcome this shortcoming.

There are 5 levels or different types of questions that constitute a case study protocol interview. Of these Level 1 and Level 2 questions are highly important and Yin recommends that the researcher should concentrate on the level 2 for case study protocol, which is defined below (Yin, 2009);

Level 1: questions asked of specific interviewees

Level 2: questions asked of the individual case (these are the questions in the case study protocol to be answered by the investigator during a single case)

Researchers must try to strike a balance between these two levels of questions. Yin (2009) observes that Level 1 questions needs to be framed with more caution as they are specific to each interviewee and needs to mixed with the Level 2 questions in order to satisfy the line of enquiry intended by the researcher.

4.3 Questionnaires

Questionnaires or social surveys are used to collect information or statistical data from a group of people. It could be mail questionnaires or surveys carried out in person. The mail questionnaires provide an impersonal method of soliciting the information. As a data collection methodology, mail questionnaire research offers several advantages (Lavrakas, 2008), some of which are:

- **Low cost** relative to costs for similar quality surveys using interviewer-administered research methods. The emergence of Internet based surveys is a new alternative to the postal survey methods.
- **High quality** data is obtained from a properly designed and executed mail questionnaires.
- The fact that the mail questionnaire is paper based or handed in a written format may conjure up the feeling of an examination, resulting in relatively **higher levels of respondent effort and attentiveness** in filling out the form.
- Mail questionnaire surveys can be expected to achieve **response rates** that are similar to or even higher than those that would be achieved by interviewer-administered methods. This is mainly because, it is accurately targeted to the sample population.

However, Lavrakas (2008) identifies that there are also certain disadvantages with mail questionnaires, such as;

- **Sampling Control:** There is only a moderate level of sampling control, as the researcher is not present in person, the respondent may not be the intended person.
- **Contingency Questions:** Contingency questions, when a particular answer to one question creates the need for a skip pattern to another question later in the questionnaire, can be problematic.
- **Corrections and Changes:** The pre-printed nature of the survey instrument offers little flexibility to the researcher. Corrections and changes once a survey field period starts, if possible at all, are difficult to implement reliably.
- **Missing Data:** The use of mail questionnaires tends to yield relatively high rates of missing data (item non-response) relative to interviewer-administered and those self-administered methods involving computerized technology.
- **Presentation Order:** There is no ability to control presentation order of items; respondents can examine the contents of the entire instrument before answering any question.

In addition to these, questionnaires may be affected by the limited information available to the researcher while formulating the questions. The respondent may also be biased, or may not recall the exact data or may also fail to convey his/her ideas concisely.

4.4 Application of research methodology

The research activity was divided into 3 major stages as shown in Figure 4.2. The initial stage of literature review was further divided into three major areas as mentioned in the previous chapter, i.e Strategic thinking, sustainability in strategy and sustainable production methods. A brief overview of the literature reviewed as part of the research work is presented in Table 4.1. Some of the keywords used in the literature search are:

- Strategy, strategic thinking, strategic planning
- Sustainability, green shipping, environmental friendly shipping
- Lean production, lean construction, lean shipbuilding
- Remanufacturing, reverse logistics, reman, innovative production

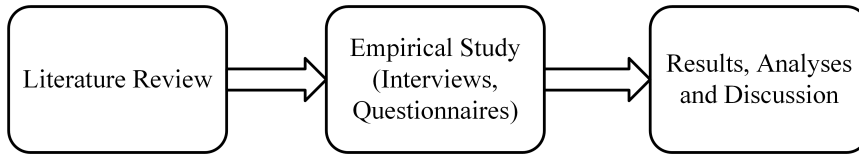


Figure 4.2: The reserach process

The second stage of the research process consisted of interviews, both face to face and telephonic. As all the interviews were scheduled, the interviewer had clear information about the interviewee and their areas of expertise. Therefore the interview guides were adapted to address specific areas of topic according to the respondents. As seen in Table 4.2, a total of 13 interviews were carried out, out of which 9 were formal interviews and the rest informal ones.

The informal interviews were helpful in gaining deeper insights in to areas that the respondents felt were important in addition to the questions raised in the formal interviews. All the face to face interviews except one was recorded and transcribed. However due to time and technical constraints only 4 of the transcribed interviews were sent for review from the respondents. Telephonic interviews were noted down and the information was cross-checked with the respondents at the end of the interviews.

Questionnaires were used as a secondary medium of information collection and were mostly sent out via emails. The response rate was less for questionnaires. In total five

Table 4.1: Literature reviewed - an overview

Sl No.	Author/Date	Title	Keywords	Method/Type
1	Ambec, S., Cohen, M.A., Elgie, S., Lanoie, P. 2013	The Porter hypothesis at 20: can environmental regulation enhance innovation and competitiveness?	Porter Hypothesis, environmental policy, innovation, performance	Case Study
2	Berchicci, L., King, A., 2007.	11 Postcards from the Edge: A Review of the Business and Environment Literature	environmental issues, business and environment, competitive advantage	Literature review
3	Brundtland, G.H., 1989.	Global Change and Our Common Future	Sustainable Development, Global Change	Commission report
4	Cummings, S., 1993.	Brief case: The first strategists.	Strategy, strategist, definition of strategy	Portfolio of commentary, opinion and research experience
5	Eiadat, Y., Kelly, A., Roche, F., Eyadat, H., 2008.	Green and competitive? An empirical test of the mediating role of environmental innovation strategy.	Environmental innovation strategy, business performance,	Case Study, Survey
6	Flidner, G., 2008.	Sustainability: a new lean principle.	Lean, environmental performance, green by-product	Case Study
7	Gehin, A., Zwolinski, P., Brissaud, D., 2008	A tool to implement sustainable end-of-life strategies in the product development phase	Sustainable development; EoL strategies	Case Study
8	Goldey, C.L., Kuester, E.-U., Mummert, R., Okrasinski, T.A., Olson, D., Schaeffer, W.J., 2010.	Lifecycle assessment of the environmental benefits of remanufactured telecommunications product within a green supply chain	Life Cycle Assessment, green, Remanufacture	Case Study
9	Gray, C., Charter, M., 2007.	Remanufacturing and product design	Design for remanufacture, manufacturing industries	Case Study - Questionnaire, interviews
10	Hart, S.L., 1995.	A Natural-Resource-Based View of the Firm.	Resource based view, NRBV, strategy	Literature review, Commentary
11	Hart, S.L., Dowell, G., 2011.	A Natural-Resource-Based View of the Firm Fifteen Years After.	strategy; sustainability; clean technology	Empirical Research

Sl No.	Author/Date	Title	Keywords	Method/Type
12	Hassan, K., Kajiwara, H., 2013.	Application of Pull Concept-based Lean Production System in the Ship Building Industry.	shipyard; leanproduction; pull, JIT	Case Study
13	Heracleous, L., 1998	Strategic thinking or strategic planning? Long Range Plann. 31, 481487.	Strategic thinking, strategy, planning	Literature review, Commentary
14	Ijomah, W.L., Childe, S., McMahon, C., 2004.	Remanufacturing: a key strategy for sustainable development	Remanufacturing, UK, Manufacturing industries	Case study
15	Ilgın, M.A., Gupta, S.M., 2012.	Remanufacturing Modeling and Analysis. CRC Press.	Remanufacturing, Manufacturing industries	Textbook
16	King, A.M., Burgess, S.C., Ijomah, W., McMahon, C.A., 2006.	Reducing waste: repair, recondition, re-manufacture or recycle?	waste; remanufacturing; sustainable design	Literature review, Commentary
17	Koenig, P.C., Narita, H., Baba, K., 2002.	Lean Production in the Japanese Shipbuilding Industry?	Lean, shipbuilding industry, Asia	Case Study
18	Lewis, M.A., 2000.	Lean production and sustainable competitive advantage.	Lean production, Competitive advantage, Case studies	Case Study
19	Liedtka, J.M., 1998.	Strategic thinking: Can it be taught?	Strategic thinking, elements of strategic thinking	Literature review, Commentary
20	Marhani, M.A., Jaapar, A., Bari, N.A.A., Zawawi, M., 2013.	Sustainability Through Lean Construction Approach: A Literature Review	Lean Construction; sustainable development	Case study
21	Menguc, B., Ozanne, L.K., 2005.	Challenges of the green imperative: a natural resource-based approach to the environmental orientationbusiness performance relationship.	NRBV; CSR; Environmental; Resource-based view	Case study
22	Mintzberg, H., 1994.	The Fall and Rise of Strategic Planning.	Strategic planning, thinking	Commentary
23	Nast, N., Thurston, M., 2006.	Remanufacturing: A key enabler to sustainable product systems.	Remanufacturing, Sustainable production systems	Commentary
24	Nishitani, K., Kaneko, S., Fujii, H., Komatsu, S., 2011.	Effects of the reduction of pollution emissions on the economic performance of firms: an empirical analysis focusing on demand and productivity.	environmental management; clean production	Case study

Sl No.	Author/Date	Title	Keywords	Method/Type
25	Porter, M.E., 1991	Know Your Place: How to Assess the Attractiveness of Your Industry and Your Company's Position In It. Inc.	Strategy, business analysis	Commentary
26	Porter, M.E., 1987.	The State of Strategic Thinking.	Strategy, strategic thinking	Commentary
27	Porter, M.E., Kramer, M.R., 2011.	Creating shared value.	Shared value creation, strategy, environment, competitiveness,	Commentary
28	Porter, M.E., Linde, C. van der, 1995a.	Green and competitive: Ending the stalemate.	Competitive advantage, green, strategy	Textbook
29	Porter, M.E., Linde, C. van der, 1995b.	Toward a New Conception of the Environment-Competitiveness Relationship.	Competitive advantage, green, strategy	Commentary
30	Pujari, D., 2006.	Eco-innovation and new product development: understanding the influences on market performance.	New product development; Sustainability	Case study
31	Schau, E.M., Traverso, M., Finkbeiner, M., 2012.	Life cycle approach to sustainability assessment: a case study of remanufactured alternators.	Life cycle sustainability assessment, Life cycle assessment, Life cycle costing, Social LCA, Remanufacturing, Alternator, Automotive parts,	Case study
32	Sharma, A., Iyer, G.R., Mehrotra, A., Krishnan, R., 2010.	Sustainability and business-to-business marketing: A framework and implications.	Sustainability, Green marketing, Recycling, Build-to-order, Reverse logistic	Literature view
33	Smith, V.M., Keoleian, G.A., 2004.	The Value of Remanufactured Engines: Life-Cycle Environmental and Economic Perspectives.	remanufacturing, reconditioning, reuse	Case study
34	Subramoniam, R., Huisingh, D., Chinnam, R.B., 2009.	Remanufacturing for the automotive aftermarket-strategic factors: literature review and future research needs.	Sustainability, aremanufacturing, strategic planning, automotive, reverse logistics	Literature view
35	Wit, B. de, Meyer, R., 2010.	Strategy: Process, Content, Context.	Strategy, strategic thinking	Textbook

Table 4.2: Interviews overview

Type of Interview	Respondent position in the organization	Number of formal interviews	Number of Informal interviews
Case Company A			
Face to Face	Deputy Managing Director	1	-
Face to Face	Manager Planning Department	1	1
Face to Face	Senior Business Analyst	1	1
Case Company B			
Face to Face	CEO	1	-
Telephonic	Sales Director	1	1
Academicians			
Face to face	Programme Leader	2	1
Telephonic	Research Scientist	2	-

questionnaires were sent, out of which responses were received for 2 of it. These responses were from the participants of the interviews. Therefore, the results from the questionnaires were incorporated in the empirical findings of corresponding respondents.

4.5 Quality of Research Design

Yin (2009) presents four test tactics to judge the quality of any research design. This research work also makes use of the same research design tactics in order to ensure the credibility of the information it presents and dependability and conformability of the arguments it puts forward.

The four tests and its practical application in this research work are (Yin, 2009):

1. **Construct validity:** This test includes identifying the correct operational measures for the concepts being studied. Yin (2009) states that in order to meet this test, the researcher must be able to define the specific concepts of the study and also operational measures that meet these concepts. As mentioned in Chapter 2.2, this research looks into a specific set of sustainability issues (three selected) and their role in the strategic thinking in Norwegian shipyards. The operational measures were predetermined to be interviews and questionnaires to study the matter, and was also backed by literature review.
2. **Internal Validity:** This test is relatively less relevant to this particular research as it applies mostly to explanatory studies (trying to explain the sequence of events) and not exploratory studies as this report. Nevertheless, four tactics to meet tackle this tests are pattern matching, explanation building, addressing rival explanations and using logic models.

3. **External Validity:** The third test deals with the problem of knowing whether the findings of the study can be generalised to areas outside the study scope. Since this particular research emphasises on the 'how' component of the research topic, results and observations give a good insight on the replicability and applicability of the study in other similar industries.
4. **Reliability:** This final test is a measure to ensure that a researcher would be able to get the same results using the same methodology at a later point of time. The goal of the test being capable of minimizing errors and biases in studies. This however is a difficult task when applied to the research topic of this thesis, mainly due to the fact that the source of information has been interviews and questionnaires. Further, the responses for questions on topics such as strategy are very much dependant on the current market situation and company's position. In addition to that, the mood of the responder also has a role in such subjective replies.

4.6 Summary of research methodology

The chapter described the research methodology used to collect the necessary information required to formulate the arguments presented in this report. The three case study methods discussed were literature review, interviews and questionnaires. Pros and cons of each of these methods were also discussed. The second half of the chapter described with the help tables how these methods have been applied in this particular research. The chapter concluded by listing 4 different tests that were carried out in each of stages of this research work in order to ensure the credibility and quality of the work.

Chapter 5

Empirical Findings

The major findings and observations from the interviews and questionnaires are presented in the following sections. The chapter has been divided into the 4 major sub sections, the first two sections presents the findings from the two case companies analysed as part of the thesis, while the third section presents the results from interviews with the two academicians. The final section reflects upon the major findings in the chapter.

5.1 Case Company A

The family owned company has a history of over 90 years in the shipbuilding industry. As illustrated in Figure 5.1, the company is primarily divided into four major divisions, design and solutions, power and control, shipping and finally the shipbuilding part. Thus the strategies for the shipbuilding were part of the larger strategy of the company and were based on the resources in all the three parts of the firm. The case company A was the largest among the two case companies in terms of scale of business, product portfolio and also resource pool.

The vision statement of the firm states that the company aims to create tomorrow's solutions for sustainable maritime growth. Their overall strategy is sustainable growth with innovation and internationalization. One of the recent attempts by the company towards sustainable development has been being part of the UN Global Compact Programme. Further, in a move to introduce catalogue ships with better performance, the company has initiated a process to bring changes in their product portfolio. They believe that it would be a great step in their commitment to the environment and clients.

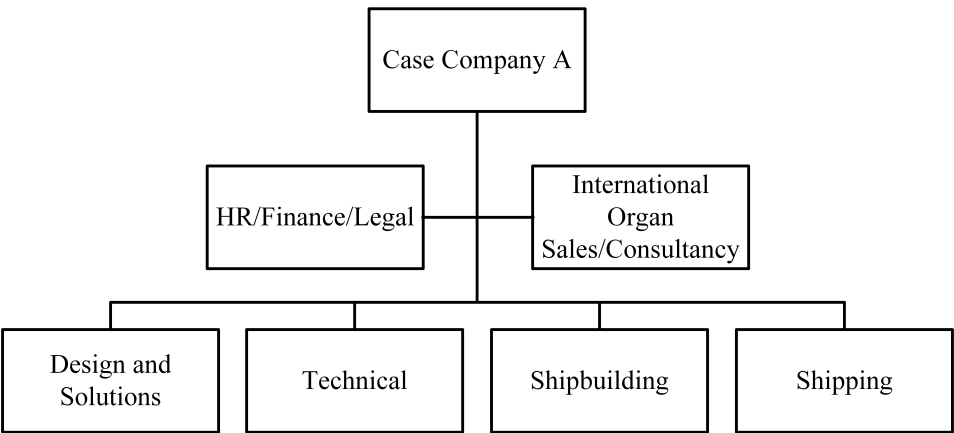


Figure 5.1: Organizational Structure of Case company A

5.1.1 The Interviews

1. Deputy Director

As the respondent was associated with the mother group of which the shipyard was part, he was able to give an overview about how the strategy of the company has evolved over the years and how it has influenced the strategy of the shipyard in particular. Since he has been in the industry for a long time, the interview began with him elaborating on the role of strategy in the Norwegian shipbuilding in general. According to him, very few companies have been actually driven by a particular strategy in the Norwegian context. He highlighted that the case company A is an exception along with another major player in the industry. Otherwise it was mostly manufacturing strategies than a business strategy in the shipbuilding industry.

According to the respondent, rather than a single strategy, case company A has resorted to a multilevel strategy encompassing its all four business areas illustrated in Figure 5.1. This approach provided a broad framework for the business units within which they could experiment and adapt their strategy to meet the needs of the market. However, he emphasized on the need of having a flexible strategy and how they have ensured in their strategic thinking that there is always room to mobilise and demobilise additional resources when needed. He also opined that this approach shows that they are more focussed on methodology and theory than a clear cut strategy.

On questions regarding the strategic thinking process, he mentioned the need for three major areas of focus while considering a strategy, namely, contingency strategies capable of meeting challenges and contingencies, flexibility and multilevel approach capability to cover all four business areas. The interview also revealed that the company made use of standard strategic management tools such as Porter’s 5 forces, generic strategies and PES-

TEL analyses. But these theoretical models were more a directional aid to enhance their capacity to understand the problem at hand and also to communicate to their customers.

The strategic thinking and formulation activity is restricted to the top management, while the implementation phase is driven by effective communication within and outside the organization. The respondent also explained the Accelerated Business Development (ABD) tool box that integrates the major strategic frameworks used by the firm.

When asked about the role of sustainability in strategies, he admitted that sustainability is not a 'big issue' in their strategies. The sustainability initiatives were primarily driven by two major objectives, one for the company's visibility and goodwill as an environmentally responsible company and secondly driven by regulations by government agencies. According to him, the biggest priority has been to be economically profitable and increase Return on Equity (ROE), as any business could pursue sustainability initiatives only after being financially successful.

He also added that the company has always maintained an organisational culture that promotes environmentally responsible activities at all levels of the organisation. Some of the biggest sustainable initiatives have been enacting the UN Global Compact and innovative production concepts, which were both strategic decisions. He opined that both the shipbuilding industry and the environment stand to gain by more efficient designs and production methods more than any other initiative. He was also critical about the possible success of LNG powered ships and other green technologies on a global scale, but observed that they had potential in a select few shipping segments such as coastal ferries.

The interview concluded with questions on the future for Norwegian shipbuilding industry and the feasible sustainable initiatives that can be enacted in the industry. He noted that the industry stands to gain a lot by revisiting many existing operational regulations on ships, as some of these imposes unnecessary restrictions on designs and operational conditions which in turn lead to higher operational cost and environmental footprints.

2. Manager Planning Department

The manger has been working with the planning processes in the shipbuilding part of company and has been overlooking the implementation of innovative production concepts such as lean. He also had experience from other industries that helped him compare and contrast the strategic thinking in those industries with the shipbuilding industry.

According to him, the evolution of strategic thinking in Norwegian shipbuilding industry has been more spontaneous rather than a planned procedure. During the interview, the respondent traced the growth of Norwegian shipbuilding industry from a solely fishing vessel supplier to Iceland during the Second World War to the present role of specialised offshore support vessel (OSV) supplier to customers from around the globe. He also stated that the industry has been experimental and innovative with its business models over the years, from mere shipbuilding to integrating various activities in the value chain.

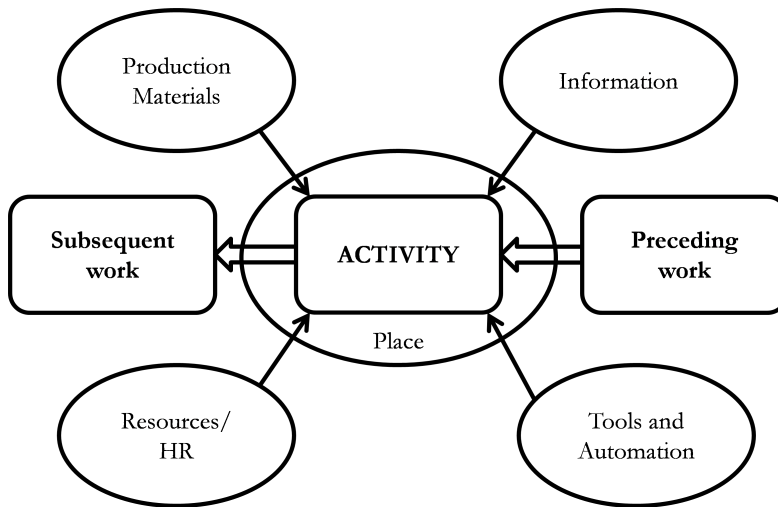


Figure 5.2: Illustration of Lean Concept adapted by Case Company A

He aired the view that the organizational culture in the Norwegian shipbuilding industry stems from the traditional fishing business, where the owners had clear knowledge and expectations about the vessel and its performance. This thought process has aided the industry to be versatile and adaptive to the market changes, such as the boom in oil prices. He also felt that Norwegian ships stood out in the world market mainly because of their value added part, thus if they need to maintain the market supremacy, the industry strategy should emphasise on innovation and high technology.

Regarding the focus on sustainability in strategy, the respondent stated that the design philosophy of the company has always been fuel efficiency and lower power requirement, which translates into as green as possible and low cost. The author finds that this view aligns with Porter's Hypothesis mentioned in Chapter 3, that 'It pays to be green'. He also added that the case company was not chosen by its clients for its commitment to being green, but rather its high technology vessels. And its environmental friendly activities were an added bonus for their customers.

On the question about practical examples about sustainability initiatives in the company, the interviewee mentioned how they have been practicing the lean construction method and how it has been adapted to the specific needs of the firm. The overall lean construction philosophy employed in the company ensures a set of pre-requisites for each activity as illustrated in Figure 5.2.

Thus a successful activity in the shipyard requires an initial work prior to the activity, a description of the work that would follow the activity such as as the basic conditions. In addition to these, the activity should have predefined location of execution, and clear availability or flow of production materials (raw materials), information, resources (knowledge, HR) and tools and machinery. This model has been employed with considerable success

in the shipyard's production lines.

According to him, the company has focussed on cultivating an organisational culture among all the employees that focuses on waste minimization and sustainable activities. On questions with regards to the work environment sustainability, he has observed that the work environment in Norway in general is good and receives necessary attention mainly due to the strict labour laws in the country.

3. Senior Business Analyst

The respondent has been working in the shipbuilding and maritime industry throughout his career, though his association with the case company is only nearly 5 years old. His previous work experience from Asia in the same industry gave the interviewer a great opportunity to get insights into the major differences in shipbuilding activity in Norway and the Asian markets.

He was also of the opinion that the shipbuilding industry has always been market driven and was devoid of any specific strategy, while at the same time emphasized on high quality and improved products. He also observed that the major reason for the boom in OSV production in Norway was the oil price boom in 2005. Nearly 70% of OSVs currently in service have been built in the last decade.

The respondent observed that steel structure accounts for nearly 55-60% of shipbuilding cost, and a reduction in waste of raw materials is the best way to be both green and economically successful. Waste reduction in turn reduces the material usage and also energy associated with it. However he stated that the company has always emphasized on its external environment and operations, such as waste water treatment and enclosed painting and blasting facilities. The analyst was however sceptical about the success of catalogue shipping for the present generation of ship owners who were particular about the specificities of their products.

5.2 Case Company B

The company has been in the shipbuilding industry for over 100 years with expertise in building ferries, fishing boats and cargo vessels. Operating at a much smaller scale and specialized in a different portfolio of vessels than company A, case company B had a different approach to strategic thinking. They had more short term strategies and are one of the very few shipyards in Norway that still carry out both ship repair and new ship building activities simultaneously in their yards. Their customer focus is primarily in Europe and new-building activities mostly include outfitting of hulls that are manufactured in yards in other parts of the world.

The company has also entered into an alliance with foreign shipyards for improved expertise and better project execution capability. The vision statement of the company states that the shipyard would aim to be among the best and the most attractive combination yards in the North Sea area. The case company also emphasizes on the environmental commitment and has been taking initiatives to improve their environmental performance. They have an environment policy in place and closely collaborate with stakeholders in meeting the principles in the policy.

5.2.1 The Interviews

1. CEO

The respondent is a member of the top management and being the CEO of the company he had a complete overview on the activities of the company, its priority areas and future plans. On questions regarding the strategic thinking process in the firm, he explained that the company began with Porter's 5 forces analysis to understand and evaluate the market situation, the threats and opportunities. This is further supported by a SWOT analysis to understand the industry and the shipyard's situation. As the shipyard's business model was a combination of new building and repair, the process was repeated for each business area. The respondent however agreed to the fact that these standard strategic analysis tools are not often capable of analysing issues specific to the shipyard setting. In order to overcome this, they have made changes to the model to suit their needs.

He identifies the high cost of production in Norway and the slow recovery after the 2008 economic crisis as the major reasons for this. In addition, the presence of low cost manufacturers in other countries has made the competition for Norwegian shipyards tougher. He remarked that the case company was in a phase of strategic realignment and was exploring joint ventures with foreign shipyards. According to him, such a move would be the most judicious one in the present situation. This was because it would pave way to develop a more economical business model, at the same time provide an impetus to improve in-house technical expertise required to supervise the foreign yards.

According to the respondent, the present shipbuilding industry has become exclusively price driven and very little priority is given to technical expertise or sustainability. However, he mentioned that the case company has been striving to build ships with environment friendly technologies and improved performance characteristics.

He categorized the company's environmental initiatives into two, namely, the green shipping initiatives and the production improvements. The latter in turn lead to waste reduction, improved documentation, evaluation of environmental performance and so on. The case company is one of the leading shipbuilders in the country with expertise on LNG shipping and the respondent believed that Norway should utilize the industry's expertise to be a leading provider of LNG fuelled ships which have much better environmental performance parameters than conventional fuels.

In addition to this, the respondent also highlighted the importance of alternate power solutions such as hybrid vessels with batteries for vessels working along the coast, government aided programs that support environmental friendly shipping solutions (eg: NOx Fondet, Miljøfinans etc.) among other sustainable strategic areas they are currently looking into. Further he also stated the firm's intentions to introduce lean production concept in their shipyard and also get the organisation ISO 14001 certified in the nearest future.

2. Sales Director

The interview with the sales director was part of a pre-project work associated with this research thesis. Due to this the questions asked in the interview were not completely restricted to the scope of thesis. However, his observations were found to be important to the analysis of this thesis topic and are therefore mentioned along with other results.

The respondent has been associated with the case company B for a long period of time and also the shipping industry for major part of his career. He also had similar views as the CEO on the strategic thinking process, which according to him mostly involved the top management and in case of company B was a 6 member body that later consulted with the board for finalizing the strategic decisions. The process made use of standard tools such as PESTEL, Porter's 5 forces and SWOT.

According to him, one of the biggest sustainable initiatives made by the company includes the LNG fuelled vessels it has put into service and also the first LNG bunkering barge in the world. He finds this as a strong strategy that needs to be pursued further. With regards to economic sustainability, the respondent opined that joint ventures with other countries is the way forward. This was because competitors from countries such as Turkey, Lithuania etc. offer ship owners prices 30% lower than Norwegian shipyards, though the production quality is never at par with ships built in Norway. He therefore observed that, technical expertise from Norway and production facilities in low cost countries could be one of the alternatives that company B shall pursue.

On questions about remanufacturing as a sustainable production concept, the respondent mentioned the successful operation of ferry vessel which was refitted into a LNG bunkering barge by the shipyard. He also added that currently remanufacturing and refitting has a business potential for experimental projects that need high initial investments. Because, the uncertainty associated with pilot projects makes old vessels an attractive option as it would keep the overall cost of construction lower.

Table 5.1 summarizes the major findings from both the case companies.

Table 5.1: Interview summary of case companies

Case Company	Company A	Company B
Organizational History	Over 90 years	Over 100 years
Size (Employees)	800-1000	200-300
Customer base	Worldwide	Mostly European clients
Major competencies	Design and customized offshore vessels	Alternate fuel powered and hybrid vessels
Business areas	New Building, Designs	New building and repairs
Project Portfolio	Offshore Support Vessels	Ferries and Cargo
Strategy Formulation	Standard frameworks such as Porters 5 forces, PESTEL	Standard frameworks such as Porters 5 forces, PESTEL
Recent strategic changes	No major changes since the last decade, but adapted to changing market situation	In a phase of strategic realignment and analysis options such as partnership with foreign shipyards
Clear Sustainability Focus in Strategy	Present indirectly	Present indirectly
Major strategic sustainability initiatives	Lean Production, Innovative and energy efficient designs, UN Global Compact	Initiatives for miljfinans, NOx Fondet, ISO 14001 certification efforts, Hybrid vessels, environmental reporting since 1998
View on Lean Production Method	Have successfully employed the lean production method and have own framework	Critical about the applicability of lean in repair projects, planning to introduce it in other areas
Solution for a sustainable future	More efficient and less costly ships with increased ROI	Environment friendly technologies such as LNG, Hybrid vessels
Concept of remanufacturing	Not yet analysed the potential	Had successfully refitted a cargo vessel into a bunkering barge. Though the complete potential is yet unexplored
Economic Sustainability	A shift from product orientation to service orientation	Joint ventures with foreign yards, Government aid for green technology
Work environment	Good work environment for the employees both in Norwegian shipyards and foreign shipyards associated with them	Good work environment for the employees ensured.

5.3 Academicians

The second group of interviewees in this research study consisted of academicians and analysts who have been working in close collaboration with the Norwegian maritime industry in their research. This set of interviews helped the author get a different perspective on the research topic. Mainly because the respondents have been associated with many industrial research projects and were able to give a critical overview of the strategies in the Norwegian shipbuilding industry and how important sustainability has been in these discourses.

5.3.1 The Interviews

1. Program Leader

The first respondent is the program leader for the Maritim21 project which is a holistic research and innovation project for the maritime industry in Norway aimed at creating a shared strategy and knowledge platform for the industry, research and politics (Maritim21, 2010).

The respondent observed that the Norwegian shipbuilding industry has been characterized by tight integration between the shipyards and the ship-owners which in turn has paved way for the development of highly competent maritime clusters. This has also been the major driver of strategies in the industry. He further added that strategies and innovations have been greatly influenced by prevailing market conditions and the ship owners decisions.

On sustainability issues, he pointed out that the success of LNG fuelled vessels has been facilitated by the NOx Fond support for the ship owners. However he was sceptical about the success of LNG fuelled vessels once the government aid stops in future. This according to him was mainly because of the fact that the shipping industry is highly cost focused. This in turn made the ship owners reluctant to choose an alternate fuelled ship when there were no financial benefits for the extra investments it demands.

For questions regarding economic sustainability in the industry, the respondent opined that technological innovations aimed at both cost reduction and efficiency improvement needs to be further stressed upon. He also considered that a cross-cutting approach that links all the stakeholders in the industry, including the academia is the way forward for the industry.

2. Research Scientist

The research scientist has been associated with the maritime industry with specific focus on logistics and strategy in the industry since 2006. Since her earlier research involved a close collaboration with one of the case companies, she was able to provide a deeper insight into the various strategic activities of the company. According to the respondent, only large companies in the industry have the resource and capability to develop, adapt and apply strategic frameworks and tools. The smaller ones mostly relied on standard frameworks such as Porter's 5 forces and SWOT. This approach according to her had certain drawbacks because most of these frameworks often failed to take into account unique features of the company and most often missed the complete value chain.

She also concurred with the other respondents that the industry was primarily driven by profit and client needs, and pre-determined strategies only had a secondary role in the companies. On questions about the feasibility of sustained funding for green technology such as NOx Fond, she opined that relying on governmental assistance as a business model cannot be a long term strategy.

The respondent observed that the commitment to research by the industry needs to be more streamlined and emphasised upon. It should be more than just a goodwill gesture. She stressed upon the need for the change in mind set of the industry, as sustainability according to her, is currently more on paper and less in action. The interview concluded with respondent noting that an efficient decision making framework with sustainability focus should be a research priority for the industry stakeholders.

5.4 Summary of empirical findings

The general observation from the interviews is that the Norwegian industries prioritize on being environment friendly in their activities. However, the changing market scenario in the shipping industry has made it irrelevant to have a specific strategy for the shipbuilding industry. Rather, the industrial players have reacted to the market changes and adapted their business models to address the demand of the changing market. Thus the strategies have been mostly driven by profit and the aim to maximize the return on investments. Further, commitment to sustainability has been driven by the aim of increasing productivity while at the same time being environmentally friendly in their activities.

Chapter 6

Discussion and Analysis

This chapter discusses and analyses the empirical findings of this thesis in the light of the literature reviewed and also evaluates a decision framework and the applicability of an innovative production concept in the Norwegian shipbuilding industry. Therefore, the chapter is divided into two major parts. Part one discusses and analyses the findings and observations from Chapter 5 and compares it with the literature reviewed in Chapter 3. While the second part of the chapter uses the observations from part 1 to develop a decision framework for an innovative production concept that would improve both the environmental performance and business opportunity of the Norwegian shipbuilding industry.

6.1 Empirical findings and correlations

The findings from different interviews presented in Chapter 5 exhibit a strong connection between various factors that affect two major themes of this thesis, i.e strategic thinking and the practical implication of sustainability in the strategic thinking process. These findings and other deductions from the interviews are summarized in Table 6.1.

The table is categorized based on the broader themes of strategic thinking and Sustainability in practice. For the purpose of result discussion and analysis, the two themes are further divided into 7 sub themes, namely;

- Strategic thinking:
 - Drivers: Critical factors that determine the success or failure of the company's strategy.

- Influencers: Factors that have an impact on the strategic thinking process.
- Supporters: Factors that facilitate the whole process, which can include tools, frameworks and workshops.
- Sustainability in practice:
 - Economic, environmental, work: The three sustainability issues investigated in the thesis.
 - Way forward: Future strategic actions that can improve the environmental performance of the company.

Some of the topics elicited similar responses from the interviewees, these are mentioned using same keywords such as market conditions, cost reductions and so on. Some of the cells are vacant for some of the respondents because the responses from those interviews were not sufficient to derive an opinion on the topic.

6.1.1 Strategic Thinking

The literature reviewed in Chapter 3.1 presented two major views on the nature of strategic thinking and the five different set of attributes that constitute the strategic thinking process. The findings presented in Table 6.1 also show this strong correlation between the major elements and the actual strategic thinking process in the shipbuilding industry. The three subsections under this theme are further analysed in the following paragraphs.

1. Drivers

The results from the interview showed that strategies in the Norwegian shipbuilding industry have been more often spontaneous and market driven than a planned effort. Being a highly competitive and cost focussed industry, the major drivers of the strategic thinking process have been the market conditions and client demands. Other externalities such as the government policies and regulations have also been a critical driving factor in strategic thinking in the shipbuilding industry.

These factors in fact are found to be consistent with Liedtka (1998)'s view that strategic thinking takes a system perspective approach as all these drivers have interdisciplinary interactions and needs to be analysed in totality in order to develop a rewarding and effective strategy.

2. Influencers

The respondents however had differing views on the factors that influence the strategic thinking. While majority of the respondents considered the firm's resources as a major influencing factor, few others viewed the regulations by external agencies such as IMO and alternate business possibilities as reasonable factors.

Table 6.1: Deductions and Findings from the interviews

Respondent	Themes					
	Drivers	Strategic Thinking Influencers	Supporters	Economic	Sustainability in Practice Environmental	Way forward
Case Company A Deputy Director	Market conditions, client demands, financial condition of the firm	Management, Organizational vision and mission, IMO regulations	Accelerated Business Development Frameworks	Increased Return on Equity focus	UN Global compact, cleaner production	Revisiting operational condition, increased efficiency, flexibility
	Market conditions, client demands, spontaneous developments	Oil prices for Offshore Support Vessels, in-house resources, regulations such as EEDI	Analytical tools, economic forecasts	Cost reduction, judicious material usage	Waste reduction, water treatment	Improved production methods and designs
Manager Planning Department	Market forces, client demands, externalities	Resources, firm's capabilities	Organizational culture, innovative mentality	Cost reduction, increased vessel efficiency	Lean production, last planner system, cleaner production facilities	Lean, waste reduction, cleaner production concepts
Case Company B CEO	Price, market conditions, government policies,	Competitors from low cost countries, environmental regulations, high cost in Norway	Porter's 5 forces, SWOT etc.	Joint ventures, innovative business models,	LNG fuelled hybrid vessels, waste reduction,	Environmental financing, government policies, innovative production concepts

Respondent	Themes					
	Strategic Thinking			Sustainability in Practice		
	Drivers	Influencers	Supporters	Economic	Environmental	Way forward
Case Company B						
Sales Director	Market conditions, client demands, regulations	Top management, alternate business possibilities,	Strategic frameworks such as SWOT, Porter's 5 forces	-	LNG fuelled vessels, hybrid vessels, waste reduction,	- Regulation reforms required to address LNG vessel requirements,
Academicians						
Programme Leader	Market forces, client demands, other externalities	Close integration between shipowner and shipyards, Oil prices for OSVs	Cluster form of functioning, flat Norwegian organisational structure	Fuel efficient vessels, technological innovations, cost reduction	NOx fondet and other initiatives to push pilot projects	- Flexibility, cross-cutting approach, faster innovation, strong maritime
Research Scientist	Profits, market conditions,	Resources, firm's capabilities	Porter's 5 forces, SWOT, PESTEL	Right partners to work with, outsourcing strategy	Compliance with environmental regulations	- Energy efficiency, change of mindset, decision making framework with sustainability focus

Nevertheless, all the respondents emphasized on the importance of flexibility in strategy in order to incorporate the emerging tendencies in strategy. Liedtka (1998) identifies this as the intelligent opportunism which provides leeway to accommodate strategies which may not be within the scope of the intended strategy determined by the driving factors.

3. Supporters

The interviews revealed that strategic thinking in the industry widely uses standardized frameworks and tools to support their decisions in the process. The respondents from the industry mentioned Porter's 5 forces, SWOT analysis and PESTEL as the most widely used strategic tools in analysing the strategy options of the firm.

However, these standardized frameworks do not cover all the dimensions of industry and is often adapted to meet the specific needs of the company. The author had used these analysis tools in an earlier research work on LNG bunkering business strategy. A close reading of these tools (Ali, 2014) shows that they fail to evaluate the complete value chain, and also does not take environmental performance factors into consideration.

Summary

The results on the strategic thinking process in the Norwegian shipbuilding industry shows that it is often 'emergent' in nature and is primarily driven by the market condition and client demands. Sustainability focus in the strategies was to a great extent influenced by strict regulations by government and other agencies such as IMO. Thus the research shows that sustainability focus in strategies in the shipbuilding industry either lacks priority or is present indirectly in the firms' activities. Nevertheless, the research also observed that the environmental performance and cleaner production methods have been emphasized in shipbuilding industry. The following section analyses how these have been practiced in the industry.

6.1.2 Sustainability in Practice

As mentioned in Chapter 2.2, this research work studied three major sustainability issues in the shipbuilding industry, namely economic, environmental and work conditions in the shipbuilding industry. In addition to these three subsections, Table 6.1 also lists future steps that the respondents think need to be taken in order to improve the sustainability credential of the industry. These findings are analysed in the following paragraphs.

1. Economic

Among the three sustainability issues discussed during the interviews, economic sustainability was found to be of the highest priority to the industry. The interview findings also show that strong emphasis has been placed on the need to sustain a minimal Return on Equity (ROE) rather than just profits. As the industry faces stiff competition from low cost countries such as China, Turkey and Korea (Rialland et al., 2009), it is all the more evident why this issue was emphasized by the respondents.

The responses show that the companies consider cost cutting and efficiency improvement as the major ways to remain economically sustainable in the industry. At the same time, the case study also shows that majority of industrial players have outsourced standard operations to these low cost countries and have only retained high expertise demanding operations such as integration and outfitting. In addition to this, companies are also trying to move towards a complete package business model focusing on service based strategy instead of just product based strategy. The latter involves only the manufacturing and delivery of ships.

Cost reduction has been achieved to a great extent by streamlining the operations, waste reduction in production phase and by increasing the operational efficiency of the vessels. The latter has been achieved through technological innovations in design and propulsion systems. These factors distinguish the Norwegian shipbuilding industry from their competitors and the analyses shows that the industrial players are striving to maintain their economic sustainability. Meanwhile some companies are still in the process of identifying the apt business model.

2. Environmental

As evident from the results presented in Table 6.1, practical steps taken to improve the environmental performance of the industry were different in both the companies. While case company A identified waste reduction, UN global compact and lean as their major steps towards improving environmental sustainability, case company B identified their expertise on LNG fuelled vessels and hybrid vessels as their major steps.

The academicians viewed that most of these activities were either driven by the commitment to comply with environmental regulations or due to the financial aid available for such steps. The industry analyses shows that NOx Fond (See Appendix A) which incentivises the investments made for LNG fuelled ships have been instrumental in realising certain pilot projects. However, these financial aids do not provide a sustainable business solution to firms as these funding schemes are often terminated after a time period (Ali, 2014).

Another interesting observation from the interview responses is the emphasis on cleaner and innovative production concepts that would benefit both the company finances and the environment. Lean production has been adapted by one of the case companies with considerable success and as mentioned in Chapter 5.2.1, case

company B also intends to implement the concept in their facilities in the near future. Thus the analysis shows that improved production concepts that follows the '*pays-to-be-green*' philosophy has greater acceptance in the industry compared to other certifications and regulations. This finding is further used in Chapter 6.2.

3. Working Conditions

Questions on working conditions in the industry elicited more or less similar responses in all the interviews. The topic was also not discussed in depth in some interviews as all the respondents opined that the working conditions in the industry was among the best in the world. The analysis shows that this is primarily because of the strict labour rights in the country and the employee friendly organisational culture in the Norwegian industries.

In addition to these, the industry also ensures that proper training and education is provided to their employees. Personal Protective Equipment (PPE) is must in production facilities and employee participation was also ensured in major phases of strategy implementation. According to the respondents, these factors motivated the employees and ensured higher level of commitment in their work.

Another interesting observation was the fact that both these companies strived to ensure similar work conditions even in their partner yards in foreign countries. This in effect would also augment the goodwill of Norwegian shipbuilding industry in the international market.

4. Way Forward

As Table 6.1 shows, all the responses on the likely future steps that would improve the sustainability factors of the industry had a similar line of thought. The findings of this research show that in order to remain sustainable with regards to all the three issues discussed, the industry needs to improve both their product efficiency and production methods.

Nearly all respondents stressed upon the importance of innovative production concepts that would reduce the cost of production and minimize or avoid wastage. A few also notes that LNG and other alternate cleaner fuels also holds great potential for the Norwegian shipbuilding industry. Academicians on the other hand observe the need to develop a cross-cutting approach capable of holistically analysing both the business and environmental performance of the firm. This however demands a more creative change in the mind set of academic players and increased commitment to research.

Favourable business environment also plays an important role in realizing most of these goals. A case in point is the absence of regulations specific to small LNG bunkering barges, which currently needs to comply with the regulations made for large LNG tankers. This attracts additional costs thus impeding the growth of this particular business segment (Ali, 2014). One of the respondents opines that the same applies to few other regulations which need to be updated to accommodate the technical competency of new vessels, current restrictions on shipping cargo in tanker vessels was an example he mentioned.

6.1.3 Literature and findings correlation

The results discussed in the preceding paragraphs show that there are a list of factors that influence strategic thinking in the Norwegian shipbuilding industry. A mind mapping activity was carried out to correlate these findings and deductions with the findings in the literature presented in Chapter 3. The results of this mind mapping exercise are presented in Figure 6.1. The systems engineering process explained in Figure 2.3 was used as the basic framework for preparing this mind map.

As seen in the figure, 4 major topics were considered in order to analyse the possible sustainable strategies for the shipbuilding industry.

The subtopics mentioned under Sustainability in practice were based on the findings in the interview. These subtopics summarize the current activities in the industry that addresses the three sustainability issues listed in Chapter 2.2. The topics titled Way Forward and Strategic thinking in Industry denote the deductions made out of the interviews as discussed in Chapter 6.1.1. The fourth topic on Sustainability in Strategy links the two strategies under NRBV, namely Pollution prevention and Product Stewardship to the empirical findings. The practical implications and relationship of these strategies to lean and remanufacturing concepts were established in Chapter 3.3.3.

The right hand side of the map identifies the possible options that meets the needs and conditions presented on the other half of the figure. Three possible options were considered and analysed in the mind mapping process. As seen in Figure 6.1, they are:

1. **Policies:** The first sub-option considered under policies was the setting up of a financial assistance programme by banks or other bodies aimed at incentivising and attracting ship owners to green technology shipping. As mentioned in Chapter 5, these financial assistance scheme have been successful in initiating some pilot schemes in the industry. The second option considered was policy changes by the government and other regulatory bodies. This could include updating the existing operational conditions as opined by one of the respondents in the interviews. The third option was tax benefits and other subsidies for boosting the business economy in the country.
2. **Business models:** The second main option considered was about introducing considerable changes in the company's business model. This included stronger and wider relationship with yards based in low cost countries based on existing joint venture initiatives. A switch to complete outsourcing of activities and reducing the industry in Norway to a provider of high technology and quality services. The third option was a switch from product offering to service offering portfolio, as this ensured more value addition and increased revenue to the company.
3. **Innovative production concepts:** The final option evaluated two production concepts that have proved to be both cost efficient and environment friendly in production facilities. These were lean production and remanufacturing.

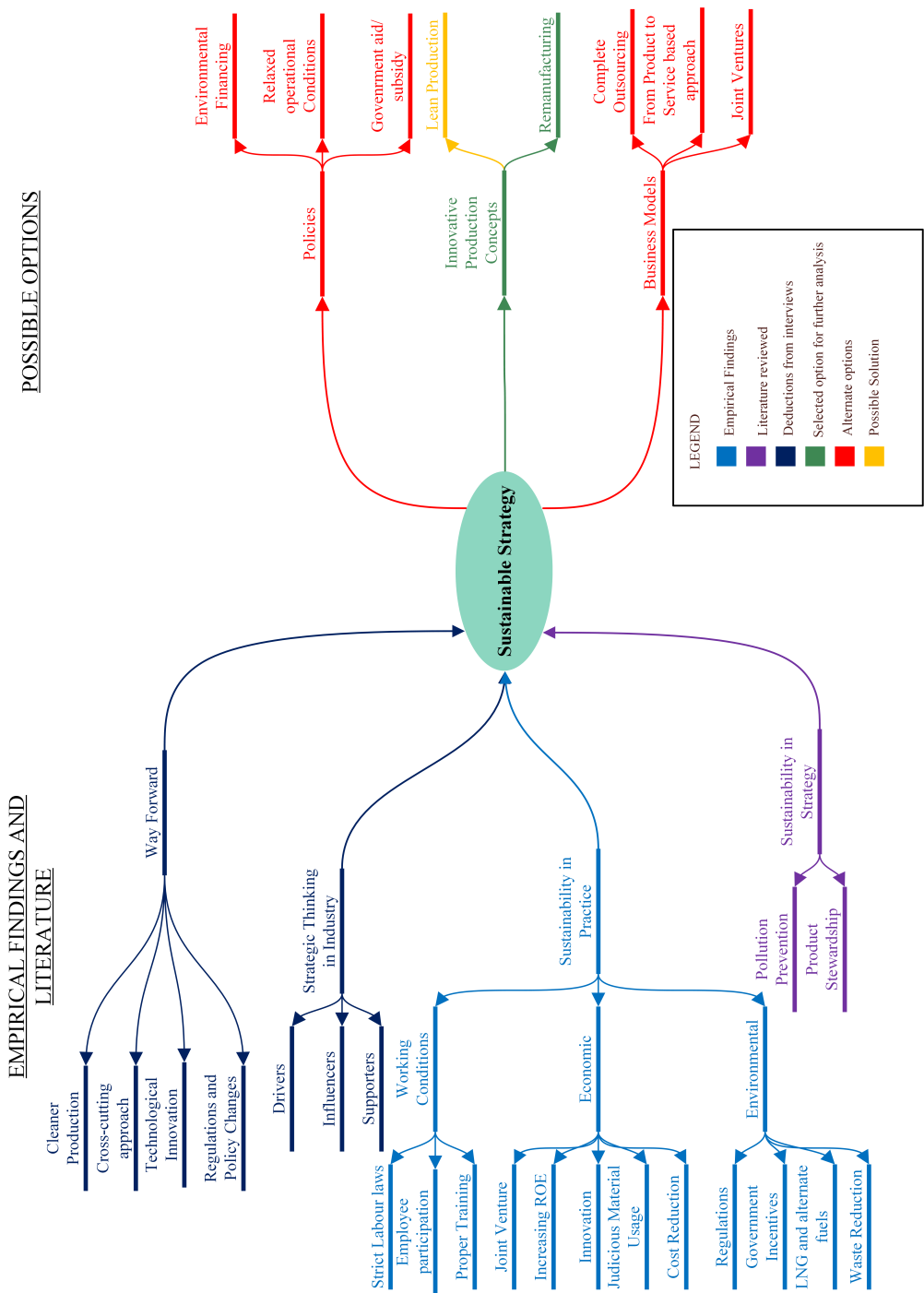


Figure 6.1: Mind map correlating the empirical findings and possible solutions

Options 1 and 2 were not further analysed as they were beyond the scope of the project mentioned in Chapter 1.2. Further, both these options are also currently being studied and tested to some extent within the industry.

As mentioned earlier, option 3 had two sub options, namely lean production and re-manufacturing. These two were further analysed as the empirical findings revealed that a sustainable business strategy in the shipbuilding industry needed to be;

- Technologically innovative
- Productivity improving
- Financially rewarding
- Less resource intensive raw materials and human resource
- Appealing to the clients; among others

As discussed in Chapter 3.3, both these concepts satisfied most of these conditions and also benefited both the company finances and the environment. Lean production has already been applied by company A with considerable success and case company B plans to introduce it in their facilities in the near future. Further, applicability of lean has been widely studied in the industry (Dugnas and Oterhals, 2008; Emblemstvg, 2014; Hassan and Kajiwar, 2013; Koenig et al., 2002; Koli et al., 2012).

Remanufacturing on the other hand is a relatively new concept in the shipbuilding context and also addresses both the economic and environmental sustainability issues discussed earlier in this report. Further, it is also based on the idea of technological innovation and cleaner production voiced by the respondents in the interviews.

Therefore, the concept of remanufacturing is further discussed and analysed in the context of shipbuilding industry and a strategic decision making framework for the same is presented in Chapter 6.2.

6.1.4 Summary of discussion on empirical findings

The preceding paragraphs discussed and analysed the empirical findings from the interviews and also presented the results of a mind mapping exercise aimed at correlating these findings with the literature discussed. Based on the mind mapping results and the arguments presented in Chapter 6.1.3, remanufacturing has been selected as a more feasible option for further analysis in this thesis.

6.2 Remanufacturing as a sustainable strategy

As illustrated in Figure 3.3, the concept of remanufacturing takes a different approach from recycling, repair and reconditioning. The generic remanufacturing process was explained in detail in Chapter 3.3.2. The following subsections present a strategic decision making framework for shipbuilding companies considering remanufacturing as an option for a new vessel order placed. The framework or the remanufacturing concept is not explained as a business strategy in itself. But is rather intended to be an effective tool for companies deciding to enter the sustainable business area of remanufacturing. This dichotomy is further commented upon in Chapter 7.1.3.

6.2.1 Framework development methodology

The methodology used for developing the framework is illustrated in Figure 6.2. As evident from the illustration, it was an iterative process involving three major steps. The first step involved discussing and studying the relevant literature on strategic thinking and remanufacturing concept. This was covered in Chapter 3 of this report. The second stage of the process looked into existing frameworks and examples in literature on strategic decision making. This process revealed that there are some existing frameworks for some industries such as automobiles and electronics (Dowlatshahi, 2005; Subramoniam et al., 2010). The third and final step involved developing a framework based on findings presented in Chapter 5 and the first two stages.

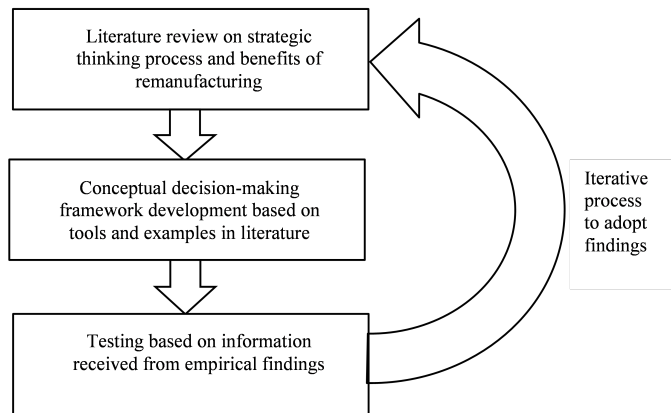


Figure 6.2: Methodology used to develop the framework (Adapted from Bocken et al. (2014))

As explained in step 6 of the Systems engineering process (see Chapter 2.3), these models were tested and verified to ensure that it met the conditions mentioned in Chapter 6.1.3. The process was repeated until a satisfying framework was developed.

6.2.2 Strategic decision making framework

As explained in Chapter 6.2.1, Dowlatshahi (2005) and Subramoniam et al. (2010) have proposed two strategic decision making frameworks based on reverse logistics and remanufacturing respectively. The framework illustrated in Figure 6.3 has been developed by taking a cue from these two frameworks and incorporating it with findings presented earlier in this thesis. The proposed framework is divided into five different stages. As shown in Figure 6.3, these five stages trace the progress of the decision making process from the initiation of the order to the final execution of the project. Each stage consists of a set of decision steps and actions that need to be taken based on the decisions. Each decision step consists of questions that generate a yes or no reply. The actions that succeed the decision box explain the steps that need to be taken according to the output from the decision box. All the five stages and adjoining decision steps are explained in the following paragraphs.

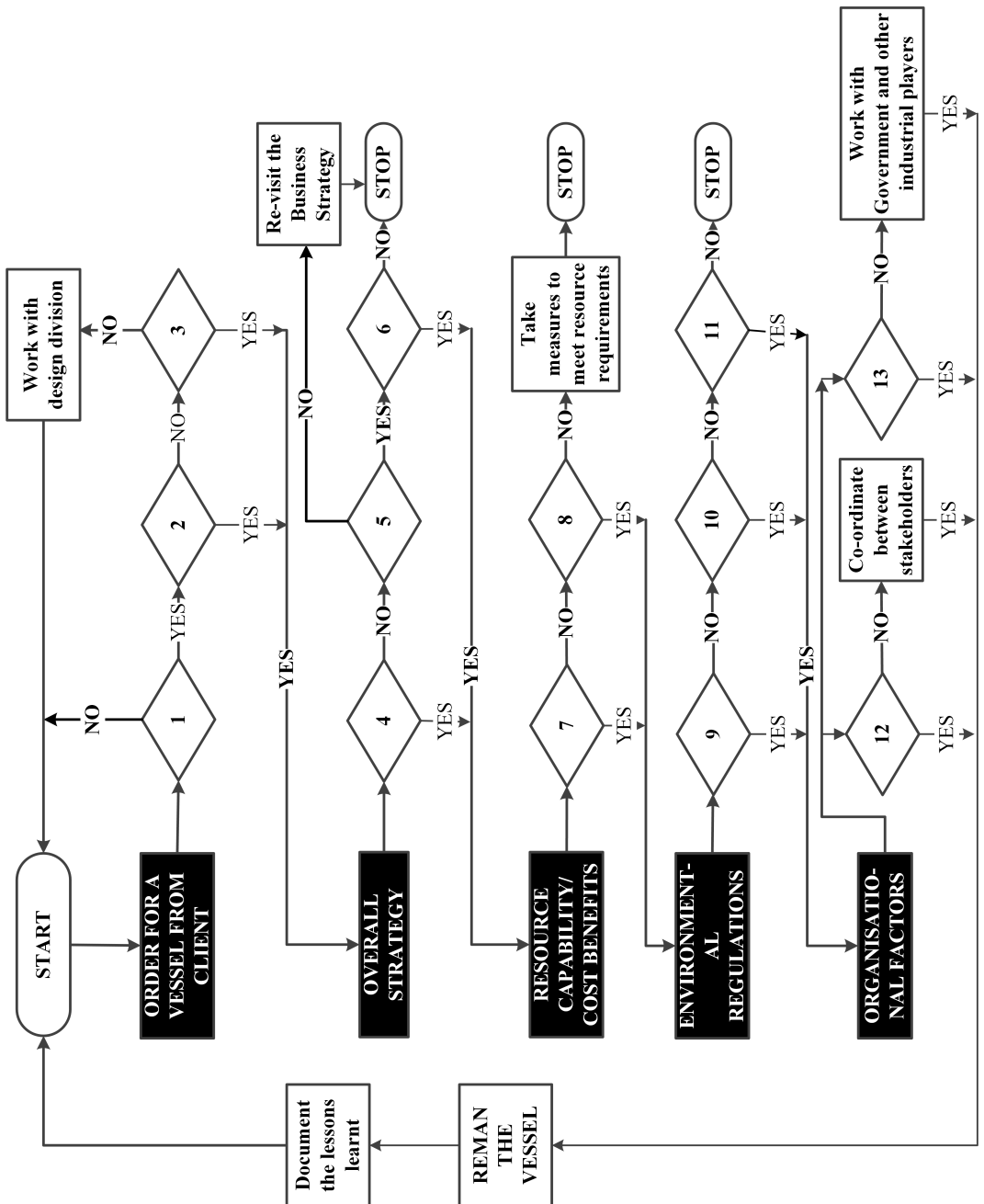


Figure 6.3: Strategic decision making framework for Remanufacturing

Stage 1 Order for a vessel from client

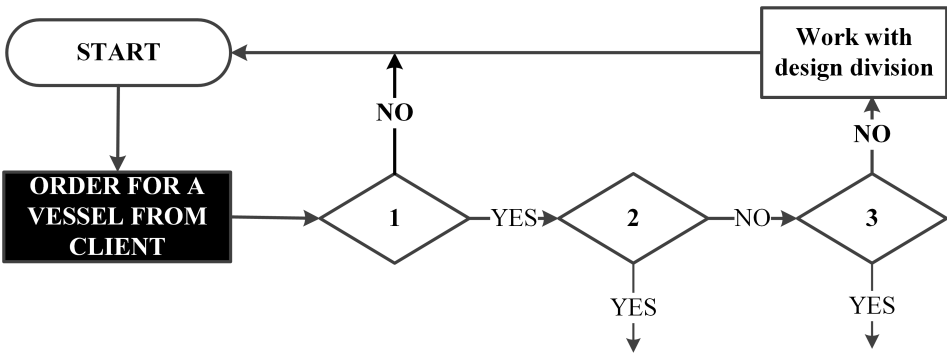


Figure 6.4: Stage 1 Order for a vessel from client

The decision making process starts with the shipbuilding company receiving an order for a vessel from its client. This process is followed by three decision boxes. The first decision box checks if the project is financially viable if a remanufacturing approach is taken. As observed in Chapter 5, the industry is highly profit driven and thus the profit margin from the project is of prime concern. If the project is not financially viable the process stops. If yes, it proceeds to the next decision box which checks for the design of available vessels to see if it is designed for remanufacturing. If the vessel is not designed with remanufacturing capabilities, the decision process checks if there is any possible alternate solutions to make the vessel fit for remanufacturing. If no, the information is conveyed to the design team to include the feature in their design stage. If replies are affirmative, the process proceeds to the stage 2.

Stage 2 Overall Strategy

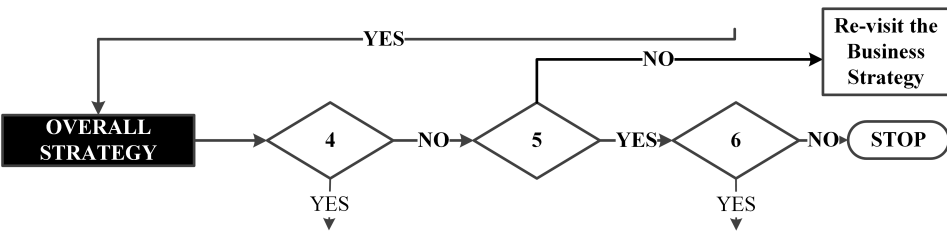


Figure 6.5: Stage 2 Overall Strategy

The second stage checks the compatibility of the process with the current business strategy of the firm in the decision box 4. If affirmative, it proceeds to the next stage. If the reply

is no, the process proceeds to decision box 5, which checks if the business strategy can be changed. If yes, decision box 6 checks if the changed business strategy aligns with the stated mission and vision of the company. Only if it aligns with the mission and vision, does the process proceed to the third stage.

Stage 3 Resource Capability/ Cost Benefits

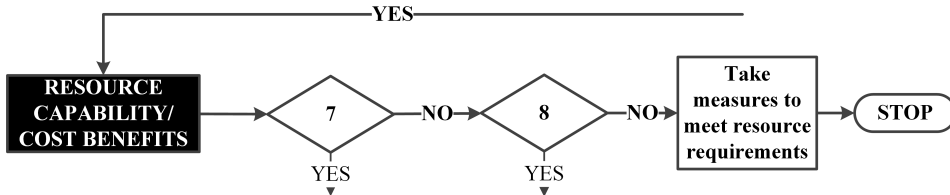


Figure 6.6: Stage 3 Resource Capability/ Cost Benefits

As shown in Figure 6.6, stage three on resource capability of the shipbuilding has two decision boxes, 7 and 8. The decision box 7 checks if the company has the necessary knowledge and resources to successfully execute the project. If yes, it proceeds to the next stage. If no, decision box 8 checks if these resources can be acquired at an affordable rate. If it cannot be acquired, the message is conveyed to the resource division of the company for further action.

Stage 4 Environmental Regulations

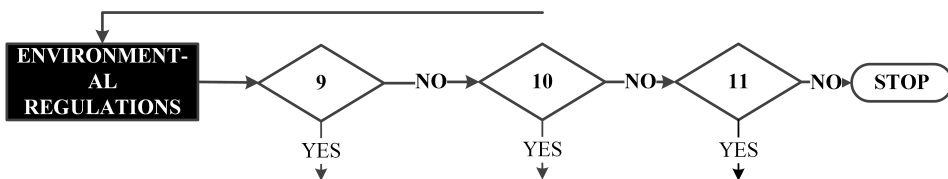


Figure 6.7: Stage 4 Environmental Regulations

The stage 4 of the decision process has three 3 decision boxes. As shown Figure 6.7, the decision box 9 checks if the remanufactured product would comply with the current and future environmental regulations and operating standards for the vessel. If the reply is no, the decision box 10 checks if the product would at least comply with the existing regulations and standards for the vessel type. The decision box 11 checks if improvements can be made to the product in order to comply with the regulations. If the reply is yes for any of these decision boxes, the process proceeds to the final stage.

Stage 5 Organisational Factors

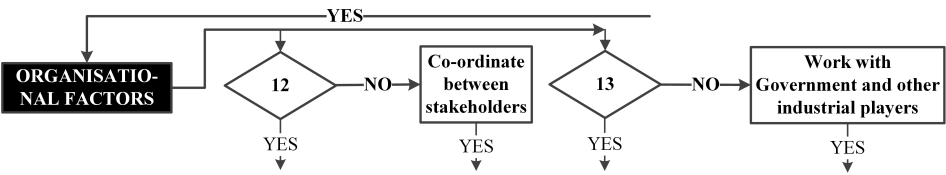


Figure 6.8: Stage 5 Organisational Factors

The final stage of the decision process relates to the organisational factors that would facilitate a successful execution the remanufacturing process. As seen in Figure 6.8, the stage consists of 2 decision boxes and two subsequent actions. Decision box 12 checks if the shipbuilding company has local facilities and communication channels in order to coordinate the activities with the stakeholders. The stakeholders could be clients, partner yards or the design company that designed the ship initially. If not, the shipbuilding company should co-ordinate between these stakeholders and then proceed. The decision box 13 checks if the company has a conducive environment that would promote remanufacturing process, such as tax credits points for the adopting green technology. If not, work with the government bodies and other industrial partners to develop a favourable business environment.

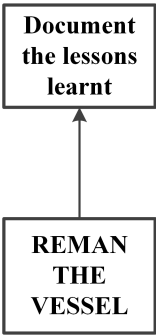


Figure 6.9: Process completion

The final process (see Figure 6.9) in the decision making is remanufacturing the vessel and documenting the lessons learnt for future projects with similar features.

6.2.3 Benefits of Remanufacturing

As discussed in Chapter 3.3.2, remanufacturing brings in certain benefits to the company and the environment. A few of these benefits are identified and illustrated in Figure 6.10.

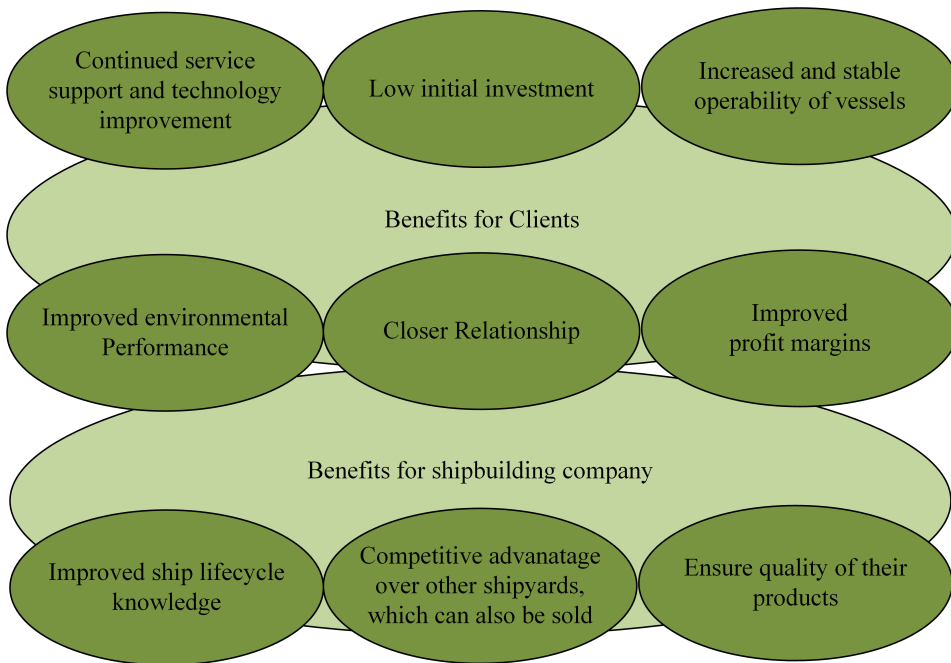


Figure 6.10: Benefits of Remanufacturing

As seen from the figure, the benefits accruing from remanufacturing can be categorized into two different sections, namely, benefits for clients and benefits for the shipbuilding company.

- **Benefits for clients:**
 - Remanufacturing ensures that the client gets continued service support from the shipbuilding company. In addition to this, the process also provides the ship-owner an opportunity to improve or change the existing technology in the vessels.
 - As identified in Chapter 3.3.2, remanufacturing keeps the initial investment lower, as the amount of virgin material required for remanufacturing the vessel would be lower than a new build.
 - Incorporating the vessel with improved technology would ensure its longer and effective operability.
- **Benefits for both clients and shipbuilding company:**
 - As stated in the environmental benefits of remanufactured products, both the client and shipbuilding company improves their environmental performance credentials by investing in the remanufacturing business.

- The process also improves the relationship between the stakeholders as the remanufacturing process demands for good coordination between the shipbuilding company and other involved in the process.
 - Both the shipbuilding company and the ship-owner would improve their profit margin as the remanufacturing process increases the life time of the vessel for the ship-owner, while at the same time provide the shipbuilding company with a new business opportunity.
- Benefits for the shipbuilding company:
 - In order to successfully implement the remanufacturing concept, the ship-builder needs to understand and analyse each phase of the ship right from the first building. This helps them to get an overview of the ship lifecycle and improve their design and operability.
 - Investing in the remanufacturing concept helps the shipbuilding company develop an unique competitive advantage over their competitors, which can be further exploited for business benefits and expansion.
 - Involving directly in the remanufacturing of vessels they manufactured, would help them ensure its build quality and operability. Thus improving their credibility in the industry.

6.2.4 Challenges for remanufacturing

As mentioned in the preceding section, remanufacturing is beneficial to both the client and the shipbuilding company in various dimensions. However, introducing the concept in the shipbuilding industry is likely to be met with certain challenges. Some of those challenges were identified and are as follows;

- Accessing the product details will be difficult for the shipbuilding company if they were not the original manufacturers of the vessels being remanufactured.
- Developing a proper pricing model for the remanufacturing process will be challenging as it is a relatively new business area in the industry. This could be further difficult as unlike new building, there can be more uncertainties while remanufacturing the vessel.
- Establishing a reverse supply chain for the vessels and also ensuring the quality of cores will be troublesome and resource intensive in the initial phases.
- Identifying a suitable core for the remanufacturing process at the right time will be challenging, if there are no existing support infrastructure unlike the case of ship recycling. The latter has an established logistics network in many parts of the world.

6.3 Summary of discussion and analysis

The chapter which was broadly divided into two parts discussed and analysed the empirical findings presented in Chapter 5 in part 1. Further, part 1 of the chapter also correlated these findings to the literature discussed in Chapter 3, with through a mind mapping activity. The results of this activity were also illustrated and discussed in details. The concept of remanufacturing, that was found to be an effective strategy from the mind mapping activity was presented in the part two of the chapter. Further, a decision making process for implementing remanufacturing in the shipbuilding industry along with its benefits and challenges were also illustrated and discussed in detail.

Conclusion

With high production costs and dropping oil prices taking a toll on it's order books, the Norwegian shipbuilding industry is currently sailing through rough waters. Stiff competition from low cost shipbuilding nations and stringent environmental regulations has made the industry's efforts to stay afloat even more challenging. It is in this scenario that this thesis work embarked on a research voyage driven by two goals, namely,

- To study and analyse the strategic thinking process and the role of sustainability in it in the Norwegian shipbuilding industry; and
- To analyse and suggest an innovative production concept that would be able to improve the sustainability performance of the company.

The research work strived towards it goals through a series of case study methodologies including interviews, literature review and questionnaires among others. The findings from these were presented, discussed and analysed in detail in Chapters 3, 5 and 6. This concluding chapter of the thesis report, correlates and evaluates the findings of this thesis with the research questions presented in Chapter 1.3. Further, it also reflects upon the choice of research methodology, implications of the findings presented in this report and possible future work.

7.1 Research Questions

Each research question and its corresponding findings from the thesis are presented in the following sections.

7.1.1 Research Question 1

What is the strategic thinking process in the Norwegian shipbuilding industry?

The first research question was formulated to find out the existing strategic thinking process in the Norwegian shipbuilding industry. As presented in Table 6.1, the interviews carried out with two case companies and a couple of academicians reveal that the industry is seldom driven by stated strategies, but are rather dogmatic in their approach to business and market conditions. The industry has over the years changed and adapted itself to the ever-changing market scenarios. The shifting customer base and client preferences have been well reflected upon in their business models. Instead of focussing on a particular strategy, the companies in the industry have ensured that their activities were always in alignment with their stated mission and vision.

To borrow the words of Mintzberg (1994), strategic thinking in the industry has always been characterised by intuition and creativity, the outcome of which has been an integrated perspective of the enterprise rather than a '*precisely articulated vision of direction*'. Strategic management tools such as Porter's 5 forces, PESTEL, etc., though widely used, are just aids to improve the clarity in the company's thought process. Thus to conclude, the strategic thinking process in the industry is all about a perfect mix of market demand, intuition and strategic management literature, though more about the first two than the latter.

7.1.2 Research Question 2

How has the focus on sustainability issues affected the strategic thinking in the industry?

As the findings of this report suggests, answering the second research question turned out to be a more challenging task. This was mainly because most activities aimed at improving the sustainability performance of the company were either not explicitly stated or were an added advantage from another cost cutting or efficiency improving activity. However, the interviews revealed that both the companies were committed to a better environment and working space at their facilities. Their interest in pursuing various sustainability initiatives such as UN Global Compact, green technology etc. are examples of this.

For streamlining the analysis process, the thesis had identified three sustainability issues, namely economic, environmental and work conditions. The discussions show that of these three, economic sustainability was of prime importance to the company, followed by environmental. The sustainability issue of healthy and safe working condition was however less stressed upon in the discussion. This is because the stringent labour laws and good work culture in Norway has ensured that working conditions in the country is above par, compared to other shipbuilding nations. Thus to conclude, the increasing focus on sustainability issue has impacted the strategic thinking in the industry to some extent. The industry evaluates the sustainability impact of its activities, but however a genuine interest to pursue sustainability issues is found to be still lacking the vigour it demands.

7.1.3 Research Question 3

What practical step can augment the sustainability efforts of the Norwegian shipbuilding industry?

The final research question has been the most inquisitive and demanding of all the three. Identifying and analysing a practical step needed a good understanding of the industry's needs, preferences and area of interests. The findings of the interviews showed that the industry has always preferred a practical approach to sustainability issues, which in addition to being a goodwill gesture to the environment also reaped financial benefits for the company. Responses from the industry also points towards a clear interest in cost reducing and efficiency improving activities. Further, the academicians hinted at the need of decision making frameworks to aid strategic thinking in the industry.

These ideas were brought together to analyse the possibilities, which are illustrated in Figure 6.1. As shown in the figure, the concept of remanufacturing was chosen for further research, as this was both novel and apt for the industry. Further, various aspects of a decision making process needed to integrate remanufacturing into the company was identified, analysed and presented in a flowchart model (see Figure 6.3). Thus to conclude, the most practical step in the industry to improve sustainability performance has been innovative production concepts that is both cost reducing and environment friendly, for which remanufacturing has been identified as feasible solution.

Nevertheless, the author experienced that the triangulation of ideas (Yin, 2009), between sustainable strategy and the remanufacturing concept was a challenging endeavour in this thesis. This was primarily because of the differing dimensions of strategy and the concept of remanufacturing. However, as seen, the author has strived to develop the aforementioned framework in order to facilitate this process. This framework, as mentioned in Chapter 6.2, would be a good foundation for a shipbuilding company intending to make a well calculated strategic decision on remanufacturing vessel if they consider remanufacturing as a possible sustainable business area.

7.2 Implications

The following sections explore the implications of the results and discussions presented in this thesis for both the industry and academic research.

7.2.1 Implications for the shipbuilding industry

The strategic decision making framework presented in this report and the discussions presented along with it points at the following major implications for the shipbuilding industry:

- The empirical findings of the thesis provides a good point of departure for the industry to explore future sustainable business areas to improve and increase their profit and environmental performance credentials.
- The decision making framework presented here could be further developed to study and implement the idea of remanufacturing in the industry.
- Implementation of the concept of remanufacturing would necessitate changes both in the design and project management departments of the industry. This would give an opportunity to the company to evaluate and enhance their in-house operations and capabilities.

7.2.2 Implications for academic research

As in the case of shipbuilding industry, the findings of this thesis is also observed to have certain implications on academic research. Some of those are:

- The concept of remanufacturing is still new in the shipbuilding industry and the concept has been applied in the industry to some extent under different terminologies such as refitting and reconditioning. Therefore the academic research can strive on arriving at a common terminological basis for the concept. This would both expedite the communication process with the industry on remanufacturing and also remove the possibility of mis-communication.
- The decision making framework described in Chapter 6.2 can be further built upon to reflect the decision parameters of both the shipowners and suppliers of components for the shipbuilding company.
- As mentioned in the preceding subsection, the remanufacturing concept would bring about changes in the company implementing it. Therefore, it would be interesting to study these changes and the subsequent course of action from an academic perspective.

7.3 Choice of research methodology

This thesis work widely used the case study method elaborated by Yin (2009). And, to its merits, the thesis was able to achieve all its stated goals. However, reflecting upon the choice of research methods, the author finds it imperative to comment that the depth of analysis in some sections of this report could be augmented with the aid of additional methods. Usage of surveys to elicit response on the framework presented in Figure 6.3 is a case in point. These were not further pursued due to resource constraints in the thesis work.

7.4 Future research

The study revealed that there is a strong emphasis on strategic thinking in the industry, which however to a large extent is devoid of plans to be more environmentally responsible. The reasons for which, the author observes are multidimensional and also dependent on the other stakeholders in the industry. Therefore it would be highly beneficial for the Norwegian maritime industry if a wider study encompassing all the stakeholders including the shipbuilding industry is carried out. Such a study would be able to bring in various perspectives and reasoning on the topic, facilitating a holistic analysis.

Further, the author believes that remanufacturing decision making framework presented in this thesis has a great potential of success in the industry. Due to resource constraints, the framework could not be tested in an actual industrial setting. There are well documented analyses on the environmental performance of remanufactured goods in other industries such as automotive and electronics (Kim et al., 2008; Schau et al., 2012; Smith and Keoleian, 2004). A detailed study on the environmental performance of remanufactured ships would increase the credibility of the concept in the industry.

All these aforementioned suggestions need a great amount of commitment from the industry for academic research. The Norwegian maritime industry has always been a great supporter of research in this field. Therefore this thesis would like to conclude on a highly optimistic note that the concept of remanufacturing as a sustainable strategy presented in this report would pave way for greater research initiatives in the Norwegian maritime industry.

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Appendix A

Terms and Definitions

- NO_x Fond : The NO_x Fond is supported by 15 partners from the Norwegian Industries. It is aimed at reducing the NO_x emission from the industries in Norway by providing financial assistance to technologies that contribute to the cause.
- Porter's 5 Forces : Porter identifies 5 forces that embodies the rule of competition in any industry. They are the entry of new competitors, the threat of substitutes, the bargaining power of buyers, the bargaining power of suppliers, and the rivalry among the existing companies. (Source : Wit and Meyer (2010))
- Return on Equity : Return on equity measures a corporation's profitability by revealing how much profit a company generates with the money shareholders have invested. (Source : Investopedia)

Appendix B

Interview Guide

Case Company A

Preliminary Information

Date : 20 March 2015

Time :

Interview type : Semi-structured

Interviewer : Faheem Ali

Participants : Deputy Director, Senior Business Analyst, Manager Planning Department

Questions

General Strategy

1. Strategic thinking and strategic analysis plays an important role in any business. How has the concept evolved in the Norwegian ship industry, especially in from a shipyard perspective?
 - (a) Has it always been an area of prime focus or did it gain importance during the troubled economic times as the mid-1990s in Norway.
 - (b) Has the strategic thinking undergone any changes in the present market situation where offshore vessels take up a major share of the vessels manufactured in Norway and is highly reliant on the oil prices?
2. What procedure due you resort to, when initiating any strategic changes at your company?
 - (a) Which stakeholders are consulted during the decision making process?

-
- (b) Who are involved in the strategy implementation stages?
3. What are the prime elements in the company's value chain?
- (a) How does sustainability feature in it?

Sustainability in Strategy

4. There has been an increased focus on sustainability in the recent times in shipping industry. The ECA regulations, ship recycling issues etc. What do you identify as the major sustainability issues you face as a shipyard?
5. How have these issues and efforts to mitigate them affected your strategic thinking, can you elucidate some examples from recent times?
6. The most aired opinion about sustainability and strategy in academic circles is that, in a profit driven industry such as shipping, the attractiveness of sustainable alternatives is closely linked with profit from it. What is your take on it?
- (a) If the case is true in your experience, what are your suggestions on things that could be done from a shipyard perspective to change the shipowners' decisions to be more environmentally responsible?
- (b) Could you mention some examples where you have succeeded and where you have not?
7. Do you rely on some analytical framework for analysing various business possibilities at your company? Do you have a systematised method while re-framing your strategies?
8. What are the disadvantages (shortcomings) that you have experienced in these frameworks? Do they miss out on certain dimensions of analysis?
9. Strategic management literature has frameworks with respect to emphasis on both profitability and environment friendliness in a business. The natural resource based view for example, which has three components:
- Pollution prevention – reducing emissions
 - Product stewardship – selecting materials and production methods to minimize wastage
 - Sustainable Development – minimize burden of the firm's growth and development on environment

How would you classify your activities under these headings?

10. Government aid and support has driven shipyard industries around the globe for a large extent, with case of Norway being an example. Do you think strategies incorporating sustainability thinking need government aids to be successful? (Case: NOx Fundet, ENOVA)

-
- (a) LNG powered ships in Norway is to a large extent dependent on NOx Fondet, do you see a future for LNG, in a scenario where the Funding stops?
11. What are the various strategic/business model options your company is currently looking at in the current market scenario?
- (a) How important is sustainability in choosing one of these options?
- (b) Has sustainability gained increased focus in recent years?

Project management

12. Any change in strategy requires a change in the operations and focus areas of the firm, has these aforementioned changes in strategy necessitated a change in the project management methods at your company? If so, how? Can you elucidate some of these changes?
13. Norwegian shipping were famed for its specialized ship products and customized designs, but there has been a shift towards catalogue ships and modular building in recent times, has this shift caused changes in your project planning stages/methods? How?
14. Your company has been in the forefront in successfully experimenting various initiatives in the Norwegian ship industry, Lean production being one for them. How has been the experience with lean production at your company? Do you think it has contributed to your sustainability goals in strategy?
15. Lean production has a significant role in being sustainable, but on the other hand it demands a lot of planning resources to be effective, how would specialised orders and customised products benefit from lean production?
- (a) A distinctive feature of Norwegian shipyards being last minute flexibility in product specification. How have you been able to maintain that feature despite being lean focussed, as the latter demands last minute changes and instant decisions?

Summing up

16. What do you think is the way forward for the Norwegian shipyards? Will it have to rely on government funding initiatives such as Enova and NOx Fondet, or move production abroad in order to remain competitive in the world market?
17. If the latter is a more likely possibility, how do you plan to sustain the local competence and strong cluster nature of the industry, as moving production abroad or relying on design sales would lead to erosion of certain competences that you have developed over the years?

Case Company B

Preliminary Information

Date : 25 February 2015

Time :

Interview type : Semi-structured

Interviewer : Faheem Ali

Participants : CEO

Questions

1. Strategic thinking and strategic analysis plays an important role in any business. How has the concept evolved in the Norwegian ship industry, especially in from a shipyard perspective?
 - (a) Has it always been an area of prime focus or did it gain importance during the troubled economic times as the mid-1990s in Norway.
 - (b) Has the strategic thinking undergone any changes in the present market situation where offshore vessels take up a major share of the vessels manufactured in Norway and is highly reliant on the oil prices?
2. Can you mention some of the major changes in business models among the Norwegian shipyards?
 - (a) What have been these changes in the more specific context of your company?
 - (b) How has your company re-positioned itself over the last 2 decades in changing external environment?
3. What procedure due you resort to, when initiating any strategic changes at your company?
 - Which stakeholders are consulted during the decision making process?
 - Who are involved in the strategy implementation stages?
4. How has focus on sustainability and environmental friendly operations influenced these changes? For example:
 - Lean Production
 - ISO Certifications
 - Regulatory authorities IMO, NMA

-
5. Any change in strategy requires a change in the operations and focus areas of the firm, has these changes necessitated a change in the project management methods at your company? If so, how? Can you elucidate some of these changes?
 6. What has been the attempts made by companies to incorporate the strategic thinking idea in their business model?
 7. Do you rely on some analytical framework for analysing various business possibilities at your company? Do you have a systematised method while re framing your strategies?
 8. If you suggest an analytical framework for the process, what factors do you consider important to be included in it? For example
 - BCG Matrix
 - SWOT Analysis
 - Porter's 5 forces etc
 9. In one of your earlier interviews with a news portal, you opine that LNG bunkering holds a great potential for the future of shipping. You also list some advantages of the same. Has these findings caused a change in focus areas at company? If so, what are they?
 10. LNG powered ships in Norway is to a large extent dependent on NOx Fondet, do you see a future for LNG, in a scenario where the Funding stops?
 11. What do you think is the way forward for the Norwegian shipyards? Will it have to rely on government funding initiatives such as Enova and NOx Fondet in order to remain competitive in the world market?
 12. What are the various strategic/business model options your company is currently looking at in the changed market scenario?
 - (a) How important is sustainability in choosing one of these options?
 - (b) Has sustainability gained increased focus in recent years?

Academicians

1. How has the concept of strategic thinking evolved in the Norwegian shipbuilding industry?
 - (a) What has been the major drivers of strategy?
 - (b) What other external factors have influenced and supported these changes?
2. What has been the major changes in the business strategies of the industry in the last few years?

-
3. How has focus on sustainability affected these changes?
 4. Does sustainability gain a prime focus on while deciding upon the strategies? Can you mention some examples from your research experience?
 5. What kind of frameworks has your contacts in the industry resorted to while analysing and deciding upon these strategies?
 6. Has sustainability been featured as criteria in these frameworks?
 7. What has been the most practical approach by the industry and other agencies striving for a better environmental performance in the industry?
 8. What do you think is the way forward for the industry both strategical and in sustainability issues?

Appendix C

Conference Paper

Remanufacturing as a sustainable strategy in an Engineer-to-Order (ETO) environment

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Abstract. Shipbuilding industry in Norway, mainly operating in the Engineer-to-order environment, is one of the most innovative in the world in terms of technology and production methods. In this paper we investigate the applicability of the concept of remanufacturing in the industry. The research takes a case study approach to study the topic and also presents an overview of the existing literature on remanufacturing and its benefits. A five stage decision making framework is proposed for integrating the concept of remanufacturing into the strategic thinking process of shipyards.

Keywords: Remanufacturing, shipyard, sustainability, engineer-to-order, strategy

1 Introduction

Environmental friendliness and sustainability initiatives have become a prime focus in all industries including shipbuilding. The industry (an example of a typical ETO environment) has witnessed a number of strategic changes to incorporate these initiatives, such as life-cycle focused ship building, lean construction methods, less polluting fuel etc. [3, 14]. Despite a growing concern about the being green in shipbuilding, investing in such solutions has been considered to be less profitable from the strategic viewpoint of a company, and the original focus on environment friendliness gets reduced to complying with the regulations [4].

However end-of-life strategies such as the concept of remanufacturing have given us real life examples of being both profit making and environmental friendly. Though backed by industrial results and academic research [11, 13] in various industries the concept is yet to be widely accepted and adopted in the shipyard industry. This paper aims at putting forward the remanufacturing concept as a sustainable and viable business strategy for the shipyard industry.

1.1 Literature Review

1.2 Strategic thinking in literature

Definitions on strategic thinking vary to a great extent in academic literature. According to [8], strategic thinking is a specific management activity whose aim is “to discover novel, imaginative strategies which can rewrite the rules of the competitive game; and to envision potential futures significantly different from the present”.

There are two prominent views on the topic. Firstly by [15] who distinguishes strategic planning from strategic thinking, according to him, the former is more analytical and an act of strategic programming while the latter is about synthesis of strategies, which involves intuition and creativity. The second view on strategic thinking consider it as a set of analytical techniques for developing strategy [15, 17]. According to [16] strategic thinking involves asking two critical questions, firstly on the structure of the industry and its likely direction of evolution in the future. The second question pertains to the companys relative position in the industry. Academic research [6, 7, 18].

1.3 Remanufacturing

Remanufacturing is ‘the process of returning a used product to at least OEM original performance specification from the customers’ perspective and giving the resultant product a warranty that is ‘at least equal to that of a newly manufactured equivalent’ [9]. The first known application of the remanufacturing process was from the ship industry in the year 1861, where a steam frigate was transformed into an ironclad ship [12].

Remanufacturing is different from recycling as the latter involves the collection, extraction and processing of component materials into the same product or a useful degraded material [11]. Thus remanufacturing is more environment friendly, as it minimizes the use of lesser virgin material, energy and has lesser material processing.

Integrating the concept of remanufacturing in the business strategy is further more important as it facilitates the designing of the process and supply chain related to the remanufacturing activity. Further remanufacturing does not hamper innovation as remanufactured products can incorporate innovative solutions in it [4]. These factors make it a suitable for the shipbuilding industry, which mostly has ETO products.

Remanufacturing is already in practice in a number of industries such as the automotive and aerospace industries [5]. Further in contrast to other secondary market or used products, remanufactured products are characterized by better reliability and quality because the remanufacturing process involves the complete disassembly of all the components in the product and restoration and replacement where needed [13]. In addition to this, remanufacturing is an environment friendly alternative as it saves energy required for the production of a new product from the scratch and also reduces the demand for recycling and new parts [19].

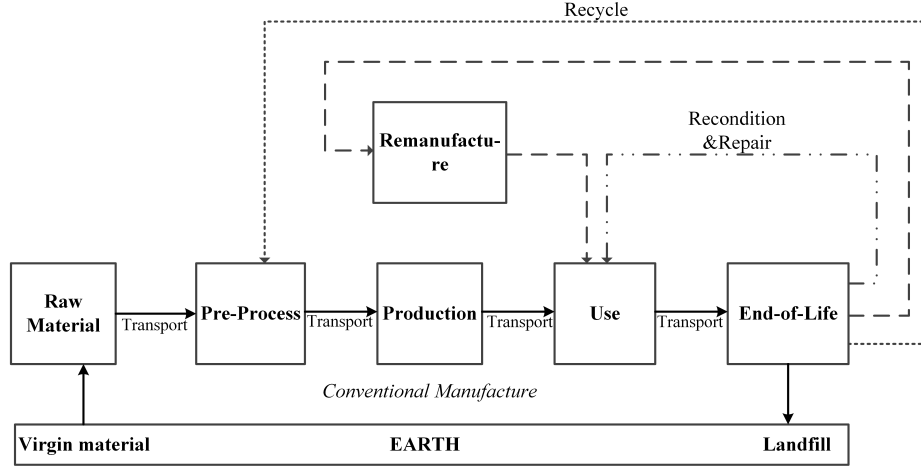


Fig. 1. Remanufacture concept and significance (Adapted from [10])

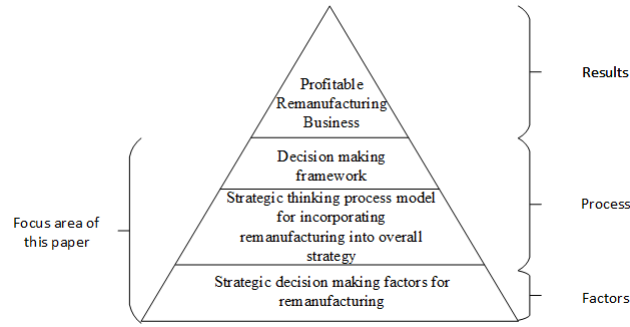


Fig. 2. Remanufacturing decision making framework and focus area of the paper (Adapted from [20])

This paper focusses on the last stage of the framework in Figure 2, i.e decision making factors that need to be analyzed while adopting the remanufacturing philosophy into the shipyards overall strategy.

2 Research Methodology

A case study method was preferred because of two reasons, firstly the research focussed on the how and why areas of the topic. And secondly, the investigators had little control over the events and the focus in strategic thinking is always on the con-temporary activities in the company. The article draws on information collected from a few of these sources, namely interviews, formal discussions and

literature review, which belong to the six sources of evidences for a case study [21].

A literature review on the topic aimed at providing a brief yet comprehensive understanding of the existing academic research in the area was carried out. For the interviews, semi-structured style was preferred as it provides more flexibility to both the interviewer and interviewee develop ideas and questions more widely on the is-sues raised in the research [1]. The interview process is summarized in the Table 1 below.

Table 1. Interviews overview

Type of In- terview	Respondent position in the organization	Number of formal interviews	Number of Informal interviews
Case Com- pany A			
Face to Face	Deputy Managing Direc- tor	1	-
Face to Face	Manager Planning De- partment	1	1
Face to Face	Senior Business Analyst	1	1
Case Com- pany B			
Face to Face	CEO	1	-
Telephonic	Sales Director	1	1
Academicians			
Face to face	Programme Leader	2	1
Telephonic	Research Scientist	2	-

2.1 Research Questions

This research aimed at studying the applicability of the concept of remanufacturing in Norwegian shipyards and how the concept can be incorporated in the strategic thinking of the industry.

2.2 Case companies

The case companies selected for the research were two Norwegian shipyards who have been in the shipbuilding business for more than 100 years. The following table provides an overview of the case companies.

3 Findings and Discussion

The interviews with both the companies were carried out based on a similar interview guide, where minor changes were made to the questions to include the

Table 2. Case companies overview

Case pany	Com-	Company A	Company B
Size (Employ- ees)		800-1000	200-300
Customer base		Worldwide	Mostly European clients
Major compe- tencies		Design and customized offshore vessels	Alternate fuel powered and hy- brid vessels
Business areas		New Building, Designs	New building and repairs
Project folio	Port-	Offshore	Ferries and Cargo

different business models and operating markets of the companies. The major findings from the interviews are summarized in the Table 3.

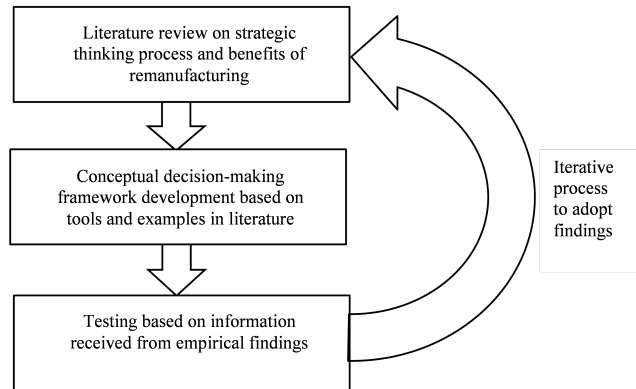
The specific findings of this paper based on the evaluations of the case study include:

- Both the case companies are yet to study the business and engineering potential of remanufacturing of ships. This can be considered to be the general situation for all Norwegian shipyards, where is there a clear untapped potential for remanufacturing process.
- Case company B was found to be more pro-active to pursue environmental friendly solutions and considered it as competitive advantage, while case company A was more reactive in nature and were complying with regulations. Company B also had some experience of refitting the hull of a ferry into a bunkering barge, which can be compared to the remanufacturing process.
- IMO regulations and environmental benefits accruing from remanufacturing can have a positive impact on the business potential of remanufactured ships.
- Integrating remanufacturing strategies into the overall business strategy should be aided by a decision making framework that would help the companies evaluate alternate options to remanufacturing. The methodology used for developing the framework (Figure 4) is shown in Figure 3.

The proposed framework is divide into five different stages. The first stage analyses if a remanufactured ship can meet the requirements of the new order, which proceeds to the second stage where the compliance of the approach with the overall strategy of the shipyard is tested. Stage three in the framework checks for the environmental performance of the ship as the common concern about remanufactured product is its below par environmental performance compared to a virgin product. The final stage looks into the cost benefits accruing from the project, based on the resources available for executing the project. The framework could proceed itself for other similar orders.

Table 3. Summary of findings from the case study

Case	Company A	Company B
Sustainability vision statement	in Sustainable maritime future	Focus on renewable energy
Strategy formulation	Standard frameworks such as Porters 5 forces, PESTEL	Standard frameworks such as Porters 5 forces, PESTEL
Recent strategic changes	No major changes since the last decade, but adapted to changing market situation	In a phase of strategic realignment and analysis options such as partnership with foreign shipyards
Clear sustainability Strategy	Sustain- Present Indirectly Focus in	Present indirectly
View on Production Method	Lean Have successfully employed the lean production method and has own framework	Critical about the applicability of lean in their shipyard, given their mixed ship portfolio
Solution for a sustainable future	More efficient and less costly ships with increased ROI	Environment friendly technologies such as LNG, Hybrid vessels
Concept of re-manufacturing	Not yet considered	More proactive compared to company B. Though the complete potential is yet unexplored

**Fig. 3.** Methodology used to develop the framework

The description for each decision stage in the framework is as following:: 1. Is remanufacturing a financially viable approach? 2. Is the existing design of the core designed to be remanufactured? 3. Are any alternate solutions available? 4. Is it compatible with the current business strategy of the firm? 5. Can the business strategy be modified? 6. Does the changed business strategy align with the stated mission and vision of the firm? 7. Does the company have necessary resources to execute the project? 8. Can the missing resources be acquired at an affordable rate? 9. Will the remanufactured product comply with existing and future environmental regulations and standards? 10. Will it comply with the existing standards and regulations? 11. Can improvements be made to the product to ensure compliance? 12. Has the company established local facilities and communication channels to in order to coordinate the activities with the stakeholders? 13. Is the company working in a business environment that supports and promotes remanufacturing?

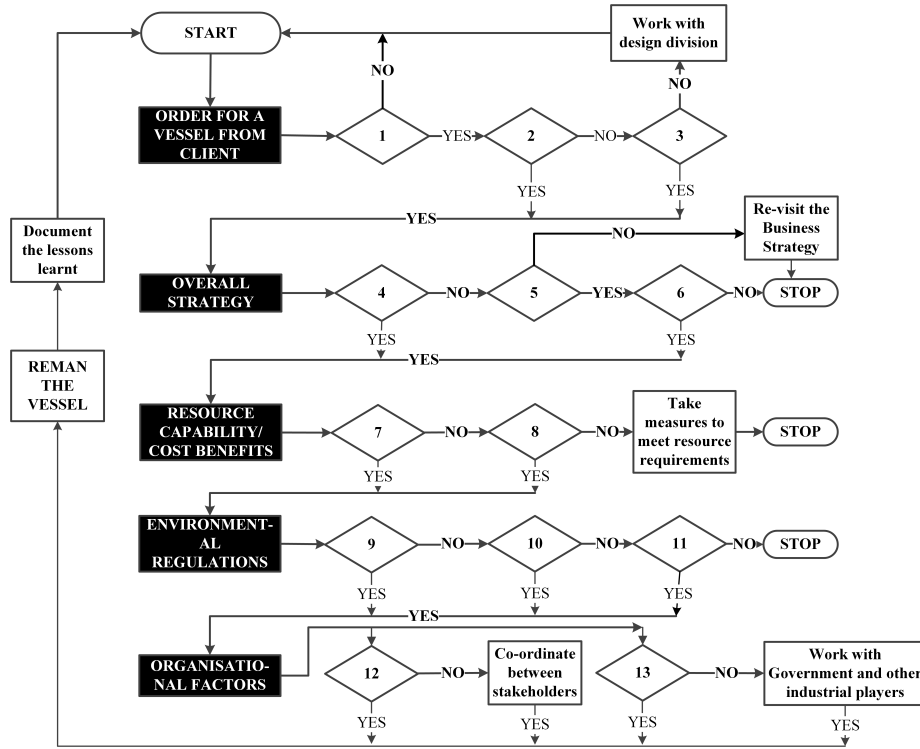


Fig. 4. Framework for integrating remanufacturing into the strategic thinking process (Based on the framework tool in [2])

4 Conclusion

The literature on remanufacturing and strategic thinking in niche industries is vast and well documented. However, there seemed to be an evident gap on the applicability of remanufacturing concept in the ship industry. This research studied the usage and presence of the concept in the Norwegian shipyards and analysed its feasibility in the industry. The case study results showed a great potential for remanufacturing strategies in the shipyards. As a result the paper proposes an eight stage framework that would aid the shipyard in integrating the remanufacturing concept into its strategic thinking process while evaluating the likely course of action for a new ship order.

The further research in the area could include the real life testing of ships based on results from environmental performance and cost benefit analysis tools.

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