



**LUND UNIVERSITY**

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**Master programme in Economic Growth,  
Innovation and Spatial Dynamics**

## **The Dynamics of the Norwegian Maritime Industry**

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*Abstract:* What are the dynamics of the Norwegian maritime industry that have allowed Norway to be top competitor in the world maritime industry? Dynamics such as history, innovation, clusters, and institutions are visited through a multidisciplinary approach in order to provide a complete picture of Norway's maritime industry. Furthermore, the Norwegian maritime industry has one world's highest cost of labor and a strong regulatory regime, yet the industry is the third largest in the world. The thesis aims to provide insights into how and why Norway has become a world maritime leader. It is hypothesized that because of high wages and strong regulatory system in Norway there is an intensive "creative destruction" process creating incentives to innovate; hence, leading to economic growth in the Norwegian maritime industry.

*Key words:* Innovation, Economic growth, Institutions, Maritime, Clusters, Norway

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## **Chapter 1: Introduction to the Thesis**

Norway has a long tradition of maritime activities going all the way back to the Vikings. Since, the nineteenth century Norway has been one of the largest maritime industries in the world. However, how has Norway been able to compete with high cost of labor, strong regulatory regime, and increased competition from East Asia with low cost of labor and weak regulatory regime? This thesis offers insights into how and why this is possible through understanding the dynamics of the Norwegian maritime industry. Therefore, the thesis uses Joel Mokry's multidisciplinary approach to present the four dynamics of the Norwegian maritime industry: (i) a historical exploration focusing on the development of the industry; (ii) a study on innovation in the maritime sector (iii) cluster investigation and development; (iv) a study on informal and formal institutions. These four studies provide the dynamics that formulate the maritime industry.

### **1.1 Previous Research**

Previous research into the Norwegian maritime industry is usually one-dimensional, in other words; only one dynamic or focus is usually presented in understanding the evolutionary development of the maritime industry such as only focusing on cluster development. This thesis will present multiple dynamics, such as historic evidence, innovation process theory, cluster development theory, and institutional theory, which suggests a co-evolutional process in the industry.

### **1.2 Research Question**

The research question is: *“What are the dynamics of the Norwegian Maritime Industry that have allowed Norway to be a major player in the world maritime industry?”*

### **1.3 Hypothesis**

High cost labor and a strong regulatory regime in Norway's Maritime industry provides for an intensive “creative destruction” environment, which in return creates innovation and growth for the Maritime Industry in Norway.

### **1.4 Demarcation**

The study will provide insights into four different dynamic's of the Maritime industry in Norway; however, the study will not cover the micro dynamics of the industry such as firm level subjects and entrepreneurship. The purpose and aim of the study is to provide

insights and to explore the Norwegian maritime industry, not to investigate the micro-economic dynamics, but gain insights through macroeconomic study.

## **Chapter 2: Methodology**

### **2.1 Research Design**

The research question in this study provides direction to the make-up of Norway's maritime industry and the dynamics that are presented within the industry. Thus, for a deeper understanding of the research question a qualitative research method would be more beneficial. A quantitative research method would perhaps not be accommodating as a qualitative study due to the multifaceted nature of this study. Therefore, the thesis contains an exploratory design. The exploratory design offers insights into the Norwegian maritime industry. The exploratory design is a useful method for gaining background information along with providing flexibility. Moreover, similar to Mokyr's "*The task of theory*", exploratory design allows for different analysis through multiply actors and/or theories (Mokyr, 2005 p.196-7).

### **2.2 Economic History Approach**

Joel Mokyr (2005) provides a diverse approach to economic history through theory-based explanation, evolution, and sources "beyond economics". There are two different theories in which one can investigate economic history: formal and informal theory (Mokyr, 2005). Formal theory however, according to Mokyr misses the key issues and overlooks the overall thesis of economic history. To put it another way, economic history is too big for one formal theory. Therefore, informal theory provides a larger scope to investigate economic history and provides different elements or points of view.

"*The task of theory*" is to make sense of these facts and to help us pick and choose among them"(Mokyr, 2005 p.196-7). "*Economic history can be overwhelmed by facts and data, surrounded by important questions of how and why. Theory builds the connection. But there is no single theory that can possibly do that*" (Mokyr, 2005 p.196-7). Therefore, one must take account for both internal and external factors. Looking beyond economics (external) to examine economic history is key for looking for better

theoretical support. Thus, by providing an informal theory to this study it will provide a more dynamic and useful approach to understanding the Norwegian maritime industry.

### **2.3 Secondary Data**

The thesis consists of secondary data information received from different sources. To provide some analytical perspective of the maritime industry in Norway, statistical data from Lyold's Marine Database, SSB (Statistics Norway) and The Norwegian Shipowners' Association (*Norwegian: Norges Rederiforbund*) have provided useful information for the thesis. In addition, scientific research papers in the related topic — clusters, innovation systems, institutional, history — have been beneficial sources of information. In addition, web pages and industrial associations have been advantageous in the development and analysis of the thesis.

## **Chapter 3: Theoretical Background**

The theoretical foundation of this thesis is multifaceted. First, a historical perspective will be presented of the Norwegian maritime industry to provide relevant insights into the development of the Norwegian maritime industry. Second, this section will introduce the relevant innovation theories for the thesis, thereby introducing Schumpeter's insights into innovation and evolutionary theory. Third, cluster formation theory and sectorial and regional innovation systems will be explored. Last, New Institutional Economics will be investigated from the acumen of Douglas North. The reason for these multifaceted and partly overlapping theories are the differences they present and the role that each plays in development of a strong maritime industry in Norway.

### **3.1 Innovation**

An important factor in understanding innovation and economic growth is through Schumpeter's research. The studies based on innovation are directed towards the innovation processes and its relationship to economic growth — in this case Norway's maritime sector. Schumpeter (1943), presents that economic development is a process of qualitative change prompted by innovation. Examples of innovation processes are the exploitation of new markets, new sources of supply, new methods of production, new products, and new ways to organize business (Schumpeter, 1943).

However, the main point of his theory is that he defines innovation as “new combinations” of existing resources for successfulness of innovation and economic growth. Therefore, he argues, creative destruction is the essential fact for economic growth (Schumpeter, 1943). The process of innovation is key within the maritime industry as the industry is always evolving through “creative destruction” process and thus the industry is creating new means of production and new products in order to compete with competition.

In addition, Schmookler (1966), emphasizes that there should be a distinction between *product technology* and *production technology*, which presents different natures of economic growth. Thus, terms such as “product innovation” and “process innovation” present different aspects of economic growth. New products may have clear, positive effect on growth; however, the process of innovation due to its “cost-cutting” features may have a more notable effect on economic growth; which, can be seen with in the Norwegian maritime industry due to high labor cost. Therefore, the process of innovation becomes a more important factor for growth and staying competitive in the industry (Schmookler 1966). Nevertheless, what is innovation? It follows, then that there must be a consequential distinction made between invention and innovation. Invention is the first happening of an idea for a new process and/or product; while, innovation is the first attempt to carry the invention into practice (Fagerberg, 2005).

Moreover, another important aspect is classifying innovations according to how radical they are compared to current and trending technology. Therefore, continuous improvement can be referred to “*incremental*” or “*marginal*” innovations, as opposed to “*radical*” innovations (such as the introduction of a totally new type of machinery) or “*technological revolutions*” (consisting of a cluster of innovations that together may have a very far-reaching impact) (Fagerberg, 2005). Schumpeter believed that the cumulative transformation of incremental innovation could be great if not greater than the initial invention. For example, Kline and Rosenberg (1986) point out:

*it is a serious mistake to treat an innovation as if it were a well-defined, homogenous thing that could be identified as entering the economy at a*



*precise date—or becoming available at a precise point in time.... The fact is that most important innovations go through drastic changes in their lifetimes—changes that may, and often do, totally transform their economic significance. The subsequent improvements in an invention after its first introduction maybe vastly more important, economically, than the initial availability of the invention in its original form (Kline and Rosenberg 1986: 283).*

In other words, Kline and Rosenberg (1986) point out that the invention becomes more important overtime through incremental innovations taking place as the initial creation may not have influential power in the economy as much as its development over time. Consequently, there can be long time lags between the invention and innovation, a lag could last several decades due to institutions, social-economical situations, etc. Furthermore, these long lags between invention and innovation can be due to a lack of sufficient materials, production skills, capital, and/or a power source. One of the elements with-in the innovation dynamic of Norway’s maritime is the dominance through incremental innovation and economic evolution of ships and maritime products helping to breaking out of path dependency and lock-in. Incremental innovation in the industry has provided for economic growth and evolution both in “product innovation” and “process innovation”.

### **3.1.1 Innovation and Economic Growth**

Two major approaches have surfaced throughout time to analyze the relationship between technology (innovation) and growth (economic growth). One is the neoclassical approach and the other neo-Schumpeterian or evolutionary approach. Neoclassical approach is composed of a homogenous set of sub-approaches. On the other hand, the evolutionary approach includes informal model as well as historical approaches (Verspagen 2005). The two approaches stress the importance of innovation and technology for economic growth, but are at odds with the behavioral foundations of innovation and growth. For instance, neoclassical theory involves a notable amount of realism in the innovation process; hence, quantitative approach. Whereas, evolutionary approach embraces both macro and micro-complications of the innovation process; therefore, applies an eclectic approach (Verspagen 2005).

### 3.1.2 Evolutionary Process

The evolutionary theory is two-fold approach in terms in its relation to economic history (Dosi et al. 1988). Evolutionary theory puts emphasis on the idea that technological changes are the fundamental driving force of economic growth — as does neoclassical, however frameworks differ. Therefore, the core of evolutionary theory is technological learning and “*qualitative*” changes that drive economic growth (Dosi et al. 1988). There is particular attention given to transformation of innovation and economic growth through endogenous social-economical means. For example, evolutionary approach empathized by Nelson and Winter, (1982) view innovation as path dependent activity by which knowledge and technology are developed through continuous interaction between heterogeneous actors and other factors.

Thus, the structure of such interaction can affect the future path of economic change. As this was the case of the development of Norway’s maritime industry through small scale decentralization in the 19<sup>th</sup> and parts of the 20<sup>th</sup> century; however, the evolution of Norway’ maritime industry in not just a single evolutionary process of technology, but co-evolutionary process; which evolves Norway’s innovation process, institutions and innovation systems – regional and sectorial innovation systems. To give better insights into the evolutionary process one must understand innovation processes.

### 3.1.3 Innovation Processes

The process of innovation is potentially confusing justified by the immense amount of knowledge; thus, this section will provide two general frameworks of the innovation process. First, innovation process involves the exploration and utilization of opportunities for *new* or *improved* processes or services (Keith 2006). In the case of Norway’s maritime industry, the improved and/or new processes are key to the industry in the 21<sup>st</sup> century, compared to 19<sup>th</sup> and 20<sup>th</sup> centuries where new products and technologies were of more importance.

Moreover, *new* or *improved* processes and services are determined by market demand, advancement of technical practice, or perhaps a combination of the two. Secondly, innovation is uncertain, because of the impossibility of predicting cost and performance

of a new product or service. Therefore, innovation process involves processes of learning through either experimental — trial and error — or improved understanding of theory (Keith 2006).

It follows then; innovation can be divided into three overlapping processes.

- *The production of scientific and technological Knowledge:* since the industrial revolution production of scientific and technological knowledge have become specialized, by discipline, by function, and by institutions. Furthermore, historical and social studies have become more important in terms of science, technology, and business as it has contributed considerably to understanding the progression and transformation of innovation (Keith, 2006). This is where history matters in Norway's maritime industry understanding the innovation process through time and space to gain why Norway's maritime sector transformed the way it did and where it could go next.
- *The translation of knowledge into working artifacts:* although scientific knowledge has been recently investigated, theory in general remains somewhat insufficient guide to technological practice (Keith 2006). Norway presents six clusters or innovation systems with over 4000 business producing products and services (Keith, 2006)
- *Responding to an influencing market demand:* this involves a continual process of analogous products and services with users' (customers) preferences (Keith, 2006).

Thus, the scope of the opportunities to transform technological knowledge into useful products and/or services vary between fields over time, which then are determined by the nature of products, users, and methods of production at a given time — lags in innovation due to the means of production and material available (Keith 2006). The next section will discuss the systems of innovation and path dependence; path dependence in Norway's maritime industry is a pivotal point of historical development in the industry as it pertains to the economic evolution and process of the industry.

### **3.2 Systems of Innovation**

This section presents an overview of the systems of the innovation theories. Thus, the section will focus mainly on sectorial and regional systems of innovation and path dependence in relations to the geography and the milieu of innovation, but will also include national systems of innovation. Systems of innovation in general terms are the determinant of the innovation process, which can include economic, social, organizational, institutional, and other factors that influence the development, diffusion and use of innovation. According to Lundvall (1992), *A system of innovation is constituted by elements and relationships, which interact in the production, diffusion and use of new knowledge* (Lundvall 1992, p. 2). This is where “history matters” in the Norwegian maritime industry in regards to its development. Geography and knowledge provide insights into path dependence.

#### **3.2.1 Path Dependence**

In regards to the maritime industry path dependence helps to provide an explanation of technology adoption and industry evolution. Path dependence can be broken down into three parts or phases: contingency, self- reinforcement, and lock-in. First, contingency relates to path emergence and creation. According to Arthur (1986), contingency is the first stage and historical peculiarities or small events matter most. Small events in Norway’s maritime history, such as wooden shipbuilding in the 19<sup>th</sup> century provided for a shipbuilding and a shipping industry.

Phase II is self-reinforcing mechanisms, a pattern or reflection or a build up that reproduces initial decision or set of decisions (Arthur 1986). In other words, a dominant solution emerges. Wooden shipbuilding in the Norwegian maritime industry was a big success; therefore, producing a strong ship merchant fleet – third biggest in the world in the late 19<sup>th</sup> century. However, phase III the path becomes locked-in and distinct character emerges. Norway’s wooden shipbuilding had created a lock-in process, as other maritime industries switched to the steam engine and steal ships Norway remained lock-in to wooden ships; thus, damaging the industry. This created the processes of creative destruction in the industry and transformation occurred in order to save the industry. Furthermore, Bart Verspagen (2006) stresses the importance of path dependence within

the innovation processes that the evolutionary approach emphasizes creation, adaptation, selection, and retention; which, in return gives away to path dependence (Fagerberg, 2006,). However path dependence is based on regional, sectorial, and milieu factors.

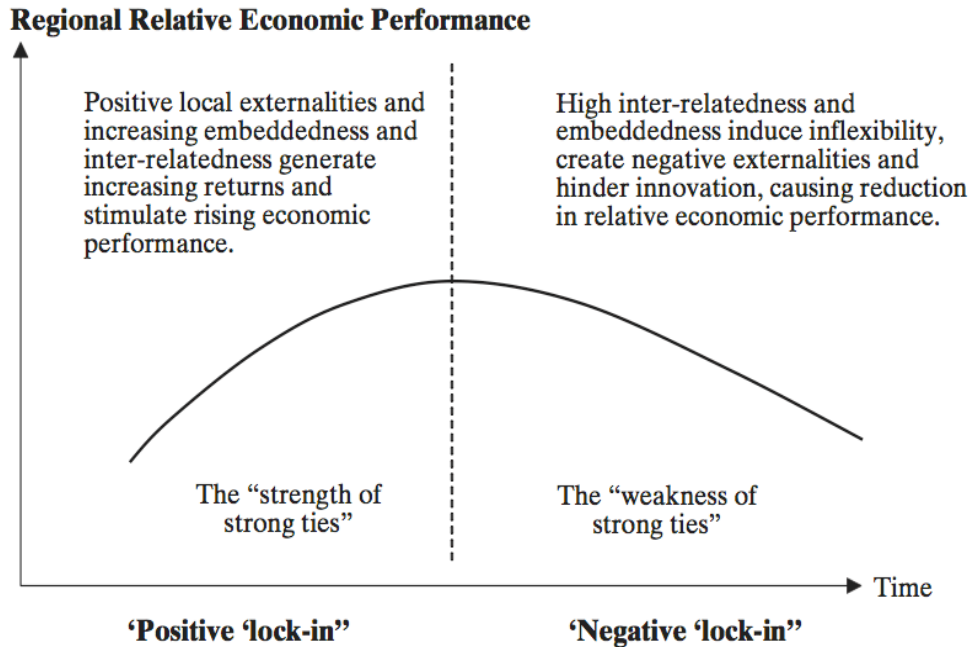
### **3.2.2 Regional Innovation Systems**

Regional Innovation System (RIS) can be defined as “*a system stimulating innovation capabilities of firms in a region so as to enhance the region's growth potential and regional competitiveness* (Isaksen, 2009.).” Moreover, according to Asheim (2002), there are three different types of RISs. The first type is territorially embedded regional innovation systems, which firms base their innovation localized through geographical, social, and cultural proximity (Asheim and Gertler 2005). In other words, this territorial embedded system is a network-based innovation system providing technology centers, ads/or research institution, which in return promotes an “adaptive technological and organizational learning in territorial context” (Storper and Scott 1995: 513).

The second type is the *regionally networked innovation system*. This type incorporates that the firms and organizations are still embedded in a specific region through network-based innovation. Cooke (2001) describes this as network RIS. The network system is a regional cluster of firms surrounded by regional supporting infrastructures. The third type is a regionalized national innovation system. Ideally, this type integrates itself in the industry and institutional infrastructure through a more national and international innovation systems — exogenous actors and relationships play larger role in the region. The regionalized national innovation system lacks a community-based relationship and/or linkages between the communities thus, pursues exogenous actors such as governmental research institutes — science parks.

However, another important part of a regions success is based on the cultural factors of a region. Cooke (2001) stresses the importance of cultural facts that can influence innovation at the regional level. He alludes to these factors as *superstructural* issues that are psychologies among the regional actors — culture of the region. Thus, the culture or the extent of the social community brings about an embeddednes of the region through shard-norms and co-operation, which depicts institutional and/or organizational behavior

and development. In addition, this embedded helps to create the materialization of milieu — social environment — within the networks, which leads to interaction among the community; therefore, bring about innovation (Cooke and Isaksen, 2009).



**Figure 1: Lock-in**

Source: *Source: Benito, G., Berger, E., De la Forest, M. and Shum, J. (2003).*

### 3.2.3 Sectorial Innovation Systems

According to Malerba (2005), Schumpeter also empathized that the evolutionary processes also carried the process across time and economic sectors, in other words, there are also important differences amidst industries and/or technological fields; hence, sectorial innovation systems. It follows then that sectorial innovation systems are distinguished by well-defined knowledge bases, technologies, inputs and a demand. Moreover, sectors are composed of a set of agents such as organizational structure, beliefs, goals and behavior, which can determine and shape path dependence. Thus, sectorial system changes over time through co-evolutionary processes. *“Sectorial innovation system approach adopts a certain technology (spanning multiple sectors) or the sector in which it is used (including various technologies) as their system boundary* (Schrepf, Kaplan and Schroeder, 2013 p.16 ).

Furthermore, particular sectors have different technologies trajectories according to Pavitt (1984) there is a four-fold taxonomy:

- *Supplier-dominated sectors – mostly traditional manufactures such as textiles and agriculture, which rely on outside sources for innovation*
- *Scale-intensive large firms producing basic material and consumer durables such as autos, white goods; sources of innovation are both internal and external to the firm*
- *Specialized suppliers – producing technology to be sold to other firms*
- *Science-based 'high tech' goods which rely on in-house and publicly funded research e.g. pharmaceuticals*

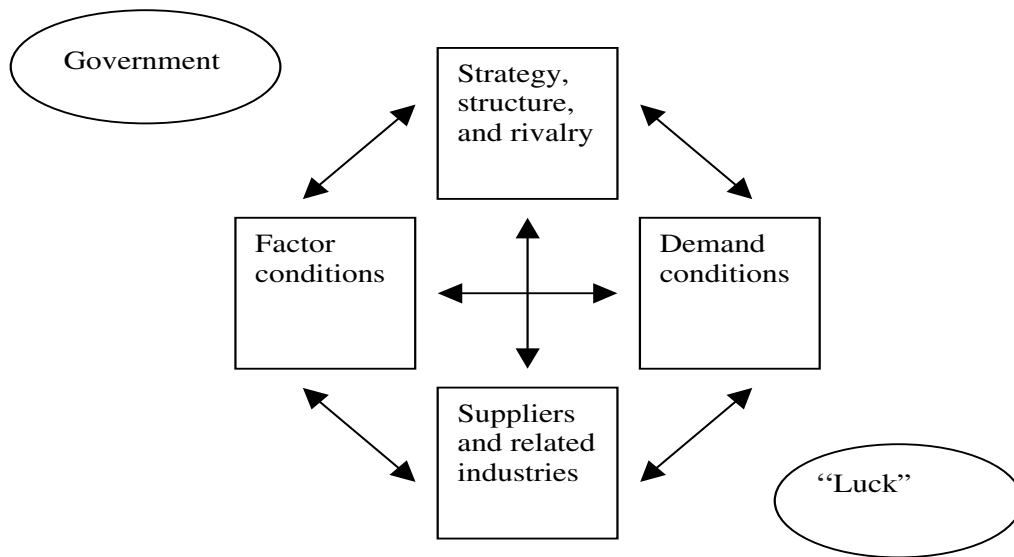
Consequently, the four-fold taxonomy raises questions with-in the maritime industry in regards to clusters. Whether there are true maritime clusters in Norway or are there sectional innovation system or regional innovation systems; providing a comparative advantage? Thus, the next section provides insights into cluster theory.

### **3.3 Clusters**

Porter's (Benito, al., 2003) cluster approach gravitates towards the competitive advantage of industries at the national level. Thus, Porter uses qualitative aspects of relations such as strategies, demand conditions, relative industries and component conditions that are interlaced and are crucial for cluster development and industrial upgrading. According to Ketels (2003) a cluster is "*regional agglomerations of firms focusing on the same technological field that are supported by a specialized infrastructure. The protagonists are connected through vertical, horizontal and lateral links.*" Porter (1990) emphasizes that competition is a key element to the cluster theory; as a result, producing a so-called "diamond theory".

The diamond theory includes four elements: a firm's structure, strategy and rivalry, the demand conditions, the related and supporting industries. In addition, the diamond also includes exogenous factors such as governments, institutions, and organizations that work in collaboration with the cluster in the diamond. Therefore, Porter's cluster

innovativeness is predominantly builds on structural attributes within the cluster, hence, a common innovation infrastructure that links to national and regional diamonds.



**Figure 2: Porter’s Diamond**

*Source: Benito, G., Berger, E., De la Forest, M. and Shum, J. (2003).*

In other words, the ideal cluster/diamond consists of the following factors: first, firms operate in a local context that encourages investment in innovation related activities characterized by local competition. Second, the region, then offers factor inputs, for example, high-quality human resources and a strong research infrastructure supporting related industries. Lastly, activity with local suppliers and related companies in the cluster as to isolated industries (Porter & Stern, 2001, p.30). In addition, local markets should not be ignored according to Porter (1990). Porter (1990), advocates that local customers are complex and arduous and thus their needs anticipant needs elsewhere. Local, regional, and nations agencies are supportive of the cluster providing funding and support of the cluster — institutions, which will be covered latter in the section. In addition, the infrastructure needs to facilitate an innovative environment in which the cluster is embedded in the national or regional innovation structure. The quality of linkages between each cluster is also important in holding together the cluster. As Porter (1998, p.79) puts it, "[a] cluster's boundaries are defined by the linkages and



*complementarities across industries and institutions that are most important to competition.”*

Furthermore, not only structures and resources of a cluster are essential, but the social processes within the cluster are important for development.

*“Social glue binds clusters together, contributing to the value creation process. Many of the competitive advantages of clusters depend on the free flow of information, the discovery of value-adding exchanges or transactions, the willingness to align agendas and to work across organizations, and strong motivation for improvement. Relationships, networks, and sense of common interest undergird [sic!] these circumstances”* (Porter, 2008, p.19).

Accordingly, Maskell and Malmeberg (1998) knowledge-based theory of a cluster emphasizes learning. It follows, then that the proximity of clusters helps to allow for knowledge creation, acquisition, accumulation and utilization for development. As Asheim and Isaksen (2002, p.83) put it *“clusters are “places where close inter-firm communication, socio-cultural structures and institutional environment may stimulate socially and territorially embedded collective learning and continuous innovation.”* However, noted earlier was the notion of “creative destruction” which provides continuous innovation and growth, latter in the discussion chapter there will be a discussion whether innovation (creative destruction), clusters, sectorial (comparative advantage) and/or institutions are the main factors for development and growth in the industry or perhaps they are co-evolutionary – one cannot live without the other.

### **3.4 Institutions**

On the other hand, North and Thomas present different fundamental explanations for economic growth. As noted earlier Schumpeter and the evolutionary theory suggest that “creative destruction” and innovation are causes of growth. However, North and Thomas explain it differently: *“the factors we have listed (innovation, economies of scale, education, capital accumulation etc.) are **not** causes of growth; they are growth”* (North and Thomas 1973, p. 2). In other words, institutions are the causes of growth, whereas,

innovation is the product – actual growth – of institutions. Therefore, there can be two different causalities between growth and innovation.

However, what are institutions? North presents the following definition: Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction (North, 1991 p.98). Furthermore, North (1991) empathizes the importance of economic institutions in the society, for instance, structure of property rights and markets. Economic institutions are important as they can influence the structure of economic incentives in a society — innovation. Thus, without property rights the individual — the entrepreneur — would not have the incentives to invest in either physical or human capital. North and Thomas (1973), also point out that economic institutions are additionally important because they help to allocate resources.

Moreover, Schumpeter's the idea of “new combination” and “creative destruction” points out that innovation depends on various types of new and existing knowledge, capabilities, and resources. In other words, the knowledge and capabilities can be acquired through external actors such as universities, institutions, or research laboratories to carry an interactive process in that different social proxies within public and private domains may be involved (Lundvall 1988, 1992; van de Ven 1999).

According to North (1991), institutions are significant to economic growth as they can shape the incentives of key economic elements in a society. For example, the institutions can influence the investment in physical and human capital along with technology (innovation) and the organization of production. In addition, economic institutions not only affect the conglomerate economic growth prospective of a certain economy, but also can affect an assortment of economic outcomes, such as distribution of resources — wealth, physical and/or human capital. Moreover, similar to Schumpeter's theory, economic institutions are endogenous. It follows, then that economic institutions are set on collective choices of a society. In contrast, there is perhaps no assurance that the given society will prefer same economic conditions; hence, different economic conditions lead to different allocation of resources.

Therefore, the cultural embeddedness of institutions plays a major role in the organization and development of institutions, as they specify and justify social arrangements and behaviors both formally and informally. Furthermore, formal institutions are written rules of a given society, for instance, laws, product information (patents), and taxes are held in-check by institutions. Thus, it can be said that informal institutions are the unwritten rules of a given society. This includes codes of conduct, norms of behavior, and other various forms. Both informal and formal institutions set foundations in which dictate a nation's behavior and/or development both micro and macro levels. For instance, the high regulations within the maritime industry, the government (institution) had raised the restrictions, which caused the maritime industry not to be competitive. Therefore, the creative destruction process ensued transforming the industry and the institutions – co-evolutionary process – in order to be competitive in the world market. Moreover, there are also other factors in which affect the maritime industry and institutions that is how informal actors can shape institutions and sectional and regional innovation systems.

### **3.4.1 New Institutional Economics**

An important framework for institutions is New Institutional Economics (NIE). NIE presumes that individuals are imperfect and face unforeseen events, thus to reduce risk and transactions cost humans create institutions, writing and enforcing constitutions, laws contracts, and regulations — formal institutions (Ménard and Shirley 2010). In addition to formal institutions, there are informal institutions such as norms of conduct, beliefs, and habits (Ménard and Shirley 2010). To build upon North's definition of institutions Aoki (2001) invites another dynamic of institutions and it's meaning and proposes that institutions are collectively recognized rules and symbols and behavioral beliefs (Denzau and North, 1994). These beliefs are called *mental models* (Denzau and North, 1994). In other words meaningful rules, which are respected and followed.

On the same path as Aoki (2001), Williamson (2000) introduces four levels of social analysis of the NIE: level one, which includes the embeddendness of informal institutions, customs, traditions, and norms of religion — or social theory. This level

significantly affects the other levels of the NIE. The second level contains the institutional environment the formal rules of the game — esp. property (polity, judiciary, bureaucracy). The third level is where the institutions of governments are located. This level includes transaction costs or *play of the game*. The fourth level is resource allocation and employment. Thus, Williamson's (2000) framework suggests that norms affect formal rules, which then affect governance structures, which affect resource allocation; therefore, there is an interrelationship between the levels. Due to the informal nature of institutions Norway could have an embedded maritime culture within the institutions in Norway, thus providing for a stronger maritime industry. For example, 1970s shipping crisis, which almost closed maritime industry in Norway, completely destroyed the industry in Sweden.

### **3.5 Summary of Theoretical Background**

The aim and purpose of this thesis is to provide insights into the dynamics of the Norwegian maritime industry and the co-evolution that has taken place within the industry through the innovation process e.g. creative destruction, innovation systems e.g. RIS and SIS, clusters, and institutions. A multifaceted networks of innovation and economic growth theories connects all of these above dynamics of the Norwegian maritime industry. Therefore, when exploring innovation and growth actors all dynamics are accounted for in order to use a multifaceted approach. According to this theoretical framework, innovation and development are diverse and thus there is not only one answer to economic development — development of the Norwegian maritime sector. Such a framework enables a better analysis of the dynamics that make the Norwegian maritime sector and its complexity. The next chapter will apply the theories into a Norwegian maritime context.

## **Chapter 4: Discussion**

### **4.1 Maritime Industry**

The maritime industry could be defined as: shipyards, shipping, suppliers of maritime equipment and related producer services (Hervik and Jakobsen 2001). The Norwegian maritime industry has always been a significant part of the economy and culture of Norway, due to its location. Shipbuilding, shipping, and maintenance of ships were

traditionally the main actors of the maritime industry and have been rooted in the local industries and still are today.

However, the industry has undergone a massive transformation since its first rise and dominance in the world maritime industry in the late 1800's. Thus, in order to understand the transformation of the industry a historical exploration will follow. The historical exploration will provide insights into path dependence with small-scale decentralization to large-scale centralization – creation of new paths in the maritime industry. It follows, then a discussion of the unique “creative destruction” process and innovation process in the Norwegian maritime industry and its affect on the growth. Furthermore, the section will also engage in sectorial and regional innovation systems – comparative advantage – versus cluster development. In addition, institutions will be probed to provide a different causality to growth in the maritime industry. Schumpeter advocates innovation is the causes of growth whereas institutional theorists encourage institutions are the causes of growth. Thereafter, all points will be summed-up and a conclusion will be presented.

#### **4.2 History Matters – Norwegian Maritime Case**

For more than a century Norway has been one of the worlds leading maritime nations enjoying a long coastline, with the North Sea as an important foundation of prosperity and misfortune. Traditionally, Norway was interconnected to domestic markets and major supply of fish and timber products. In the 19<sup>th</sup> century Norway was an immense wood producer; as a result, it was fruitful to development ships and merchant fleets for trade. There was an intertwinesness of timber exports and merchant ships, this was known as the “Siamese twins” and the beginning of the Norwegian maritime industry, which would eventually propose a path dependent strategy. There are many sources of path dependence; however, in the Norwegian maritime case the developmental path was shaped by dependence on a particular raw material (forestry) and the technical possibilities provides for related and derived industries; hence, the maritime industry and the shipbuilding sector.

By the late 19<sup>th</sup> century the merchant fleet had grown considerably to the third largest in the world. One of the causes of such exposition and growth was due to British politics —

import duties on timber and the Navigation act — which implied that the shipping sector had to look elsewhere and explore new markets around the world, which became pivotal for the development and growth of the industry (Brautaset and Tenold, 2008). The Navigation Act was the restricted use of foreign trade between England and its colonies, which forced Norway to expand elsewhere around the world. Arthur (1989), presents that in the beginning of path dependency is the contingency phase, this phase empathizes the historical peculiarities or “small events” that matter most. Contingent phase is known for path emergence and creation. The second phase is introduced through self-reinforcement; hence, the expansion of the maritime market through small events such as the Navigation Act forcing Norway to expand, giving a way to a pattern and dominate course of action. In other words, the maritime industry was becoming a major force in Norway’s economy, especially the building of wooden sail-ships.

Moreover, the British Navigation Act was abolished in the 1850’s, consequently, this opened-up more international shipping and trade routes for Norway. Norway benefited from the already encompassing merchant fleet and thus gained a more dominant position in the world shipping industry. Since, the British Navigation Act was abolished this allowed Norway to be more liberal with international trade, thus Norway expanded to other markets and gained market share within the international shipping industry. However, 1860 was turbulent time for Norway’s shipbuilding sector. Until the 1860s local shipyards were the main source for merchant ships. However, the Norwegian government abolished a twenty percent import tax on second-hand vessels, which by the end of the 1860s second-hand ships out numbered newly built ships (Brautaset and Tenold, 2008). By this time Norway’s institutions or government was starting to play a bigger role within the maritime industry. Institutions were now the “rules of the game” for the industry.

In addition, the Norwegian maritime industry at this time was comprised of small-scale decentralized path, meaning small-scale person or family-owned companies using informal knowledge (i.e. fish, shipbuilding, timber). The path originated from the First Industrial Revolution, when the development of Norway took place in small workshops

using traditional knowledge. Despite this, the 1870s were a radical change in technology for the maritime industry as a whole through the transition of sailing vessels to steam engines. Nonetheless, Norwegian ship owners held on to the wooden sailing vessels longer than most maritime countries as the sailing vessels were still profitable long distance (Camilla and Stig 2008). However, by the late nineteenth and early twenty century sailing vessel were becoming less competitive and the Norwegian fleet had dropped from thirty percent to five percent of the world trade.

In other words, the industry was locked-in into wooden shipbuilding, mostly due to small-scale decentralized path – family owned or personal businesses as they found it harder letting go of the current path. There are two lock-in phases; the first one consisted of “positive lock-in”, which suggests increasing embeddedness and interrelated engendering returns and rising economic performance. This was seen through the globalization of Norway’s maritime industry. The second phase was “negative lock-in”; high interrelatedness and embeddedness induce inflexibility; hence, hindering the innovation process and causing relative economic performance (Martin and Sunley). The maritime industry dropped twenty-five percent of the market share due to “negative lock-in” phase. However, Norway would eventually escape the ‘lock-in’ phase from two sources of new paths. First, transplantation from other more industrialized maritime industries.

The main mechanism of transplantation is the importation of new industries or technologies from elsewhere – Great Britain – which then forms the basis for new pathways (Martin and Sunley). Second, upgrading of existing industries, perhaps co-evolution process was emerging. Thus, the upgrading phase details the revitalization and enhancement of the industrial base through infusion of new technologies or introduction of new products and services. Co-evolutions does not involve only two processes coming together, but multiple. These new paths co-evolved and provide for large-scale industrialization in the maritime industry, however, Norway would keep intact their small-scale decentralized path, as it has created a firm foundation for maritime related actives.

The 20<sup>th</sup> century was a turning point for the Norwegian maritime industry the effects of two world wars and the Great Depression dominated the periods from 1915 to 1945. During the intra-war period shipping declined due to the reduced growth of international trade; however, internationalization increased with foreign direct investment (FDI) (Brautaset and Tenold, 2008). Furthermore, after the fleet reduction during World War I a demand surplus occurred from a brief post-war boom. The post-WWI boom led to structural shifts in world trade and thus tanker transportation became a strong focus in the maritime industry and especially in Norway. Norwegian ship owners took advantage of the new demand pattern (Brautaset and Tenold, 2008). According to Brautaset and Tenold (2008), Norway managed to tailor their tonnage – *ships in terms of the total number of tons registered or carried or of their carrying capacity* – to the demand, escaping the inter-war period unhurt. This time Norway had escaped lock-in phase through adjusting their maritime economy to the demand of the market. Thus, Norway in 1922-1939 increased their fleet to around 2.5 million gross registered ton and increased their fleet by forty percent, while the rest of the world declined (Brautaset and Tenold, 2008). Norwegian ship owners built the largest tanker fleet in the world. These also meet that demand for maritime labor grew and the average size of Norwegian ships also grew. During this time Norway had created a niche in the tanker market and thus fueled the maritime economy.

Through 1945 and 1973 Norway had another post-war boom after WWII, but in this case structural changes transpired regarding regulations and the demand for more international trade especially in petroleum. Similar to 1850 when Norway built up a massive merchant fleet and was on the frontier of international trade; Norway, once again was producing an immense tanker fleet after WWI; and then after WWII oil becomes a dominant factor in world trade. Norway had already built a sizeable tanker fleet and was on the frontier of oil shipping. The oil industry provided an opportunity for Norway's growth, the increase production of remote areas around the world provided a demand for tankers and thus transport grew tremendously. The volume growth and longer voyages led to an increase



in tanker demand, 14% annual increase while other transportation had a growth of 9% per year (Brautaset and Tenold, 2008).

The 1960's were a different story, however; institutional changes in the maritime industry changed the very nature of the industry. The maritime sector had turned from a low-wage to a high-wage industry, crews aboard ships were now entitled to social benefits and increased income; thus, the comparative advantaging was also changing. In the beginning, Norway had created a comparative advantage due to low wages and specialization in shipbuilding in the maritime industry. In addition, the International Labor Organization (ILO) and institutions imposed more regulations within Norway's maritime industry. The regulations addressed issues such as wages, hours of work, and manning — manning are rules and regulations on board a ship according to ILO. Furthermore, through 1945 and 1973 increased government intervention took place, regulations on labor affected the Norwegian ship owners; however, there was easy access to capital. Therefore, ship owners invested in large and technologically advanced ships such as the oil tankers, as there was a growing demand for these ships.

Moreover, 1970 - 2000 was a turbulent time for the industry, but a time of growth and path creation in the industry. From 1970 to 1986 there was a depression in the shipping industry, which then forced Norway to take desperate measures to save the ship owners. To save the industry institutions imposed a more intensive regulatory regime, however it was ineffective. Tanker transports declined more than 50%, thus overcapacity ensued and freight rates were hardly covering the operation cost (Brautaset and Tenold, 2008). Ship owners saw demand go down to almost non-existent and freight rates and vessel values also fell. In addition, a massive down scale in the Norwegian merchant ships also followed and thus Norway's share of the world tanker and merchant fleet was rapidly declined. *In 1970 Norway had been fourth on the list of the world's leading maritime nations – by 1987 the country had been relegated to 18th place* (Camilla Brautaset and Stig Tenold. p.575, 2008). The number of companies also declined more than two-thirds (176 to 56). The OPEC oil crisis damaged Norway maritime economy and thus tonnage declined more than 75%. (Camilla and Stig 2008).

However, in the early 1970's Norway found oil in the North Sea, which would change the industry and create new paths in the maritime industry. Offshore oil would become part of the industry in Norway. However, the oil industry would not take its effect on the industry until the 1980s. Furthermore, by the late 1980s Norway began to liberalize the maritime regulations and change the institutional setting in order to stay competitive in the industry. China and East Asia were being more competitive in the maritime industry, which pressured Norway to change policies. Thus, the Norwegian International Ship Register was established. The point of the register was to combine Norwegian capital with lower-cost foreign labor. This would improve international competitiveness and provide a more agreeable regulatory regime. Due to the institutional change in the industry Norway was able to regain market share and by the 1990s Norway was the fourth biggest maritime nation almost quadrupling. (Brautaset and Tenold, 2008).

Norway's maritime industry proved to be co-evolutionary, involving multiple paths and creative destruction of both micro and macro foundations. The 19<sup>th</sup> century lock-in damaged the industry, however, it forced Norway to evolve the maritime industry to small-scale to large-scale industrialization. In addition, competition also drove Norway to change its regulatory regime in order to stay competitive in the maritime industry. Norway enjoyed a comparative advantage for over a century due to low cost labor, regulations, and access to capital. However, rising competition and regulations made Norway adapt to the changing times and thus their comparative advantage disappeared; therefore, a restructuring process took place.

The 21st century has also left its mark on the maritime industry. Norway's maritime industry has become a technological and innovative and knowledge-based system industry, due to the competitive nature of the maritime industry; particularly, competition from low labor cost industries. To put it another way, according to Thomas L. Friedman adds that the world is becoming more flat in terms that there is now a more level playing field and competitors have an equal opportunity. However, Norway has a unique "creative destruction" process that allows Norway to be relatively innovative and thus

allowing the industry to compete with low cost wage countries. The next section will provide insights into the 21<sup>st</sup> century as technology and innovation has become the dominant path in Norway. Therefore, the next section will discuss the innovation process (creative destruction), innovation systems (NIS & SIS), and clusters in Norway's maritime industry and the co-evolutionary process-taking place within the dynamics.

### **4.3 Innovate Nature of the Maritime Industry**

Norway once was one of the poorest nations in Europe, Norway's GDP was three-quarters that of Western Europe. However, by 1973 Norway had caught up with Western Europe and by the early 2000s, Norway's GDP per capita was roughly one quarter higher than most of Western Europe. Hence, by the 21<sup>st</sup> century Norway had become one of the richest countries in the world. Norway's transformation was very remarkable, but how can such growth be explained? Many believe that oil was the main factor for the explosion in wealth and ultimately what has improved Norway's maritime industry. Oil might be a factor in the growth, but it is not the sole factor that has allowed for Norway's growth neither the key factor.

Thus, the counterfactual proposition as follows "if Norway did not find any oil would the country be as dominate in the maritime industry and one of the richest countries in the world providing for innovation?" The counterfactual method implies that "had conditions been different" the sequence inferred would have not of taken place (North, 1968 p.470). This thesis suggests that if Norway did not find oil would it still be one of the best maritime industries in the world and a relatively innovative nation; just have to look at the Nordic neighbors. According to Global Innovation Index (GII) 2013, Sweden ranks 2<sup>nd</sup>, Finland 6<sup>th</sup>, Denmark 9<sup>th</sup>, Iceland 13<sup>th</sup>, Norway 16<sup>th</sup> in the innovation index. Furthermore Sweden, Finland, and Denmark rank in the top 15 GDP per cap capita in the world according to International Monetary Fund (IMF). Therefore, perhaps Norway would be in the same position as their neighbors and thus their maritime industry would not be affected drastically; however, Sweden's maritime industry failed in the 1970s due to the maritime shipping depression. Norway was able to recover due to institutional changes (Norwegian International Ship Register) and not from the accumulation of oil.

Moreover, Norway has always been a maritime leading economy, many economists suggest that national resources endowments and/or labor supply alone could be the answer; however, in the past two decades intangibles such as knowledge and/or innovation has been a prime actor of economic growth in the maritime industry in Norway. That being said, innovation – creative destruction – and development have been important components to the maritime industry as competition from East Asia with low-wages, less environment standards etc. Thus, in order to stay competitive Norway has evolved through creative destruction.

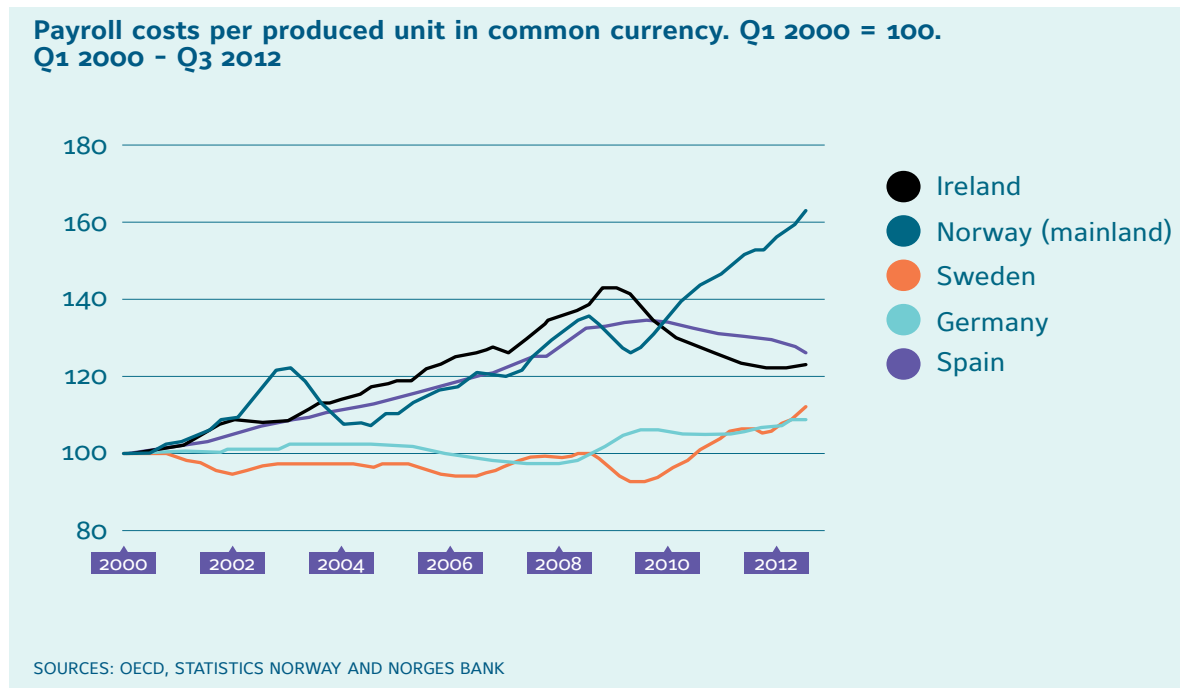
#### **4.4 Creative Destruction**

The exploitation of new knowledge and technology is important typically for small countries such as Norway and its maritime industry. According to Lundvall (Lundvall 1992), a considerable amount of learning and innovation occurs beyond the boundaries of organizations specifically to support innovation. Norway's maritime industry and its GDP per capita in the 1850s were rather low compared to other western European countries, yet the maritime industry thrived. Therefore, disregarding economic growth or growth in the maritime industry from non-formal development in innovation related activities perhaps creates a bias in economic development.

Furthermore, Schumpeter suggested innovation of the entrepreneur leads to creative destruction as innovation causes old inventions, technologies, skills, and equipment to become obsolete. This process is prevalent all around the world, but in Norway there is a perhaps an “invisible hand” pushing creative destruction through high wages and high regulatory regime in Norway; hence, due to high wages and regulation firms have to be innovative and able to find cost-cutting innovating features in order to stay afloat in the industry.

Therefore, there can be a more intensified creative destruction process occurring. In other words, high-wage and regulations in the maritime industry can be associated with higher turnover rates of businesses and/or industries – higher rates of creative destruction, giving a way to economic growth and intensified innovation process (Aghion, P et al.). Figure 3 illustrates the rise in Norwegian labor costs. Consequently, for Norway it has become

important to be efficient. The creative destruction process has pushed Norway to apply cost-cutting features to the industry in order to stay competitive. In addition, creative destruction is not the only dynamic in the industry, which promotes growth and innovation. Innovation systems such as RIS and SIS present informal knowledge in Norway’s maritime industry that also leads to innovation and sustained growth.



**Figure 3: Labor Wages in Norwegian Shipping Industry**

Source: *The Norwegian Shipowners’ Association (Norwegian: Norges Rederiforbund) Maritime Report 2013*

#### 4.5 Innovation Systems in Norwegian Maritime Industry

Informal knowledge and social learning are key to innovation within localized and small-economies such as Norway’s maritime industry. Thus, sector growth involves local and international interaction among people, as well as, collective forms of resource allocation within local communities to help build new production activities (Wicken, O). “Learning by doing” or “Learning by using” produces incremental technological improvements. This incremental innovation has the ability to improve productivity over long periods of time. Norway’s maritime industry through the centuries has evolved from the transformation of incremental innovation and the development of institutions.

Consequently, a co-evolutionary process has taken place through lock-in phase and institutional development providing new paths for ship design and expansion of the industry.

In addition, incremental innovation in policies such as Norwegian International Ship Register have created opportunities for growth within the industry. However, being able to adapt and transform from the old path to the new path is also principal for industrial development and was key for Norway's maritime industry. New forms of production in the late nineteenth century challenged the old path of Norway's maritime industry. Old export sectors were challenged by new technologies, particularly, the development of the steam ship – creative destruction. Thus, in order to sustain such a small-scale industry innovative milieu plays important role in the continuous process of innovation.

Innovation milieu are complex networks of informal relationships in geographical area (R. ttmer, 2011). In short, they are composed of a specific culture and encompass the production system and the social economic actors; thus, enabling collective learning and reducing uncertainty and building trust in the innovation processes. Therefore, norms, values, and rules shape the relationships within the cluster or regions — similar to institutions. The economic relevance to milieu relies on the cognitive element as milieu reduces the uncertainty in the process of decision-making and innovation; hence, collective learning (Camagni, 2004). Asheim & Gertler (2006), empathizes mergers between communities and interrelated industrial sectors as it creates a community that shares mutual knowledge and builds trust within a regional context; as a result, transaction costs are reduced and an industrial atmosphere is created facilitating knowledge development in the local industry. Thus, the communities in both aspects contribute to innovation and benefit from technological spillover between regional firms.

As noted by Schmookler (1966) there is a difference between “product innovation” and “process innovation”, new products may have clear, positive effect on growth; on the other hand, the process of innovation due to its “cost-cutting” features may have a more notable effect on economic growth. The innovation process may be linked to milieu

relationship between firms and regions, as a result provides cost-cutting processes of innovation and thus creating economic growth in the maritime industry. Innovation milieu also empathizes regional innovation systems, though localized geographical, social, and cultural proximity. The small-scale path in Norway's maritime industry has never fully evaporated, which this networking could be one of principle dynamics of Norway's industry, which has been able to root itself and offer a base for the industry.

Although localization as a factor of growth and development is fairly hard to be supported by quantitative methods or empirical studies, interactions are necessary to further innovation capabilities, which are enabled by the proximity between actors (Lunvall 1992). According to Global Innovation Index (GII) 2013) Norway Ranks 16<sup>th</sup> last of any Nordic country, thus why is thesis presenting that Norway's maritime industry is "innovative"? Asheim and Coenen (2005) present that there are two different knowledge-bases: analytical and synthetic. Different modes of knowledge separate the two; analytical is derived from tacit knowledge and synthetic is derived from coifed knowledge, thus innovation is derived from two different knowledge-bases. Mentioned earlier was the small-scale path and its prevalent stay in the maritime industry, it follows, then that what makes the Norwegian maritime industry unique among others is perhaps the small-scale path – personal and family owned businesses – and its synthetic knowledge base.

A synthetic knowledge-base refers to an industrial setting where innovation takes place through the application of existing knowledge and/or through combinations of knowledge; hence, Schumpeter's theory of "new combinations" of existing resources bring about innovation and economic growth (Asheim and Coenen 2005). Furthermore, synthetic knowledge-base occurs in response to the need to solve specific problems in the interaction of clients and suppliers (Asheim and Coenen 2005) i.e. specialized advance industrial machinery such in the maritime industry and shipbuilding in Norway.

According to Asheim and Coenen (2005) R&D is generally less important in the synthetic knowledge base, which is perhaps why the innovation index can be skewed.

The synthetic knowledge in the maritime industry in Norway presents intangible assets to the industry and thus cannot be measured through the means of tacit knowledge. Moreover, tacit knowledge often results from experienced gained in the workplace through by doing, using, and interacting, which has been presented through the small-scale path in Norway. The innovation process by the means of synthetic knowledge is often positioned towards efficiency and reliability of new products, thus leads to incremental innovation process; hence, modification of existing products such as ships, and marine products (Asheim and Coenen 2005). Synthetic knowledge could also be associated with product diversification.

#### 4.6 Diversification

Product diversification in the maritime industry has provided synergies for innovation and creating sectorial and regional innovation systems and cluster development. Porter and Marshall (1998) point out that diversification is more favorable for innovation than that of specialization. One of the unique elements of the Norwegian maritime industry is the diversification of products and services. There are over 4000 companies diversifying in marine products in Norway.

Industry	Number of companies
Shipping companies	2,501
Ship building and repairing	456
Ship brokering	332
Shipping consultants	106
Shipping equipment and engines	65
Other shipping industries	306
Other shipping services	287
<b>Total</b>	<b>4,053</b>

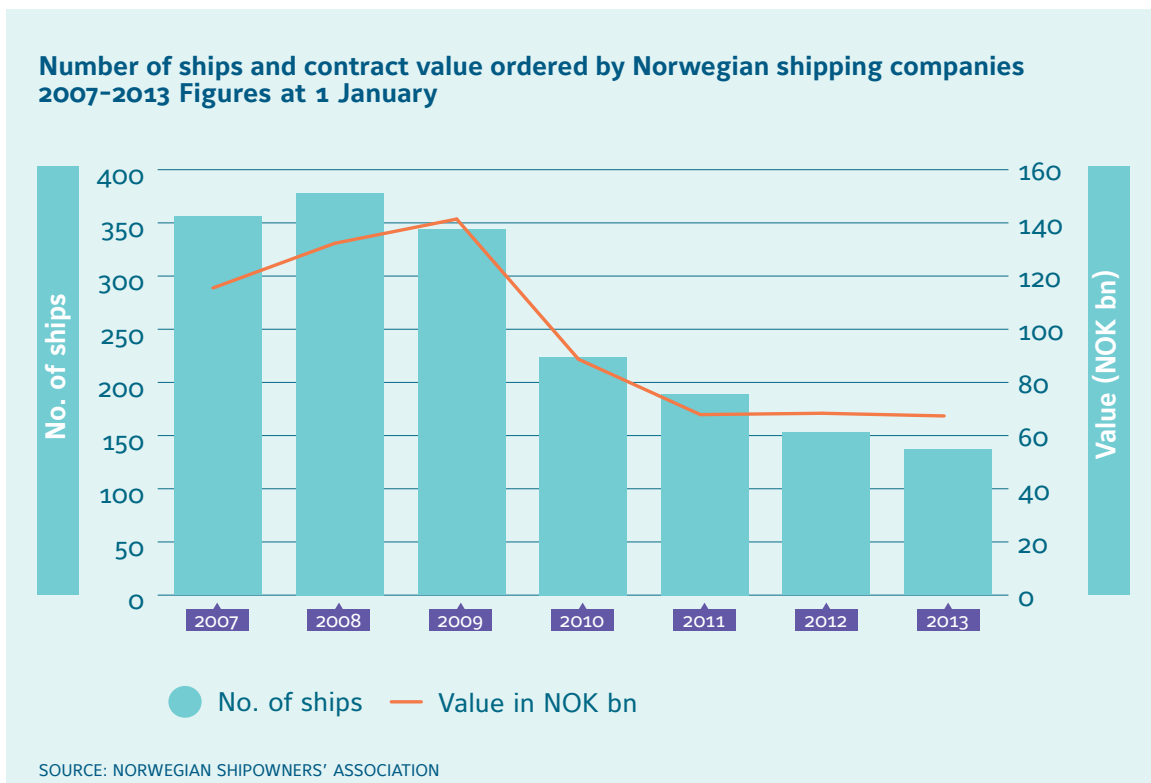
**Figure 4: Number of companies in maritime industry (2006)**

*Source: Wijnolst, N. (2006). Dynamic European maritime clusters*

Diversification in the maritime industry was rather important. Periods of over captivity in the shipbuilding sector, particularly during the shipping crisis, became an issue. Thus, diversity of products and services became more important in times of crisis. However,



in recent year's diversity in the maritime industry has become more important due to competition from low labor and low regulation nations. Shipbuilding in Norway has suffered due to the increased completion from China and East Asia and the financial crisis in 2008- 2009. Figure 5, presets that in 2008 there were 378 vessels with a value totaling an estimated NOK 150 billion; however, by 2013 the total number of ship had fallen to 137 ships value of NOK 66 billion. Nevertheless, it seems that the industry has equalized and there could be in the future an upward trend in the number ships as the financial crisis around the world recovers. Nonetheless, Norway has been already adapting to the crisis and competition from East Asia. The competition from Asia and the number ships being built has created a new path for Norway and thus a demand for maritime equipment has ensued (Andersen, 2007).



**Figure 5: Number of ships and value of contracts**

Source: *The Norwegian Shipowners' Association (Norwegian: Norges Rederiforbund) Maritime Report 2013*

Diversification in the maritime industry has been important in order to sustain innovation and growth. Innovation consists of invention, creation of novelty, and knowledge and perhaps the most important exploitation of knowledge to create products and services. Thus, diversification can provide positive effects of innovation; applying knowledge to new and existing products contributes to expansion. Shared knowledge provides advantage throughout the industry, which transfers across divisions; hence, diversifying knowledge and producing technological development aids in the innovation progress.

This is precisely what Norway's maritime industry has been celebrating through the last decade diversifying in marine parts such as maneuvering equipment and propulsion systems; hence, expanding the market with exploring new products and services (Økland, 2010). This has also allowed Norway's maritime industry to expand. Diversification thus tends to generate networks with other related marine markets creating niche markets such as winches, propulsion, and GPS systems. Furthermore, Jacobs (Desrochers and Leppälä, 2011) advocates that local economic diversity creates interaction between individuals processing different knowledge bases; hence, resulting in more innovation and better economic growth – local milieu improving the innovation process. As a result, market diversity has influenced the development of cluster or sectorial/regional innovation systems. The next section will provide insights to whether Norway's maritime industries are comprised of clusters and/or sectorial innovation system.

#### **4.7 Cluster or Sectorial/Regional Knowledge**

An important theme in the evolution of the Norway's maritime industry was the significance of networks and communication within community. Cluster formation and development also rely on the socioeconomic elements, as does sectorial innovation systems. Moreover, Lundvall emphasized that knowledge is the most fundamental resource in the modern economy, and accordingly, that the most important “process is learning” (Wicken, O 2009). Thus, cluster and sectorial/regional formation stresses the significance of knowledge as a production factor. The maritime industry in Norway originates from the small-scale decentralized path — small firms and/or family owned companies — which have been able to develop through co-evolutionary processes of

creative destruction and path dependence. However, the question is whether the co-evolutionary process has produced clusters and/or sectorial innovation systems.

Moreover, Holte and Moen suggest there are six clusters that make up the maritime industry i.e. Vestfold, Kongsberg, Hordaland, Møre, Mid-Norway, North Norway clusters (figure 6). These clusters are designated specifically by the Norwegian Centres of Expertise (NCE) based on a competition between 24 applicants, which six clusters were decided to be the most internationally competitive global clusters and the selection was based on evaluations of the clusters' and the firms' resources, ongoing cluster dynamics, innovation activity and collaboration, international linkages and the quality of applied projects (Isaksen, 2009). Criticism can be drawn from the above criteria, according to Malmberg and Power (2006), there are four criteria in which make-up clusters: interaction, spatial agglomeration, self-identify (functionally defined industrial system) with policy initiatives and academic research, and proven success.

<b>Cluster Name</b>	<b>Area of Expertise</b>
Vestfold Cluster	Main activities revolving around ship owners, service industry as banking, insurance, Classification services, etc.
Kongsberg Cluster	Produces a wide range of advanced products and systems for off-shore, automotive and maritime industry. Focused on exporting ship equipment, World leader in drilling equipment, (un)loading equipment for marine operations, and traditional shipping activity
Hordaland Cluster	Installation, running and maintenance of sub-sea installation
Møre Cluster	Complete maritime cluster of ship builders, ship design (especially for advanced off-shore operations), equipment and service suppliers.
Mid-Norway Cluster (Raufoss)	Great expertise in technological and operational offshore expertise related to petroleum and deep sea activities.

North Norway Cluster (Trøndelag)	Exploration of resources. Ships and offshore process oil and gas installations
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**Figure 6: Norwegian Maritime Clusters**

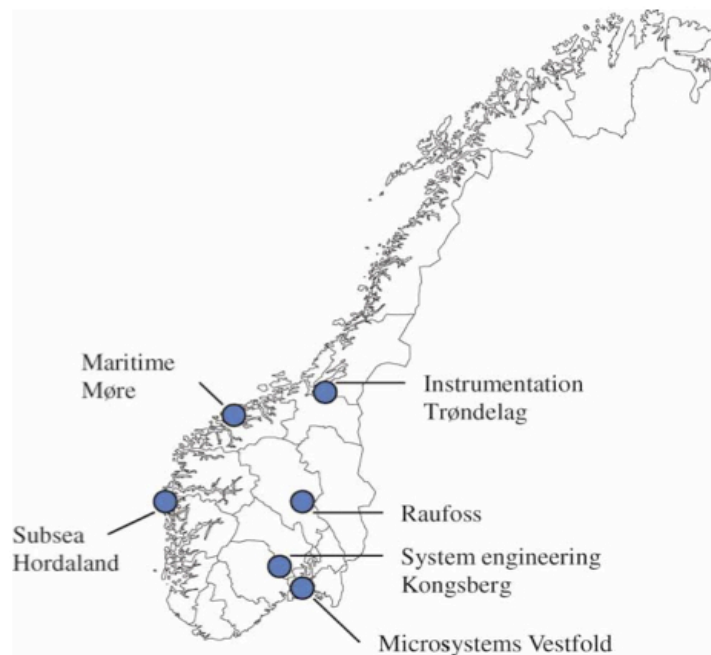
Source: *Holte, E. and NOT, \. (2010).*

The fourth criterion draws attention however; the concept of a cluster becomes synonymous with competitive success. In other words, the idea of the cluster is not just a geographical or system (sectorial innovation system) concentration, but a dynamic and competitive cluster (Malmberg, 2005). It follows then, that there are three endogenous mechanisms characterizing regional clusters. The first mechanism is the co-location of many similar firms (Harrison et al., 1996). The main factor is a common pool of workers and common specialized subcontractors and service firms, and educated research facilities dominating the local industry (Malmberg, 2005). Thus, there is a common specialized area that provides proximity inputs from the supplier, consultants and diverse specialists (Malmberg, 2005). The second mechanism is the innovation pressure, specifically, local producers competing and the third mechanism is the development and diffusion of knowledge inside the cluster.

Malmberg and Power (2006), argue that knowledge in clusters is created through various forms of interaction — local collaborative interaction. Networking in the Norway’s maritime industry has been a pivotal point in its development. Networking takes various forms: creation of links among firms, image and brand building, internationalization strategy, technological knowledge, and universities (Malmberg and Power, 2006). In addition, knowledge in clusters is created through increased competition and intensified rivalry. The co-evolution process in the maritime industry along with small-scale decentralization has created a unique atmosphere for creative destruction and rivalry. As Malmberg and Power (2006) have pointed out the rivalry between similar firms in local milieu will be more intense, thus creating pressure to innovate in order to beat local rivals. Proximity between actors such as equipment and service suppliers, ship builders,

ship owners, and design companies have allowed spillovers, as this allows for innovation and/or breakthroughs in technology, vessel design, etc.

On the other hand, these clusters could be regional innovation systems, providing a comparative advantage between the regions. One type of regional innovation systems is territorially embedded regional system consisting of firms, which are localized through geographical, cultural and social proximity. In addition, sectorial systems of innovation could be present within a regional context. Malerba defines a sector as: “*Different sectorial environment in terms of sources, actors, technologies, networks, and institutions affect the innovation that takes place. A sector is a set of activities that are unified by some related product groups for a given or emerging demand that share some basic knowledge*” (Malerba, 2004: 9-10). A key element of sectorial and regional innovation systems is knowledge and its structure. Knowledge may differ considerably across sectors and regions, thus affect the innovation activities, organization and behavior of firms; hence, technological opportunities differ among sectors.



**Figure 7: Location of six Norwegian Clusters**

Sources: Holte, E. and IOT, \. (2010)

Figure 7 shows that the so-called clusters are separated by knowledge in a certain areas – shipbuilding, oil, finance, offshore rigs, maintenance etc. For example, North Norwegian cluster (Trøndelag) present knowledge in exploration of resources, ships and offshore process oil and gas installations; where, Vestfold Cluster revolves around ship owners, service industry, banking, insurance, classification services, etc. Therefore, why are the clusters or perhaps sectors separated by knowledge? It follows, that these sectors or clusters are separated by their comparative advantage of tacit knowledge and specialization of marine products in certain regions. Local milieu, geography, and diversification process has persuaded certain specialization to take place in different regions; for example, the Northern Norway Cluster (Trøndelag) and its specialization in offshore products. It could be that Northern Norway was prevalent in mining, thus knowledge and networks in the region producing mining knowledge; hence, creating a specialized cluster or sector in mining. Moreover, the Norwegian maritime industries as mentioned earlier are relatively decentralized, thus linkages become an important factor in the development of sectors and/or clusters.

#### **4.7.1 Maritime Linkages**

Norway's maritime industry is relatively decentralized where the North cluster developments oil and gas equipment and the Vestfold cluster is mostly into services, it seems that maritime business are spread across Norway; hence, a more decentralized system in Norway. Each region or perhaps sector has important differences, thus, this geographical specialization, combined with national and international linkages provide a competitive strength within the maritime industry (Wijnolst, 2006).

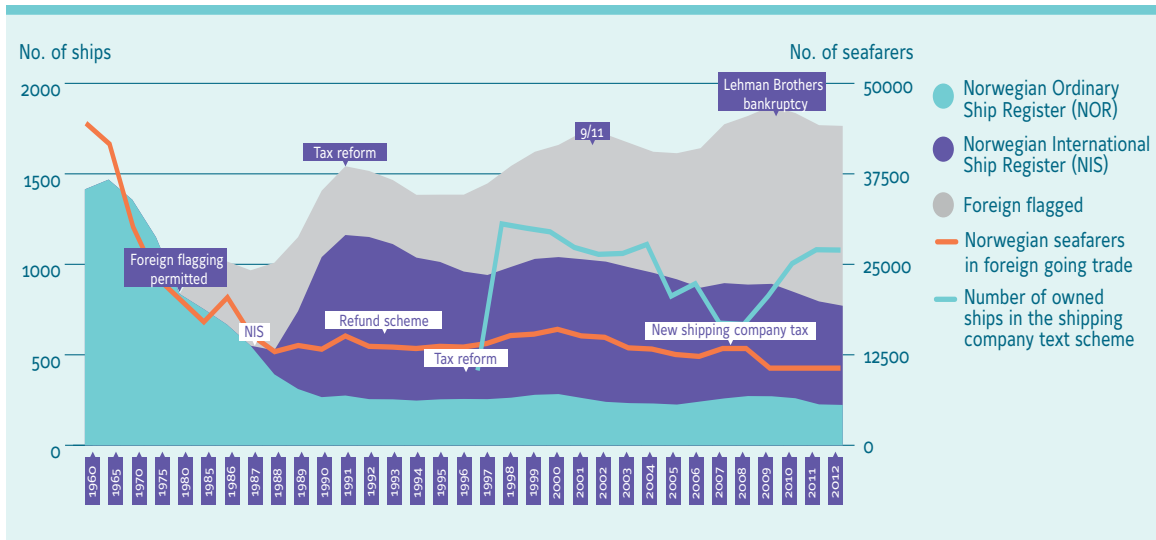
Moreover, in order to provide a more in-depth evaluation of the clusters or sectors in Norway's maritime industry a quantitative approach may be more useful in the analysis of cluster development and/or sectorial innovation system. This section's aim was to explore whether Norway's maritime industry was comprised of "true clusters" as appointed by NCE. However, whether the regions are clusters or sectorial innovation was not the main dynamic explored, but how the knowledge i.e. tacit knowledge is diffused. The next section will provide a different causality to growth and innovation. According to

North, innovation “is” growth rather than the “cause” of growth. Thus, institutions cause innovation and economic growth in the maritime industry in Norway.

#### **4.8 Institutions and Innovation**

Institutions include common habits, establish practices, rules, law, standards and norms which vary from binding to less binding informal and formal. North and Thomas (1970) suggest that institutions cause growth i.e. innovation. Institutions were traditionally considered as obstacles to innovation, but recent studies suggest institutions can both hinder and support innovation (Edquist, 1997). Furthermore, Edquist (1997) also points out institutions and innovations have three assumed basic functions. First, provide incentives for invest in innovation actives; second, to provide essential information to reduce uncertainty; and third, to manage conflicts and cooperation.

However, an important institutional factor to realize is Norway’s ability to promote an attractive maritime industry. Attractiveness is a function of several factors, competence in specialized goods and services, also policy conditions of the country compared to substitute locations such as Denmark, Netherland, or Germany. According to North (1991), institutions are significant to economic growth as they can shape the incentives of key economic elements in a society. For example, the institutions can influence the investment in physical, human capital, and policies. Institutions have been a major determinate in the Norwegian Maritime industry through tax, wage, labor and regulations, which have both hinder and helped innovation and economic growth. Figure 8 shows how institutions have affected shipbuilding in the maritime industry through tax reforms and the Norwegian International Ship Register (RIS) suggesting institutions can have a positive effect on growth.



**Figure 8: Norwegian maritime institutional changes and reforms**

Source: *The Norwegian Shipowners' Association (Norwegian: Norges Rederiforbund) Maritime Report 2013*

The figure also illustrates how tax reforms and regulatory reforms have had a optimistic affect of the Norwegian shipping industry. In addition, a long-term trend line would present an upward positive trend in institutional changes. Competition is intense, especially, from lower wage and less regulatory systems, thus it could be advocated in the absence of the measures Norwegian institutions have taken Norway's may not be in the position that it is today.

Moreover, in regards to clusters, institutions play an important role. Cluster development also relies on exogenous support such as governments, national institutions, and policies, which are all factors that can stimulate innovation. Exogenous factors, for instance, can serve as research universities and/or venture capital supporting innovation and the development of clusters. Parto (2008), suggests that institutions play an important role in the shaping of clusters, both hindering and proving opportunity. Institutions also shape comparative advantages as institutions include habits, rules, laws standard of norm, both formal and informal. As noted earlier Norway has high wages costs; thus, institutions have to play an even bigger role in the innovation process and development within the maritime industry. In order to stay competitive in the maritime industry Norway's



institutions must be active in promoting and sustaining innovation in such a high cost industry.

In order for institutions to develop and support clusters, specifically the Norwegian maritime industry, incentives for investing in innovation must be prevalent; providing information to reduce uncertainty and to manage conflicts and cooperation. In other words, being the foundation of innovation and supporting of entrepreneurial activities. Thus, in order to build a strong or stronger maritime industry, institutions need to be present and active. Norway's government has provided institutions such as *Innovation Norway*, which provides gateways to innovation and development in the Maritime industry. Institutions such as: Arena Fritidsbåt, Arena Ikuben, Maritimt Forum, NME, Arena Maritime Cleantech West, Norsk Industri, NCE Maritime help to facilitate development and innovation (<http://www.innovasjon Norge.no/no/maritim/>). In addition, there is a knowledge-hub in Trondheim Norway; which, provides research-based institutions such as SINTEF (Stiftelsen for industriell og teknisk forskning), Marinek and NTNU (Norwegian University of Science and Technology) that provide incentives for innovation and growth in the maritime industry. In addition, open innovations through institutional means have provided additional support in order to compete with lower wage countries.

#### **4.8.1 Open Innovation**

Small-scale decentralized developmental path has been a dominant path for Norway's maritime industry in the early stages of development and it still remains economically important to the industry. However, large-scale centralized enterprises have been a dominant path in Norway since the first and second industrial revolutions, but the business culture and informal institutions — customs, habits etc — have carried over to the large scale activities. This synergy has created the bases for open innovation in the Norwegian maritime industry.

Moreover, according to Chesbrough (2012), open innovation is “the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation” (Chesbrough 2012, p.20). The point of open

innovation is to engage with a wider variety of participation among institutions, firms, networks, suppliers, third parties, partners and customers. The maritime industry provides open innovation activities in particular looking at the Møre Cluster; which, hosts various innovation actors. The Møre Cluster (see figure 7) hosted various institutional research universities along with three cities in which are prominent research and development communities — Bergen, Alesund, and Trondheim. Open innovation provides social and territorial embedded interactive learning process, which takes place through network of collaborators spilling over to other regions and thus providing knowledge-base interaction and development (Lundvall, 1992). In contrast, closed innovation firms generate their own ideas in return they develop and manufacture and market themselves; hence, using mainly internal knowledge. Due to Norway's strict laws in the maritime industry open innovation has been a key component to Norway's maritime industry and cluster development in order to stay competitive in the world market (Økland, 2010).

## **Chapter 5: Conclusion**

This study has explored four dynamics of the Norwegian maritime industry, historical analysis of path dependency, innovation with regards to creative destruction, clusters versus sectorial/regional innovation systems, and institutions and their role in the industry. The historical study proved that history matters in the Norwegian maritime industry as it showed a co-evolutionary process. This co-evolutionary process entailed not just a two-fold evolutionary process, but a three-fold evolutionary process detailing path dependence, creative destruction, and incremental innovation in the industry. The historical dynamic told a story of how and why the industry changed and where it is now. The industry is once again changing due to globalization and increased competition; however, the industry has adjusted through the innovation processes.

The second dynamic, innovation, proved to be a unique process in the maritime industry; as, the industry appeared to have an intensive “creative destruction” process that brought about innovation and growth. Due to high wages and regulations the creative destruction process becomes more distinctive. In addition, innovation does not only occur in tangible

objects, but also through process innovation. Schmookler (1996) pointed out there two types of growth, tangible new products and intangible innovation processes. Innovation process provides cost-cutting features, which can have positive effects on growth just as new and defined products can or even more. Thus, the high wage costs and strong regulatory regime also push the industry to promote an intensive creative destruction process and stipulating attention into the innovation process as it encourages cost-cutting production features. These two processes of innovation together give the Norwegian maritime industry a unique advantage over their competition and thus allows the industry to be able to compete with low wage and weak regulatory systems.

The third dynamic was tacit knowledge and the development of clusters and/or sectorial innovation systems. The historical analysis specified small-scale decentralization path in Norway's maritime industry, which include personal and family-owned business. These paths were very important as it created networks and perhaps trust; hence, helping with some of the cost-cutting features in Norway's maritime industry. However, there is criticism towards whether the maritime clusters in Norway are "true clusters" or sectorial/regional innovation systems. Nonetheless, whether there are clusters or sectorial innovation system, communication, networks, and tacit knowledge is very import to the industry. The knowledge of maritime related products and services provides a competitive advantage in the maritime world industry.

Lastly the fourth dynamic was the institution's involvement in the development of the industry. The historical section previewed several of the institutional changes that took place in the maritime industry. At first institutions damaged the industry and took away the comparative advantage. However, in the 21<sup>st</sup> century institutions have become important due to the high wage labor and regulations. Thus, institutions involvement in innovation and connection with the community become perhaps more important in an industry that has to compete globally with low wage and low cost operations. Therefore institutions have contributed to positive influences and thus have been fruitful in the 21<sup>st</sup> century through research institutions and local communities; thus, achieving development and growth in the maritime industry.

These four dynamics create the Norwegian maritime industry. The study has provided insights into the industry as a whole and explored the elements of the industry through a multidisciplinary approach. Innovation processes have been a key element to the Norway maritime industry and will continue to do so, however the industry will face even more challenges due to the rise of competition from East Asia and high standard in the industry in Norway. Thus, it becomes even greater importance to work in a co-operational environment in order to stay afloat in the world maritime industry for Norway.

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