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# 12. Towards sustainable production in industrial clusters

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**Sammendrag** For å møte de store utfordringene med global oppvarming og tap av biologisk mangfold, må industribedrifter svare på samfunnets krav om å produsere og levere sine produkter på en mer bærekraftig måte gjennom radikalt endrede produksjonsprosesser, logistikk og forretningsmodeller. Bedrifters måte å produsere produkter og tjenester på har imidlertid utviklet seg over mange år, noe som er knyttet til kultur og tradisjoner på organisasjonsnivå, men også innenfor bransjer og nettverk der disse organisasjonene opererer. På den ene siden kan disse forholdene utgjøre en barriere mot radikal endring mot bærekraftig produksjon, på den annen side kan innovasjonsevnen til industrinettverk og klynger bidra til å forberede selskaper til denne overgangen. I denne studien har vi gjennomført en kvalitativ casestudie av den maritime klyngen i Møre og Romsdal for å undersøke hvordan små og mellomstore bedrifter i regionale klynger responderer på forventinger om bærekraftig utvikling. Funnene viser at klyngeselskapene besitter unik kunnskap og kompetanse som kan representere en viktig ressurs for utvikling av en ny bærekraftig utvikling. Diversifisering av den maritime klyngen kan imidlertid svekke relasjoner mellom klyngeselskaper, redusere kommunikasjon og dermed svekke klyngens innovasjonsevne.

**Abstract** To deal with the challenges of global warming and the loss of biodiversity, industrial companies must respond to stakeholder pressure for producing and delivering their products in a more sustainable way. This can be achieved through transformation of production processes, logistics and business models. Companies manage their operations based on their culture and the traditions in which these organizations operate. These can be seen as barriers to radical change towards sustainable production. However, through collaboration and knowledge sharing industrial networks can assist companies in meeting the transition to sustainability. In this qualitative study of a maritime cluster in the county of Møre and Romsdal, we investigate how small and medium-sized companies in a regional cluster respond to the need for sustainability development. The findings show that the cluster companies possess a unique knowledge and expertise resource that can be transformational and create a new path of development. However, diversification in the cluster may

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weaken integrity between the companies and consequently reduce communication between them and weaken their ability to innovate.

**Keywords** Industrial cluster | Sustainability transition | Drivers and barriers

## INTRODUCTION

In recent years, the topic of sustainability has encouraged both researchers and practitioners to explore new ways to create value. Inter-firm networks may play an important role in achieving environmental and societal gains, as it can be difficult for firms to achieve these on their own (Mazzoni, 2020; Nielsen, 2019). Industrial clusters are important for the economic system and may also play a vital role for the society's development towards sustainability. Companies and institutions in clusters share a culture characterized by a high degree of trust (Bell, Tracey, & Heide, 2009). Moreover, geographical proximity is seen as a driving force for enhanced trust and collaboration, which drives innovation (Porter, 1998). These characteristics of clusters have the potential to drive implementation of sustainability-oriented practices and novel projects. However, clusters may also present barriers that hinder the development of new paths towards more sustainable practices due to lock-in effects and dependence on institutional aspects, which decreases the ability to innovate (Grabher, 1993; Trippl, Grillitsch, Isaksen, & Sinozic, 2015). The operational management literature has covered sustainability themes mainly at firm and supply chain levels (Koberg & Longoni, 2019; Seuring & Müller, 2008). Yet, clusters and their potential to bring environmental and social improvements remain under-investigated in the literature.

In the recent years of growing awareness about the climate and societal problems, several studies have explored clusters' reorientation towards sustainability. These studies address the integrated efforts of cluster firms together with regulatory bodies on the path to green economic development (Davies, 2013), the role of policy and normative context for the green transition (Sjøtun & Njøs, 2019), the role of EU policies (Derlukiewicz et al., 2020) and circular economy opportunities for industrial clusters (Mazzoni, 2020; Nielsen, 2019). Previous studies on clusters have mainly focused on the role of policy, examples of best practice and more generalized investigation of clusters. Moreover, previous studies have not explored how the established values and norms of a cluster's culture may influence the transition toward sustainability. The study by Liu, Feng, Zhu, and Sarkis (2018) suggests that cluster theory has potential in examining green supply chain manage-

ment and circular economy topics, although it has not been among the top theories in these fields. There is a need for research exploring how being a part of clusters influences companies' reorientation in this respect. This paper aims to examine the potential of clusters to contribute towards sustainability development. The core question of the paper is this: *How can cluster membership contribute to small and medium-sized enterprises' transition towards sustainability?*

The study contributes to the recent stream of literature addressing clusters' role in the transition towards sustainability. While advancing theoretical knowledge regarding the role of cluster membership for sustainability, the study also provides knowledge for industrial managers and policy makers, focusing on the sustainable development of regional economies. To answer the research question, we have carried out a qualitative research study based on interviews with managers of the Norwegian maritime cluster and secondary data assessment. Currently, the cluster is aiming to strengthen its position towards industrial restructuring and respond to increasingly stricter sustainability requirements and industry standards at national and international levels.

The paper proceeds as follows: First, we present cluster theory as a theoretical lens for facilitating the adoption of sustainability and sustainable innovations in regional industries. In the following sections, we discuss the results from the case study and how it can advance our understanding of cluster membership for sustainability transition.

## LITERATURE

### Cluster theory

In large parts of the literature on sustainability, the organizational and supply chain level are given a prominent place (Gawon, Yalcin, Hales, & Hee Yoon, 2019; Gold, Seuring, & Beske, 2010; Koberg & Longoni, 2019; Seuring, Brix-Asala, & Khalid, 2019). While supply chains involve upstream and downstream cooperation of companies related to manufacturing and delivery of specific products or services to the end customer, clusters are geographical concentrations of companies and other institutions, such as educational, regulative and other supportive entities. Studies addressing the linkage between supply chain management and cluster theory have investigated how supply chain managers can benefit from the advantages of geographic proximity characteristics for clusters (DeWitt, Giunipero, & Melton, 2006). While the intersection of cluster theory and SCM offers an opportunity for building a competitive advantage based on the locally available resources, the role of clusters in the sustainability transition has been under-investigated.

According to the definition given by Porter (1998), clusters can be characterized as industrial regions or locations that are focused on one specialized type of industry (Marshall, 1997). Companies in clusters are claimed to exhibit a high degree of competitiveness due the vital and innovative business environment (Porter, 1998). A cluster integrates various actors, from focal firms, suppliers, service and infrastructure providers to government institutions and educational, research and technical organizations. Foreign companies having permanent presence in the cluster are also considered as being cluster members (Porter, 2000). Cluster literature includes studies dealing with regional studies (Lu, Reve, Huang, Jian, & Chen, 2018), as well as economic geography describing the various advantages of belonging to a cluster, and explores the underlying reasons for why clusters represent beneficial contexts for companies (Porter, 2000). Studies reveal that geographical proximity plays an important role in facilitating the development of trustful and long-term relations as a platform for communication and social interaction (Porter & Ketels, 2009), exchange of knowledge, mutual learning and cooperation (Dyer & Singh, 1998), and joint problem-solving and co-creation of value (Hammervoll, Halse, & Engelseth, 2014). Different forms of proximity – namely, geographic, organizational, cognitive, social and institutional proximities – have been identified as important for cooperation and knowledge exchange (Boschma, 2015; Asheim & Isaksen, 2002).

Previous studies have mainly focused on clusters' role in economic development through enhanced productivity and innovation (Porter, 2000; Trippl et al., 2015). However, the increased awareness of climate problems and socio-ethical issues has created a need for research on how clusters can facilitate the transition towards a more sustainable economy. Several studies have been published in this field. A study by Davies (2013) provides an investigation of cleantech clusters' role in the green economy and suggests that for pushing forward the green transition, the effort of cluster actors should be combined with wider institutional resources and responses. In a similar vein, a study by Sjøtun and Njøs (2019) explores clusters at the policy level and focuses on the green reorientation in Norway, while Derlukiewicz et al. (2020) discuss how EU policies strengthen the position of clusters in achieving sustainable development. Kyllingstad and Rypestøl (2019) argue that sustainability is driven by integrated efforts of different groups of actors in the cluster, both at the system level and the firm level. The studies mentioned above investigate how sustainability or the green transition can be achieved in industrial clusters by emphasizing the role of policy makers and regulative bodies. The literature in this field is, however, still scarce. There is a need for studies examining the role of the cluster context for sustainability reorientation of cluster companies.

Knowing the benefits of clusters for innovation and regional development, we aim to expand the field of research by identifying how cluster environments can affect transformation towards sustainable operations by considering both potential advantages and barriers.

## Cluster evolution and development of new growth path

Sustainability reorientation can be considered as a complex transition process involving changes at different levels, including technology, policy, economics/business/markets, and culture/discourse/public opinion (Geels, 2004, 2011). Although interaction is vital for driving the transition, norms and values within the cluster may represent a strong facilitating factor for the sustainability transition. In order to understand how the transition may occur within a cluster, our point of departure has been previous studies within cluster research literature that investigate changes and evolution of clusters. The development of clusters, their growth, maturity, decline and renewal, is based on previous events in the region, localized capabilities, routines and institutions and is facilitated by knowledge infrastructure, supporting organizations, technological and institutional set-up, cultural aspects and policy applied in the region (Trippl et al., 2015). Co-location leads to the creation of a shared culture and trust that enables formal and spontaneous communication. Moreover, regional co-location and collaboration between different private and public organizations linked to mutual interest leads to regional innovation and development (Fogelberg & Thorpenberg, 2012). Firms' innovative capacity and technological capabilities can enhance radical innovations and are crucial for new path development (Asheim & Isaksen, 1997). Porter (2000) argues that connections between companies and industries in the cluster are crucial for new business formations. Thus, mutual orientation or goal-oriented transition towards sustainability may lead to knowledge acquisition and innovations for sustainability. This may be different from a range of historical emergent transitions without a specific goal for reorientation (Geels, 2011; Smith, 2007). Furthermore, the diversification of firms and products and the development of new niches are essential for cluster transformation (Sjøtun & Njøs, 2019).

Previous studies reveal that innovation is one of the key enablers for sustainability (Adams, Jeanrenaud, Bessant, Denyer, & Overy, 2016; Neutzling, Land, Seuring, & Nascimento, 2018). The study of Bathelt, Malmberg, and Maskell (2004) proposes two aspects that affect innovation and new knowledge creation in clusters: local buzz and global pipelines. Related to the concept "local buzz", the authors suggest that firms in the cluster can benefit from the locally available net-

works, information and news that spread fast within the cluster environment. Face-to-face contacts between workers at different companies can take place during formal and informal meetings. Furthermore, knowledge exchange and technology transfer can occur when firms cooperate in specific projects, during personal contacts of engineers and employees and when an employee changes workplace within the cluster (Asheim & Isaksen, 2002).

Trippl et al. (2015) suggest that cluster growth is linked to innovation, which is facilitated by collective learning, access to tacit knowledge and skilled labour. Tacit knowledge is embedded in the experience of employees and in routines at the workplaces (Asheim & Isaksen, 2002; Trippl et al., 2015). Bathelt et al. (2004) propose that during new product development "the knowledge is being transformed and perfected through processes of learning and socializing," meaning that knowledge undergoes constant transformations and improvement over time (p. 25). Sjøtun (2020) argues that maritime engineers perform a central role in the development and implementation of new technology and in lobbying for green transition. In this study, engineers take part not only at the firm level for the development of new technological solutions, but also at an industrial cluster field by offering solutions to support industry competitiveness and job creation, thus assisting in regional industry renewal.

Global pipelines comprise different socio-institutional and cultural environments that allow for a broader set of knowledge, technological settings for the local cluster actors (Halse & Bjarnar, 2014). The cooperation with foreign customers can lead to R&D knowledge exchange between local and international innovation systems (Asheim & Isaksen, 2002).

In his study on cluster evolution, Boschma (2015) discusses how industrial, network and institutional dimensions facilitate regional resilience. The author suggests that there can be two kinds of new growth paths: path renewal and new path creation, where both can be affected by regional factors. Furthermore, if the region has one main specialization, it may have fewer opportunities for renewal and diversification, while diversified regions are considered to have more opportunities for new path growth. The availability of related industries can enhance industry learning and encourage joint work and the combination of resources and capabilities.

Grillitsch and Trippl (2016) show that regions can possess barriers to structural change and new path development. Trippl et al. (2015) suggest that homogeneity and heterogeneity in competencies can also be associated with cluster growth and decline. Furthermore, proximity can lead to lock-in effects hindering new path development (Grillitsch & Trippl, 2016; Hassink, 2010). Grabher (1993) suggests that lock-in effects evolve from institutional environments that preserve the exist-

ing industrial structure and hinder the ability for renewal. Consequently, cluster membership may also involve barriers that may hinder the transition to a more sustainable economy (Derlukiewicz et al., 2020).

The literature presented above provides a brief overview of the cluster literature addressing cluster innovation and evolution. The literature has not yet developed a comprehensive understanding of how industrial clusters may evolve to facilitate companies' transition towards sustainable operations. This study aims to contribute to this discussion by exploring how cluster companies in the region of Møre and Romsdal deal with the global call for reorientation towards sustainability.

## RESEARCH METHODS

The study aims to gain a deep holistic view of a research problem associated with cluster membership and sustainability transition. To explore how cluster membership contributes to transition into more sustainable operations, we have carried out a qualitative single case study (Yin, 2018) in the Norwegian maritime cluster in Møre and Romsdal. A single case study method is suitable for extending the theory and illuminating and extending relationships and logic among study objects (Eisenhardt, 1989) and is therefore appropriate for shedding light on the research problem at hand. The purpose of the study has been to achieve a deeper understanding of the cluster and to facilitate theory development (Baskarada, 2014). Although, the study is based on one case, a maritime cluster, the analysis includes outcomes about six organizations within the cluster (Yin, 2018). Furthermore, qualitative research assumes that social reality is human-based; thus, people's meanings and practices are used to understand particular cases (Strauss & Corbin, 1994).

To gather comprehensive information regarding the role of cluster in sustainability transition, we have conducted interviews with different actors in the cluster such as shipyards, equipment manufacturers, ship design companies and the cluster organization. The data collection encompasses interviews with employees that allow us to fulfil the requirement to use numerous knowledgeable interviewees, representing various hierarchical levels and functional areas that can limit bias and ensure external validity (Eisenhardt, 1989).

The analysis starts with a short historical overview of maritime cluster evolution for highlighting its main periods and the evolution. Further, the discussion covers the ongoing situation of the cluster in relation to the sustainability transition by identifying drivers and barriers. To ensure the validity and reliability of the qualitative research, we followed the principles of trustworthiness (Guba & Lincoln, 1994).

We followed a semi-structured interview approach consisting of an identified set of questions and opportunity to refocus the questions and ask additional questions during the interview process (Baskarada, 2014). The interview questions were designed in a way to cover such topics as (1) sustainability work in the cluster and in the firm, (2) how companies perceive their belonging to the cluster with respect to the sustainability transition against theoretical overview in the literature section and (3) challenges and opportunities regarding the transformation of the cluster. Our data gathering started in October 2020 and continued until April 2021. It is based on interviews with managers that were conducted digitally due to the restrictions associated with the Covid-19 outbreak. The duration of each interview was approximately one hour. Data were obtained from six organizations. All interviews were transcribed and saved in the qualitative software NVivo 12 Pro for further content analysis. To evaluate data gathered, we applied analytical generalization that allows us to compare theoretical findings with case study results (Yin, 2018). Furthermore, the data gathering involved secondary data assessment that consists of media coverages, annual and sustainability reports and reports regarding maritime industry published by Menon Economics. Finally, data were collected through observations during the annual maritime cluster conferences in 2018, 2019, 2020, 2021 and other cluster events. A wide range of data sources contributes to understanding the current situation and the development of the cluster over recent years. Table 12.1 gives an overview of the maritime cluster companies that we interviewed.

**Table 12.1** Maritime cluster companies

| Firm | Specialization | Revenue, NOK mill (2019) | Number of employees | Ownership |
|---|---|---|---|---|
| Firm 1 | Maritime cluster organization | - | - | Local |
| Firm 2 | Shipyard | 7938 | 805 | Multinational |
| Firm 3 | Shipyard | 27 | 8 | Local |
| Firm 4 | Shipyard | 2002 (in 2018) | 81 | Local |
| Firm 5 | Maritime equipment manufacturer | 1095 | 347 | Local |
| Firm 6 | Maritime equipment manufacturer | 162 | 105 | Local |

## Case description: The maritime cluster

Shipbuilding in Møre and Romsdal is mostly represented by small and medium-sized firms specialized in complex manufacturing of tailor-made unique ships (Amdam, Bjarnar, & Wang, 2018; Halse, 2017). The cluster has gradually expanded from the construction of fishing boats into a full-blown cluster, integrating various

companies such as shipyards, producers of engines, propellers and other equipment, as well as local educational and supportive organizations (Amdam, Lunnan, Bjarnar, & Halse, 2020). Today, cluster companies deliver a variety of vessel types such as offshore supply, offshore wind, aquaculture, exploration cruise, ferries, yachts and fishing vessels (Jakobsen, Helseth, & Aamo, 2020).

The Norwegian maritime cluster is an interesting case for several reasons. The cluster has achieved a leading position in the international market due to the cluster companies' competence within advanced technologies and the manufacturing of advanced and high-quality vessels for offshore supply operations. Companies located in Norway are known for having good working standards and social norms, low levels of corruption and stringent environmental regulations compared to developing countries. Moreover, Norway has good infrastructure, logistics systems, and educational and research organizations, and is advanced in technology and digitalization. Consequently, all these factors are beneficial for sustainability-oriented changes of Norwegian clusters.

Since the negative association between fossil fuels on climate issues has become evident, the debate regarding the future of the industry is ongoing. Moreover, growing awareness toward sustainability has established new goals for many businesses with the purpose of reducing the negative impact of their current operations. The maritime industry must comply with increasingly stricter sustainability requirements and industry standards at national and international levels such as emission control issues by the International Maritime Organization and the International Convention for the Prevention of Pollution from Ships; Environmental, Social and Governance (ESG) reporting; and EU Taxonomy (Klima- og miljødepartementet, 2019). Moreover, the market is signalling an increased demand for low- and zero-emission ships.

## FINDINGS AND DISCUSSION

To answer the research question, we investigated both past events and the current situation in the cluster.

### Cluster development

Historically. the geographical location with proximity to the ocean has been a driver for locals to engage in the construction of fishing boats. The discovery of oil fields in Norway in 1969 represented the start of a new era for this industry, with a new demand for vessels that could serve offshore operations and services. Ship-

owners and manufacturers entered a new development phase to which they needed to respond, developing and building entirely new vessels to serve the oil industry. This also motivated new business development to fill the gaps in the local market and to expand the local network with suppliers located in other parts of the country and abroad. Changes in supply chain structure were followed by the growth of companies and intensified cooperation and knowledge sharing between companies and supply chain partners (Halse, 2017). In the 1990s, globalization transformed the industrial cluster from being a local to a globally oriented cluster (Amdam et al., 2020). This led to the development of a more formalized form of communication and contracting among companies (Halse, 2017). However, cluster companies aimed to contain product development and design processes in-house in order to protect knowledge (Bjarnar, 2010; Halse, 2017). Cluster dynamics with close cooperation between cluster companies involving knowledge exchange between shipowners and shipyards made the transition to the offshore market possible (Halse, 2017).

The downturn in the offshore market in 2014 made it clear that the cluster and its companies could not continue as before. Thus, it marked the beginning of a new phase where companies had to reorient towards alternative market segments such as passenger vessels, short sea shipping, fisheries and renewable energy. The costly reorientation to cruise and passenger shipbuilding required building new competence and investments in new technology. Moreover, companies aimed to establish cost-efficient supply chains in order to make the construction of cruise vessels more profitable (Jakobsen et al., 2020). Despite the efforts and investment in the transition, companies have been struggling with the low profitability associated with building cruise and passenger vessels and have not received the expected number of orders and revenue (Jakobsen et al., 2020). In 2020, the outbreak of Covid-19 led to increased market uncertainty, and the respondents expect a reduction in orders from the cruise market in the future.

## The role of cluster culture in facilitating sustainability transition

The Møre and Romsdal region includes a variety of firms and supporting organizations, allowing cluster firms to find a partner for cooperation. The maritime cluster organization GCE Blue Maritime performs an important role in facilitating relationships between cluster members and developing common competitive strategy through the fostering of cooperation and innovation. Moreover, the cluster organization facilitates the transition of the industry and contributes to developing its knowledge and competence base. GCE Blue Maritime shares office space

with the cluster organizations for the marine and furniture industries, which enhances cross-industrial collaboration and innovation and supports the development of the regional industries, with each of them having an express ambition to develop sustainability on their agendas. Whereas most cluster organizations focus on specific sectors, one of the cluster organizations in the county brings together actors from various industries, stimulating cross-industrial collaboration and new network creation. Moreover, there are four higher educational institutions and two research organizations in the county that create opportunities for joint research projects and additional financing/grants for exploring new sustainability oriented solutions.

During recent years, cluster organizations have started to consider sustainability as an important long-term strategic direction for regional industries. Document analysis of the maritime cluster shows that during 2013–14 the cluster administration defined global partnership and recruitment as some of the strategic goals, but sustainability did not yet emerge as an important topic. However, some years after the oil crisis, when sustainability issues had gained more attention, companies started to cooperate in projects on the development of green products and solutions. Findings indicate that there has been an increasing focus on sustainability in the cluster organizations' work, as well as in research and educational institutions. However, respondents of Firms 2 and 6 are still relying on and expecting more orders for the offshore oil and gas supply sector.

Being under the umbrella of the same cluster, culture, regional and national regulations, and policies, it is easier for cluster firms to be aware of and follow the same standards and habits established in the country's social and ethical norms, compared to the situation in globally dispersed supply chains. The culture of shipbuilding lies in the local society's orientation towards maritime activities on the basis of their location and traditions. Over the years of industrial development, it became not only a business but a part of cluster identity that related to shared perceptions and understanding among cluster companies (Amdam et al., 2020).

Core business areas in the cluster, such as work with steel and the design and construction of advanced vessels, have been developing through many years and remain important for the cluster. Globalization through the outsourcing of activities has introduced the risk of reduced flexibility, weakening local shipbuilding competence and knowledge (Halse & Bjarnar, 2014; Menon Economics and Boston Consulting Group, 2021). Respondents in Firms 1 and 4 claim that existing maritime competence in the region is a basis for new and modernized directions in the cluster's development. Firm 4 has been acquired by a group external to the cluster which has initiated a new strategy for the firm and the cluster – recycling

of ships. Recycling represents a new business opportunity for firms and can potentially promote sustainability and stimulate new work opportunities for locals. According to respondents from Firm 4, competence and long experience in shipbuilding are important elements for running recycling, repair and rebuild operations, as indicated in the following:

> "Recycling is a reverse process to shipbuilding. You must perform recycling in the best possible and efficient way. 'Steel expertise' is absolutely needed for that kind of operation".

This statement confirms that local knowledge gained over the years of experience and skilled labour are essential for reorientation of the cluster firms toward new operations such as recycling. Recycling operations in the region represent a transformational strategy for the manufacturing of newly designed ships that can be more sustainable in operations and can be recycled easier. Moreover, it opens opportunities to create a circular economy supply chain, which will require new actors who can operate within recycling, rebuilding, and reuse activities.

The respondent from Firm 1 refers to the key competencies and strengths of the maritime cluster, which is needed to enable the industry to overcome the transition. He claims that it is crucial for the firms in the maritime cluster to satisfy a new demand by using ready-available knowledge, capabilities and experience gained throughout the cluster's history. Hence, according to this respondent, cluster firms should be cautious about getting involved in totally new business areas where they do not have enough competence and knowledge. Reorientation towards something new in the maritime industry is quite challenging for firms and employees, as stated in the following:

> "For people to think differently and react differently when you are so good at what you do – it is not an easy task."

This indicates that established culture and historically accumulated norms, capabilities and ways of thinking need to be challenged for reorientation towards sustainability thinking. Although the maritime industry is seeing increased demand for more sustainable solutions and performance, customers' requests do not always reflect this. The respondents say they are prepared to deliver more sustainable solutions, but that this is dependent on customers' needs:

> "…we are prepared to design and make boats that do not use carbon-based fuels. However, currently there is quite little demand for such products, and

> this is the biggest problem. But we must be prepared anyway to produce that kind of product."

And similarly, another response from the representative of Firm 1:

> "… sustainability lies at the bottom, and many talk about it. Ideally, there should be zero emissions, but no one buys it."

Since the oil crisis, the number of local shipping firms has dramatically decreased. Shipping firms perform an important role in the cluster, as the respondent says:

> "Shipping firms are not present in all of the segments, thus we lose 'drivers' for innovation, because the shipping firms are one of the drivers, that also pay the bills."

With fewer shipping companies in the region, the traditional representation in the cluster that used to include shipowners, shipyards, equipment suppliers and design firms is changing, which may affect the innovativeness of cluster companies. According to the respondent from Firm 1, this is a reason why international cooperation could be beneficial for local industry. However, when establishing relationships with foreign companies, one should consider challenges as differences in institutional context, low trust, risk of failure and required investment and resources to make the cooperation fruitful for both parties. Cultural differences can also hinder the sharing of tacit knowledge between actors. Furthermore, it may create a challenge for communication and working culture, which is reflected in this respondent's quote:

> "It was good to have closeness between equipment supplier and shipyard, so that the discussion and communication goes smoothly. The problem is when a significant part of the workforce is foreign … Then you buy hull and equipment from abroad, but what about the culture of cooperation and flexibility at the Norwegian shipyard?"

Changes in the cluster structure and operations associated with globalization may represent a risk of weakening knowledge and competence locally, which is an important foundation for cluster competitiveness and development. Internationalization can weaken competitiveness of local shipyards (Menon Economics and Boston Consulting Group, 2021). In this sense, globalization may represent challenges for the transition to a more sustainable industry. Similarly, the competence

of Norwegian companies in complex offshore oil and gas projects is vital for developing the offshore wind industry (NHO, 2020).

Findings show that some of the equipment suppliers operating at the national and international levels and offering products for several market segments have exhibited more stability during recent years (Jakobsen, Lind, & Abrahamoglu, 2021). Cluster specialization can limit firms' product portfolio and flexibility to transform, but at the same time having a rich foundation from previous transformations, in addition to tacit knowledge and unique competence, might facilitate new business development. On the other hand, the recent market changes have demonstrated the vulnerability of the cluster due to its narrow specialization in the offshore market. According to Trippl et al. (2015) this can be viewed as a lock-in effect of clusters being specialized in one major field of operation. Furthermore, Derlukiewicz et al. (2020) discuss some of the disadvantages that clusters can bring for businesses, including a risk of economic downturn in regions that rely on one large industry that may cause growth in unemployment and other social issues.

The maritime cluster has accomplished the transition from specializing in fishing vessels to building offshore supply vessels. This experience can be considered as an advantage for further reorientation of the cluster. History can also be seen as a constraint and opportunity "as it sets the scope for re-orientating technologies, skills and institutions in regions" (Boschma, 2015, p. 736), meaning that new path development can be facilitated by available resources and capabilities. Derlukiewicz et al. (2020) argue that it can be more challenging to encourage companies related to heavy industries to follow sustainability reorientation. Furthermore, the costly transition towards new market segments can demotivate some of the actors' willingness to change. Even though we have seen a move in the cluster towards new markets, the respondents from Firms 2 and 6 say they expect to deliver more products to the offshore market. This is supported by Grillitsch and Trippl (2016), who describe how strong capabilities that have been developed over the years with investments in knowledge, routines and infrastructure become a barrier for firms to change and invest in new transitions.

The common opinions of the respondents and findings from the secondary data assessment indicate that currently the maritime cluster faces many structural changes that represent a risk for its future development (Jakobsen et al., 2020; Jakobsen, Helseth, & Baustad, 2019). Some of the respondents agree that the cluster is on the way to fragmentation towards several market segments and the value chains will be transformed. During fragmentation there is a lack of connectedness between networks. Consequently, communication and cooperation are concentrated within instead of between networks (Tödtling & Trippl, 2005). Thus, know-

ledge sharing and innovation activities concentrated within networks could be reduced due to diminished communication and interdependency between these networks. According to Grillitsch and Trippl (2016) this can be seen as a barrier for growing new paths if we consider the cluster as one entity. However, the diverse market orientation in the cluster indicates that the existing path is changing. Consequently, the findings show that the actors who are looking into reorientation towards sustainable development might face issues related to the lack of partners and resources available.

In the transition process towards more sustainable operations, clusters are considered as drivers for innovation; competition, which creates opportunities for learning and new knowledge acquisition; and access to regional capabilities. For supply chains which are not part of the clusters, the influential role is given to the leading firms – firms with a higher level of power – who set the supply chain requirements. These supply chains are often globally dispersed and therefore do not provide access to the local benefits of traditional clusters. In globally dispersed supply chains, geographic distance increases complexity and logistics costs, and emissions due to transportation are higher than in localized supply chains. Unlike supply chains, clusters are characterized by geographic, organizational, cognitive, social and institutional proximity between companies (Boschma, 2005), which makes it easier for a company to select a supplier or a partner that will have similar values and follows similar practices. In cluster environments, close geographic proximity and trust facilitate the exchange of knowledge and technology, which fosters the innovation necessary for the development and implementation of sustainable solutions.

## CONCLUSION

The purpose of this study is to shed light on the current reorientation process towards sustainability through the lens of cluster theory. According to the study, sustainability is well defined as a strategic direction in the cluster policy. The findings in this study indicate that cluster organizations play an important role in strengthening the industry towards sustainability. Moreover, our findings indicate that shipbuilding knowledge and competence represent a foundation for development towards sustainability, as shown in the example with recycling and repair of vessels. The regional culture has been important for the development of a basis of unique expertise and knowledge, which could be vital for a new path development towards sustainability. However, cluster companies are focusing on delivering solutions according to customer requirements, which in some cases are not in line

with a transition towards sustainability. Moreover, some of the firms do not seem to be ready for transformational changes as their knowledge is based on experience gained from delivering to the offshore market over several decades.

Another challenge is the recent diversification of the cluster, which can lead to new separate production networks with lower degrees of communication and cooperation between networks, which can weaken the traditional advantages of cluster membership – close relations, ease of communication and interdependency. Globalization and changes in cluster structure can weaken the companies' knowledge and competence, which will indirectly reduce the companies' ability to undergo transformation.

On the basis of the empirical findings from the maritime cluster in Møre and Romsdal, which are analysed through a cluster theory perspective, this study contributes to the understanding of how cluster membership can facilitate and hinder companies in their transition to more sustainable practices and operations. The study also gives insight for industrial managers and policy makers, focusing on sustainable development of regional economies. The study has some limitations as it draws on the empirical data of one industrial cluster in a high-cost location.

## REMARKS

The authors declare no conflict of interest.

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