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# Knowledge and practices towards sustainability and circular economy transitions: A Norwegian manufacturing perspective

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**Abstract.** The extant literature shows that companies are willing to transition into sustainability and the circular economy (CE) yet lack the knowledge and skills to transform their actions to meet sustainability challenges in a meaningful way. Indeed, for companies to act in an environmentally responsible way, they must know enough about environmental issues, yet literature on this knowledge standpoint is missing. This paper assesses the knowledge and practices among manufacturing companies working towards sustainability and CE transitions. The study employs a survey design and in-depth interviews with 20 firms from the manufacturing industry in Norway. This study contributes to the theoretical understanding of sustainability and CE transitions by providing insight into the knowledge and practices of manufacturing firms, which may at the same time facilitate decision-makers in planning for the development of a CE and promote the sustainable development of the manufacturing industry in Norway.

**Keywords:** Sustainability, circular economy, sustainability knowledge and practices, manufacturing industry.

## 1 Introduction

Competitive pressures, innovation and market potentials, regulatory concerns, and a sense of corporate social and environmental responsibility have prompted many companies to engage in sustainability issues in recent years [1]. Sustainability is used here as a common notion referring to “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” [2, p. 3]. From the business perspective, the circular economy (CE) is understood as a model that is “restorative and regenerative by design, and aims to keep products, components, and materials at their highest utility and value at all times” [3, p. 1]. In this study, CE is viewed as an approach to implement the much-discussed concept of sustainable development [4]. The sustainability and CE transitions are due to the many environmental problems (e.g. climate change, resource depletion), which are brought about by unsustainable consumption and production patterns [5]. In fact, to develop society and the

corporate world towards a more sustainable state, an incremental continuous transition is needed, which according to [6] is the response to a number of persistent problems confronting today's modern societies. To be able to respond to these challenges, [7] advocates that we need the will to do it - a sense of urgency, a will that follows from an attitude of concern and we need to develop knowledge of sustainability/CE, which will then be transformed into sustainable patterns of human activities. Succinctly put, if companies have knowledge of sustainability and CE, then they should be able to understand what drives and blocks sustainability/CE transitions, and how such transitions can be accelerated [6]. This is consistent with Velenturf and Jopson [8], who argue that companies are willing to transition into sustainability and CE yet lack the knowledge and skills to transform their actions to meet sustainability challenges in a meaningful way. Indeed, for companies to act in an environmentally responsible way, they must know enough about environmental issues [9]. However, numerous theoretical frameworks have been developed to explain this gap between the possession of knowledge and awareness related to sustainability and displaying behavior that consciously seeks to minimize the negative impact on the environment (e.g. minimize resource and energy consumption, use of non-toxic substances, reduce waste production). Although various studies have been undertaken, no definitive explanation has yet been found [10].

Against this backdrop, this study aims to assess the knowledge and practices among manufacturing companies working towards transitioning into sustainability and the CE. This focus on manufacturing companies can be justified on the following grounds: Firstly, companies are endowed with resources and capabilities, as such they have the potential to drive the change towards a more sustainable economy [1]. Secondly, they are the most influential institutions within the market, which is the most dominant coordinating institution in the world [11] and thus any strategy aiming at increasing sustainability cannot be pursued without their involvement. Thirdly, those companies that dominate economic activity are increasingly viewed as a major cause of the current ecological crisis [12, 13] and hence it is essential that they commit to being proactive in the transition towards a more sustainable economy [13, 14]. This study therefore contributes to burgeoning research on sustainability and CE in the manufacturing industry. By contextualizing it to the Norwegian manufacturing industry, it provides a novel counter-point company perspective on knowledge and practices towards sustainability/CE.

The paper proceeds as follows. Section 2 reviews literature related to knowledge and practices towards sustainability and the CE. Section 3 describes the method employed by the study, followed by analysis and discussion in section 4. Finally, Section 5 presents the closure and limitation of the study.

## **2 Knowledge and practices in sustainability and CE transitions**

Sustainability transitions are long-term, multi-dimensional, and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumption [15]. However, there is little research

on knowledge and practices related to sustainability and CE transitions. Extant literature focused on the gap between awareness and behavior; for instance, Blake [16] looked into the value-action gap in environmental policy, and on the external environmental pressure on firms and their behavior [17]. While Kollmuss and Agyeman [10] found that increases in environmental knowledge and awareness generally did not lead to pro-environmental behavior. Regarding studies that focused on the awareness and behavior of firms toward developing a CE, Lin [18] found increasing CE knowledge levels among industrial firms. However, as can be seen from the review of literature, despite the wealth of evidence concerning environmental awareness and the behavior of firms, there is little research on the knowledge and practices of firms in transitioning into sustainability and CE. Thus, this study seeks to contribute to knowledge for sustainability and CE transformation and should therefore be deemed essential.

In the subsequent section, the method employed in this study is presented.

### **3 Method**

Considering the study's objective, a multiple-case-study approach was deemed appropriate since it is suitable for replication purposes [19]. In contrast to a single case study, a multiple-case-study approach increases external validity and reduces observer bias [20]. The case companies for this study were selected from an industrial cluster that comprises 50 companies from different industries (e.g. heavy machinery, IT, plastic, lighting system). Since it is typical in case study research to select cases by applying specific criteria, instead of selecting a random or stratified sample [21], the following main selection criteria were applied in this study: (1) if the company was a manufacturing company with either in-house or outsourced production, and (2) if the company was interested in exploring business opportunities under the sustainability logic, where the business model(s) is aligned with the triple bottom line.

Data were collected through a survey, where 20 manufacturing companies with different market segments (e.g. advanced equipment to maritime/casting industry) responded to the self-administered questionnaires via Quest Back. The survey design was chosen as it is often the most direct and cost-effective way of soliciting the respondents' opinions about the subject of interest [22]. In order to gain an in-depth understanding of the companies' perspectives on sustainability/CE, semi-structured interviews were conducted with the CEO and departmental managers of eight of the 20 companies. To allow for data triangulation [19], these data sources were supplemented with document analysis of official documents such as sustainability/CE articles and company websites.

The next section presents the analysis and discussion of the study.

### **4 Knowledge and practices towards sustainability and CE**

The study's results indicate that the companies have a relatively good general understanding about sustainability, have a positive view of it and a relatively strong willingness to act toward its development. Figure 1 shows different viewpoints of how companies understand sustainability. These definitions are categorized according to the

similar elements identified in all the given definitions (20 in total). Here we can see that there is a strong focus on the long-term perspective and a strong awareness of the three dimensions of sustainability. For example, 30% of the companies report that sustainability is concerned with assuming that nature and the environment are not an inexhaustible resource and so, it is essential to protect them and use them rationally, by making sure that their businesses do not harm the environment. While 60% of the companies defined sustainability through the following interconnected pillars: environment, economic and social and the future generation. This definition corresponds to the one provided by the widely acknowledged Brundtland Report ‘*Our Common Future*’ describing it as “development which meets the needs of the present without compromising the ability of future generations to meet their own needs” [10, p. 43].

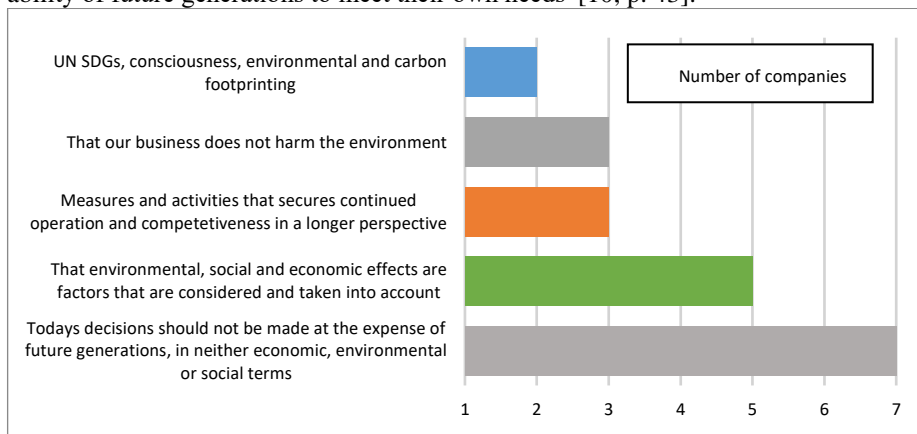


Figure 1: Different aggregations of interpretations of “Sustainability” and what that means to the companies

Considering the CE, the results indicate that most of the firms had heard of the CE (95%) and most of them could identify CE with regeneration and recycling of waste, minimization of resource consumption and waste production. This result corresponds to Lin et al’s [18] finding that most industrial firms have increasing CE knowledge levels.

Further, the survey reveals how the companies ranked how important different dimensions of sustainability are for them. Unsurprisingly, the economic aspect of sustainability is identified as the most important for all the studied companies. This is also evident in Gusmerotti et al’s [23] study, where the findings suggest that the economic drivers are the only effective lever for the transition towards more sustainability. On the other hand, social sustainability is ranked as more important than environmental sustainability. This result is somehow unexpected, especially bearing in mind that social sustainability is often overlooked relative to the other two aspects. What is more, from the in-depth interviews it shows that most of these companies under study are regarded as “cornerstone companies” and as such, they view the social aspect of their role in the region as very important. Consequently, these companies recognize the significance of their relationships with people, communities and society, and thus social responsibility becomes part of their core business strategy and they consider how their

activities affect people. Ultimately, this might lead to unlocking new markets, becoming the source of innovation for new product lines, raising internal morale and employee engagement as well as helping retain and attract business partners, all of which are of vital importance for business competitiveness, survival and local community development [24].

Additionally, the survey identifies the measures that the companies perceive as their best possibility to improve their work with environmental sustainability. As illustrated in Figure 2, influencing the upstream value chain by setting environmental requirements to purchased goods, is seen as the least promising area for action. While influencing customers by offering more sustainable products, is identified as the best measure of improving their sustainability efforts. This result is in line with the companies' prioritization of economic sustainability over the other aspects, since by influencing customers, they are placing the customers at the center of corporate strategy, which is based on the insight that customers are the basis of company profitability [25].

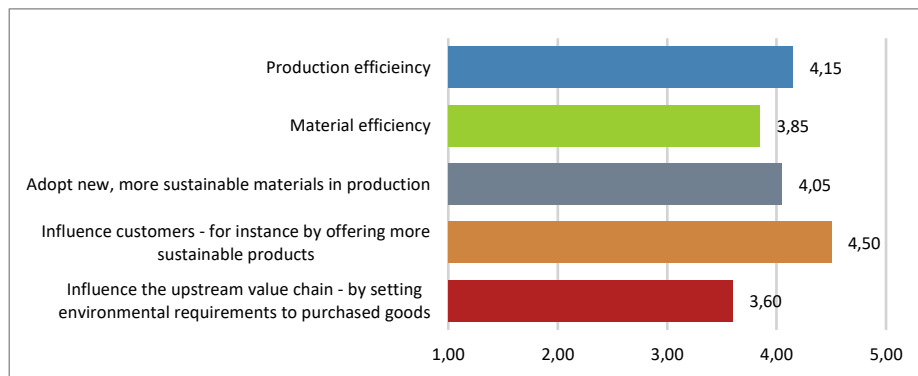


Figure 2: Best chances of improving the sustainability efforts of the company

Besides, interview data reveal the barriers that are most relevant for the companies under study when it comes to implementing sustainable business models (SBMs). These barriers are structured following three categories: 1) regulatory, 2) market and financial and 3) behavioral and social. The most frequently mentioned barrier is lack of economic incentive, followed by financial risk. This is due to the complex nature of SBMs and the typically higher initial cost and investment required for implementation [26]. This implies that a great deal of advances in economic model innovation will need to be made if these companies are to effectively become sustainable.

The results also describe the actions currently being taken by the companies in how they work with sustainability. Figure 3 shows a range of different approaches among the companies, from having a central role in the company's strategy to having no particular focus on sustainability at all.

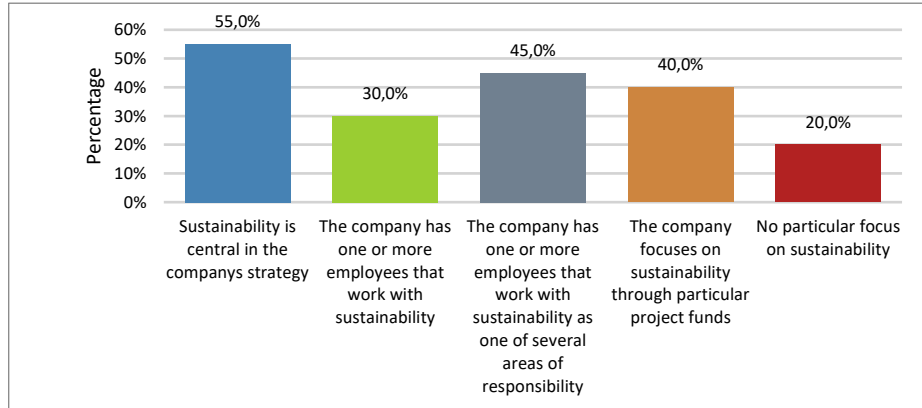


Figure 3: How does the company engage in sustainability?

In addition, the results indicate that approximately 60% of the companies already have plans of transitioning into a CE, 20% do not have any plans, whereas about 20% report that CE is irrelevant for them due to the complexity of their products (their products have a lifespan of 50 years and due to their material mix, it is impossible to reuse them after end of life). Moreover, the results show different ways on how the companies can approach CE (see Figure 4). Most of the companies (80%) report developing new markets and innovative business models, as one way of making a shift to a CE. This is in consonance with EMF [27], who assert that the shift to a CE requires innovative business models that either replace existing ones or seize new opportunities.

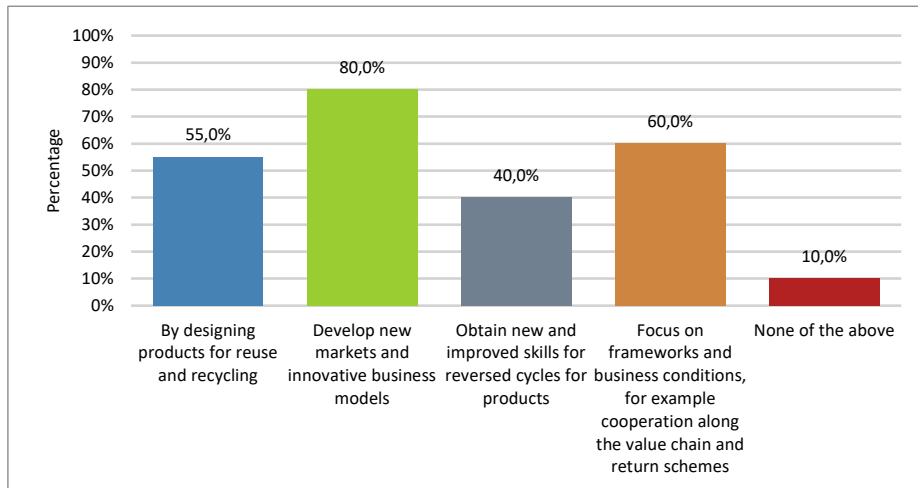


Figure 4: How the companies identify ways to approach the circular economy

What is more, the results show measures already taken by the companies in transitioning towards a CE and these include, among others, 1) cooperation with customers on return and upgrading solutions instead of delivering new products; 2) focusing more on recycling all of production waste not only the products and avoid producing “use and

throw” products and 3) working by following CE principles (reduce, reuse and recycle) – with as effective production as possible, and recirculating materials and products.

## 5 Closure and limitation

This study has sought to assess the knowledge and practices among manufacturing companies working towards transitioning into sustainability and the CE. The results present a picture that is quite interesting, even though not unexpected. The level of knowledge and practices regarding sustainability is generally high among the companies under study. This can partly be explained by the high level of requirement and regulation Norwegian industry is faced with, both domestic and internationally. The Norwegian business culture, where taking extended responsibility for social and environmental conditions, also play an important role. Thus, although the level of knowledge and practices seem fairly high, we see a difference in their perception of “sense of urgency”. Some companies are focusing on only meeting minimum requirements, while others are inspired in doing more – although not all know how to proceed to increase their effort. One important aspect concerning this industry’s sustainability efforts is the ability to adapt to new regulations and requirements. From this study, it is clearly stated that the industry has an increased focus on sustainability from company ownership and management perspective, and that this focus is expected to increase in the years to come. However, this is not highlighted as a negative challenge, it is rather emphasized that more and stricter regulations and requirements on sustainability performance are welcomed, as this removes and excludes some of the competing companies that are not able to comply with this.

A limitation of the current study warrants attention as it addresses specific cases in a particular geography, one economy only, Norway and manufacturing industry. Hence, as a further avenue for research, we suggest in-depth case studies with other industries as well as other economies.

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