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Newsletter

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Research Area 3: Innovative and Sustainable Organizations

This newsletter is published prior to each workshop of SFI Manufacturing. The aim is to keep the community up to date with the current research that is being carried out within and related to the centre. This issue of the newsletter is focused on the research area Innovative and Sustainable Organizations.

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SFI Manufacturing

A cross-disciplinary centre
for research based innovation
for competitive high value
manufacturing in Norway

sfi = Centre for
Research-based
Innovation

The Research Council of Norway

About the research area

The research area Sustainable and Innovative Organizations concerns the human and organizational aspects of advanced manufacturing companies. Research questions highlighted are: How could a manufacturing company be organized to develop the employees' competences in line with new technology? How to develop new product and production technology to stay competitive? How can sustainability issues be integrated into product and process development? How to best interact with other companies, educational institutions and research institutes in order to obtain long term sustainability?

Overall objective and work packages

The overall objective of the research within this area is to develop knowledge and solutions for advanced work systems that are able to utilize new technology and flexible and automated processes to manufacture sustainable multi-material products. The work is organised into two work packages (WP's):

- WP3.4 – Future Manufacturing Organization models
- WP3.5 – Sustainable business model development

Organizational aspects are essential for long-term development and success of competitive industries. Research in RA3 has contributed to theories and practices along several dimensions.

An important contribution has been the development of a benchmarking methodology for enterprise maturity mapping (input from 1183 respondents) focusing on digitalization and innovation. This has resulted in a digital survey tool, applied in the mapping of some of the SFI Manufacturing partners. The results have been analysed, and the feedback has been provided to/discussed with the participants. The activity has been published in journals and presented at conferences and in reports.

A challenge identified by the industry partners is Industry 4.0 decision support at shop floor level. This topic has been addressed and resulted in a tool which is demonstrated in two enterprises (spin-off project) based on "SmartWatch", providing specific information to shop floor operators.

Additionally, by addressing the balancing strategies in industrial clusters and the clusters absorptive capacity, the research has resulted in policy guidelines directing industry and policy makers, balancing exploration and exploitation strategies for ensuring vital manufacturing industry in the short and the long run. Methods for exploitation of unique local knowledge bases have been provided. Field work has been conducted and has resulted in several international publications, which provide a good description of the industrial network our partners are connected to.



Photo 1 & 2. The next SFI workshop will take place at furniture manufacturer Ekornes. Photo's: Ekornes

During the forthcoming workshop at Ekornes, which is a joint activity between WP3.4 and 3.5, highlighting organisational and sustainable elements, the last research results will be presented. In the evening of Monday 28th October, the scenario activities will be presented and discussed. A number of important impact factors for the manufacturing industry have been identified from international and national reports, and have been applied in a methodology for scenario development. On Tuesday 29th October, the latest activities in the PhD-projects will be discussed.

Update on the research activities

WP3.4 – Future Manufacturing Organization Models

Scenario building - Drawing a picture of the future

For the fourth time in our history, we're in the midst of a game-changing transformation regarding the way we produce products. The first two revolutions arose via mechanization, by help of water and steam power, and mass production by help of electrical power. The fourth industrial revolution will take what was started in the third revolution with the adoption of automation, by help of electronics and IT, and enhance it with smart, autonomous and more sustainable systems, which are fuelled by data and artificial intelligence. New technologies, market and sustainability challenges require adjustments in the way we organize our industrial activities. Norwegian industry is a microsystem on an international arena characterized by continuous development and important trends.

SFI Manufacturing and RA3 have established an analysis group to assist the work towards a smarter organization of our industrial activities. The group consists of four researchers who have analysed major international and national reports in order to synthesise trends that have a major impact on our industry of today and tomorrow. Such trends include increasing customization, technological standardisation, maker economy, production close to customer, circular economy, remanufacturing and de-manufacturing, biowaste, increasing middle class in developing countries, lifelong learning and higher demand for complex cognitive skills for example.

Scenario building

The analysis group has identified a number of important impact factors described in major international and national reports (from for example World Economic Forum, EU Commission Reports, McKinsey Global Institute, OECD and Digital21). These factors will to varying degrees affect Norwegian industrial companies and the markets they are operating in. The main outcome of this study will include 1) A whitepaper on how to organize the Norwegian industrial production of the future, and 2) A methodology for assessing trends and for scenario building that can provide important input into the companies' strategy development.

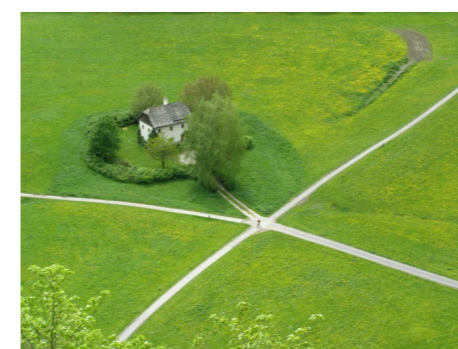


Photo 3. Illustration of different scenario's. Photo: Pixabay

The Ekornes case study

During the Ålesund workshop, the analysis group will give a brief demonstration of a scenario methodology that can give Ekornes input to its strategy work. Scenario building is a way to craft a narrative. It's a narrative based on different possible futures, and it's in a way a "historical fiction" that is useful as an input to further strategic work. After an introduction to the methodology, participants of the workshop will have the opportunity to practically try out this methodology on parts of the Ekornes' case study.

WP3.5 – Sustainable business model development

Knowledge for sustainable management and governance of value chains

In this work package we address the fact that a company's business model changes over time, based on marked trends, technological innovations and demands from key stakeholders. The recent years have shown a great increase of societal expectations when it comes to the responsibility of the manufacturing industry for its social and environmental impacts. The United Nations Sustainable Development Goals (SDGs) have since 2016 been driving this development.

Manufacturing companies are expected to develop products and processes in line with the SDG's. For example, goal number 12 addresses the environmental impacts, and the Norwegian government has stated a national goal of minimum 40% reduction of greenhouse gases emissions in 2030 compared to 1990-level. In order to drastically reduce emissions and the use of resources, innovation that is more radical is required.

An underlying principle of industry engagement with the SDG's, is that companies extended their scope of sustainability thinking to cover the complete value chain the company belong to. By help of industry 4.0 technologies in interaction with customers and suppliers, manufacturing companies have increased potential to contribute to enhanced sustainability of the complete value chain. This development may have implication not just for organizing value chains, but also for the localization of production.

Applying the broad SDG's in specific industrial context creates cognitive tensions and technological challenges. For example, both increased digitization and the use of multi-materials, have positive and negative impacts on environmental performance, e.g. products are lighter, but it might be difficult to separate the material fractions after the primary use stage.

This work package addresses the challenges of applying the SDG's with an emphasis on circular economy principles (SDG number 12). By applying a global production network perspective in analyzing sustainability of each stage of the value chain, we will provide the participating companies with knowledge for sustainable management and governance of value chains.

PhD progress reports

Eirik Bådsvik Hamre Korsen

I started my PhD in January 2017 and are now halfway through. My research area is Performance Management (PM) in manufacturing organisation. I aim to describe how the management systems works within the industry. My research is qualitative, and four of the SFI Manufacturing participants provides data through interviews. In 2019, I have published the first article on how an organization can combine the use of Balanced Scorecard (BSC) with Hoshin Kanri (HK) to increase the likelihood of a successful strategy implementation. The BSC can be used to articulate and communicate the strategy, where HK can link the long-term strategy into day-to-day operations. The paper is available [here](#).

Based on my research and the initial analysis, there are three areas I will continue to explore in the second half of my PhD. First, I want to describe the PM systems used in the manufacturing organizations. In particular how technical controls (what we measure, tools, and formal management processes and reviews) interrelates with social controls (how people interrelates, build a culture, and empowers employees) to increase performance. Secondly, I want to identify how digitalization influence the way we manage, our PM system, and in particular the social controls. Finally, I aim to understand the interrelation between the PM system and how the organization cope with changes, both continues improvement and larger improvement projects.



Henrik Brynthe Lund

Hi, I am Henrik! I started my PhD in August 2016, which I am now in the process of completing (early December 2019). As a geographer, I study the influence of local, regional, national and global processes on the development of local and regional industry. An important aspect of this is recognizing history's influence on current developments. Therefore, we have studied the historical development of the prevailing core cluster competences in the Kongsberg and Raufoss clusters, systems engineering and automation and light-weight materials. We identify the importance of the nation state in the post-war era, acting as owner, market creator (NATO) and research partner (FFI), and how this laid the basis for the industrial development at Kongsberg and Raufoss. Furthermore, state interventions contributed to the development of the core cluster competencies that constitute a comparative advantage for the firms located at Raufoss and Kongsberg today.

The thesis also covers contemporary developments, both within and outside the two clusters. Advances within manufacturing technologies is challenging Norwegian manufacturers in terms of knowledge and competence. We identify the cluster firms' ability to identify, acquire and exploit new technologies to increase competitiveness and innovativeness as essential. This ability depends on firm internal process in technology and knowledge upgrading, but we also find that intermediaries are essential in terms of accessing knowledge and technology actors outside the cluster. New technologies also challenges the competence of those working in production. We claim that skilled workers are essential for the successful

implementation of advanced manufacturing technologies on production lines. In the extension of this, vocational education institutions become essential for the competitiveness of manufacturing firms, as these institutions provide the industry with a qualified workforce. In order to provide a vocational education that fits with the industry's knowledge demands, extensive collaboration between industry and education is needed when developing vocational education programmes. Finally, the thesis includes a study of how the development of local and regional capabilities, in combination with advanced manufacturing technologies, has enabled the reshoring of Norwegian manufacturers.

Marit Moe Bjørnset

I started my PhD in autumn 2016. In spring 2019, I came back to work again after a year home in maternity leave. The main topic for my PhD, is life cycle assessments (LCA), and how they can help facilitate the transition towards a green economy by focusing on circular thinking. My PhD is co-financed by the (now ended) competence project [SISVI](#) – Sustainable Innovation and Shared Value Creation in the Norwegian Industry.

Life cycle assessments can be utilized to develop tools that integrates environmental management into core business activities, and thereby prepare the manufacturing industry for the green shift. Since my return I have been focusing on completing a literature review paper on circular economy in manufacturing companies. The review provides insight into how circular economy is used and interpreted in a manufacturing context, and for me is a useful foundation to build my case work upon. During this autumn I will continue to use Hexagon Ragasco as a case and complete the writing of a paper about the strategic use of life cycle assessment in their sustainability efforts.



Vetle Engesbak

Hi! I am Vetle and I started my PhD in April 2015. I explore how organizations with mature production systems may better organize to capture the value from step-change improvements. Industrial organizations need to continuously improve their production process in order to remain competitive. Improvements typically take the form of efficiency gains through cost reductions and increased production volumes. Local improvements from rationalization techniques such as Lean, TQM and Six Sigma are important, but organizations also need complex organizational learning from exploration activities in order to remain competitive.

In exploring how organizations may achieve this, I look at questions such as: What characterises organizational learning in process industries? How should expert divisions (for instance R&D) collaborate with the line organization to support implementation of new technology? Moreover, how does rationalizations efforts in the production process influence the organization's ability to innovate?

Relevant research projects

KPN: Lean-Management

2015 - 2019. Partners: Benteler Aluminium Systems Norway, Kongsberg Automotive, Kongsberg Maritim, Nammo, Ernst & Young, NTNU, SINTEF Manufacturing

The project's primary goal is to understand, model, verify and demonstrate lean management roles, responsibilities and practices at all organizational levels and across organizational boundaries, to develop knowledge in order to increase competitiveness in the Norwegian manufacturing industry.

The project has gained an in-depth understanding of what characterizes excellent lean management within the Scandinavian working life. It goes beyond the application of well-known tools in a relentless pursuit of learning and continuous improvement at the shop floor, and across the organization's wider value streams. This leads to a question we are currently working on: how to educate and train current and prospective managers so that they build the required competencies?

KPN: ManuNet 4.0 - Manufacturing Network 4.0

2015 - 2019. Partners: Pipelife Norge, Brunvoll, Ekornes, Kleven Verft, Norwegian Rooms, Ikuben, SINTEF

Global sourcing of production, increased international competition and financial crisis call for a new level of excellence in manufacturing. Knowledge-based innovation, cost reduction and creating company specific value chains and manufacturing networks with a global supplier base, are essential strategies to face these challenges.

ManuNet 4.0 aims to develop a knowledge base and methodology for the dynamic design of manufacturing networks, innovation and knowledge sharing, and next generation manufacturing operations, to achieve sustainable growth and competitiveness. The project concerns how networks are able to capture innovation and value in distant networking, and particularly how the configuration and design of global supply network will affect knowledge sharing and innovativeness in those networks.

The project will develop knowledge on the connection between location and innovativeness, as well as knowledge on how to assure effective knowledge exchange in a given network configuration. This involves an in-depth study of value co-creation in manufacturing networks, and research on how this can be improved.

KPN: SISVI - Sustainable Innovation and Shared Value Creation in Norwegian Industry

2014 - 2018. Partners: Hexagon Ragasco, Plasto, Raufoss Water & Gas, Wonderland, åkp, Forsvarsbygg, NTNU, SINTEF Manufacturing

Based on the concept of sustainability, SISVI will support Norwegian industrial firms in developing their own unique competitive strategy with respect to internationalization, innovation and interactions in networks. The project emphasizes environmental and green aspects as drivers for innovation and value creation, and the development of sustainable business models is an important topic within the project.

KPN: V-ALU-E - Cross-Industry, Cross-Science Collaboration Strategies for Value Driven Aluminum Product Development

2017 - 2021



The primary goal of V-ALU-E is to develop new insights, models and capabilities for accelerated, value-driven innovation of aluminum products, tested and verified in a research environment that enhances collaboration between academia and industry, as well as industry sectors.

Besides developing knowledge on scrum-based product development methodology, cross-project learning in companies and co-creation between industry and academia, the project is expected to contribute to a series of aluminum product innovations and demonstrators in cooperation with aluminum users. The project team will be situated at NAPIC (NTNU Aluminum Product Innovation Centre), a transdisciplinary centre hosted by Department of Mechanical and Industrial Engineering.

IPN: SmartChain - Automation and Digitalization for Efficient Supply Chains

2017 - 2020. Partners: Kongsberg Maritime Subsea, Norautron, Oswo, Virinco, SINTEF Technology and Society, SINTEF Manufacturing

Norwegian suppliers have had a significant competitiveness and growth potential related to knowledge-based production of highly advanced and innovative products with a high degree of customization. Over the years, we have positioned ourselves in the top of many premium market segments. However, when competition from low-cost competitors intensifies, can we also assert ourselves in the volume segments? The main goal of SmartChain is to develop methods and solutions that ensure efficient supply chains with a high degree of technology-enabled production, including planning and control.

KPN: The lean-digitalization paradox

2019 - 2023. Partners: Benteler Automotive, Equinor, Norsk Hydro, Deloitte, Kværner, NTNU, SINTEF Manufacturing

Lean management remains the fundamental approach to operational excellence within Norwegian industry. The next wave of industrial improvement is widely considered to be driven by the application of digital technologies. Digitalization should not replace lean management. Rather industrial companies are seeking to understand how the two approaches can be utilized synergistically.

Starting in 2019, the project will:

- Pinpoint and understand the tensions, barriers and opportunities between lean and digitalization, and assess how these tensions best can be managed in Norwegian industry.
- Develop theories and managerial guidelines for digitalization of Norwegian industry based on lean principles with respect to of planning, decisions systems, supplier collaboration and work organization.
- Demonstrate the application of these guidelines in the participating companies and document how they lead to improved manufacturing performance.
- Educate 2 PhDs and 1 post-doc, and produce 20 scientific articles or book chapters.



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