Organizational Enablers for Digitalization in Norwegian Industry

Lars Harald Lied(✉), Maria Flavia Mogos, and Daryl John Powell

SINTEF Manufacturing AS, S.P. Andersens Vei 3, 7491 Trondheim, Norway
{lars.harald.lied,maria.flavia.mogos,
daryl.powell}@sintef.no

Abstract. Norway has a long cultural tradition for organizing its working life. A dialogue-based and cooperation-oriented model constitutes the way work life functions locally in companies as well as at the national level. This article addresses how the basic values of this practice promote processes of industrial digitalization in Norway. The digitalization of industry and society has many faces, but the focus here is on organization, forms of collaboration and management that create the foundation for successful digital implementation in the industry. Within the framework of a working life that requires ever-increasing competence at all levels, this article shows that intra-corporate collaboration between management and employees generates common goal understanding and process commitment. This paper highlights seven organizational enablers for digitalization in a Norwegian industrial context. Our findings from a cross-case analysis of data collected through 33 case studies of successful digitalization processes at Norwegian companies in a diverse set of industries suggest that the digitalization of industry requires cross-functional and inter-organizational collaboration to develop more specialized expertise from all employees, and this serves as a key element for success within industrial digitalization.

Keywords: Digitalization · Operations management · Multiple case study

1 Introduction

Today's industrial challenge is largely about how to generate increased competitiveness through the strategic implementation of digital technologies. Operators and machines must cooperate with an interaction we have not envisaged before [2]. Technological impact will again alter our ways of organizing and manage industrial production. Access to current information is no longer reserved for managers only [3]. Hierarchical organizations are replaced by flatter structures with autonomous production teams. These teams have access to all the data needed to do a good job. The operator must increasingly communicate with the robot through programming, computing has become cloud-based and information is visually distributed via screens and other digital platforms. This new human – machine interface (HMI) calls for specialized skills among operators and a reconsidered understanding of being a leader. The communication and division of responsibilities between manager and employee are changed in a way that requires a dynamic organization that can cope with change.

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Digital solutions create a framework for how to organize processes, workplaces and communication in the future.

2 Theoretical Background

2.1 The Norwegian Model as an Enabler for Industrial Development

In Norway there is a well rooted tradition based on dialogue and involvement. It is a tripartite co-operation with the Norwegian Confederation of Trade Unions (LO), the Confederation of Norwegian Enterprise (NHO), and the Norwegian government constitute this model. Formal cooperative measures go back to 1935 when board representation for employees was fixed by law [4]. The Norwegian model (NM) for work-life design is a cooperative model based on trust and respect among the parties involved. Trust is the key element for success in this model. Both the employer and the employee side of work-life have agreed upon a series of tools to avoid unnecessary use of energy in search of best performance. The unions, and specifically the employee representatives, have a demanding role in such a model. On one hand, they are the representatives of the employees' interests. On the other hand, they are obliged to co-operate with the employer, and align the company's goals and employees' interests. This challenging role has been described as the balance between "boxing and dancing" [5]. The model is culturally embedded in all levels of Norwegian work life, and it sets a strong guideline for priorities made in work-life. Management and organization mirror this in a direct way. This dialogue based and involving way of organizing generates a true feeling of motivation and a sensation of being both useful and important. The voice of the employees is heard, and they feel ownership to both process and result. This way of organizing work-life has also produced a higher level of trust between leaders, employee representatives and unions in Norway compared with other countries [7].

2.2 Industry 4.0

Germany launched its so-called "Industrie 4.0" initiative in 2011 as part of the country's high-tech industrial strategy, introducing the idea of a fully integrated industry [6]. Since then, Industry 4.0 has gained worldwide interest and has opened up a range of new business potential and opportunities [7]. A commonly accepted overview of Industry 4.0 technologies includes: Autonomous robots, simulation, horizontal and vertical integration, industrial internet of things, cybersecurity, cloud computing, additive manufacturing, augmented reality and big data analytics [8]. Together, these technologies are considered to be the pillars of Industry 4.0, presenting manufacturers with opportunities for digitalization and integration of physical and virtual environments building capabilities for better problem-solving and learning in action – leading to increased operational performance and competitiveness. Inspired by Industry 4.0, the Norwegian government announced a strategy for a 'greener, smarter and more innovative' industry in 2017, which has become commonly known simply as "digitalization" [9]. Thus, in recent years, Norwegian industrial companies have been increasingly adopting Industry 4.0 technologies.

3 Methodology

Our research design is guided by the following research question: *What are the organizational enablers for digitalization in the Norwegian industry?* Given this what-type question, we selected a multiple case study approach [10], as this enabled the identification of organizational enablers in real digitalization processes and with a relatively full understanding of the nature and complexity of digitalization. This article is built on a multiple case-study conducted among Norwegian industrial companies in 2019. The study was called, *Pioneering Norwegian industrial companies and their experiences from digitalization.* The research foundation SINTEF was given a mandate by the Ministry of Trade, Industry and Fisheries (NFD) to explore how digitalization could strengthen future industrial production in Norway. Over a six-month period, SINTEF conducted a total of 170 interviews distributed across 33 *successful companies*[1] in a diverse set of industries including automotive, defense, food, maritime and process industry. The set of selected companies included all the finalist of *Årets smarteste industribedrift* (Smartest Industrial Company of the Year in Norway). A written report summarized the semi-structured interviews at each company. Trade union representatives, production and top leaders responsible for digitalization and technology developers were interviewed about their experiences with digitalization and their thoughts about its effects on future manufacturing. Responses were triangulated with company documentation and extensive field notes that were collected during company meetings and tours. For an increased accuracy of the empirical findings and increased construct validity [11], the results have been reviewed by a working group that included participants from industry, research/academia, NFD and the SINTEF researchers that conducted the interviews. The study of 33 cases enabled a fruitful cross-case analysis, an easier identification of representative relationships between the informants' experiences during the digitalization processes and their causes, and thereby a higher internal and external validity [12]. An interview guide was used, which focused on four main areas: (i) Curiosity in using new technology, (ii) Integration and utilization of digital tools (technology opportunities) throughout the business, (iii) Changing business models as a result of digital opportunities, and (iv) Reflections on the future. Potential benefits of using the NM of work-life organisation was defined as an overarching focus.

4 Discussion

When focusing on organizational enablers for implementing digitalization in the industry, the analysis of the SINTEF study data can be summarized in the following emergent themes:

Ensuring Company Democracy. Decisions regarding the implementation of new digital technology includes the employees in a direct way. Job content becomes altered,

[1] A *successful company* was defined as a company that can demonstrate successful development and implementation of digital technology.

new skills are required and processes must be reorganized due to new and increasingly complex technology [13, 14]. Within such a framework, it is most important to make sure that the "voice of the employee" is heard. Our study showed that the industrial companies genuinely involved the employees at an early stage in the process. By doing so, the company management gained trust, transparency and support from the union. By establishing this relation early on, several major elements were secured:

- The management secured a higher degree of momentum in the upcoming process of implementing new digital technology
- The union could influence decisions along the process
- The process produced less errors since decisions were considered from different angles during the process. A clean process requires less adjustment afterwards
- Collective goals generated a collective feeling of ownership to the solution. A broad involvement also creates a common vision
- Employees understood that digital technology also includes jobs with more stimulating content, which may replace tedious operations [14]
- Employees felt increasingly comfortable, since they mastered the new technology.

For instance, one of the case companies, a manufacturer of heavy mechanical parts for offshore installations, has managed to streamline their well-rooted internal processes by giving their operators a smartphone with digital work instructions. However, right from the start, they involved relevant operators in the team that was developing the technological solution, alongside technology developers. Moreover, during many days the operators were observed while working and their feedback during and after the workshops that were organized along the project, were recorded and they were the starting point for real improvements. The company regarded this close and early involvement of the operators as decisive for the smooth adoption of the new technology among employees with very different background. This and all the other effects listed above are a product of organizing the process in accordance with the NM.

If one compares the implementation of new digital technology with the introduction of robots in the 70s and 80s, then this study shows a distinct difference in the attitude of the unions. Back then, the unions tried to hold back the implementation of robots due to the fear of losing jobs. The confrontation between trade union and management characterized the international automotive industry to a great extent [15]. The SINTEF study of Norwegian industrial companies show that employee representatives today sees digital technology as a necessity to safeguard future jobs and competitiveness. They genuinely support the measure and most of the companies involve employees in the whole process. It is important for companies to take advantage of this common attitude as they work on digitalization.

Safeguarding Well-Balanced External Relations. Digital implementation calls for digital skills. Medium sized and smaller companies do often lack internal IT skill required for identifying and implementing digital technologies [16]. Organizing processes is often left with the option of using external consultants. Such solutions bring both pros and cons, but our study showed that a company easily can become too dependent on a single sub-contractor/supplier. A company's IT solutions require a high degree of trust in the relationship between customer and supplier. On one side, it is

important for an IT provider to know the company well. On the other hand, such a customer-supplier relationship can develop into something unhealthy if the relationship leaves the customer in a lock-in position. The customer must use his/her position in an active manner which indicates that the customer - supplier relationship is of a positive nature. For industrial companies, it is important to secure healthy and well-balanced relations to external support when implementing new digital solutions. For instance, another company in the survey developed in-house a dashboard and decision-making system for production management, by help of an off the shelf Microsoft app. Earlier, the company would have contracted consultants for this type of development. However, their experience was that the process took too long and there was insufficient collaboration with their personnel during the process. Thereby the technology adoption was more cumbersome, and the development contributed to a much lesser extent to organizational learning and growth than during the in-house development. Nevertheless, the in-house development required a broad set of competences, that traditionally, many industrial companies did not have. The personnel needed to understand how to extract the necessary data, structure the data, analyze it, and ensure a user friendly and real-time presentation of the results on the dashboard.

Valuing Internal IT Skills. The SINTEF study also showed how important internal IT skills can be when digitalizing the industry. Employees with "above average" IT interest can make a huge difference in these processes. By actively searching for new IT solutions in their daily work, they can combine their personal IT interest with IT situations needed to be solved at work. Leaders who understand this potential organize for joining internal opportunities with company needs. Such processes often show the company what choices and opportunities that exist. Employees with IT skill knows company routines, products and internal affairs, and therefore they can also play the role of a bridge builder. For instance, at a tool producer in the survey the operators are allowed to program the machines that they use. To this end, the company created a forum for knowledge sharing and joint learning that included both senior operators and apprentices, and both older and young personnel. By seeing their digital competencies valued, the operators' motivation for their working place and for contributing to digital improvements increased even more. Thus, employees' own commitment and knowledge thirst increases the company's opportunities to capture new technology/opportunities.

Recognizing Young Talent. Another key element for a successful digital implementation is how the company organize their internal resources in general. Leaders need to understand what a digital transformation really is about. The SINTEF study showed some examples of processes that were suffering from insufficient digital maturity and understanding at management level. Leaders must enter these digital processes at an early stage and then follow up by taking an active and genuine part. Several companies in the survey stated a distinct awareness to join younger employees with leaders responsible for decision making, rather than sideline young talent – which is often a symptom of "Big Company Disease" [17]. A number of respondents reflected that the younger "digital native" generation often has a greater ease of understanding the opportunities and limitations of key enabling technologies, than the older and more "analog" generation, to which many of their leaders belonged. By actively including young employees in the project teams, companies can improve

the outcomes of their digitization endeavor. Moreover, by organizing pre-projects, project groups, pilot projects, etc. companies ensured a higher degree of digital competence in digitalization projects. This shows that different forms of conscious diversity enhance the quality of a digitalization process.

Building Cross-Functional Autonomous Teams. Teamwork in the industrial production has been the way to organize production for a long time [18]. Analyzed data from the study show that operators still work in teams, but they work more autonomously due to the implementation of digital technologies. Relevant information has become more visual and accessible [19]. Due to this development, operators have gained the opportunity to see and understand a broader part of the value chain. Some of the companies also stated an awareness to organize teams in a cross-disciplinary manner. By doing so, they also created a unit more capable of thinking in an innovative way. This trait can be helpful since product development and improvement related work often is initiated at the shop floor.

Promoting Learning in Action. Operators and engineers work more closely when using digital solutions. They unite in digitized processes with digital tools in their common quest for improved practice. One of the companies located their engineers in the areas of manufacturing in order to safeguard a close relation between engineers and operators. Operators and engineers may have different ways of interpreting a problem, but by joining efforts, they are able to reach a higher level of understanding which again adds value to the product/process. This way of work organization was not common earlier when the work force was organized in traditional silos – a further symptom of "Big Company Disease" [17].

Organizing for Flexibility. A common mention for many of the companies in the study was their awareness to organize for change. Flexibility, therefore, stands out as a key feature for a successful digitalization. Quick responses, flexible solutions and an adjustable structure of organizing work has become essential for preventing loss of time and other resources [20]. The ability to continuously adapt to changing circumstances has become a key feature. Systems and processes need to solve contextual changes in order to perform optimally. The companies in the study organized their processes accordingly to safeguard these features.

5 Conclusion

There are numerous ways to derive great value from digitalization. Fostering internal collaboration through greater engagement of employees is one of them. This paper has highlighted seven organizational enablers for digitalization in a Norwegian industrial context. The findings are based on a cross-case analysis of data collected through 33 case studies of successful digitalization processes at Norwegian companies in a diverse set of industries. Collaboration between management and employees also emerged as a necessary success criterion for digitalization. Flatter and cooperation-oriented models are well suited to cope with the dynamic and demanding processes of digital transformation. Such an approach can prevent the loss of useful energy on resistance

through building a joint taskforce promoting digitalization. The NM holds traits that give Norwegian companies a potential and valuable advantage that can be useful for industrial digitalization. Finding the best way to digitalization will vary from company to company depending on their competence, resources and digital maturity. Thus, our findings suggest that it makes sense to utilize both external and internal organizational possibilities. They may, together with digital technologies, boost the digital transition in search of more efficient industrial production.

In terms of limitations, we recognize that the Norwegian context specifically represents both the major strength and weakness of the study. This is because the NM appears to present us with an advantage for industrial digitalization. However, further work should test the seven enablers in other industrially developed countries.

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References

1. Ashrafian, A., et al.: Sketching the landscape for lean digital transformation. In: Ameri, F., Stecke, K.E., von Cieminski, G., Kiritsis, D. (eds.) APMS 2019. IAICT, vol. 566, pp. 29–36. Springer, Cham (2019). https://doi.org/10.1007/978-3-030-30000-5_4
2. Romero, D., et al.: Towards an operator 4.0 typology: a human-centric perspective on the fourth industrial revolution technologies. In: Proceedings of the International Conference on Computers and Industrial Engineering (CIE46), Tianjin, China (2016)
3. Kotter, J.P.: Leading Change. Harvard Business Press, Brighton (1996)
4. Bergh, T.: Avtalt spill. Hovedavtalen 75 år. LO/NHO, Oslo (2010)
5. Huzzard, T., Gregory, D., Scott, R.: Strategic unionism and partnership: boxing or dancing? Book of Abstracts (2004)
6. Brettel, M., et al.: How virtualization, decentralization and network building change the manufacturing landscape: an industry 4.0 perspective. Int. J. Mech. Ind. Sci. Eng. **8**(1), 37–44 (2014)
7. Hofmann, E., Rüsch, M.: Industry 4.0 and the current status as well as future prospects on logistics. Comput. Ind. **89**, 23–34 (2017)
8. Powell, D., Romero, D., Gaiardelli, P., Cimini, C., Cavalieri, S.: Towards digital lean cyber-physical production systems: industry 4.0 technologies as enablers of leaner production. In: Moon, I., Lee, G.M., Park, J., Kiritsis, D., von Cieminski, G. (eds.) APMS 2018. IAICT, vol. 536, pp. 353–362. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-99707-0_44
9. Industrien – grønnere, smartere og mer nyskapende. Det kongelige Nærings og Fiskeridepartementet (2016–2017)
10. Meredith, J.: Building operations management theory through case and field research. J. Oper. Manag. **16**, 441–454 (1998)
11. Karlsson, C.: Researching operations management. In: Researching Operations Management, pp. 20–55. Routledge (2010)
12. Eisenhardt, K.M.: Building theories from case study research. Acad. Manag. Rev. **14**(4), 532–550 (1989)

13. Holm, M.: The future shop-floor operators, demands, requirements and interpretations. J. Manuf. Syst. **47**, 35–42 (2018)
14. SINTEF: Lær av de beste - Hvordan skaffe seg konkurransekraft gjennom digitalisering. SINTEF (2020)
15. Stewart, P., et al.: We sell our time no more: workers' struggles against lean production in the British car industry. Pluto Press (2009)
16. Romero, D., Bernus, P., Noran, O., Stahre, J., Fast-Berglund, Å.: The operator 4.0: human cyber-physical systems & adaptive automation towards human-automation symbiosis work systems. In: Nääs, I., et al. (eds.) APMS 2016. IAICT, vol. 488, pp. 677–686. Springer, Cham (2016). https://doi.org/10.1007/978-3-319-51133-7_80
17. Ballé, M., et al.: The Lean Sensei. Lean Enterprise Institute (2019)
18. Van Dun, D.H., Wilderom, C.P.: Lean-team effectiveness through leader values and members' informing. Int. J. Oper. Prod. Manag. (2016)
19. Romero, D., Gaiardelli, P., Powell, D., Wuest, T., Thürer, M.: Digital lean cyber-physical production systems: the emergence of digital lean manufacturing and the significance of digital waste. In: Moon, I., Lee, G.M., Park, J., Kiritsis, D., von Cieminski, G. (eds.) APMS 2018. IAICT, vol. 535, pp. 11–20. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-99704-9_2
20. Suri, R.: It's About Time: The Competitive Advantage of Quick Response Manufacturing. CRC Press, Boca Raton (2010)