Diagnostics of Opportunities – A Dialogue Tool for Addressing Digital Factory Maturity

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Abstract. For over 15 years, the concept of Industry 4.0, now transitioning into Industry 5.0, has been a focal point for the manufacturing sector. Yet, the success of companies in embracing digital transformation varies. There are numerous models and assessment tools for assessing digital readiness and maturity. Several models have been developed over the years, but firms also realize no "one-size-fits-all" exists when testing them. Previous studies show that firms must take charge of their own digital transformation (DT) journey to find a path that suits their specific needs.This qualitative paper is driven by a case study supported by a within-case analysis conducted with a heavy-machine industry with fourteen production plants worldwide – data collected from 2020 to 2023. Volvo Construction Equipment (Volvo CE), created Factory 4 Tomorrow (F4T) to address Industry 4.0. The central challenge for the F4T initiative was how to facilitate an inside-outside approach to identify an inclusive maturity model that emphasizes learning and collaboration. A diagnostic of opportunities model was created to aid the organisation's transformation journey. It aimed to support all plants by evaluating their maturity in digital transformation, identifying gaps, and support in prioritising. Unlike traditional models that assess and compare plant levels, this model aimed to foster awareness and alignment, establishing a shared language. Thus, a unique model was explicitly crafted for the firm. The process of developing the model itself enhanced awareness and alignment. Therefore, this paper explores the development process - failures and successes - to compile a digital transformation maturity model tailor-made to a firm's needs and goals. The objective is to offer comprehensive advice for firms to implement DT initiatives effectively in a way that suits them.

Keywords. Digitalisation, maturity, manufacturing, smart production

1. Introduction

Considerable resources and research have been dedicated to assessing digital readiness and maturity, often leading to a consultancy-driven market. Sometimes, businesses may

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invest in advanced technology without the expertise for effective utilisation or alignment with business strategies. The transformation challenges affect industries of all sizes, sectors, and configurations. Operations, the Production division of Volvo Construction Equipment (Volvo CE), has responded to Industry 4.0 through its Factory 4 Tomorrow (F4T) initiative to expedite the company's lean transformation and prepare for the future by leveraging DT. Together with researchers in a previous research project, a maturity model/diagnostics of opportunities, was created. The model aimed to simultaneous explore and exploit, while ensuring continuous improvement and advancement of digital transformation deployment, addressing the company's dynamic environment.

Verhoef et al. [1] have identified five research streams relevant to digital transformation: (1) phases of digital transformation, (2) digital resources, (3) organisational structure, (4) digital growth strategies, and (5) metrics and goals. This study seeks to contribute to studies primarily on streams 1, 2 and 3 covering a discussion relevant to the areas of information systems, strategic management, and innovation and operations management. Examples of contribution include discussion on how digital readiness of firms may help the transition through the phases of digital transformation, and if businesses must change from their traditional departmental structures and instead adopt a holacratic approach using flexible teams (circles) formed by employees with specific roles.

According to Kretschemer and Khashabi [2] *"(…) it is still not clear how digital transformation precisely impacts firms' internal processes to create output and, eventually, their organisation design (…) still see a need for an integrated view to generate a unified picture on how digitisation affects organisation design".*

Therefore, research questions emerge: How to design a tailor-made digital readiness and maturity assessment model? How can the organisational structure be adapted to facilitate factory transformation under the company's level of digital maturity?

The objective of this paper is to offer comprehensive advice for firms on how to find their unique path toward successful DT adoption through an engaging narrative, grounded theoretical discussions, and practical examples.

2. Theoretical framework

Recent studies have shown that manufacturing companies are at the initial stage of digital transformation. Survey results pointed out that 60% of the companies are still implementing *ad hoc* pilot projects, only 10% out of the 700 manufacturers surveyed have completed their implementation processes, and only 3% recognised the transformation to a Digital Factory [3].

The 2022 Global Smart Industry Readiness Index Initiative findings pointed out the different levels of digital readiness and maturity when comparing industry sectors and companies' sizes. Multi-national corporations (MNCs) are far ahead of SMEs, with a clear strategy on factory digital transformation for real-time connectivity and decision-making. However, this development has not been shared with SMEs, indicating the need for adaptative and tailor-made models for the manufacturing industry. Among sectors, machinery and equipment, general manufacturing, and precision parts were accessed as in a low-maturity state, facing many challenges such as the company's size, lack of

resources, products and production processes hindering the adoption of advanced manufacturing technologies [4].

Drivers for digital transformation include efficiency, flexibility, resilience, and transparency, and the three last ones, even more after the disruptive impacts of the global pandemic. Regulatory and stakeholder pressures make sustainability relevant to all sectors [3, 5]. Previous studies on digital readiness [5, 6] showed that manufacturing companies struggled with digital transformation due to the lack of appropriate organisational and operational readiness. Readiness characteristics include agile management, digital leadership, and cross-functional collaboration [7, 8]. Paths for digital maturity indicate evolution from limited implementation initiatives (business units or regions) to an embedded digital organisation model with dedicated project teams guided by a coordination organisation oversight digital solutions and central management of systems and standards that offer a significant level of flexibility on a regional level [3].

Saariko et al. [7] outlined challenges and characteristics hindering successful digital transformation across different business stages. In the early digitisation phase, businesses often initiate minor digital projects to project innovation, rely on external partners for advanced capabilities, lack standardised solutions leading to interoperability issues, and collect extensive data without a defined purpose. Technology implementation does not profoundly impact business models or revenue streams at the digitalisation stage. Instead, it involves minor enhancements to internal processes and centralised operations. The value chains remain linear, with limited collaboration and co-creation opportunities. Challenges at the highest maturity level include a lack of long-term internal digital transformation strategy, fear of innovation due to uncertainty, sociotechnical discrepancies, and an internal culture misaligned with a more open and decentralised approach. The authors offered recommendations: start with purposeful small-scale initiatives, establish strategic partnerships for a competitive edge, engage in standardisation efforts, prioritise data ownership and ethical considerations, and ensure internal ownership and commitment to the change process.

Nadkarni and Prügl [9] emphasise the pivotal role of middle managers in digital transformation, highlighting the shift from hierarchical control to fostering collaboration within networks. Effective utilisation of digital tools for enhanced organisational performance is crucial, with support from top management. Successful digital transformation necessitates transformative leadership, specific managerial and organisational capabilities, a corporate culture and work environment shift, and strategic partnerships, such as collaborations with startups, to expedite the transformation process. Furthermore, adapting skills and competencies acquisition plans to keep pace with rapid technological advancements is essential. The authors also underscore the need for established companies to create interconnected, yet separate organisations dedicated to integrating and commercialising disruptive technologies alongside their core business operations ([9], p. 260).

To support transformation, Roos, and Nilsson [10] highlight that organisational readiness for change is influenced by what needs to change, the process of change, the context or environment, and the people involved. They link motivation for change to beliefs, psychological safety to skills and competencies, cohesion to a focused team, knowledge creation to innovation, and engagement to clear roadmaps and goals. They stress the importance of strong motivation to implement change processes for readiness. Workshops are vital in promoting and preparing change groups, ensuring participants

value the change, possess the necessary skills, have a clear vision, and maintain motivation, psychological safety, and group cohesion.

De Sousa Jabbour et al. [11] identified critical success factors for digital transformation, including Management Leadership, Readiness for Organisational Change, Top Management Commitment, Strategic Alignment, Training and Skill Development, Empowerment, Teamwork, Effective Communication, Organisational Culture, Project Management Approach and Consideration of Cultural Differences.

Kane et al. [12] ask: how is a digital business different from other businesses? The answer lies in the digital business's ability to act and adapt quickly, especially in terms of communication and decentralised decision-making. It also involves a shift in culture and mindset, as well as the structure of the organisation, like combining full-time employees with external talent. Ultimately, it focuses on effectiveness, impact, and value rather than just efficiency. Digitally mature companies have decentralised decision-making systems, prioritise continuous learning, and have a clear digital strategy and use key performance indicators and are able to quickly adapt and transform. To successfully transform, companies need to define a digital strategy, commit to leadership, and resource allocation, establish a transition team, and integrate digital capabilities with business goals [12, 13].

2.1. Organisational Design and Digital transformation

An "organisation" can be defined as a complex system comprising multiple agents with clearly defined boundaries and overarching system-level goals (purpose). Each individual agent within the organisation is anticipated to contribute to achieving these shared goals [14]. Organisational design is all about arranging how a company works best. It is a systematic way of setting up the proper structure, processes, culture, and leadership, among other factors, so the organisation can achieve its goals effectively and efficiently.

Structure in an organisation involves how tasks, resources, customers, and markets are allocated among different individuals or groups. On the other hand, coordination is about bringing these units together effectively through communication, IT, leadership, culture, incentives, routines, and procedures—essentially, the management aspect. These two aspects, structure and coordination, are interconnected. Once a structure is determined, it influences the available options for coordination to achieve a good fit. Coordination is a real-time management challenge that requires substantial information processing, unlike the structure, which is more of a decision-making and analytical task. Coordination mechanisms must be designed effectively to ensure smooth operations during ongoing activities [15, 16].

The essence of an organisation lies in its clear objective, which cannot be efficiently achieved by a single person but necessitates collaborative efforts from multiple individuals or agents, each driven by their self-interest and flexibility in pursuing sub-goals. Organisation design plays a vital role in breaking down the overarching goal into manageable components for groups of agents, overseeing their successful completion, and integrating them to achieve the 'organisation's overall output. Digital transformation can revolutionise how companies structure and organise tasks to achieve their desired outcomes, introducing new crucial elements and rendering some traditional tasks obsolete. It emphasises the importance of adapting to new digital functions for market success while highlighting the increased efficiency of digital devices in replacing many

conventional tasks and roles. In addition, it can modify how tasks are grouped by altering how information is interconnected [14].

According to Kotter [17], organizations established in the 20th century were primarily focused on efficiency and reliability rather than speed and agility. However, in a fast-paced world, it is vital to have a more agile, network-based structure. Instead of completely discarding what we know, we can reintroduce a more flexible structure to meet the demands of modern times. He suggests implementing a dual operating system, which means an agile and flexible network of individuals who strive to create, improve, and maintain innovative business solutions. Associated with a lean, stable and functional hierarchy that is responsible for operating and expanding a successful and sustainable business. The agile network must include influential individuals and leaders within the organisation who support the change, a diverse representation of expertise across different business areas with credibility throughout the organisation to garner respect and seriousness for the change effort and leaders capable of driving the change process effectively. Building trust and fostering a shared goal among the network is crucial and achieving this requires dedicated team-building sessions outside the usual workplace to strengthen interpersonal connections and align on common objectives.

3. Method

In studies where the effects of a change are examined, such as pre-and post-event studies, the methodology is typically referred to as a case study. The case study is an empirical research method that explores current phenomena within their specific context, which aims to investigate real-life situations in detail, providing a comprehensive understanding of the subject matter, such as a program, event, activity, process, or individual(s) over a limited time frame.

For this research, a qualitative explanatory approach was employed in a single case study, using a holistic case approach that relied heavily on narrative and phenomenological descriptions. While themes and hypotheses were considered, they were secondary to the overall understanding of the case ([18], p. 8). The study is explanatory and focuses on addressing the "how" surrounding the phenomenon's reality. Single case studies can provide unique insights into a phenomenon or problem, with a comprehensive description of the culture and context, among other details, to provide enough basis for the transferability of the findings [19, 20] . The case study was analysed holistically in a specific context, as described in Figure 1, inspired by Runeson and Höst [21]. The researcher uses various data collection methods to gather detailed information over an extended period to gain insight into the subject of study. Over four years, multiple sources of information, such as direct and participant observations, structured interviews, surveys, workshops, and practitioner feedback sessions. The research team evaluated preliminary results to increase validity and reduce bias. Findings were analysed using content analysis techniques supported by theoretical background [21, 22, 23].
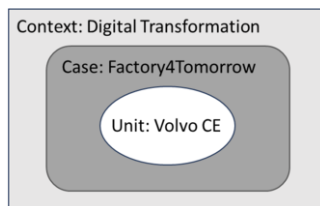
Figure 1. Holistic case approach.

3.1 Case company description

The company in study, Volvo CE, is a solution provider offering heavy machinery solutions including excavators, wheel loaders, articulated haulers and road machinery worldwide. The production part of Volvo CE, called Operations, decided to address Industry 4.0 in their own way, by an initiative named Factory 4 Tomorrow (F4T). The purpose is to accelerate the company's lean journey and adapt to the future by leveraging digital transformation. The vision is transforming into smart and connected manufacturing, and bringing benefits to employees, customers, shareholders, and partners in the ecosystem. F4T was initiated globally 2020, reaching 14 different production sites.

4. Factory 4 Tomorrow set-up

4.1. Organisational set-up of Factory 4 Tomorrow

Volvo CE decided a network set-up for the implementation of the F4T initiative. Each site has a cross-functional local team, called SFT (Smart Factory Team). The team is crossfunctional, including e.g., manufacturing engineering, IT, logistics, maintenance, and quality. The participants also have other roles in the line organisation, meaning the same person supports both exploration and exploitation [25]. Normally the team consists of 5-8 people and is led by the SFT leader, whose responsibility is to coordinate the work and connect with other SFT leaders. The SFT tasks include investigating and testing new technology, develop competence, and share knowledge across communities and sites.

Each SFT has a connected local sponsor team at the site. The purpose with this sponsor team is to support the SFT with resources, funding, and communication.

There is also a global cross functional team to support, named the core team. The participants in the core team are to be the overall change agents by inspiring the culture and sponsoring the transformation journey. The core team members also support in their areas of expertise e.g. technical matters. It is also the responsibility of the core team to develop and manage the diagnostic of opportunities model. There is also a governance structure including fora supporting this network way of working.

4.2 Development of the diagnostics of opportunity

To support the digital transformation journey, a diagnostic of opportunities model was created. The model was based on the research conducted in the Smart PM research project and is a readiness and maturity evaluation model. The purpose with the model is

to support all Volvo CE sites to evaluate their maturity and readiness regarding the digital transformation. It aimed at achieving simultaneous exploration and exploitation while ensuring continuous improvement and advancement of digital transformation deployment. It should be a support to identify gaps, and guide how to prioritise F4T projects to add the most value to the organisation. The model aims to create awareness and alignment, increase sharing and collaboration, and develop people. After using the model, the plant should have a clear view of current status as well as future wanted position, including identified roadblocks and opportunities to prioritise.

The diagnostic model comprises four core areas: Smart Governance and Digital Strategy, Connected Manufacturing, Virtual Manufacturing, and Autonomous Manufacturing. These areas further break down into 18 subthemes and 61 categories, see Figure 2 and Figure 3.
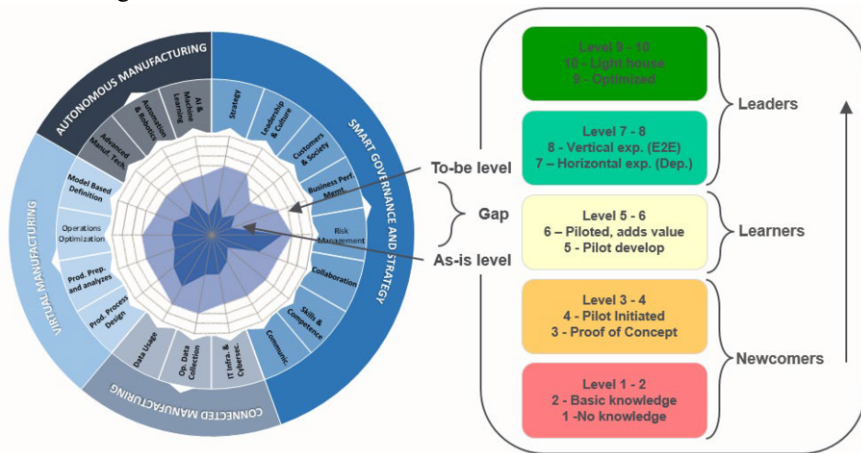

Figure 2. Overview of Diagnostics of Opportunities topics, including maturity levels [24].

It is worth noting that digital transformation encompasses technical advancements and substantial soft elements. These softer aspects must be managed in parallel with technological progress to ensure a comprehensive digital maturity journey. Much of the model addresses governance and strategic aspects, often involving "soft" elements like Leadership and Culture.

Themes	Subtheme	Categories
Smart Governance & Digital Strategy	Strategy	Vision, Value drive, Investment, Horizontal and Vertical integration
	Leadership and Culture	Leadership, Culture, Innovation management, Understanding and common language
	Customers and society	Involvement of customers, New Business Models and Value Creation,
	Risk management and Business Continuity	Risk management and Business continuity
	Collaboration	Knowledge sharing, Internal collaboration (VCE), External collaboration
	Skills and Competences	Competence to drive and achieve Factory 4 Tomorrow, Competence needs, Future competence needs
	Communication	Communication, Visual appearance

Figure 3. Examples of Subthemes and Categories related to Smart Governance and Digital Strategy.

For each subtheme, there is a description of the area and why this is important, to align the view. When performing the diagnostics of opportunities, the team goes through all the parts and agrees on a current and future score for each category, see Figure 2. There are questions to support the discussion for each category, see Figure 4.

- **Theme:** Smart governance and digital strategy
- **Subtheme:** Strategy
- **Category:** Vision
- **Description:** To assure that there is a clear vision and purpose for identifying and executing opportunities to become the Factory 4 Tomorrow. It involves a clear definition of the vision and directions for the plant along the supply chain. Our investments and decisions are in line with the vision and our investment plan capture new advanced manufacturing technologies. To assure that the Factory 4 Tomorrow implementation is followed up and that progress and success is measured.
- **Questions to support the discussion:** Is it clear why and where we want to go smart and connected? Is it aligned with the plant vision? Is it aligned with global visions? Example: F4T parts are included in the plant vision

Figure 4. An example from the diagnostics of opportunities following up on the category "Vision".

5. Empirical findings and analysis

The findings presented in this section represent the analysis of internal documents and reports, comparing more mature site processes with less mature ones. By conducting rounds of Menti surveys, F4T model's strengths and challenges were identified during the implementation. In addition, interviews with key employees involved in the change were conducted to follow the evolution of the digital transformation process. The Diagnostic of Opportunities model and process played a crucial role in driving organisational and technological changes, as described in F4T's internal reports from 2019 to 2023.

5.1. The role of the Diagnostic of Opportunity model during the phases of digital transformation.

The findings are divided into four phases, which reflect the critical conditions related to the organisational readiness model developed in a previous stage and reported by Machado et al. [5, 6]. The phases are not entirely sequential but overlap to some extent. The main challenges in phases A, B, and C are focused on organisational design, governance, and competence. In Phase D, the teams are more mature and can focus on systematic technology implementation. This indicates that the first three years of implementing the Digital Transformation strategy were mainly dedicated to digital readiness, competence development, governance set-up, and technical pilots, enabling further escalation of technological systematic advancement.

   Phase A -Digital Readiness Conditions During this phase, the F4T team tested the original model with the support of academic research, cross-functional collaboration, benchmarking, and workshops. The F4T team closely monitored the piloting test for a week, and daily feedback sessions were held with the local site F4T team. Based on the site's input, small adjustments were made. During this phase, the F4T purpose, vision, and strategy were discussed intensively to align with the company's strategic goals.

Besides the Industry 4.0 knowledge development, this phase represents the full awareness of the digital readiness conditions in all dimensions, gaps and strategies for moving to readiness to a maturity path.

Phase B – Implementation of Diagnostics of Opportunities Over two years, all manufacturing plants were given the opportunity to conduct the Diagnostic of Opportunities. The primary objective was to evaluate the level of understanding and alignment with the F4T to establish a baseline for future assessments. After two years, a comprehensive analysis of the current state and a strategic plan tailored to the plant's needs and identified opportunities would be conducted to move forward with the next level of digital transformation.

During this phase, the F4T teams emphasise the importance of involving the management team in the assessment process and establishing continuous dialogue to achieve alignment on site. This creates a solid foundation for change and long-term management commitment. Some sites faced difficulty involving their management in evaluating opportunities, making it challenging for them to make progress. The responsibility was shifted to the SFT to make the necessary changes. During this phase, a survey was conducted to gain a more in-depth understanding of the strengths and challenges. The survey results showed that the diagnostic of opportunities model and process provided created significant value to the sites, exemplified below by a Smart Factory Team Leader quote. The survey identified challenges in change management, resource availability, competence development, and implementation.

"The big value is that it forces the team (and the site) to sit down and discuss all the questions. That gives a common view on the topic. The structure and the result help in defining a roadmap. And of course, by adding external people, knowledge is added."
-     *Smart Factory Team Leader*

Phase C – organisational update. During phase C, the core team followed up with sites on F4T roadmaps that were developed from the Diagnostic of Opportunity evaluation. The aim was to understand where these sites stood in their digital transformation process and their need for support. The survey results were analysed, and the challenges identified were addressed. Competence development for the entire organisation was a major focus, and discussions were held with management on how to support change management better. Strengths, challenges, and the need for support were all considered. The core team also highlighted the lack of resources, such as the limited availability of the core team and key stakeholders of focus areas for the continuous cross-site and cross-function dialogue discussions to develop new ways of working.

At this stage, the sites were learning and advancing and beginning to find their new ways of and organising for change. For instance, they started involving more people using new approaches in two plants. The core team received valuable input from the sites for improvements. As a result, the Diagnostic of Opportunity model became somewhat outdated. For example, the logistics perspective in the model needed to be described in greater detail, sustainability and Industry 5.0 needed to be incorporated even more. There was still a need to strengthen the focus on implementation. Although there had been a significant emphasis on innovation and collaboration, sites were now facing challenges with implementation.

Phase D – model update In the Spring of 2023, the core team revised their approach along with SFT, and suggested an expanded approach that will better support implementation for both the core team and SFT. As a result, the Diagnostic of

Opportunity model, assessment, and evaluation will be updated to support sites in the upcoming digital transformation steps.

It is important to note that during this phase, the focus should not be on the maturity levels of the assessment. Sites that have taken the assessment before having realised that as they gain more knowledge about digital transformation, they can answer the questions realistically (learning curve). This may result in reduced overall maturity scores in some cases, but it ultimately leads to more realistic and meaningful strategic planning. Achieving the highest level of maturity is not the ending goal, the desired or needed appropriate level will be defined through the current and future company's plans and equipment availability.

The Operations Leadership Team (OLT) at the same time created a Digitalization Board, which marks a significant change in governance for F4T. At some plants the work to be performed by SFT members were included in an agile approach with prioritisation in 10 weeks sprints. Additionally, a new F4T set-up proposal has been introduced that is divided into site roles and global roles to deal with specific challenges.

The SFT team is exploring digital factory opportunities, securing resources, and implementing the F4T teams, while the site networks (SN) are focused on implementing the site's digital initiatives securing resource availability, and involving and empowering the whole organisation. The goal is to move from pilot initiatives to scale and increase leadership involvement. Each plant must have a site owner (SO) leading investigation and expansions for specific key areas.

Looking at the bigger picture, the F4T core team needs to be restructured with Business Owners (BO) holding global roles in the focus areas. These BOs will be responsible for leading VCE Digital Roadmaps, driving business outcomes, and increasing leadership involvement. The core team will be held accountable for product development, capabilities, and processes, working towards achieving the desired digital maturity state and increasing focus on digitalisation of operations with a long-term perspective.

5.2 *Theoretical and managerial contributions*

The findings contribute to studies on change management and agile network structures, as Kotter [17] proposed. In addition, it provides insights into new organisational designs for digital transformation, extending studies such as Burton and Obel [15]. The empirical findings validate the findings reported in previous studies, such as Machado et al. [5, 6] on organisational digital readiness and maturity. In terms of competencies, reinforce the key role of soft skills as enablers of transformation (Phases A to C), confirming in this case that technologies are not the hindrance to maturity, but lack of resources, strategic alignment, and appropriate desire states. The findings' limitations rely on the case context and specific characteristics and aim to provide insights to other manufacturing industries to follow their own path to achieve the level of digital transformation that best fits their needs and customers' expectations, not falling into the trap of competitive or technology pressures.

6. Conclusions and next steps

The study can be concluded by answering the research questions:

- **How to design a tailor-made digital readiness and maturity assessment model?** Digital transformation encompasses technical advancements and substantial soft elements, like governance and strategy. These softer aspects must be managed in parallel with technological progress to ensure a comprehensive digital maturity journey. Some advice could be to start with existing models and adapt those according to the 'organisation's specific needs. It is important for the organisation to make it "its own", to address the "not invented here syndrome". It has shown successful to use the assessment model as a dialogue tool, to create a common language and awareness rather than focusing on the resulting score. The model should be "a living document", continuously adapted to the changing needs of the organisation.
- **How can the organisational structure be adapted to facilitate factory transformation under the company's level of digital maturity?** The network structure enables cross functional involvement as well as a possibility for employees to engage in both exploration and exploitation. A network structure is easier to adapt to changing conditions based on digital maturity than a hierarchical.

When the organisation matured in its digitalisation journey, the demands on the diagnostics of opportunity model also changed. In the first phase there was a need to create a shared language and awareness about the topic globally. Creating the diagnostics of opportunities helped the global team align and create a shared language. In phase B, the diagnostics of opportunities worked as a dialogue tool to gather around at the plant level. The main impact occurred when there was cross-functional participation. In those cases, a deeper understanding happened that it is an initiative that everyone needs to be involved in, not solely IT or manufacturing engineering. In phase C the need for supporting implementation occurs, to include more topics related to Industry 5.0. The sites started to show initiatives to change the organisational set-up to better support their digitalisation journey. In phase D a need to update the model occurred, to focus more on technical details for some parts. It is crucial for the company to continue developing the assessment model and incorporate Industry 5.0 topics to maintain its usefulness as a dialogue tool.

References

[1] Verhoef PC, Broekhuizen T, Bart Y, Bhattacharya A, Qi Dong J, Fabian N, et al. Digital transformation: A multidisciplinary reflection and research agenda. J Bus Res. 2021;122:889–901, doi: https://doi.org/10.1016/j.jbusres.2019.09.022

[2] Kretschmer T, Khashabi P. Digital Transformation and Organization Design: An Integrated Approach. Calif Manage Rev. 2020;62(4):86–104, doi: https://doi.org/10.1177/000812562094029

[3] PWC (2022). PwC Digital Factory Transformation Survey 2022. Available at: https://www.pwc.de/en/strategy-organisation-processes-systems/operations/digital-factory-transformation-survey-2022.html

[4] WEF (2022). The Global Smart Industry Readiness Index Initiative: Manufacturing Transformation Insights Report 2022. World Economy Forum. Available at: https://www3.weforum.org › docs › WEF_The_Global_Smart_Industry_Readiness_Index_Initiative_2022

[5] Machado, CG, Almström, P, Oberg, AE, Kurdve, M, Almashalah, SY. Maturity framework enabling organisational digital readiness. In: Safsten, K. and Elgh, F. (Eds), Advances in Transdisciplinary Engineering. c2020,13, p.649-660, doi: 10.3233/ATDE200204

[6] Machado CG, Winroth M, Almström P, Ericson Öberg A, Kurdve M, AlMashalah S. Digital organisational readiness: experiences from manufacturing companies. J. Manuf. Technol. 2021;32(9):167–82, doi: https://doi.org/10.1108/JMTM-05-2019-0188

[7] Saarikko T, Westergren UH, Blomquist T. Digital transformation: Five recommendations for the digitally conscious firm. Bus Horizons. 2020;63(6):825–39, doi: https://doi.org/10.1016/j.bushor.2020.07.005

[8] Chari, A. et al. Dynamic capabilities for circular manufacturing supply chains—Exploring the role of Industry 4.0 and resilience Business Strategy and the Environment, 2022; 31(5), 2500-2517.

[9] Nadkarni S, Prügl R. Digital transformation: a review, synthesis and opportunities for future research. Manag. Rev. Q. 2021;71(2):233–341.

[10] Roos, J, Nilsson, V. Driving Organizational Readiness for Change through Strategic Workshops. International Journal of Management and Applied Research. 2020;7:1-28, doi: 10.18646/2056.71.20-001.

[11] De Sousa Jabbour, A.B.L et al. When titans meet—can industry 4.0 revolutionise the environmentally-sustainable manufacturing wave? The role of critical success factors, Technological Forecasting and Social Change, 2018; 132: 18-25.

[12] Kane et al. Coming of age digitally. June, 2020.

[13] Ghobakhloo, M. The future of manufacturing industry: a strategic roadmap toward Industry 4.0. J. Manuf. Technol. 2018; 29(6):910-936, doi: https://doi.org/10.1108/JMTM-02-2018-0057

[14] Kretschmer T, Khashabi P. Digital Transformation and Organization Design: An Integrated Approach. Calif Manage Rev. 2020;62(4):86–104, doi: https://doi.org/10.1177/000812562094029

[15] Burton RM, Obel B. The science of organizational design: Fit between structure and coordination. J. org. des. (Aarhus). 2018;7(1):1–13, doi: https://doi.org/10.1186/s41469-018-0029-2

[16] Burton RM, Obel B, Håkonsson, H. Organizational design: a step-by-step approach. 2015, 3ed. Cambridge University Press, Cambridge

[17] Kotter, J.P. Accelerate: Building Strategic Agility for a Faster-Moving World, 2014, Harvard Business Review Press, Boston, MA.

[18] Stake RE. The art of case study research. 1995, Sage.

[19] Yin, R. Case Study Research: Design and Methods. 2014, 5th ed., Sage, Thousand Oaks, CA

[20] Priya, A. Case Study Methodology of Qualitative Research: Key Attributes and Navigating the Conundrums in Its Application. Sociological Bulletin. 2021; 70(1): 94-110. https://doi.org/10.1177/0038022920970318

[21] Runeson P, Höst M. Guidelines for conducting and reporting case study research in software engineering. Empir Softw. Eng.: an Int. J. 2009;14(2):131–64, doi: https://doi.org/10.1007/s11301-020-00185-7

[22] Scholz, R., Tietje, O. Embedded case study methods. SAGE Publications, Inc., https://doi.org/10.4135/9781412984027

[23] Creswell J. W. Research design: Qualitative, quantitative, and mixed method approaches (4th ed.). SAGE Publications; 2014

[24] Stålberg, L. & Ericson Öberg, A. 2022. Factory 4 Tomorrow Organization-Challenges and Enablers to Encourage Simultaneous Exploration and Exploitation. In: Advances in Transdisciplinary Engineering: . Paper presented at 10th Swedish Production Symposium, SPS 2022 (pp. 122-134). IOS Press BV, 21