

Faisal Imran

# **Digital transformation of industrial organisations**

A sociotechnical study on the role of leadership, structure and culture in achieving performance outcomes



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## Tiivistelmä

Digitaalisesta transformaatiosta (DT) on tullut teollisten organisaatioiden strateginen prioriteetti, jotta ne voisivat hyötyä digitaalisen teknologian tarjoamista muutosmahdollisuuksista. DT yhdistää modernia digitaalista teknologiaa ja organisationaalista strategiaa merkittävien liiketoimintahyötyjen saavuttamiseksi. Viimeaikaiset tutkimukset ovat pääasiassa keskittyneet DT:n teknisiin osaluaisiin tai ovat olleet kirjallisuuskatsauksia. On tehty vain muutamia käsiteellisiä ja empiirisiä tutkimuksia siitä, kuinka teolliset organisaatiot ovat digitaalisesti muuttuneet.

Tämä väitöskirja vastaa sosioteknisen järjestelmän näkökulmasta seuraaviin kysymyksiin: Kuinka teolliset organisaatiot valmistautuvat DT:oon? Tähän kysymykseen vastauksena tehtiin neljä empiiristä tutkimusartikkelia edistämään ymmärrystä DT:sta. Käyttämällä kvalitatiivista monitapaustutkimusta, tämä väitöskirja tunnistaa tärkeimmät DT:n mahdollistajat, jotka auttavat tapausorganisaatioita saavuttamaan tavoitellut suoritusavoitteet. Tämä väitöskirja pyrkii edistämään ymmärrystä DT:sta sekä teorian että johtamisen kannalta, ottaen huomioon sosioteknisen näkökulman ja tutkimalla integroivaa lähestymistapaa menestyvään digitaaliseen transformaatioon teollisissa organisaatioissa.

Tutkimuksen tulokset viittaavat siihen, että tapausutkittujen organisaatioiden pääfokus on johtamisen rooleissa ja kompetensseissa, muuttuvissa organisaatorakenteissa ja -kulttuureissa, jotka ovat pääasialliset menestyksekkään DT:n mahdollistajat. Lisäksi tulokset osoittavat, että tunnistetut muutoksen mahdollistajat auttavat tapausutkimuksen organisaatioita saavuttamaan ketteryyttä, asiakaskeskeisyyttä ja tehostunutta yhteistyötä, jotka ovat DT:n tärkeimmät suoritusavoitteet. Lisäksi tulokset korostavat, että teollisten organisaatioiden on optimoitava oma sosiaalinen ja tekninen järjestelmänsä DT:ta varten saavuttaakseen parhaat tulokset.

Tämä tutkimus osoittaa, että menestysekäs DT on riippuvainen siitä, kuinka hyvin teolliset organisaatiot mukautuvat ja päivittävät organisaatorakennettaan ja -kulttuuriaan ottamaan huomioon DT:n vaatimukset. Johdon rooli tässä muutoksessa on elintärkeä. Johtajien on johdettava esimerkin avulla muuttamalla perinteistä johtamistaan DT:n vaatimuksiin sopivaksi.

Avainsanat: Digitaalinen transformaatio, teolliset organisaatiot, johtamisroolit, johtamiskompetenssit, organisaatorakenne, organisaatiokulttuuri, ketteruus, asiakaskeskeisyys, tehostettu yhteistyö, laadullinen tutkimus, sosiotekninen teoria.

## Abstract

In order to leverage the transformational possibilities of digital technology, digital transformation (DT) has become a strategic priority for industrial organisations. DT uses a mix of modern digital technologies and organisational strategies to facilitate significant business improvements. Recent studies have mostly concentrated on the technical components of DT or literatures reviews, while few conceptual and empirical studies have examined how industrial organisations are digitally transformed.

This dissertation builds on the sociotechnical system perspective to answer the following question: How do industrial organisations prepare for DT? To address this question, four empirical research articles have been formulated to advance the knowledge on DT. By adopting a qualitative multiple case study method, this dissertation identifies the most important enablers of DT that help to achieve the targeted performance outcomes of the case organisations. This dissertation attempts to advance both theoretical and managerial understandings of DT by adopting a sociotechnical perspective and exploring an integrative approach for the successful DT of industrial organisations.

The results of the study indicate that the case organisations' main focus is on leadership roles and related competencies, changing organisational structures and organisational culture, which are the main enablers of successful DT. Further, the results show that the identified enablers help the case organisations to achieve organisational agility, customer centricity and enhanced collaboration, which are the main targeted performance outcomes of DT. In addition, the results emphasise that industrial organisations must jointly optimise their social and technical systems for DT in order to achieve the best results.

Overall, this research demonstrates that a successful DT depends on how well industrial organisations readjust and update their organisational structures and organisational cultures to match the DT requirements. The role of leaders is vital in this change, and they must lead by example by adjusting their traditional style of leadership to match the DT requirements.

Keywords: Digital transformation, industrial organisations, leadership roles, leadership competencies, organisational structure, organisational culture, agility, customer centricity, enhanced collaboration, qualitative research, sociotechnical theory.

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And my success is not but through Allāh. Upon Him, I have relied, and to Him, I return. (Quran 11:88)

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## Abbreviations

DT	Digital Transformation
STS	Sociotechnical System
IT	Information Technology
IS	Information Systems

## Publications

This dissertation incorporates the following four research articles:

Butt, A., Imran, F., Helo, P., & Kantola, J. (2023). Strategic design of culture for digital transformation [Manuscript submitted for publication].

Imran, F., Shahzad, K., Butt, A., & Kantola, J. (2021). Digital transformation of industrial organizations: Toward an integrated framework. *Journal of Change Management*, 21(4), 451–479, <https://doi.org/10.1080/14697017.2021.1929406>

Imran, F., Shahzad, K., Butt, A., & Kantola, J. (2023). Preparing leadership for digital transformation: An empirical study on emerging roles and competencies of industrial leaders [Manuscript submitted for publication].

Imran, F., Shahzad, K., Butt, A., & Kantola, J. (2023). Achieving performance outcomes through digital transformation: An empirical study of structural changes in industrial organizations [Manuscript submitted for publication].

# 1 INTRODUCTION

## 1.1 Background of the study and research gaps

Digital technologies have been changing many aspects of business life, intertwining social and organisational infrastructure. Therefore, practitioners in industrial organisations have been facing the challenging task of transforming their organisations to sustain and thrive in this digital age. Digital technologies have challenged the way industrial organisations operate (Vial, 2019), including their traditional business models, organisational hierarchies, leadership styles and cultures (Gupta & Bose, 2022; Karimi & Walter, 2015; Oh et al., 2022; Vial, 2019). As a result, digital technologies, which include but are not limited to cloud computing, the industrial internet of things (IIoT), advanced algorithms, hyper-connectivity, artificial intelligence, self-learning systems, automation, big data and analytics, are disrupting traditional organisations (Gilchrist, 2016). Neglecting the transformative power of digital technologies is no longer an option for industrial organisations, as it may result in a loss of competitiveness, which could drive them out of business (Konopik et al., 2022; Matt, Hess, & Benlian, 2015). Conversely, successfully embracing digital technologies can help organisations enter into novel markets, resolve unsolved problems, operate more efficiently and gain and retain a competitive advantage (Konopik et al., 2022; Oh et al., 2022; Singh & Hess, 2017; Vial, 2019). Therefore, the only way forward for industrial organisations is to adopt this technological shift (Singh & Hess, 2017; Smet, Lurie, & George, 2018), which is known as industry 4.0 or the fourth industrial revolution (Gilchrist, 2016), and capitalise on the opportunities provided by these disruptive technologies.

The process through which organisations respond to environmental changes by using digital technologies is referred to as digital transformation (DT) (Vial, 2019; Zhu, Ge, & Wang, 2021). While the implementation of digital technologies is at the heart of this organisational transformation, DT goes beyond mere adoption of these technologies (Björkdahl, 2020), such as the digitisation of communication processes, work-related processes or expanded capabilities for data storage, and involves the integration of technologies and business (Vial, 2019; Zhu et al., 2021). DT represents a fundamental organisational change, through which organisations develop their capabilities to use digital technologies to reshape their businesses (Riasanow et al., 2018). Sony and Naik, (2020) view DT as a sociotechnical phenomenon consisting of social and technical systems that interact to accomplish a shared objective. According to the sociotechnical system perspective (STS), when introducing new technologies (called technical systems) in the workplace, equal

importance should be given to social systems (e.g. organisational structure, culture, processes and people) (Davis, Challenger, Jayewardene, & Clegg, 2014; Woodward, 1965). The joint optimisation of technical system with social systems (Appelbaum, 1997) is essential for organisations to maximise the effectiveness of new technologies (Mumford, 2000; Trist & Baumforth, 1951). Moreover, the introduction of new technologies at work without considering their effects on social systems may result in the failure of DT (Björkdahl, 2020; Mumford, 2006). Therefore, one of the main contributions of this dissertation is that it examines DT from an STS perspective, responding to calls to implement STS theory in new research domains such as DT and to provide a sociotechnical-based integrative approach to help organisations achieve successful DT (Davis et al., 2014; Sony & Naik, 2020).

The main purpose of DT is to achieve targeted performance outcomes and major business improvements (Singh & Hess, 2017) that help organisations survive and thrive in today's fast-paced dynamic business environment (Smet et al., 2018). The literature has highlighted agility as one of the main targeted performance outcomes of DT that helps organisations respond quickly to unexpected changes in the business environment (Cheng et al., 2020; Li et al., 2021; Zhang et al., 2022). Digital technologies enhance organisational speed and effectiveness, which helps companies recognise emerging opportunities or threats in competitive markets (Bharadwaj, 2000). Moreover, DT is crucial for achieving organisational agility (Bharadwaj, 2000; Hess et al., 2016; Li et al., 2021), although effectively achieving organisational agility through DT remains an elusive goal for most organisations (Ahlbäck et al., 2017).

Similarly, digital technologies facilitate collaboration beyond organisational boundaries in a flexible and cost-effective manner (Ferri et al., 2020) with the help of digital social tools. Internally, the collaboration of information technology (IT) experts with business experts has been highlighted as one of the most important aspects of successful DT (Li et al., 2021). Digital technologies enable real-time information sharing with all stakeholders, which ensures swift and effective decision-making and enables firms to adapt quickly to a changing environment (Li et al., 2021). Therefore, enhanced collaboration is another major goal that organisations target through DT. Finally, becoming a customer-centric organisation has been identified as another major goal of DT (Abhari et al, 2021; Fitzgerald et al., 2013; Hartl & Hess, 2017). The rapid advancement of digital technologies has affected the expectations of customers, who now require organisations to deliver new types of value and enhanced services (Hartl, 2019; Smith & Beretta, 2020). Therefore, DT aims to promote a customer-centric mindset in organisations to meet increasing customer demands. Hence, this

dissertation aims to explore how ongoing changes in the case organisations related to DT help in attaining agility, enhanced collaboration and customer centricity.

Researchers and practitioners view DT as a complex puzzle (Guinan et al., 2019) that requires the formulation of dedicated DT strategies (Horlacher et al., 2016; Gerald et al., 2016; Matt et al., 2015). Accordingly, most organisational leaders are focussed on understanding how this digital revolution is affecting their firms (Björkdahl, 2020). According to Vial (2019), successful and sustainable DT requires an integrated approach in order to change an organisation's structures, processes, technologies and culture. Similarly, Björkdahl (2020) argued that it is not technological issues that concern business leaders engaged in DT efforts. Rather, successful DT requires re-optimisation of organisations to capture value from digital technologies (Björkdahl, 2020). Consequently, organisations must rethink their social structures, such as leadership roles, competences, structures, culture and processes, to capitalise on the opportunities provided by digital technologies.

Research on DT has been developing and improving over the past decade (Zhu et al., 2021), enhancing the knowledge of digital practices (Sony & Naik, 2020; Vial, 2019; Warner & Wäger, 2019). However, most of the recent literature has focussed on the technological facets of DT (Henriette et al., 2015; Majchrzak et al., 2016; Porter & Heppelmann, 2015), while other researchers have reviewed the DT literature to find integrated solutions for the DT of organisations (Bockshecker et al., 2018; Cortellazzo et al., 2019; Henriette et al., 2015; Vial, 2019). For example, Vial (2019), Bockshecker et al. (2018), Hanelt et al. (2021), Konopik et al. (2022) and Haskamp et al. (2021) performed detailed literature reviews on DT, highlighting the need for empirical studies on the topic. Meanwhile, most of the empirical work on DT has focussed on specific contexts. For example, Chaniass and Hess (2016) centred their research on the use of digital technologies to enhance business performance. Majchrzak et al. (2016) explored organisational system developments with the adoption of new digital platforms. Chouaibi et al. (2022) analysed the influence of DT on organisational performance, highlighting the related risks, while Oh et al. (2022) identified factors contributing to the success of DT.

However, the existing literature falls short in terms of examining how industrial organisations undergo DT empirically. Thus, based on the current state of the literature, this dissertation seeks to address this significant research gap by studying the DT of three large industrial organisations. To do so, a qualitative multi-case study is used to explore the common patterns of DT in the case organisations. Building on the sociotechnical perspective, the dissertation

examines the ongoing changes in leadership roles and competencies, organisational structures as well as organisational culture that are identified as main enablers of DT. Further, the dissertation contributes to the DT literature by explaining the role of DT enablers in helping organisations to achieve performance outcomes, including organisational agility, enhanced collaboration and customer centricity.

## 1.2 Problem statement and research objectives

### 1.2.1 Problem statement

DT is a phenomenon that requires fundamental organisational changes (Björkdahl, 2020; Riasanow et al., 2018; Vial, 2019). Nonetheless, despite the multiplicity of perspectives on the role of leadership, changing organisational structures, updating the existing organisational culture, the sociotechnical perspective on DT as well as the role of DT in attaining agility, enhanced collaboration and customer centricity are lacking to address the topic comprehensively, as most studies are based on literature reviews or have narrow scopes. In other words, the literature does not provide a complete theoretically and empirically integrated framework concentrating on the sociotechnical view on DT to identify ongoing changes in the enablers of DT as well as how these changes help organisations achieve targeted performance outcomes.

### 1.2.2 Research objective

This study's primary purpose is to increase the understanding of DT (from a management point of view) in the context of industrial organisations. To achieve this objective, this dissertation aims to investigate the DT process of industrial organisations. The first article identifies the key focus areas (enablers) where the most is happening in the case organisations to achieve an impactful DT. Moreover, it elaborates on how these enablers help the case organisations achieve their targeted performance outcomes. The second article outlines the key emerging roles of leaders and the competencies that are required to support the DT of the case organisations. Further, it explains in detail how the identified leadership roles and competencies contribute to achieving the targeted performance outcomes. The third article aims to enhance the understanding of how the organisational structures of industrial organisations are being altered to align with their DT programmes. Moreover, it examines how those structural changes help the case organisations become agile, collaborative and customer centric. Finally, the fourth



article addresses DT from an organisational culture point of view. It seeks to identify the main changes in organisational culture that are necessary to prepare for DT.

### 1.3 Research question

The main research question is motivated by the burgeoning discourse on DT in industrial organisations.

**RQ:** *How do industrial organisations prepare for DT?*

The sub-questions guide the dissertation's focus toward specific research gaps related to leadership, organisational structure and organisational culture. Four sub-questions are formulated to address this main research question:

**SQ1:** *What are the enablers and targeted performance outcomes of DT? How do the identified DT enablers help industrial organisations achieve their targeted performance outcomes?*

**SQ2:** *What are the emerging roles and related competencies required for industrial leaders to succeed in DT? How do the identified roles and competencies contribute to achieving the desired performance outcomes?*

**SQ3:** *What structural changes are happening in industrial organisations to support successful DT? How do the identified structural changes help organisations achieve agility, enhanced collaboration and customer centricity?*

**SQ4:** *How can industrial organisations strategically design a culture in their pursuit of DT?*

Figure 1 outlines the framework of the dissertation.

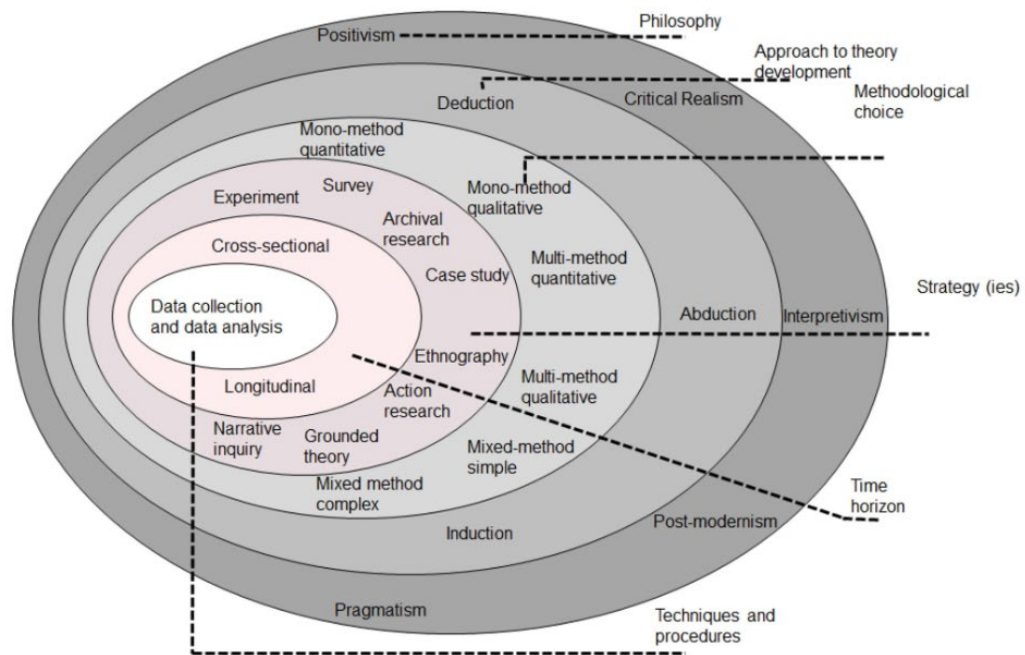
<p><b>Article 1</b></p> <p>DT enablers and targeted performance outcomes</p> <p>SQ1: What are the enablers and targeted performance outcomes of DT? How do the identified DT enablers help industrial organisations achieve their targeted performance outcomes?</p>		
<p><b>Article 2</b></p> <p>Emerging roles and competencies of leadership for DT</p> <p>SQ2: What are the emerging roles and related competencies required for industrial leaders to succeed in DT? How do the identified roles and competencies contribute to achieving the desired performance outcomes?</p>	<p><b>Article 3</b></p> <p>Changing organisational structures for DT</p> <p>SQ3: What structural changes are happening in industrial organisations to support successful DT? How do the identified structural changes help organisations achieve agility, enhanced collaboration and customer centricity?</p>	<p><b>Article 4</b></p> <p>Changing organisational culture for DT</p> <p>How can industrial organisations strategically design a culture in their pursuit of DT?</p>

**Figure 1.** The dissertation's framework

DT aims to keep organisations relevant in fast-paced business environments through disruptive and exponential technologies. In this context, article 1 explores the most important enablers of DT in the case organisations and identifies the main performance outcomes of their DT programmes. The remaining three articles examine the specific enablers that were found in article 1 and links them with the targeted performance outcomes. The dissertation is based on the STS perspective. It argues that the social systems and newly implemented technical systems must be jointly optimised to reap the full benefits of digital technologies. Hence, this dissertation contributes to the literature on DT through the theoretical lens of STS theory. Specifically, it advances the understanding of how industrial organisations prepare for DT by identifying DT enablers and linking them with targeted performance outcomes. The main contribution of this dissertation is to provide a comprehensive integrative framework of DT that not only elaborates DT enablers in detail but also explains how these enablers help organisations to achieve desired performance outcomes.

## 1.4 Research approach

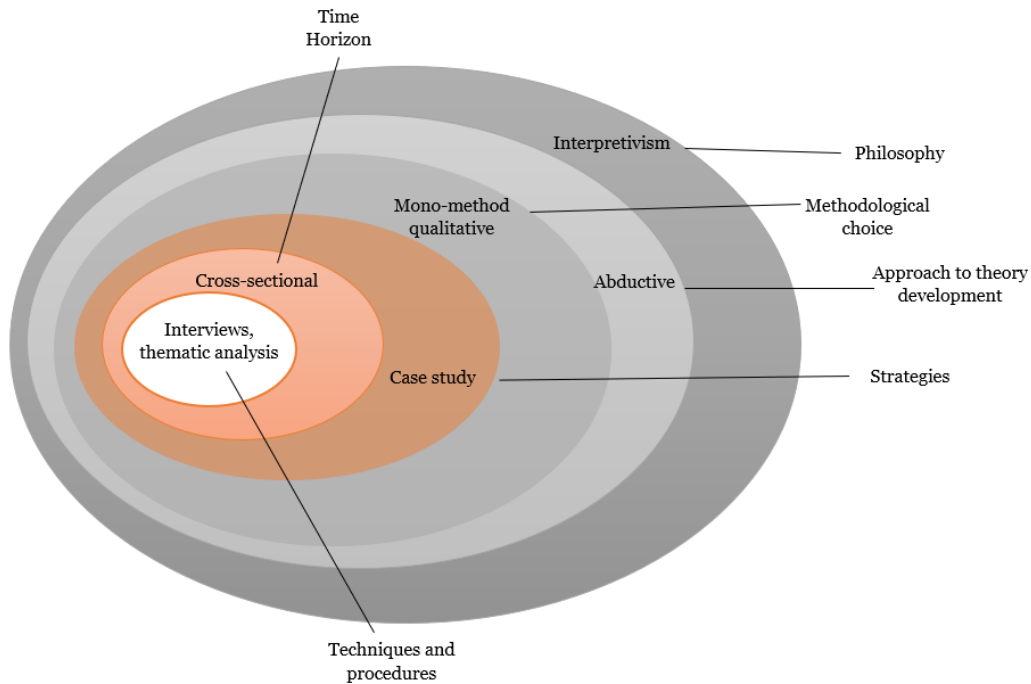
The research approach outlines the researcher's stance with regard to the philosophies, approaches, strategies, methodological choices, time horizon and, techniques and procedures that are applied. One of the most famous research models utilised by researchers is the research onion developed by Saunders, Lewis, and Thornhill (2019), which is shown in Figure 2.



**Figure 2.** Research onion (Saunders et al., 2019)

In this dissertation, the philosophical stance of the researcher was based on interpretivism, seeking an in-depth understanding of the subject. This stance focusses on the collection of people's thoughts and ideas and draws holistic views. The approach in this research work is based on abductive reasoning as the researcher's observations and theory go hand in hand. Accordingly, this dissertation does not aim to test hypothesis like positivist studies or formulate new theories as might be found with a grounded theory approach. Further, this dissertation did not focus on theory testing. Rather, in alignment with interpretivism and abductive reasoning, this study adopted a mono-method qualitative approach based on a case study method to gain an in-depth understanding of the subject matter in a real-life setting. The time horizon refers to the number of points in time at which the researcher collects data. Here, the data were only collected at one point, and thus it was a cross-sectional study. The

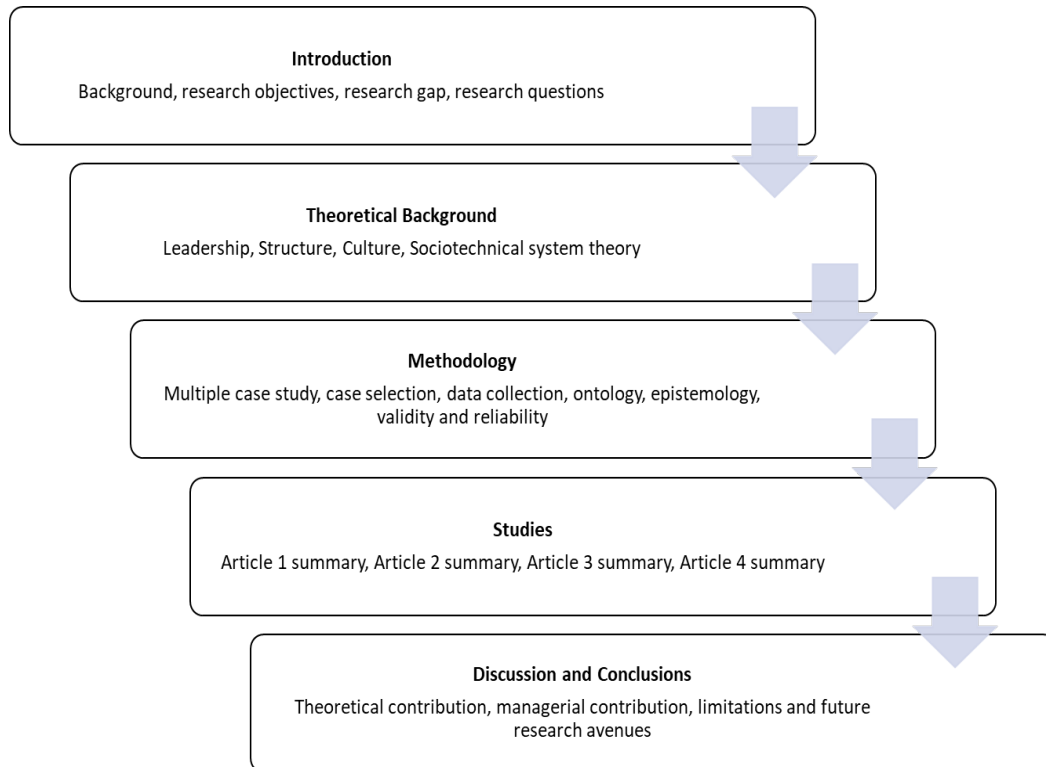
primary data were collected through semi-structured interviews. In addition, this study also utilised secondary data, which were based on publicly available data, online data as well as internal reports of the case organisations. The data analysis was based on Gioia et al.'s (2013) systematic coding and thematic analysis approach. In following, Figure 3 presents the research onion of this dissertation.



**Figure 3.** Dissertation's research onion

## 1.5 Dissertation structure

This dissertation consists of two sections. The introduction, theoretical background, methods, article summaries, discussion and conclusions chapters make up the first section of the dissertation. The objective of the first part is to provide context for the research, explain the key themes and position the articles. Figure 4 displays the structure of the first section of the dissertation.



**Figure 4.** Structure of the dissertation

The second part consists of four articles. Articles 1, 2 and 3 were co-authored by Imran, Shahzad, Butt and Kantola. Article 4 was co-authored by Butt, Imran, Helo and Kantola. Imran was the primary author of the first three papers and was primarily responsible for creating, writing and structuring the articles as well as gathering and analysing the data and organising the review process. The fourth article was led by Butt, while Imran contributed to the data collection, data analysis and finalising the article. Table 1 provides a summary of the articles' detailed research questions, theoretical grounds, research methods, research contexts, case selection processes and samples.

**Table 1.** Overview of the articles

	<b>Article 1</b>	<b>Article 2</b>	<b>Article 3</b>	<b>Article 4</b>
<b>Research Question</b>	What are the enablers and targeted performance outcomes of DT? How do the identified DT enablers help industrial organisations achieve identified targeted performance outcomes?	What are the emerging roles and related competencies required for industrial leaders to succeed in DT? How do the identified roles and competencies contribute to achieving the desired performance outcomes?	What structural changes are happening in industrial organisations to support successful DT? How do the identified structural changes help organisations achieve agility, enhanced collaboration and customer centricity?	How can industrial organisations strategically design a culture in their pursuit of DT?
<b>Theoretical background</b>	STS perspective	STS perspective	STS perspective	STS perspective
<b>Research method</b>	Qualitative case study	Qualitative case study	Qualitative case study	Qualitative case study
<b>Research context</b>	Digital transformation	Digital transformation and leadership	Digital transformation and organisational structure	Digital transformation and organisational culture
<b>Unit of analysis</b>	Focal companies	Focal companies	Focal companies	Focal companies
<b>Sample</b>	4 case companies	3 case companies	3 case companies	3 case companies
<b>Key data sources</b>	12 open-ended interviews + extensive secondary data	41 semi-structured interviews + extensive secondary data	41 semi-structured interviews + extensive secondary data	41 semi-structured interviews + extensive secondary data

## 2 THEORETICAL BACKGROUND

### 2.1 Digital transformation

In the literature, the terms of DT (digital transformation) and digitalisation are used interchangeably (Bockshecker et al., 2018) in reference to the same phenomenon. However, it is important to differentiate their meanings, as their concepts and practices differ fundamentally. Both terms originate from digitisation, which refers to the technological transformation of analogue information into a digital arrangement (Da Silva et al., 2016). For instance, organisations use IT to digitise their processes and enhance their efficiency (Ross, 2017). Digitalisation involves the integration of multiple technologies into all aspects of life that can be digitalised (Legner et al., 2017). Parida et al. (2019, p. 391) defined digitalisation as the ‘use of digital technologies to innovate a business model and provide new revenue streams and value-producing opportunities in industrial ecosystems’, which goes beyond merely digitalising every possible thing. However, the focus of digitalisation is mainly on enhancing the digital features of products and services.

Meanwhile, ‘DT is the combined effects of several digital innovations bringing about novel actors (and actor constellations), structures, practices, values and beliefs that change, threaten, replace or complement existing rules of the game within organisations, ecosystems, industries or fields’ (Hinings et al., 2018, p. 53). Similarly, Vial, (2019, p. 118) defined it as ‘a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies’. Some authors view DT as a sociotechnical phenomenon (Sony & Naik, 2020) that affects every aspect of an organisation, including its personnel, structures, procedures and culture (Konopik et al., 2022). In this dissertation, DT is defined as a holistic (Vial, 2019) sociotechnical phenomenon (Schnasse et al., 2021; Sony & Naik, 2020) that requires organisations to make overall changes in order to integrate and benefit from digital technologies.

DT is key to success in industry 4.0, which is also called the fourth industrial revolution (Lasi et al., 2014). The term industry 4.0 was coined by the German government to refer to its high-tech strategy initiatives (Lasi et al., 2014). Unlike the past three industrial revolutions (see Table 2), industry 4.0 emerged due to the exponential evolution of modern technologies, including advanced algorithms, the internet of things, hyperconnectivity, automation, self-learning systems, cloud

computing, big data and analytics and artificial intelligence (Gilchrist, 2016; Lerch & Gotsch, 2015). These technologies offer greater efficiency, new functionalities, optimisation and higher reliability, which pose both opportunities and challenges to organisations (Lasi et al., 2014). Table 2 presents an overview of the past four industrial revolutions (Imran & Kantola, 2018).

**Table 2.** Industrial revolutions (adopted from Imran & Kantola, 2018)

	<b>First Revolution</b>	<b>Second Revolution</b>	<b>Third Revolution</b>	<b>Fourth Revolution</b>
<b>Names</b>	Mechanisation	Mass Production	Computerisation	Industry 4.0
<b>Time Period</b>	Late 18 <sup>th</sup> to Early 19 <sup>th</sup> century	Late 19 <sup>th</sup> to Mid-20 <sup>th</sup> century	2 <sup>nd</sup> half of the 20 <sup>th</sup> century	Early 21 <sup>st</sup> century
<b>Mode of Production</b>	Steam engine and mechanical production	Electricity and division of labour	Electronics and information technology	ICT technologies
<b>Production Structure</b>	Industrial cities	Industrial region	Global production networks	Global value chains

To survive in this this fourth industrial revolution, organisations must undergo massive organisational transformation, more specifically, DT. Organisations must adopt a technology-based perspective to re-evaluate their services, roles and processes (Eden, Burton-Jones, Casey, & Draheim, 2019). This not only involves the integration of digital technologies (AlNuaimi et al., 2022; Gilchrist, 2016) into all business areas but also the realignment of organisational ways of working with these technologies (Gupta & Bose, 2022). According to the literature, many organisations are striving to undergo DT in relation to their organisational structures, culture, business models, strategies or IT (Verhoef et al., 2021). McKinsey et al., (2018) reported that only 30% of DT initiatives succeed due to the complexity of organisational change efforts (Bartsch et al., 2021). Moreover, McGrath and McManus, (2020) highlighted that leaders nowadays are rushing to invest in radical DT, which leads to expensive DT failures. Li (2020) argued that the main cause of these failures is the growing difference between reality and rhetoric as well as an ongoing strategy–execution gap.

Therefore, there is a need for research on the DT process of industrial organisations to explore the most important changes that occur during this



progression. Article 1 offers a comprehensive view of the DT of industrial organisations and outlines the roles and competencies of leadership, organisational structure and organisational culture. Further, the article links these findings with the performance outcomes that the case organisations are aiming to achieve through DT. Table 3 summarises key recent studies on DT.

**Table 3.** Key studies on digital transformation

<b>Authors</b>	<b>Methods</b>	<b>Literature Contribution</b>
(Björkdahl, 2020)	Multiple-case study approach	It explored the DT of 26 organisations. The results show that firms are focussing on achieving better efficiency through DT rather than pursuing growth. Moreover, they struggle to capitalise on the opportunities provided by DT.
(Gimpel et al., 2018)	Qualitative study	It argues that, to master digitalisation, organisations must master six components: value proposition, data, customers, organisation and transformation management and operations.
(Berghaus & Back, 2017)	Multi-case study	This study identifies how managers approach DT in their firms. It identifies five approaches to start DT programmes: centralised, bottom-up, IT-centred, innovation-centred and channel-centred.
(Bockschecker et al., 2018)	Literature review	This study defines and distinguishes the terms digitisation, digitalisation and DT from a sociotechnical perspective. It also identifies seven phenomena related to these terms, including collaboration, flexibility, sharing, mobility, co-creation, communication and connectivity.
(Ghosh, Hughes, Hodgkinson, & Hughes, 2022)	Qualitative study	This study focusses on the development of organisational capabilities for DT and provides a new integrative conceptual framework based on an analysis of the DT of case organisations.
(Hanelt et al., 2021)	Literature review	This research examines DT from the standpoint of organisational transformation. It offers a multidimensional framework based on previous research and argues that DT enables the further adoption of digital business ecosystems. In addition, it derives four viewpoints on DT: compartmentalised adaptation, holistic co-evolution, technology impact and systemic shift.

<b>Authors</b>	<b>Methods</b>	<b>Literature Contribution</b>
(Gupta & Bose, 2022)	Longitudinal case study	This research involves a longitudinal case study of two digital start-ups in to identify the key characteristics that drive DT in digital companies. It offers a framework for analysing how digital business transformation occurs in entrepreneurial enterprises through information interchange with the surrounding environment.
(Oh et al., 2022)	Quantitative study	This research seeks to discover the determinants of DT success. It scientifically investigates the elements that influence the personal and societal acceptability of DT. The results demonstrate that planned behavioural elements and inventive features have a favourable influence on DT acceptance attitude and that DT acceptance attitude has a beneficial effect on personal DT acceptance.
(Konopik et al., 2022)	Systematic literature review	This research analyses a comprehensive set of organisational capabilities and offers a conceptual framework that clusters organisational skills into seven essential topics for managing DT.
(Chouaibi et al., 2022)	Quantitative study	This research examines the effects of DT on organisational performance by focussing on the risks involved. The findings indicate a rising interest in DT, which may help businesses improve their organisational performance.
(Haskamp et al., 2021)	Literature review	This research indicates that companies undertaking DT are confronted with several obstacles and inertial factors. It includes the antecedents, key attributes, dimensions, moderators and outcomes of inertia in its framework. In addition, it provides four pathways for expanding our knowledge of inertia in the context of DT to make DT a more effective and fruitful endeavour.
(Vial, 2019)	Literature review	It defines DT as a process in which digital technologies cause disruptions that elicit strategic responses from organisations seeking to alter their value creation paths while managing the structural changes and organisational barriers that influence the positive and negative results of this process.

## 2.2 Sociotechnical system theory and DT

STS arose as a consequence of the UK Tavistock Institute's research on the introduction of coal mining machines, which revealed the interdependence of technology and social elements (Trist & Baumforth, 1951; Woodward, 1965). STS derives from general system theory (VonBertalanffy, 1950) and classifies work systems as a combination of social and technological subsystems (Parker et al., 2017). The social subsystem consists of structures, tasks, organisational procedures, culture, roles and responsibilities and leadership (Konopik et al., 2022; Matt et al., 2015; Vial, 2019). Meanwhile, the technical subsystem consists of technologies and tasks (Pasmore, 1994). Malik and Orr (2022) outlined three key characteristics of STS theory:

- i. The performance of an STS system is maximised when social and technical systems are jointly optimised (neither of these are dominating the other) (Appelbaum, 1997).
- ii. When pursuing organisational objectives, social and technological subsystems must be open to their environment and responsive to change (Emery & Trist, 1965).
- iii. To be able to adapt effectively to the environment and fulfil its objectives, the variety of a self-regulating system must be proportional to its complexity (Klemsdal et al., 2017).

Some authors have also included 'organisation' as third dimension of STS design (Schnasse et al., 2021). Organisations are comprised of several interconnected aspects. Consequently, planning a change in one component of the system without considering how it will affect the other components may reduce the efficacy of the change (Eason, 2014) or cause it to fail. From a DT perspective, organisations must re-optimize their social systems (e.g. structures, culture and leadership) with newly introduced technical systems (implementation and integration of digital technologies) (Appelbaum, 1997). For instance, if a technical change happens, such as the introduction of a new digital platform to promote innovation within the organisation, the organisation must consider what new competencies are needed by its personnel as well as how to change the culture to get the most out of this particular technology. Hence, STS theory is a potent lens for examining technological-driven change, or DT, through the joint optimisation of social and technical systems.

DT goes beyond the mere implementation of digital technologies (Henriette et al., 2015; Prodi et al., 2022; Sony & Naik, 2020), requiring changes in structures,

tasks, organisational procedures, culture, roles and responsibilities and leadership (Konopik et al., 2022; Matt et al., 2015; Vial, 2019). Based on the STS perspective on organisational transformation, technologies and machines are not the controlling factor with humans in a subordinate role (Mumford, 2006). Rather, it holds that the social embeddedness of technology interactions with organisational actors plays a decisive role in business value generation (Dacin et al., 1999). Large changes, such as DT, require the prudent design of social and technical systems in an organisation (Pasmore et al., 2019). Moreover, the STS perspective incorporates the organisations' people, goals, processes, infrastructure, technology and culture (Davis et al., 2014). Table 4 provides an overview of recent studies using the STS perspective to study DT. Each article in this dissertation is analysed from the STS perspective.

**Table 4.** Research overview on STS perspective and DT

<b>Authors</b>	<b>Methods</b>	<b>Literature Contribution</b>
(Schnasse et al., 2021)	Literature review	Identifies 27 sociotechnical risks related to DT. Further empirical research is required to validate the identified STS risks.
(Prodi et al., 2022)	Case study Research	It explores the role of intermediary organisations in changing sociotechnical systems and overcoming ecosystem limitations. Moreover, it is a comparative study that seeks to understand whether policy-makers have embraced a socio-technical understanding of industry 4.0.
(Beier, Ullrich, Niehoff, Reißig, & Habich, 2020)	Literature review	This paper defines industry 4.0 from a sociotechnical point (categorised as human, technology and organisation subsystems) of view by offering a comprehensive summary of its essential characteristics.
(Hartl & Hess, 2020)	Qualitative study	This research examines the shift from IT projects to DT from an STS perspective. It recognises that this transition process is marked by exporting difficulties and structural concerns, which may be solved through bricolage, borrowing competence and alliance-building intervention tactics.
(Sony & Naik, 2020)	Literature review	This research incorporates an STS viewpoint into the integrative architectural design for implementing industry 4.0. The study contends that effective industry 4.0 deployment requires vertical, horizontal and end-to-end integration. In addition, the research proposes a design method for three kinds of integration mechanisms in industry 4.0, considering the influence of sociotechnical systems on people, infrastructure, technologies, processes, culture and objectives.

<b>Authors</b>	<b>Methods</b>	<b>Literature Contribution</b>
(Davis et al., 2014)	Opinion paper	This paper argues that STS researchers must be more daring and encourages the evolution and expansion of the methodology. In addition, it contends that STS should be applied to a far broader spectrum of complicated issues and global difficulties (e.g. DT).
(Bockschecker et al., 2018)	Literature review	This paper defines digitisation and DT and provides conceptual differentiations of these terms. Further, it embeds the DT phenomenon in the context of sociotechnical system theory.
(Hartl & Hess, 2020)	Ethnographic case study	Using STS theory as a conceptual research lens, this study examines the transition phase of an information system (IS) infrastructure project.
(Fuchs & Hess, 2018)	Qualitative research	From the perspective of sociotechnical systems theory, this study conceptualises the agile transformation process as an episodic change process consisting of a succession of many agile transformation stages. These stages involve both dramatic and gradual change and are bounded by constraints created by emerging challenges.

### 2.3 Leadership and DT

DT consists of powerful and disruptive changes, which makes leadership a complex and demanding task (Cortellazzo et al., 2019). At the same time, leadership is crucial to the successful implementation of DT (Benitez et al., 2022; Cortellazzo et al., 2019; Kane et al., 2019). DT require leaders to design and execute digital strategies for adopting digital technologies to enhance organisation performance and remain competitive (Hesse, 2018). However, DT creates new leadership challenges, as it requires changes in traditional leadership to account for ongoing global changes (Bunjak et al., 2022).

Recent studies have coined the term ‘digital leadership’ (Benitez et al., 2022; Bresciani et al., 2021; Weber et al., 2022) in reference to leaders who are dealing with DT. Digital leadership lies between IT-savvy leadership and business-savvy leadership (Weill & Ross, 2009), that is, it can include IT leaders with solid commercial insights or business leaders with impressive digital skills (Benitez et al., 2022). Digital leaders should be able to understand digital technologies, markets and business and have the strategic leadership skills needed to drive DT (Benitez et al., 2022). Weber et al. (2022, p. 228) defined a digital leader as one ‘who detects digital trends early, challenges the status quo, understands the

opportunities and risks of the organization's DT, and develops a clear digital vision and related strategy as highly competent, leading to high levels of cognitive trust in the leader'.

The existing literature has highlighted certain new leadership roles that organisational leaders must play to succeed in DT. Resistance to change is one of the main challenges organisations face when implementing a transformation programme. Hence, one of the primary responsibilities of leaders is to articulate a clear vision about emerging technology (Gençer & Samur, 2016) to convince people to adopt new technologies at work (Bunjak et al., 2022). Similarly, AlNuaimi et al. (2022) and Vial (2019) highlighted the role of leadership in developing digital mindsets to respond to disruptions related to digital technologies. AlNuaimi et al. (2022) mentioned three leadership habits supporting success in DT: keeping up on current knowledge of and trends in emergent digital technologies, defining the direction of technology-driven change and investment strategies and guiding the team through the process of change.

Similarly, the literature highlights important competencies that leaders must possess to implement successful DT in their organisations. Kane et al. (2019) found that transformative vision, a forward-looking perspective, digital literacy and adaptability are the most important competencies of leadership in the digital era. According to Abbu et al. (2020), the main characteristics of digital leaders are being fast, cross-hierarchical, team oriented and cooperative, with a strong focus on innovation. Oberer and Erkollar (2018) reported that personal competencies, mindsets and the ability to apply new methods and instruments are the most critical dimensions of digital leadership.

Table 5 summarises recent studies on leadership in connection with DT.

**Table 5.** Research overview on leadership and DT

<b>Authors</b>	<b>Methods</b>	<b>Literature Contribution</b>
(Weber et al., 2022)	Quantitative/ survey-based study	This research examines the efficacy of two complementary leadership behaviours that are relevant in the digital age: task-oriented (or more accurately, DT-oriented) and people-oriented leadership behaviours, particularly their interaction.
(Hesse, 2018)	Qualitative study	This research analyses leaders' perceptions of digitalisation to better understand the effects of digitalisation on leadership.
(Cortellazzo et al., 2019)	Literature review	The core results of this research indicate that leaders play a crucial role in the establishment of a

<b>Authors</b>	<b>Methods</b>	<b>Literature Contribution</b>
		digital culture: They must build connections with various and dispersed stakeholders, facilitate collaborative processes in complicated contexts and address important ethical problems.
(Vial, 2019)	Literature Review	This study highlights the need to create new leadership positions, new roles as well as new competencies.
(Bunjak et al., 2022)	Quantitative	This research demonstrates that shared leadership moderates the link between perceived transformational leadership and individual followers' adoption of IT innovation. In addition, management innovation at the organisational level moderates the relationship between transformational leadership and IT innovation adoption, which is mediated by shared leadership.
(Benitez et al., 2022)	Mix method approach	This research demonstrates that digital leadership improves innovation performance through the digitalisation of a company's platform. In addition, the study shows the evolution of the ideas of digital leadership competence and platform digitisation capability.
(Gençer & Samur, 2016)	Quantitative	This article demonstrates that both transformational and transactional leadership styles are somewhat and equally connected with technological leadership skill levels.
(AlNuaimi et al., 2022)	Quantitative	This research shows that digital transformational leadership and organisational agility affect DT favourably, and transformational digital leadership influences organisational agility.
(Abbu et al., 2020)	Quantitative /Survey	This study reports that digitally native organisations view leadership as a crucial factor for DT success. Leadership traits and competencies distinguish digitally mature firms from digitally created enterprises.
(Blanka, Krumay, & Rueckel, 2022)	Qualitative study	This research highlights the gap in research on DT regarding the role of human resources and employee competencies. The study employs a human-centred perspective on digitalisation and establishes a framework as an artefact that considers employee capability in relation to an organisation's digital transformation level.
(Porfírio, Carrilho, Felício, & Jardim, 2021)	Quantitative study	This research examines how business factors, in conjunction with managerial characteristics, foster DT in Portuguese enterprises. This research model

<b>Authors</b>	<b>Methods</b>	<b>Literature Contribution</b>
		explores the link between digital strategies and corporate and business strategies based on the features of the organisation and its management. The findings of this research support the significance of leadership and, in particular, the importance of managers' coherence with the goal of their firms to encourage more advanced phases of DT.
(Busulwa, Pickering, & Mao, 2022)	Literature Review	This research emphasises the DT and digital business management skills that hotel managers must possess. In addition, a framework for combining DT and digital business management abilities with previously recognised digital technological competencies needed by hotel managers is proposed.
(Pihlajamaa, Malmelin, & Wallin, 2021)	Quantitative study	This study identifies DT triggers and establishes a management framework in response. In addition, it proposes that organisations may build new transformative competence combinations by participating in three activities: generating new competences, encouraging competence combination and increasing transformational leadership.

It is evident from the review of the literature on leadership from a DT perspective that this has become a popular research topic (Abbu et al., 2020; AlNuaimi et al., 2022; Vial, 2019; Weber et al., 2022). However, the way in which organisational leadership is changing during the process of DT is less understood (Bresciani et al., 2021; Oreg & Berson, 2019), especially from the point of view of industrial organisations, which are hardcore traditional organisational. Moreover, recent research calls for further studies on leadership to support link between leadership and technology adoption (Cortellazzo et al., 2019) by exploring leadership roles and competencies (Benitez et al., 2022) and the contextual conditions that may lead to successful DT. Accordingly, this dissertation identifies the key leadership roles and competencies (AlNuaimi et al., 2022; Philip, 2021; Pihlajamaa et al., 2021; Tigre & Curado, 2022) that leaders of industrial organisations focus on during the DT process.

## 2.4 Organisational structure and DT

Digital technologies (Gilchrist, 2016) have become ubiquitous and represent a significant part of the fabric of most organisations. Consequently, they are having an important impact on organisational structures (Doherty et al., 2010). The



relationship between organisational structure and technological change is not a new topic in the literature (Harvey, 1968; Wanda J. Orlikowski, 2000). However, in this fourth industrial revolution, both technologies and organisations are undergoing unprecedented changes (Wanda J. Orlikowski, 2000) that require new or updated structures. As DT necessitates new strategies (Matt et al., 2015), it also requires changes to the formal and informal structures of the organisation (Worren, 2016). Moreover, reorganisations are typically associated with changes in organisational structures (Chandler, 1962).

The effectiveness of organisational transformations diminishes when they face anti-change organisational structures or managerial practices (Worley & Lawler, 2006). Moreover, the efficacy of change initiatives is largely determined by organisational design, including organisational structures (Worley & Lawler, 2006). Researchers associate the need for organisational restructuring with the increasing requirements for agility, flexibility and innovation within organisations (Worley & Lawler, 2006), which are essential to gain the full benefits of new digital technologies (Imgrund et al., 2018).

Organisational structure refers to the arrangement of people, departments and other subsystems of organisation (Fry, 1982). Harvey (1968) associated it with the internal properties of an organisation. Meanwhile, structural changes have been defined as 'variations in a firm's organizational setup' (Matt et al., 2015, p. 341). Organisational structures consist of different parameters. According to Aston University researchers, these parameters include centralisation, formalisation, standardisation, specialisation and configuration (Pugh et al., 1968). Specialisation is concerned with the division of labour, while centralisation is when decision-making power lies at a higher hierarchical level. Formalisation relates to how strictly written rules are followed in an organisation. Standardisation refers to unified ways and rules of behaviour. Finally, configuration (also known as hierarchy) represents the relationship between different units and departments. Similarly, Harvey (1968) argued that there are four main aspects of structure from a technology point of view. These include sub-unit specialisation (division of work), levels of authority, the ratio of managers and supervisors to total personnel and programme specification (mechanisms or rules). Fry (1982) stated that the theoretical dimensions of structures consist of complexity (vertical and horizontal differentiation), formalisation and centralisation (hierarchy).

However, in this dissertation, we focus on three main components of structure—formalisation, hierarchy and integration—for two main reasons. First, we conducted an initial study of the case organisations (twelve interviews) to explore the effects of DT on industrial organisations. From a structural point of view, this

study showed that formalisation, hierarchy and integration are the main three components where the most changings are occurring. Therefore, we chose them for further investigation. Second, these structural dimensions have been comprehensively covered in the prior literature. Formalisation refers to the level of job codification and rule observance inside an organisation, reflecting the extent to which an organisation employs its rules and procedures to dictate personnel's conduct (Liao et al., 2011). Hierarchy deals with vertical layers (i.e. authority, autonomy and decision-making) within an organisation (Ford & Slocum, 1977; Kleinknecht et al., 2020). Integration comprises internal interactions and horizontal collaboration, including how closely different segments, departments, functions and businesses work on any specific topic.

However, most of the classic studies (as they were conducted during the earlier industrial revolutions) focussed on production technologies and their impact on organisational structures (Harvey, 1968). However, technologies related to industry 4.0 or DT are far more exponential and disruptive (Brynjolfsson & McAfee, 2014), which not only impacts production but also the other processes of organisations. In a world driven by disruptive and exponential digital technologies, organisational structures must account for the fact that strategy implementation and re-implementation is an ongoing process. (Worley & Lawler, 2006). Moreover, traditional organisations discourage change. Therefore, in order to transform into 'built to change' organisations, companies must rethink their basic design principles (Worley & Lawler, 2006). Similarly, digital change requires flexible structures consisting of agile organisational forms, separate business units and functional digital areas (Verhoef et al., 2021). The bureaucracy involved in old traditional structures reduces response speed and innovativeness. Thus, to stimulate digital transformation, industrial organisations require flexible structures that allow fast responses to constant digital change (Verhoef et al., 2021).

Digital technologies support personnel in self-organisation, helping to avoid the delays caused by hierarchical setups (Snow et al., 2017). Further, digital technologies allow organisations to run their businesses with greater speed and lower costs and provide opportunities to co-design and co-produce with their customers. Moreover, they enable personnel to collaborate internally and externally to make process improvements and develop new solutions (Snow et al., 2017). As DT is bringing key changes to organisational structures (Kretschmer & Khashabi, 2020; Kuusisto, 2017), there have been multiple calls for further research on this topic (Horlacher et al., 2016). While a number of recent studies (as shown in Table 6) have addressed this gap, it remains unclear how industrial

organisations are modifying their structures in practice (Vial, 2019). Table 6 summarises the recent literature on organisational structures in the context of DT.

**Table 6.** Recent literature on organisational structures and DT

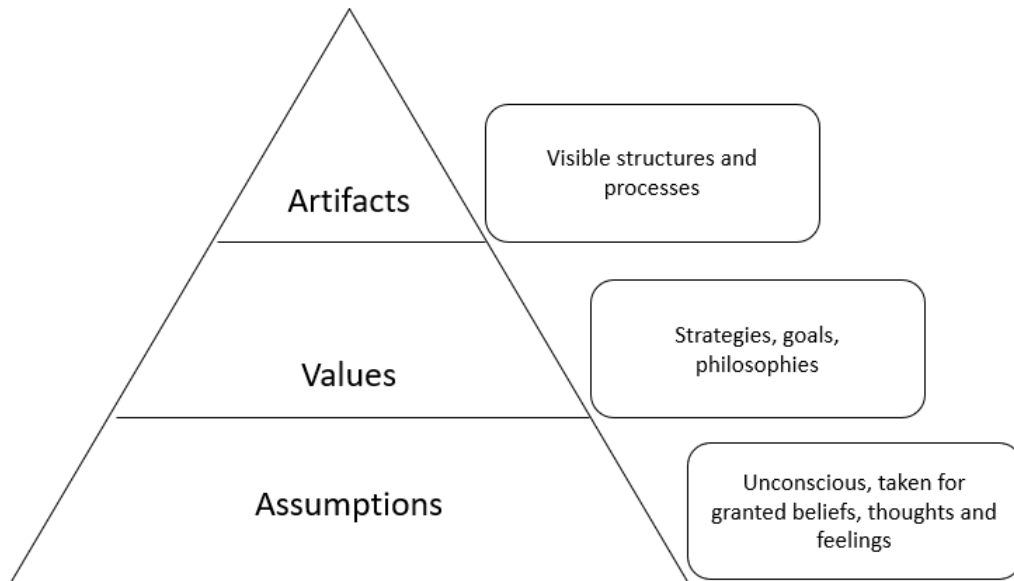
<b>Authors</b>	<b>Methods</b>	<b>Literature Contribution</b>
(Smith & Beretta, 2020)	Qualitative research	This paper examines the effects of structural changes on organisations and their members. In particular, it explores structural separation vs structural integration approaches through a paradox lens.
(Verhoef et al., 2021)	Literature review	This review identifies the scarce research on organisational structures for DT, showing that DT requires different, non-traditional organisational structures.
(Burton & Obel, 2018)	Literature review	From a digitalisation perspective, this research shows how different requirements of information flow require different organisational design strategies. The results highlight the need to investigate structures and coordination mechanisms through experimentation.
(Snow et al., 2017)	Conceptual paper	This study proposes a conceptual framework for the efficient design of digital organisations. Rather than hierarchical control and coordination systems, this article emphasises the importance of self-organising structures in DT. It also demonstrates how actor-oriented approaches might be used in digital organisations.
(Horlacher et al., 2016)	Multiple-case study	This study describes different organising logics that companies implement for DT as well as the interplay between vertical and horizontal design parameters.
(Mustafa, Solli-Sæther, Bodolica, Håvold, & Ilyas, 2022)	Quantitative study	This study illustrates that decentralised and informal structural arrangements are suitable for DT that requires skill variety, interdependence and integration. The results of this study also supports flexible and agile structures rather than hierarchical mechanisms of coordination and control.
(Aboiron & Aboiron, 2022)	Literature review	This study focusses on organisational change and value creation through DT. It reports the effects of DT on organisational structure based on theories of structural contingency. It also analyses the effects of DT on the primary functions, support functions and decision-making processes of organisations.

<b>Authors</b>	<b>Methods</b>	<b>Literature Contribution</b>
(Livijn, 2019)	Case study	This study investigates the role of middle managers in organisational design, highlighting the importance of middle managers in designing new forms of organising.
(Björkdahl, 2020)	Literature review	This study demonstrates that the most successful organisations have decentralised their DT, have flexible internal procedures and learn from their errors.

## 2.5 Organisational culture and DT

Along with the importance of leadership roles and competencies and updated organisational structures, organisational culture holds a significant position in DT. Culture is defined as ‘the collective programming of the mind which distinguishes the members of one group or category of people from another’ (Hofstede, 1994, p. 1). Uttal (1983) extended this definition by adding a behavioural aspect and referred to it as a ‘system of shared values (what is important) and beliefs (how things work) that interact with a company’s people, organizational structures, and control systems to produce behavioural norms’. The behavioural outcome was also mentioned by other scholars, such as O’Reilly & Chatman, (1996), who defined culture as a ‘system of shared values defining what is important, and norms, defining appropriate attitudes and behaviours, that guide members’ attitudes and behaviours’. According to Schein (1984), culturally ingrained behaviours are learned, shared assumptions of possible solutions to perceived problems. Further, Schein (1990) viewed culture as a significant stabilising force with numerous levels that vary in their visibility and interpretability.

Several models of organisational culture exist in the literature. We based our research on Schein’s (1984, 1990) organisational culture theory, which reflects organisational culture at three levels: artefacts, values and assumptions. A successful transformation requires a ‘dynamic fit’ between these levels of cultural indicators. With such a fit, the social and technical subsystems of an organisation are able to sustain mutual support for the people’s values, assumptions and beliefs and artefacts (Osmundsen et al., 2018). Otherwise, the misfit of values, artefacts and tacit assumptions leads to cultural ineffectiveness, that is, the failure to embrace the strategic changes required for business longevity (Schein, 2009). Figure 5 provides an overview of the levels of organisational culture.



**Figure 5.** Levels of culture, based on (Baumgartner, 2009; Schein, 1996)

The most observable component is artefacts, positioned in the most apparent and tangible layer of the cultural canvas. Schein (1997, p. 17) described artefacts as follows ‘At the surface we have the level of artefacts, which include all the phenomena that one sees, hears, and feels when one encounters a new group with an unfamiliar culture’. This includes visible products of the group, for example, the architecture of its physical environment, its language, its technology and products, its artistic creations and its style as embodied in clothing, manners of address, emotional displays, myths and stories told about the organisation, published lists of values, observable rituals and ceremonies and so on (Schein, 1997). Examples of artefacts are products, office arrangements, architecture, documentation, language, technologies, dress styles, myths and stories about the company, rituals and ceremonies (Baumgartner, 2009).

An organisation’s cultural values are built on its historical knowledge. For example, if a particular solution resolves a problem at work, and if a group of personnel has a shared perception of that success, it becomes a shared value or belief. This is also referred to as ‘*preferable modes of conduct*’, which are guided by principles of survival in social circles (Rokeach, 1973). Organisations adopt certain espoused values as their preferred behaviours (Schein, 2004). The espoused values may also be characterised as conscious strategies, goals or philosophies, which are often utilised to justify behaviours (Chen & Corritore, 2008).

Lastly, in order to comprehend the reasoning behind overt behaviours and supporting espoused values, it is necessary to study the underlying assumptions of a culture (Schein, 1997). Such assumptions are ‘unconsciously shared as obvious truths and develop as shared values and beliefs, becoming repeatedly instantiated over time’ (Chen & Corritore, 2008). These values become unconscious beliefs, perceptions, thoughts and feelings which serve as a direct response to problems. Hence, they become taken-for-granted truths shared and passed on by organisational members. Although underlying assumptions are difficult to elicit and change, as they are essentially invisible (Chen & Corritore, 2008), it is not impossible to change them. Overall, these three levels—artefacts, values and assumptions—constitute a particular culture.

The literature identifies organisational culture as a critical factor for organisational effectiveness (Denison & Mishra, 1995; Zheng et al., 2010), competitive advantage (Boniface, 2011), strategies (Kaplan, 2011) and responses to environmental changes (Bertels et al., 2016; Grover et al., 2022). Most importantly, a failure to pay proper attention to culture is one of the major reasons for failures in organisational transformation (Kane et al., 2016). Therefore, it is essential for successful change initiatives (Cameron & Quinn, 2011), such as DT (Sony & Naik, 2020; Vial, 2019). Culture has a tendency to root an organisation in past practices that are no longer suited for a changing world. Consequently, cultural change is the biggest challenge for achieving an impactful DT (Westerman et al., 2019). On one hand, it is a valuable asset with the potential to support organisational transformation and the exploitation of digital technologies, while on the other hand it can also be a source of inertia that prevents change (Hartl, 2019). Therefore, organisations have to carefully re-evaluate their cultures and align them with the DT.

In this digital age, the organisational culture is different from that adopted by traditional industrial organisations (Kane et al., 2018). Studies have categorised traditional forms of culture into four main categories: adhocracy, clan, market and hierarchy cultures (Grover et al., 2022). An adhocracy culture promotes entrepreneurship and creativity and values innovative outputs, transformation and agility (Cameron & Quinn, 2011). A clan culture encourages commitment, communication and development (Cameron & Quinn, 2011) and emphasises teamwork, participation and consensus (Grover et al., 2022). A market culture fosters competitiveness and productivity by focussing on customers and strong controls (Cameron & Quinn, 2011). Finally, a hierarchical culture focusses on internal maintenance, with an emphasis on stability and control (Cameron & Quinn, 2011). Companies with a hierarchical culture assume that clear lines of

decision-making authority, standardised rules and procedures and control and accountability mechanisms are keys to success (Cameron & Quinn, 2011).

Scholars coined the term digital culture to address new cultural demands for DT (Westerman & McAfee, 2012). Digital culture is linked with digital intensity (i.e. investments in technology-enabled initiatives) and transformation management intensity (creation of leadership capabilities to drive DT) (Grover et al., 2022). Organisations with competitive advantages are measured high in both digital and transformation management intensity. Moreover, such organisations adopt a digital culture that allows them to envision future changes and adopt accordingly (Grover et al., 2022; Westerman & McAfee, 2012). Digital culture is defined as ‘a set of beliefs, values, and assumptions that are shared by employees of an organization regarding digital technologies’ (Abhari et al., 2021; Gregory et al., 2009). Importantly, digital culture does not refer to advanced technology per se but rather to developing a digital mindset and habits in the organisation (Abhari et al., 2021).

Although successful DT and organisational cultures have been highlighted in the literature (Gurbaxani & Dunkle, 2019), most of the recent research on organisational culture (in the context of DT) has been conceptual and advisory (Verhoef et al., 2021; Vial, 2019). Only a handful of recent studies have addressed this phenomenon empirically. For example, Berghaus and Back (2017) illustrated the importance of top management in DT through a digital culture change. Abhari et al. (2021) adopted Hofstede’s cultural dimensions for digital culture and explored how a positive employee experience and digital governance support DT. Hartl and Hess (2017) used the Delphi method to identify few cultural values that play a role in the DT of organisations: openness to change, agility, tolerance of failure, willingness to learn, participation, cooperation, customer centricity, entrepreneurship, risk affinity and innovation. Martínez-caro, Cegarra-navarro, and Alfonso-Ruiz (2020) found that digital culture positively impacts the adoption of digital technologies and business value development. Table 7 summarises recent research on organisational culture in the context of DT.

**Table 7.** Literature review on organisational culture and DT

<b>Authors</b>	<b>Methods</b>	<b>Literature Contribution</b>
(Tuukkanen, Wolgsjö, & Rusu, 2021)	Qualitative study	This paper highlights the most important cultural values for DT: dynamic reactions to changing environmental demands, striving for organisational development, affinity toward the organisation, constant learning, tolerance of mistakes, openness to calculated risks, trust between the

<b>Authors</b>	<b>Methods</b>	<b>Literature Contribution</b>
		company and its clients, trust within the organisation and cooperation within the organisation.
(Grover et al., 2022)	Literature review	This work promotes the toolkit view of organisational culture and connects it with the collective meaning perspective to provide a new theoretical basis for organisational culture researchers, particularly in the IS sector.
(Abhari et al., 2021)	Quantitative study	According to the findings of this research, without understanding the drivers of digital governance, businesses may fail to realise the full potential of DT. To increase the success of a DT, it is necessary to increase employee engagement in digital governance.
(Hartl, 2019)	Exploratory Delphi study	This paper identifies cultural values critical for a successful DT. These values include openness to change, customer centricity, innovation, agility, willingness to learn, trust, entrepreneurship, tolerance of failure, communication, risk affinity, participation and cooperation.
(Westerman et al., 2019)	Review paper	This paper lists four key values of digital culture: impact, speed, openness and autonomy. It also provides principles for creating the necessary organisational culture.
(Hartl & Hess, 2017)	Delphi method	The study identifies 12 cultural values that play a role in the success of DT, positioning them within the competing value framework (CVF). The results show that the adhocracy and clan culture types contribute to DT.
(Berghaus & Back, 2017)	Quantitative study	This study highlights organisational activities that enact DT as a disruptive change. In the early phase of the DT, top management has the responsibility for organisational culture change. Collaboration platforms promote work coordination between different parts of the organisation, thus influencing the company's culture.
(Dasgupta & Gupta, 2010)	Quantitative study	This study examines the factors influencing the acceptance and adoption of information technologies and systems, including organisational cultural factors related to social influence, performance



Authors	Methods	Literature Contribution
		expectancy, facilitating conditions and expected effort, which impact individuals' attitude toward DT.
(Duerr, Holotiuk, Wagner, Beimborn, & Weitzel, 2018)	Qualitative study	This study relies on Schein's model to identify artefacts, values and beliefs and the underlying assumptions of digital culture. It is the first study to explicitly identify the facets of digital culture.
(Ghosh et al., 2022)	Qualitative study	This study shows that the development of digital transformation capability (DTC) by specifically reconfiguring existing capabilities is dependent on the organisational culture. The results show that a transformative culture is needed to shift from an old mindset to a new one.
(Martínez-caro et al., 2020)	Quantitative study	The results of this study show that digital culture positively impacts the adoption of digital technologies to support business value development. The research offers a potential definition of digital culture from the perspective of strategic planning: a means through which an organisation can begin to plan for digital strategies in a rapidly changing environment.

## 2.6 Performance outcomes of DT

The primary objective of DT is to help organisations effectively manage severe competition, market volatility and the demands of ever-evolving technical breakthroughs in the current dynamic business environment (Li et al., 2021). Digital technologies help organisations to improve their operations by integrating IT functionalities, which in turn help them to redesign business processes to transform IT capabilities into a competitive advantage and improve financial performance (Li et al., 2021). Therefore, organisations utilise digital technologies to become more agile, customer centric and collaborative to stay ahead of their competitors. The following includes a review of the literature on agility, collaboration and customer centricity in the context of DT.

### 2.6.1 Agility

DT is one of the main strategies for achieving organisational agility (Hess et al., 2016; Li et al., 2021). The constantly changing business environment requires organisations to respond quickly to unexpected changes in the market, which is

known as organisational agility (Cheng et al., 2020). The word agility was introduced in 1991, when the notion of the agile enterprise was introduced to American industry (Goldman et al., 1995). It refers to the ability to gather and interpret diverse and extensive information to identify and predict external changes in order to quickly improve product and services offerings to address customer needs (Lu & Ramamurthy, 2011). According to Dove (2001), agility consists of two parts: alertness and response. Alertness refers to the organisational ability to sense environmental changes and underlying opportunities. Meanwhile, response refers to the organisational ability to perform appropriate activities after identifying environmental changes or opportunities. Therefore, agility keeps organisations alert to the changes that occur in this digital age and allows them to deploy resources to respond quickly and creatively (Dove, 2001).

The link between the adoption of technologies and gaining organisational agility is not new in the literature (Cheng et al., 2020; Lu & Ramamurthy, 2011). Digital technologies support agility through IT-enabled capabilities, such as digitised work processes and knowledge systems (Sambamurthy et al., 2003). According to Banker et al. (2006), a higher IT capability is correlated with higher production agility in manufacturing plants. Similarly, Pavlou and Sawy (2010) found that the organisations with high IT-leveraging capabilities are more likely to be agile and are able to obtain a competitive advantage in a short period of time when facing a turbulent business environment. Similarly, in the fourth industrial revolution, the adoption of digital technologies is a way to improve an organisation's information processing capabilities, leading to organisational agility (Li et al., 2021). Digital technologies affect the way information is collected, stored, analysed and disseminated (Wang et al., 2018), thus shaping the communication and collaboration among different organisational stakeholders (Li et al., 2021), which lead to organisational agility.

The integration of digital technologies with business processes enables organisations to stay proactive and obtain critical information ahead of their competitors (Mathiassen & Pries-Heje, 2006). Hence, for organisations to achieve DT-based organisational agility, they must be able to move swiftly and rapidly deliver digital technology solutions (Feeny & Willcocks, 1998). This requires adjustments to their existing organisational structures and culture as well as supportive organisational leadership (Crocitto & Youssef, 2003). Most previous research has focussed on IT capability as a critical enabler of organisational agility (Cai et al., 2017; Gonçalves et al., 2021; Lu & Ramamurthy, 2011). It has also been shown that organised knowledge processes and business intelligence improve agility (Cheng et al., 2020), as do informal managerial ties with external stakeholders (Zhang et al., 2022). Indeed, studies have argued for the need to

study new approaches to leadership and culture to facilitate organisational agility (Linda Holbeche, 2018). Accordingly, this study focusses on how ongoing changes to organisational structures, culture and leadership roles related to DT help to support organisational agility.

### 2.6.2 Enhanced collaboration

Collaboration is defined as ‘two or more individuals working toward a common goal by sharing and exchanging information’ (McQuay, 2005). Digital technologies facilitate collaboration beyond organisational boundaries in a flexible and cost-effective manner (Ferri et al., 2020). Digital social tools empower organisational staff in a highly collaborative co-creation culture that fosters rapid communication and content sharing and enables rapid adaptation of the tools to meet people’s information-searching demands (Nylen & Holmström, 2015). Collaborative tools, such as Slack, support the collaboration of global virtual teams irrespective of location and time (Gofine & Clark, 2017). Moreover, enhanced collaboration is one of main ways to achieve organisational agility, and fast and informal collaboration is needed to make personnel feel safe and trust each other, supporting fast knowledge exchange and effective collaboration for continuous learning (Goncalves, 2021). Interaction and interpersonal, cross-functional and organisation-spanning relationships are crucial elements of agility and the DT paradigm (Crocitto & Youssef, 2003; Vial, 2019).

DT also leads organisations to collaborate effectively with external stakeholders (Bharadwaj, 2000; Li et al., 2021). Innovative digital technologies support the development of appropriate IT infrastructure that integrates external stakeholders, encouraging longer-term relationships (Feeny & Willcocks, 1998). Moreover, digital technologies enable a highly interconnected IT network that permits complex interactions with external stakeholders and promotes knowledge exchange (Bradley et al., 2012; Li et al., 2021). From the perspective of internal stakeholders, it helps to bring IT experts and business managers close to each other (Clemons & Row, 1991). This strategic alignment ensures that DT contributes to business value within the organisation’s strategic framework (Li et al., 2021). Further, it enables IT and business experts to consult with each other on a regular basis, helping to promote a mutual understanding of IT and business responsibilities (Feeny & Willcocks, 1998). This integration of IT and business improves synergy and joint decision-making and facilitates successful DT (Li et al., 2021; Lu & Ramamurthy, 2011). Moreover, enhanced collaboration among internal stakeholders and functions reduces cognitive conflicts and enhances lateral relationships, communication and trust, which leads to impactful DT.

Overall, DT allows organisations to integrate internal and external stakeholders for real-time information sharing, ensuring fast and efficient decision-making, which allow organisations to respond rapidly to dynamic environments (Li et al., 2021).

### 2.6.3 Customer centricity

The rapid development of digital technology has not only fundamentally altered business structures and the nature of competition but also affected customer demands (Hartl, 2019; Porter & Heppelmann, 2015; Westerman & McAfee, 2012), as they require new values to be delivered to them (Smith & Beretta, 2020). Digital technologies enable the creation of new and improved consumer goods and services (Tuukkanen et al., 2021). Hartl (2019) defined DT as 'IT enabled change through digitalization of products, services, core processes, business models and customer touch points'. Similarly Abhari et al. (2021) argued that 'the digital technologies can alter the culture of organizations that can be characterized by that organization's customer centricity, responsiveness, and willingness to learn after the introduction of new digital tools and technologies'. Fitzgerald et al.'s (2013) definition of DT also includes enhancing customer experience as one of the major goals of DT. Gale and Aarons (2017) linked successful DT with higher sales and improved customer satisfaction, reflecting the fact that customers are an important consideration in DT. In fact, DT is essential for meeting ever-changing customer needs, which leads organisations to become customer centric (Hartl, 2019), and organisations' readiness to change facilitates DT.

Customer centricity is defined as 'the willingness to adapt to meet customer needs' (Tuukkanen et al., 2021). Organisations with a customer-centric mind-set make every decision with their customers in mind (Shah et al., 2006). Research has shown that customer centricity is one of the main cultural values necessary for successful DT (Shah et al., 2006; Tuukkanen et al., 2021). Similarly, continuous customer collaboration is also an important aspect of agility (Paluch et al., 2020). This includes the development of customer-sensing capabilities, customer response capabilities, cost efficiency, information sharing, customer service and external learning (Mills et al., 2020). Moreover, DT is essential for organisations to meet the demand to bring products to market faster, become customer centric and engage in iterative development (Bharadwaj et al., 2013; Horlacher et al., 2016). The literature also addresses the concept of co-creation, which requires collaboration and the involvement of customers in product development. Therefore, this study examines how ongoing changes to organisational structures,

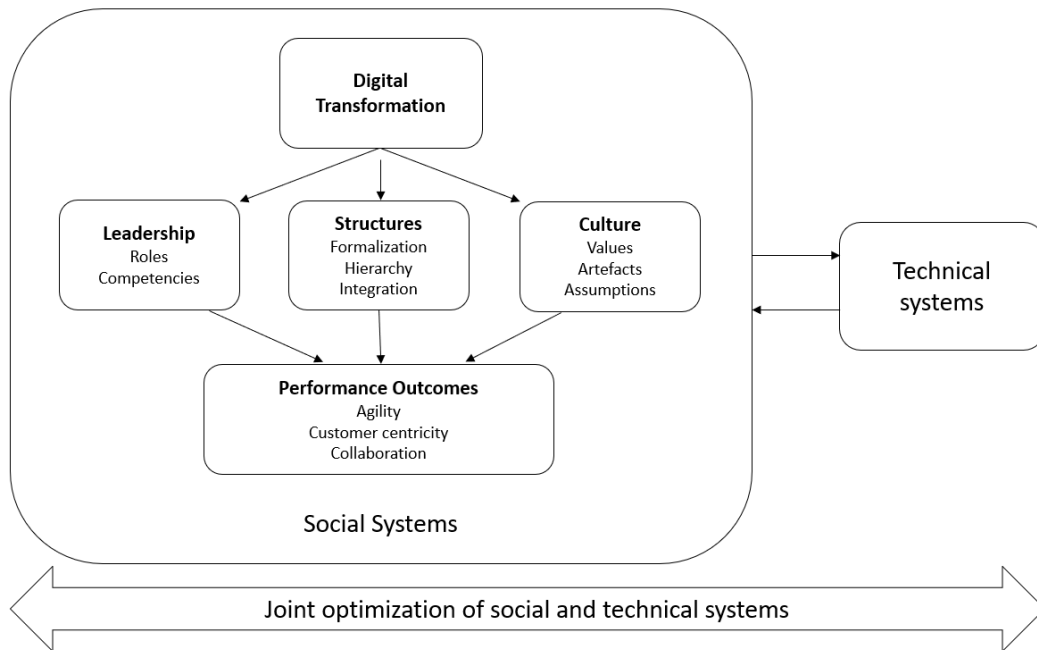
culture and leadership can make case organisations more customer centric through their DT.

## 2.7 Conceptual framework

Based on the literature review above, it is evident that our understanding of DT in organisations has increased significantly in the past decade. Different researchers have approached DT with different theories, from different angles and in different contexts. While DT has been defined by several researchers (Hinings et al., 2018; Parida et al., 2019; Vial, 2019) from different perspectives, the core aspect of these definitions is the adoption of innovative digital technologies and accordant changes in organisational practices to achieve major business improvements. Further, the review shows that different researchers have emphasised different organisational artefacts that may contribute to successful DT in different organisations. Crucial factors include the role of leadership and leaders' competence (AlNuaimi et al., 2022; Benitez et al., 2022; Cortellazzo et al., 2019; Hesse, 2018; Weber et al., 2022), organisational structures (Björkdahl, 2020; Mustafa et al., 2022; Smith & Beretta, 2020; Snow et al., 2017; Verhoef et al., 2021) and organisational culture (Abhari et al., 2021; Grover et al., 2022; Hartl, 2019; Martínez-caro et al., 2020). In addition, organisational agility (Hess et al., 2016; Li et al., 2021; Lu & Ramamurthy, 2011), enhanced collaboration (Crocitto & Youseef, 2003; Ferri et al., 2020; Li et al., 2021; Vial, 2019) and customer centricity (Gale & Aarons, 2017; Smith & Beretta, 2020; Tuukkanen et al., 2021) are the main targeted performance outcomes of DT programmes. Finally, we also emphasise the role of the STS (Beier et al., 2020; Schnasse et al., 2021; Sony & Naik, 2020) perspective in successful DT.

Based on the review, this dissertation argues that a study is needed that combines all these organisational factors and performance outcomes and provides a conceptual framework that can act as a guide for the successful DT of industrial organisations. Therefore, building on the STS perspective, this research work proposes an overall conceptual framework for DT. It explores DT from an STS viewpoint and explains the key enablers in the case organisations. Figure 6 presents a conceptual framework of DT, which is addressed in the four research articles that follow. Overall, the dissertation mainly focusses on the social systems of the case organisations in order to explore DT. Leadership, structure and culture are regarded as the most important enablers, which require careful planning on the part of the case companies to successfully implement DT programmes and achieve their targeted performance outcomes. Lastly, this conceptual framework

illustrates that the identified social elements must be jointly optimised with newly implemented technical systems to achieve impactful DT.



**Figure 6.** Conceptual framework

### 3 METHODOLOGY AND DATA

The researcher's ontological, epistemological and methodological decisions as well as the research paradigm serve as the primary sources of direction for the researcher's activities (Guba & Lincoln, 1994). Therefore, this chapter addresses the methodological decisions made in the study and the empirical research design that was used based on the goals of the research. Specifically, it presents extensive arguments for the selected philosophical assumptions, procedures and research methods and approaches.

#### 3.1 The study's philosophical assumptions

Qualitative research is usually categorised as *positivist*, *interpretive* or *critical* (Myers & Avison, 2002). Positivist studies emphasise reasonable and logical methods for objective research (Carson et al., 2001). A positivist approach presupposes that the world is the same for everyone and supports its reasoning with regularities, labels, structures and causal relationships. Interpretive studies emphasise interpretation and in-depth topic knowledge. According to Burrell and Morgan (1979), this approach is based on the notion that individuals perceive their experiences differently from one another. In addition, the researcher's findings and theory go hand in hand in interpretative investigations. Finally, critical studies seek to challenge the status quo, thus regarding current social circumstances as limiting and alienating (Orlikowski & Baroudi, 2002).

This dissertation is based on interpretive study. As it does not attempt to change the way in which the case organisations adopt DT, critical studies are not appropriate. Further, it is not based on positivism because it does not involve testing a hypothesis. Rather, the study examines and considers the collected data as a reflection of a reality. The data collection is based on interviews and public documents from the case organisation. Moreover, this dissertation is founded on abductive reasoning since as the research subject was relatively new and less known in the literature at the beginning of this work. Therefore, researcher started the study based on the initial data. Furthermore, STS theory goes hand in hand throughout the research. Hence, in accordance with the abductive method, this dissertation does not aim to test hypotheses, as do positivist research, as well as do not formulate new theories as might be found with a grounded theory approach.

Scientific studies are usually founded on ontology, epistemology and methodology (Guba, 1990). Ontology represents the researcher's basic assumptions about reality and understanding of the world. Burrell and Morgan (1979) define ontology as the science of being and relate it to the question of whether objective reality

exists. Epistemology refers to how we view the world, how we know what we know and how can increase our knowledge of the phenomenon under study. The researcher's ontological and epistemological choices determine the methodology chosen for the research. Methodology refers to how the researcher conducts the research to gain knowledge.

### 3.2 The study's ontological choices

Ontological paradigms are categorised as positivism, post-positivism, critical theory, constructivism (Guba & Lincoln, 1994). Positivism holds that reality is independent of what is perceived by observers. In their attempt to explain causalities and lawlike generalisations, natural sciences frequently portray positivism from an ontological viewpoint (e.g. a company with the highest output-to-input ratio is more productive than its competitors.). Researchers and respondents are seen as independent of one another in positivist investigations. In post-positivism (also known as post-empiricism), it is presumed that reality is flawed because it is believed that humans do not fully comprehend reality. According to post-positivism, observations can be influenced by a researcher's background and values. Meanwhile, critical theory holds that reality is influenced by a variety of values that change through time (e.g. social and economic values). According to constructivism, reality is intangible and socially constructed, influenced by people's perspectives and experiences of the world (Schwandt, 1994). Additionally, as people learn and absorb new information, that may alter reality. This dissertation is based on the premise that reality is socially produced and modified by informants. Therefore, it represents social constructivism from an ontological point of view. Further, the reality in this research is based on the interpretations, experiences and worldviews of the interviewees.

### 3.3 The study's epistemological choices

Epistemology refers to what comprises scientific knowledge and how a researcher knows what he knows or does not know. It is the relationship between the observer and reality (Carson et al., 2001). In this dissertation, reality is viewed as multifaceted, relative and complex, and thus interpretivism is the appropriate epistemological choice. Moreover, the knowledge has been obtained personally and flexibly, which is also in alignment with the epistemological choice of interpretivism. In addition, the researcher believes that the interviewees' discourses are based on reality and their experiences. The researcher approached the field with previous knowledge of the topic. Nevertheless, due to the complexity



and unpredictability of reality, the study plan was developed throughout the research process. Further, the researcher believes that the insights shared by the interviewees during the research process deepen the existing knowledge. This is in alignment with the notion of interpretive studies, according to which knowledge is evolving and accumulating. Specifically, this interpretive study aims to comprehend and interpret the reasons, meanings and subjective experiences of the interviewees to analyse socially constructed realities. In sum, the researcher assumes that people's experiences and environments shape their understanding of reality. Therefore, the data collected for research depends on the experiences of the actors involved (e.g. interviewees and researchers). The researcher accepts these constructs and assumes the knowledge shared by the interviewees is real. Nonetheless, the researcher's comprehension of the topic and research process reflect his personal perception of the subject.

### 3.4 The study's methodological choices

In addition to ontology and epistemology, methodology is a crucial component of a paradigmatic base (Tronvoll et al., 2011). Methodology is the way of obtaining knowledge and explains the relationship between the theory and method. Moreover, it provides a perspective for examining the phenomenon in question. A range of options are available to aid in method selection throughout the research procedure. In this dissertation, a multi-case study method has been adopted to study the DT of industrial organisations. A case study is an appropriate strategy for answering the question "How and why is the phenomenon seen in the actual world?" While this method helps to understand the phenomenon in more detail, unlike surveys, generalisation is not possible based on a case study (Eisenhardt & Graebner, 2007). Moreover, case studies advance theoretical propositions (Yin, 2003), and they generate holistic and contextual in-depth knowledge by utilising multiple sources of data (Eriksson & Kovalainen, 2016).

From a methodological point of view, the selection of the case study method is in alignment with the interpretive nature of this dissertation. In business and management research, case studies help to present complex and hard-to-grasp problems in a practical, accessible, vivid, personal and down-to-earth format (Eriksson & Kovalainen, 2016). Eriksson and Kovalainen (2016) categorised case study as intensive and extensive case studies. An intensive case study explores one or a few cases in-depth, while an extensive case study utilises multiple cases and maps common patterns across those cases (Eriksson & Kovalainen, 2016). In this dissertation, an intensive case study method is used to explore the DT programmes of the selected case companies in depth.

### 3.5 Research design

The research design is the process of relating the obtained data to the research questions (Edmondson & McManus, 2007). However, the research design does not only apply to the empirical portion of the study. It addresses everything from the theoretical reading and methodological decisions to the actual data collection, analysis and writing (Eriksson & Kovalainen, 2016). In this dissertation, the research design was the same for all the articles, including the methods, data collection and data analysis methods. However, article 1 was utilised as an initial study to identify initial DT patterns of the case companies. Therefore, it only included 12 interviewees. Articles 2, 3 and 4 were based on all interviewees who participated in this research. Article 1 provided an overall research framework, and we attempted to dig deeper by conducting more interviews in articles 2, 3 and 4.

### 3.6 Data collection

Every article in this research dissertation discusses the data collection procedure in detail. According to Yin (2003), case studies typically employ interviews, observations and archival information. The collected data can be based on primary data, which consists of interviews and direct observations, while secondary data is obtained from company documents, reports and online materials (Eriksson & Kovalainen, 2016). This research mainly utilised interviews as the source of primary data, further supported by secondary data on the case companies, such as publicly available reports, websites and internally shared documents. Collecting data from multiple sources is called triangulation, which helps to identify patterns across cases and enhances the reliability of data collection.

The data were collected from three significant global industrial firms headquartered in the Nordic countries. The case organisations were chosen based on methodological expediency, which permits the selection of unique cases that are readily available to researchers and provide an opportunity to examine the phenomena under investigation (Huberman et al., 2012). The chosen case companies are engineering powerhouses founded during the second industrial revolution. The distinguishing characteristic of these organisations is that they are undergoing the transition from traditional business practices to those required by the digital era. All case firms began their DT programmes between 2015 and 2016. They campaign for DT in their respective professional circles. Table 8 provides an overview of the case organisations.

**Table 8.** Overview of case organisations

	<b>Case A</b>	<b>Case B</b>	<b>Case C</b>
<b>Industry</b>	Recognised leader in smart technology and complete lifecycle solutions for the maritime and energy industries	Market leader as well as a pioneer in variable frequency drives, cooling & heating systems and energy management	A significant player in the forest, wood and papers industries, which is, developing its energy industry business
<b>DT Strategy</b>	A separate dedicated digital organisation was developed by hiring CDO to lead DT	Digital transformation responsibilities were assigned to business segment's heads	Digital transformation responsibilities are assigned to unit heads
<b>Sales in 2021</b>	4.8 Billion	7.5 Billion	9.8 Billion
<b>Number of Employees</b>	17000	40000	17000
<b>Number of Interviewees (Higher Management)</b>	14	8	8
<b>Number of Interviewees (Middle Management)</b>	5	3	3

For primary data collection, we relied on semi-structured interviews with 41 respondents. In total, 13 face-to-face interviews and 28 online (skype and Zoom) interviews were conducted, which ranged from 50 to 90 minutes in length. Thirty of the interviewees were with people in higher-level management positions, such as vice presidents, directors, heads of department/unit/business and general managers. The remaining 11 interviewees held middle-level management positions, such as senior managers, engineers, project managers and managers. All participants were responsible for DT of their respective areas. Two researchers conducted most of the interviews to ensure dependability and consistency in the process (Guba & Lincoln, 1994). We also designed a semi-structured interview guide to obtain an inclusive understanding of the DT of the case organisations. Although specific questions were formed based on each interviewee's position and knowledge, the overall focus was on the respondent's experiences with the phenomenon in question. Further, the researcher improvised during the interviews if anything unexpected emerged that needed more explanation. In addition to interview data, secondary data consisting of publicly accessible

resources (e.g. web blogs, online interviews, films, reports and website information) were used to gather further insights. We ceased data collection upon saturation, that is, when no further insights emerged.

### 3.7 Data analysis

The data were coded and analysed in a systematic manner (Gioia et al., 2013). The data analysis began by reading and coding both the primary and secondary data to identify key themes. The interview transcripts spanned over 500 pages and 46 hours of content. To transcribe the interviews, we used an online platform that converts voice to text. The researcher proofread the transcripts while listening to each recorded interview. To ensure independent parallel analysis, two of the authors involved in data collection also participated in the coding. This dissertation employed the data analysis technique of Gioia et al. (2013). Specifically, the initial raw data were organised into concepts, and themes were then developed that enabled the identification of DT patterns in the industrial organisations. The initial coding was based on three main criteria: (1) Are interviewees' insights applicable to the phenomenon in question? (2) Do several informants provide insights? (3) Are the interviewees' insights interesting and useful? Based on these criteria, an initial analysis yielded a large set of statements concerning the phenomenon in question. The NVivo 12 programme was used in the coding process and allowed us to document the creation of ideas and linkages. First, we analysed whole interviews and generated first-order concepts based on the interviewees' statements. The first-order concepts were then examined to identify more abstract second-order themes after iterative discussions between the researchers. Finally, based on the second-order themes, we formed aggregated the dimensions.

### 3.8 Validity and reliability

Validity and reliability are used to measure the quality of research. They are essential indicators that pertain to the repeatability, quality, consistency and precision of the study results (Creswell & Clark, 2011). In qualitative case studies, reliability describes the extent to which the research method yields the same findings each time the research is executed. Meanwhile, reliability refers to the credibility of case studies as well as the precision of the research findings based on the use of specific techniques (Creswell, 2013). Each article in this dissertation is based on a logically developed, consistent and accurate approach, balancing the meta-inferences and research objectives. Validity refers to whether the research

provides the right answers and measures something that is of research interest. There are four main tests to evaluate the quality of empirical research: construct validity, internal validity, external validity and reliability. Eriksson and Kovalainen (2008) suggested different dimensions to measure the trustworthiness of qualitative research, which they referred to as credibility, transferability, dependability and confirmability. However, this dissertation uses the traditional classifications.

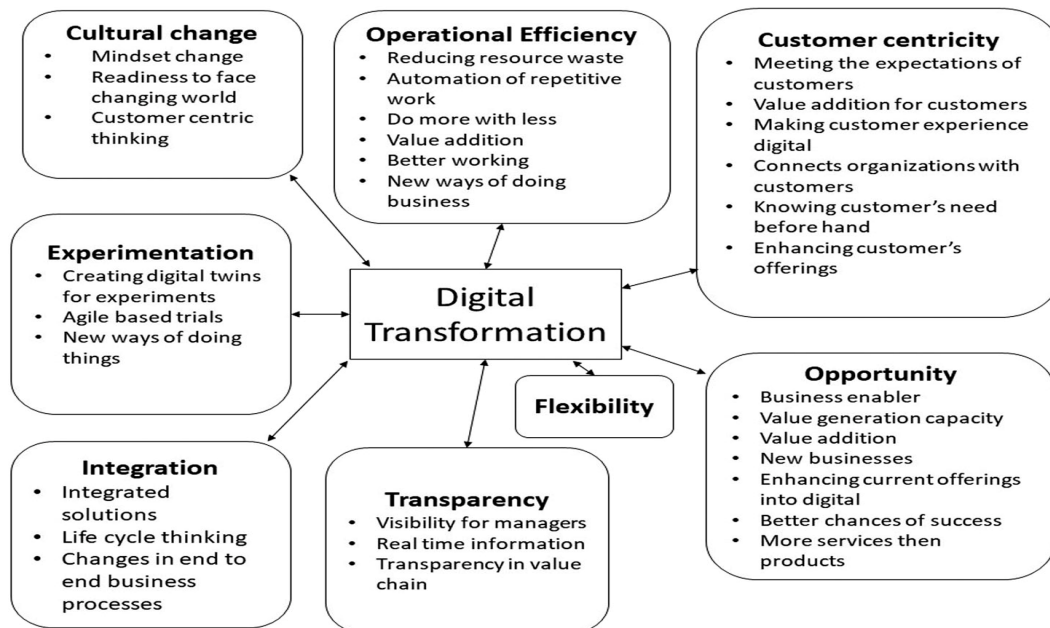
Construct validity refers to the operationalisation of measures to test the concepts in the study. In this dissertation, to enhance construct validity, we use multiple sources of evidence, including primary (interviews) and secondary data (company documents, archives, company websites). Moreover, we maintain chain of evidence by citing the quotations appropriately and supporting the theoretical concepts through citations. In addition, we construct and draw on a database of interviews and transcripts. Internal validity addresses casual relationships, which is an important aspect of positivist studies but does not concern descriptive or exploratory case studies. External validity refers to the generalisation of findings. In this dissertation, thematic analysis is used to identify the commonalities in the DT programmes of the case organisations, and thus the results are not generalisable.

## 4 ARTICLE SUMMARIES

The dissertation consists of four separate articles that focus on the DT of industrial organisations. The first article was published in the *Journal of Change Management* (Imran et al., 2021). The remaining three articles are currently in the review process. However, shorter versions of each article were published in the proceedings of Jufo 1 level conferences (Butt et al., 2021; Imran et al., 2020, 2022). This chapter highlights the important findings and contributions of the articles. The full versions of each article are provided in the second part of the dissertation.

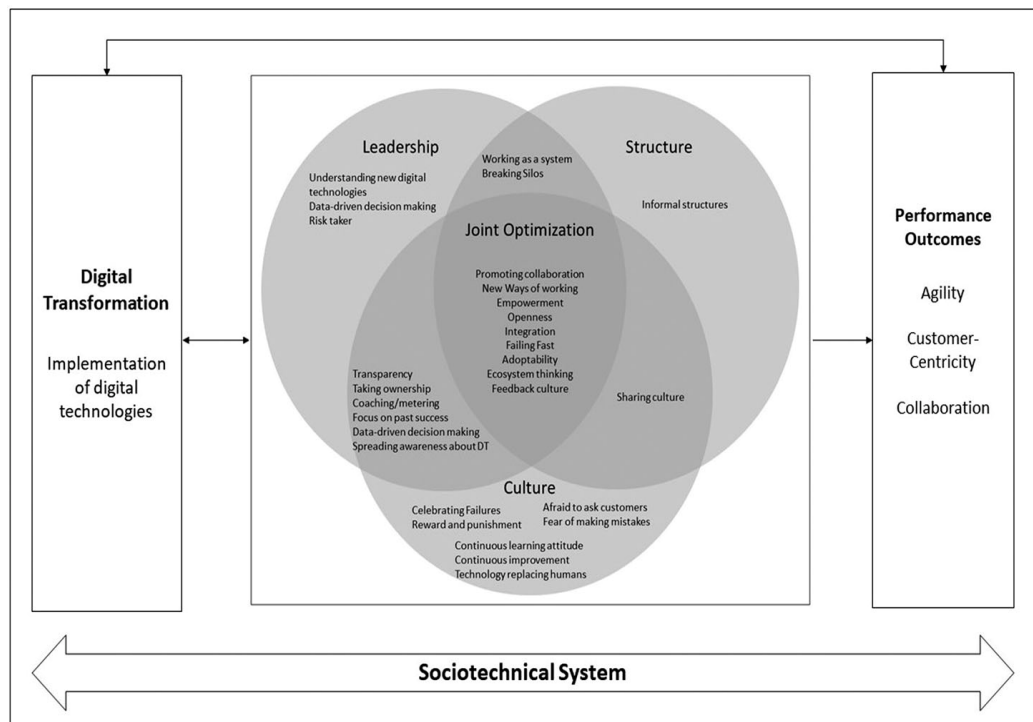
### 4.1 Digital transformation of industrial organisations: Toward an integrated framework

Article 1, entitled *Digital Transformation of Industrial Organisations: Toward an Integrated Framework*, explored the DT of industrial organisations from an STS point of view, specifically focussing on social systems. Based on the pilot study, this paper studied the key enablers of DT progression in contemporary settings and identified performance outcomes. First, this study collected views on how case organisations conceptualise DT. This revealed different opinions on the part of the interviewees. They interpreted DT as something that brings new opportunities, transparency, and integration, promotes experimentation, enhances operational efficiency, and leads to customer centricity, flexibility and cultural change (Figure 7).



**Figure 7.** Interpretations of DT from the interviewees' perspective

Further, article 1 identified the three main enablers of DT. Leadership was found to be the most important enabler, as it drives the other two (i.e. structure and culture). The article identified two strategies adopted by the case organisations from a leadership point of view. One case organisation hired an external digital leader to drive their DT, while the other delegated DT tasks to existing organisational leaders. However, in both cases, the main focus was on emerging new work roles to drive DT as well as the most important leadership competencies for performing these roles. Organisational structure was the second enabler. The existing organisational structures of the case companies were rigid and required special attention on the part of leadership. Moreover, this study also identified two different strategies adopted by the case organisations from a structural point of view. One of the case organisations built a parallel structure to develop digital capabilities, which later merged back into the main organisational structure. Meanwhile, the other two case organisations delegated DT tasks within the existing structures. The results also showed that changes were required to the organisational hierarchy, formalisation and integration to drive DT in the case companies. Organisational culture was identified as the third enabler. Overall, article 1 explored cultural change from the perspective of values, artefacts and assumptions.



**Figure 8.** Overall results of article 1

In addition, the study also illustrated that the transformation of these three identified enablers led the industrial organisations toward agility, customer centricity and enhanced collaboration, which were the targeted performance outcomes of their DT programmes. According to STS theory, leadership, structure and culture must be jointly optimised in order to attain these performance outcomes. Figure 8 illustrates the joint optimisation in detail.

The model presented in Figure 7 provides a bird's-eye overview to practitioners of the ongoing DT programmes of the case organisations. For instance, it informs practitioners that DT should not be a standalone technological effort. Rather, it is crucial to jointly optimise the most important enablers as well as social and technical systems to get the best out of it. Moreover, the model highlights the importance of social systems in technology-led change to encourage sociotechnical thinking. Furthermore, this study explains in detail how these social elements can contribute to attaining performance outcomes (agility, customer centricity and collaboration) to achieve impactful DT.

## 4.2 Preparing leadership for digital transformation

The second article in this dissertation is entitled 'Preparing leadership for digital transformation: An empirical study on emerging roles and competencies of industrial leaders'. It examines how industrial organisations are preparing their leadership to support their DT programmes. Specifically, it identifies key emerging work roles of industrial leaders and outlines the most important competencies for performing those roles. The study finds that coaching style leadership, digital enablers, the use of a digital vision to motivate and inspire, promoting collaboration internally and externally, working beyond one's title, digital champions, trying out new things and learning from failure and enabling digital culture are key work roles of organisational leadership in the adoption of DT. Furthermore, the study reveals key competencies that are needed to successfully perform the identified work roles: digital knowledge, digital vision, risk-taking ability, empowerment, managing teams, failing fast, managing disruption, open mindedness, creating trust and collaborative and factual decision-making. Finally, this study also links the identified roles and competencies with DT performance outcomes and explains how they are interlinked. Figure 9 summarises the overall results of the article.





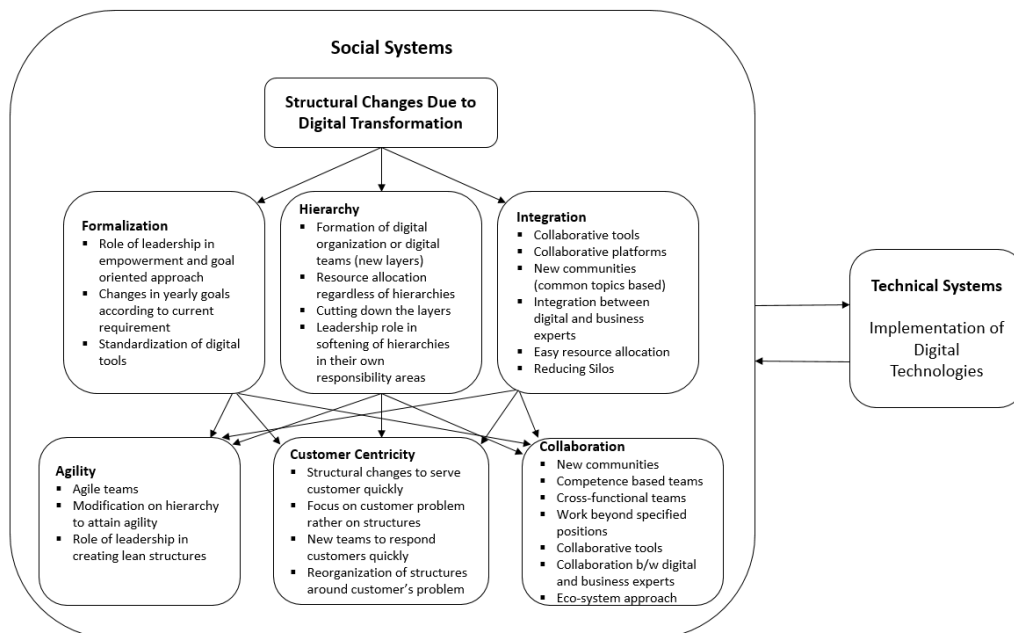
**Figure 9.** Results of article 2

The presented framework relates to the knowledge of how new leadership roles collectively support DT activities in industrial organisations and which leadership competencies are most important to carry out DT impactfully. It provides practical implications for organisational leaders who design and execute digital strategies where business decision-making is linked with the way the business benefits from the use of technology.

### 4.3 DT-based structural changes in industrial organisations

Article 3 is entitled 'Achieving performance outcomes through digital transformation: An empirical study of structural changes in industrial organizations'. This article examines changes in industrial organisations' structures in an effort to attain impactful DT. Building on a sociotechnical

perspective, this study employs three main structural dimensions to examine the structural changes: formalisation, hierarchy and integration. First, the findings highlight two structural strategies adopted by the case organisations: building a new parallel structure to develop digital capabilities and allocating digital development tasks within the existing structures of the organisations. Second, the article identifies the main structural challenges faced by the case companies in pursuing successful DT programmes. These challenges include rigid structures, traditional hierarchy, working in silos, problems with resource allocation, organisational size and old-fashioned leadership. Third, it explores and breaks down major changes happening in the structures from the perspective of formalisation, hierarchy and integration. Finally, it links the identified structural changes with the performance outcomes of DT, that is, agility, customer centricity and collaboration. Figure 10 presents the overall results and framework of this article.



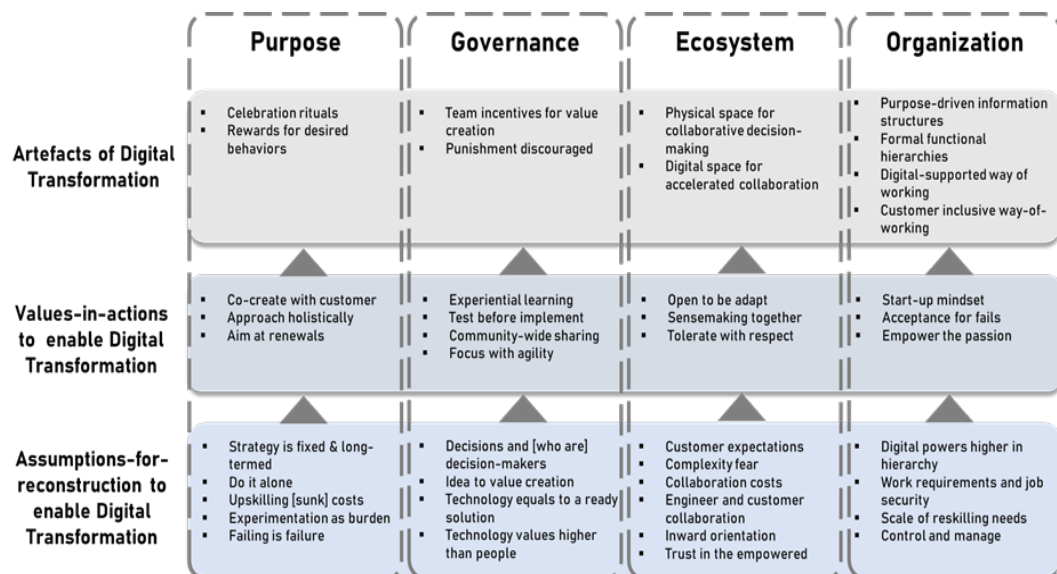
**Figure 10.** Results of article 3

The results emphasise that organisational structure is one of the most rigid artefacts that managers must consider when implementing new digital technologies. Digital technologies can strengthen existing centralisation (i.e. reinforce classical power structures) or facilitate decentralisation (i.e. enable the distribution of information within the organisation). Therefore, managers must define their objectives carefully concerning what they aim to achieve through structural changes when implementing new digital technologies. Second, our findings emphasise the role of leadership in reducing formalisation and

hierarchical layers to facilitate impactful DT. As the rigid traditional structures in industrial organisations are deeply rooted, the best place to begin structural change is at the leadership level. It is much more convenient to make structural changes in individual functional areas than at the organisational level.

#### 4.4 Strategic design of culture for digital transformation

Article 4, entitled ‘Strategic design of culture for digital transformation’ complements the earlier research findings on DT culture, addressing the call for an investigation of how industrial organisations prepare their culture in their pursuit of DT. Building on Schein’s cultural definition, this study explores the ongoing changes in organisational culture related to values, artefacts and assumptions. The identified values in the actions, assumptions and artefacts guide the execution of DT as a strategy by operationalising the social power of organisational systems. Further, the findings of this study extend social system design by including culture in the organisational strategy, that is, strategy, technology and social considerations are inseparable within the three layers (artefacts, values and assumptions) of organisational culture. Moreover, the study analyses each cultural component through the lens of STS strategic design, which focusses on purpose, governance, ecosystem and organisation. Figure 11 presents the exploratory framework for the strategic design of culture to support DT.



**Figure 11.** Exploratory framework for the strategic design of culture

The results of the study could guide executives in how to prepare their business culture as a social force that propels DT for future business proofing. The findings

confirm that a successful strategy execution rooted within an organisation's social system requires a cultural understanding of how the organisation works. Although previous literature has suggested that less formal (social) mechanisms are critical for strategy execution, our findings shed light on how such social mechanisms work in an organisation's cultural layers of values, assumptions and artefacts. Further, with our identified values related to action, assumptions and artefacts, the leaders in our three cases frame the required social controls for DT.

## 5 DISCUSSION AND CONCLUSIONS

This dissertation seeks to understand how industrial organisations prepare for DT by exploring their leadership roles and competencies, organisational structures and organisational culture. The dissertation addresses gaps in the extant DT literature related to business leadership, structure and culture. It advances the STS perspective by focussing on the changes required in the social systems of organisations in order to align them with newly introduced technical systems. Moreover, it shows how the identified changes in leadership, structure and culture contribute to achieving organisational agility, customer centricity and enhanced collaboration in industrial organisations. The final section of this dissertation outlines the dissertation's theoretical and managerial contributions, its main limitations and potential future research avenues.

### 5.1 Theoretical contributions

The purpose of this dissertation is to increase the understanding of the DT process inside industrial organisations. It approaches this issue from four distinct angles, as given in the four separate research articles. Each article adds to the specific research question by presenting empirical evidence regarding the phenomena.

The first article seeks to answer the following questions: *What are the enablers and targeted performance outcomes of DT? How do the identified DT enablers help industrial organisations achieve their targeted performance outcomes?* This research question is motivated by the fact that the existing literature on DT lacks empirical clarification regarding this phenomenon. Specifically, the existing literature overlooks the idea of DT, which is utilised to guide businesses in reaching their performance outcomes. The most important contribution of this research paper is the identification of crucial strategic areas for organisations focussed on adopting DT. First, it shows that DT often begins with the emergence of new leadership roles when incumbent firms develop and execute digital strategies (Benlian & Haffke, 2016; Horlacher et al., 2016). Further, the identified leadership roles that lead to DT must be filled by leaders who possess the appropriate set of skills and can align technological and social systems by making the necessary adjustments (Mumford, 2000; Reck & Fliaster, 2019). Second, this paper contributes to the literature on organisational structure by identifying it as an important enabler of DT that can either assist or inhibit DT in industrial organisation (Gehrke et al., 2016). It demonstrates that organisational structure is the most rigid artefact (Schein, 1985). Although it is hard to transform, it is a crucial DT success factor in the case organisations. Third, organisational culture is

identified as another important enabler of DT (Scheibe & Gupta, 2017), which is foundational for any organisation (Nambisan et al., 2017). As organisational culture develops over a long time period (Vincenzi, 1993), it takes time to modify it in light of new realities, such as DT. In addition to the identification of DT enablers, the study also explores three main targeted performance outcomes of the DT programmes of the case organisations: organisational agility, enhanced collaboration and customer centricity.

One of the main contribution of the article is that, compared to prior studies that have explored the DT of organisations through literature reviews, opinion papers or by focussing on technical issues of DT (Henriette et al., 2015; Porter & Heppelmann, 2015; Sony & Naik, 2020; Vial, 2019), it provides empirical evidence on the DT process and focusses on the social part of this phenomenon. Further, it contributes to the STS perspective, addressing the call for the application of STS in new domains (Davis et al., 2014), such as DT. By exploiting the STS perspective, this study provides a holistic view on the most important social elements (enablers) that must be changed to achieve DT performance outcomes. In addition, the study shows that the identified social elements must be optimised together for successful DT. Overall, this paper is important because it describes DT from an STS point of view and contributes to the literature on change management and DT. This paper has been published in the *Journal of Change Management* (Imran et al., 2021).

Article 2 seeks to answer the following research questions: *What are the emerging roles and related competencies required for industrial leaders to succeed in DT? How do the identified roles and competencies contribute to achieving the desired performance outcomes?* These questions are focussed on exploring leadership in the context of DT, as existing research on this subject is fragmented (Benlian & Haffke, 2016; Björkdahl, 2020; Eberl & Drews, 2021; El Sawy et al., 2016). Leadership plays a crucial role in the success of organisational transformation (Caulfield & Senger, 2017), as leaders empower their followers to comprehend and implement the change to ensure excellent outcomes from DT investments (Cortellazzo et al., 2019). Therefore, the key contribution of this article is the identification of key emerging work roles of leadership as well as outlining the competencies required to perform those roles (Björkdahl, 2020).

Another key contribution of this paper is that it links the identified roles and competencies with the targeted performance outcomes of DT. First, as agile organisations aim to be fast, efficient and effective to meet the pace of changing business environments (Denning, 2018), leadership roles such as enabling, leading by example and working beyond one's job title help them to stay ahead (Busse &

Weidner, 2020). Further, competencies such as risk-taking, digital vision, failing fast, open-mindedness and managing disruption allow leaders to be proactive rather than reactive to environment changes. Second, digital technologies enable leaders to collaborate in new ways through the use of innovative digital tools (Petrucci & Rivera, 2018). Digital strategies have forced a change in business ecosystems, necessitating significant internal and external cooperation and coordination (Reck & Fliaster, 2019), which can be supported by the leadership roles of digital champions and leading by example. Similarly, leaders with collaborative abilities promote information sharing and engagement and assist their followers in mitigating the negative aspects of change, including resistance, fear and knowledge hoarding (McKenzie & Aitken, 2012). Finally, leadership contributes to making organisations more customer-centric by utilising the right digital technologies. Leaders who possess a digital vision and collaboration abilities are better equipped to make their organisations genuinely customer centric (Pihir et al., 2019). Therefore, this paper is important because it highlights and explains the key leadership areas for impactful DT. A short form of this paper has been published in the proceedings of AHFE 2020 (Imran et al., 2020). The full-length paper is in the review process by *Technology in Society*.

The third article deepens the understanding of the role of organisational structures in relation to DT. It contributes to the organisational structure and DT literature by answering the following question: *What structural changes are happening in industrial organisations to support successful DT? How do the identified structural changes help organisations achieve agility, enhanced collaboration and customer centricity?* Building on the sociotechnical perspective, this paper raises the need for a new structural approach to DT, as pre-mechanistic structures (Mumford, 2000) were designed for stable and predictable environments. However, the rapidity and unpredictability of change in the contemporary business environment, fuelled by disruptive digital technologies, strongly emphasises the need for a structural shift (Shahzad, 2020; Worley & Lawler, 2006). Therefore, this article addresses structural modifications with regard to formalisation, hierarchy and integration. The results reveal that case organisations are becoming flexible in their goal setting and that leadership is playing an important role in reducing formalisation by empowering the organisational personnel. Although DT requires flat hierarchies to cope with fast-paced business environments (Verhoef et al., 2021), this can lead to chaos in large organisations (Mrówka & Pindelski, 2011). Therefore, it is important to find a balance between rigid and flat hierarchies to support DT (Horlacher et al., 2016). The case organisations utilise a new range of advanced digital collaboration tools to integrate within the organisation as well as with external stakeholders (Duerr et al., 2018).

Second, the increasing business clock speed (Gimpel et al., 2018) requires modern firms to pursue organisational agility, necessitating flexible organisational structures (Kuusisto, 2017; Verhoef et al., 2021). Low formalisation and fewer hierarchical layers are necessary to attain agility (Alavi et al., 2014; Kuusisto, 2017). To achieve customer centricity, industrial organisations must move from being product-oriented organisations (Gebauer & Kowalkowski, 2012) toward becoming customer centric. Industrial organisations need to integrate their customers by flexing their rigid structures to help nurture closer relationship with the customers (Day, 2003; Shah et al., 2006) and foster customer intelligence and customer co-creation (Fjeldstad & Snow, 2017). The case organisations are promoting horizontal and cross-functional integration and facilitating resource reallocation to enhance collaboration (Beier et al., 2020; Oesterreich & Teuteberg, 2016). Finally, the results of this study map the social shaping of structural modifications from a sociotechnical perspective. A segment of this paper has been published in the AHFE 2022 conference proceedings (Imran et al., 2022). The full-length paper is in the second round of review by the *Scandinavian Journal of Management*.

The fourth article seeks to answer the following research question: *How can industrial organisations strategically design a culture in their pursuit of DT?* The article contributes to the literature on organisational strategy by investigating the cultural design of DT as a sociotechnical phenomenon (Kane et al., 2016; Kim et al., 2014; Sony & Naik, 2020). By operationalising the social power of organisational systems, the identified values related to action, assumptions and artefacts direct the execution of DT as a strategy. This study supplements the results of previous research on DT culture, answering the call for research on how industrial organisations prepare their cultures for DT (Berghaus & Back, 2017; Duerr et al., 2018; Hartl & Hess, 2017; Martínez-carro et al., 2020; Wamba et al., 2017). Among the three levels (artefacts, values and assumptions) of organisational culture, strategy, technology and social systems are intertwined. Thus, the results of this study extend social system design, showing that culture is a crucial component of organisational strategy (Abhari et al., 2021). Further, our study reveals a novel strategy for developing culture as a strategic asset that is a valued, uncommon, imperfectly imitable and irreplaceable source of competitive advantage (Barney, 1986). In addition, the cultural values, assumptions and artefacts of DT are identified in the exploratory framework for the strategic design of the purpose, governance, ecosystem and organisation (Pasmore et al., 2019). The results also show that cultural awareness of how an organisation operates is necessary for successful strategy execution rooted in an organisation's social systems (O'Reilly & Chatman, 1996). The shorter version of this paper has been



published in AHFE2021 (Butt et al., 2021). The full version paper is currently in the first round of review by *Long Range Planning*.

## 5.2 Synthesised results and overall contributions

This section addresses the dissertation's primary question: *How do industrial organisations prepare for DT?* To answer to this question, this dissertation has investigated the DT process of three large industrial organisations. First, the results confirm that DT is not just about the implementation of innovative digital technologies (Björkdahl, 2020). Rather, it requires a dedicated organisational transformation programme to update the organisational practices to reap the full benefits offered by the newly implemented digital technologies. DT is a fundamental organisational change that can help organisations to become agile and customer centric while enhancing their collaborative capabilities with the help of digital technologies and updated organisational practices.

Second, this dissertation responds to the call for applying sociotechnical thinking to new domains of research, such as DT (Davis et al., 2014). In doing so, it confirms the notion that joint optimisation of the social and technical systems (Appelbaum, 1997) of organisations is required for the successful DT of industrial organisations. The findings of this dissertation show that the case organisations are making major efforts to update their social systems to match the needs of newly introduced technical systems (Sony & Naik, 2020; Woodward, 1965).

The third and the most important contribution of this dissertation is that it integrates the most important organisational practices (identified as organisational leadership, organisational structure and organisational culture) into a single framework (Vial, 2019) and explains how these practices (also named enablers) complement each other in supporting successful DT. By combining the scattered literature on these enablers, the study contributes to research on leadership, structures and culture as well as DT (Vial, 2019). The proposed comprehensive integrated theoretical and empirical framework explains the emerging work roles of leadership and related competencies, the major organisational structural changes required for DT as well as the most important cultural values, assumptions and artefacts required for successful DT. Finally, the integrated framework links the identified organisational practices with the targeted performance outcomes of DT, thus contributing to the literature on agility, collaboration and customer centricity (Abhari et al., 2021; Ahlbäck et al., 2017; Ferri et al., 2020; Li et al., 2021).

### 5.3 Managerial contributions

This dissertation's published papers are intended to provide practitioners with useful information for designing and managing a successful DT programme. The findings imply that DT initiatives should not be handled as technology-led undertakings in isolation. Rather, numerous technical and social activities require alignment and cooperative optimisation to successfully leverage DT projects. This research specifically cautions practitioners against disregarding social factors when developing and executing DT solutions. Further, it promotes sociotechnical thinking among engineers and technical leaders, who are often educated and rewarded for technical achievement but tend to disregard social aspects when adopting digital technologies (Di Maio, 2014). Further, this research emphasises the most significant social components, namely, leadership, structure and culture, which practitioners must consider while implementing DT programmes. In addition, it shows how these social elements aid the achievement of DT performance outcomes (i.e. agility, customer centricity and collaboration).

The dissertation highlights the key role of organisational leadership in making this change possible. It provides practical implications for organisational leaders who design and execute digital strategies in cases where business decision-making is linked with the way the business benefits from the use of technology. The dissertation identifies the most important leadership work roles for supporting DT programmes. In addition, it lists the most important leadership competencies for succeeding in this digital world and achieving impactful DT. Further, it links the identified roles and competencies with the targeted performance outcomes of DT programmes to guide practitioners.

Based on the findings, practitioners must also understand the importance of ensuring the right organisational structures for successful DT. Organisational structure is one of the most rigid artefacts, which is hard to change and must be examined carefully when implementing DT. Digital technologies can either strengthen existing centralisation (i.e. reinforce classical power structures) or facilitate decentralisation (i.e. enable the distribution of information within the organisation) (Schwarz Müller et al., 2018). Therefore, managers must define their objectives carefully in terms of what they aim to achieve through structural changes when implementing new digital technologies. Additionally, the flexibility or rigidity of organisational structures is linked with the organisational leadership. For example, organisational leadership plays a crucial role in reducing formalisation and hierarchical layers to support impactful DT. The results also suggest that it is easier to make structural changes in individual functional areas rather than at the organisational level.

Lastly, the dissertation also offer guidance for practitioners regarding the strategic design of organisational culture for DT. It shows that values related to action, assumptions and artefacts guide the execution of DT by operationalising the social power of organisational systems. The results show that strategy, technology and social aspects are inseparable within the three layers (artefacts, values and assumptions) of organisational culture, which requires coherent up-brings of social systems alongside the technology-laden strategy execution by practitioners. For practitioners, the results highlight that a successful strategy execution rooted in an organisation's social system requires a cultural understanding of how the organisation works. The findings show how such social mechanisms work in an organisation's cultural layers of values, assumptions and artefacts. With this information, leaders and managers of organisations can learn how to prepare their business culture as a social force that propels DT to ensure future business proofing.

#### 5.4 Limitations and future research directions

As with any research, the limitations of this dissertation must be acknowledged. These limitations provide opportunities for future research. Although each article discusses its limitations in detail, this section describes the dissertation's general limitations and possible future research avenues.

First, all of the articles are based on the qualitative multiple-case study method, which prevents generalisation of the results (Eisenhardt & Graebner, 2007). This opens the door for quantitative (functional/positivist) studies evaluating the proposed models in reality. Quantitative research would provide more generalisable findings and aid practitioners in determining which social areas should be fostered based on generalisable data. Second, the dissertation focusses on large, multinational, hard-core engineering companies operating in the energy and environmental sectors. In addition, our case companies are global industrial organisations with rich histories. Younger industrial organisations, especially those with operations limited to one or a few geographical regions, might offer different insights regarding DT. Accordingly, the results cannot be generalised to other sectors and contexts. Therefore, future studies could examine the same research models in different sectors. The dissertation's findings should not be considered exhaustive, and the inclusion of other organisations could provide additional insights.

Third, there is need for a greater understanding of the DT process in individual organisations. Consequently, future research should use more single-case studies

to investigate this phenomenon. Fourth, this study utilises cross-sectional data collected during the DT process of the case organisations. However, future studies should utilise longitudinal data to analyse the DT of case organisations to explore its actual effects on the incumbents. Fifth, similarly, this study adopts a specific theoretical viewpoint (i.e. STS theory) to study the DT of industrial organisations. Future research could utilise other viewpoints, which might lead to different results in the context of industrial organisations. Sixth, the data were analysed by three researchers in order to reduce bias. However, more researchers with different backgrounds might draw different conclusions. Finally, this study investigates commonalities between the case organisations' DT programmes using thematic analysis. In future studies, cross-case analyses could provide new and different insights.

## 5.5 Conclusions

In today's digital world, traditional industrial organisations have realised the importance of adopting digital technologies at work to achieve performance outcomes. However, few conceptual and empirical studies have examined the DT of industrial organisations.

This dissertation develops the STS perspective and takes the view that the social and technical systems of industrial organisations must be jointly optimised when seeking to implement DT. Social systems are equally important when planning a technology-led change in an organisation. Therefore, ignoring or putting less effort into aligning the social systems with the newly implemented technical system can lead to failure of technology-led changes, such as DT. The majority of recent research has focussed on literature reviews (Li et al., 2021; Vial, 2019) or the technological aspects of DT (Henriette et al., 2015; Porter & Heppelmann, 2015; Sony & Naik, 2020), which leaves a gap in holistic empirical studies on DT from an STS perspective. This dissertation addresses this gap by exploring changes in the social systems of the case organisations when implementing DT. The qualitative research methodology permits an in-depth examination of DT in the case organisations in order to provide a more comprehensive answer to the primary research question.

This dissertation sheds light on the most important enablers of impactful DT (i.e. organisational leadership, organisational structures and organisational structures) and highlights the targeted performance outcomes (i.e. organisational agility, customer centricity and enhanced collaboration). It extends the understanding of the role of leadership in DT as well as the competencies required

to fulfil these leadership roles. Further, it identifies the organisational structure as the most rigid artefact, which requires special attention and adaptation on the part of organisational practitioners depending on the DT requirements. In addition, the dissertation examines what changes are required in the sub-components of organisational structures (i.e. formalisation, hierarchy and integration) to ensure impactful DT. It also provides a detailed roadmap for designing an appropriate organisational culture, considering values, assumptions and artefacts, to support DT. Finally, the dissertation links all three identified enablers with the targeted performance outcomes of industrial organisations to provide an overall framework for successful DT.

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## Digital Transformation of Industrial Organizations: Toward an Integrated Framework

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### ABSTRACT

Industrial organizations are responding to new risks and opportunities originating from exponentially growing and disruptive digital technologies, by taking company-wide digital transformation initiatives. However, the key enablers of such digital transformation initiatives that facilitate operational performance outcomes in industrial organizations demand further investigation. Therefore, drawing on the sociotechnical system theory (STS), the objective of this study is to explore the digital transformation enablers and their impact on performance outcomes. Research data was collected from four leading industrial organizations that engaged in digital transformation programmes. Our results indicate that leadership, structures, and culture are the key enablers of digital transformation that help industrial organizations to achieve performance outcomes (i.e. collaboration, customer-centricity, and agility). By providing an empirically grounded integrated framework with future research propositions, this study contributes to the existing literature on digital transformation and sociotechnical system theory.

### KEYWORDS

Digital transformation (DT); industrial organizations; leadership; culture; structure; sociotechnical system theory (STS)

### MAD statement

This article aims to make a difference by exploring industrial digital transformation in order to identify the key enablers and performance outcomes. We highlight the need for alignment and joint optimization of social and technical systems to effectively capitalize on the digital transformation initiatives. Moreover, we call for urgent attention to the development of leaders, as well as the further identification of supportive digital transformation leadership competencies. Competent leaders assume a central role in correcting outdated and invalid assumptions, conceptualizing new ideas, and reinforcing cultural values. Furthermore, we elaborate the necessity of cultural transformation in industrial organizations for impactful digital transformation. Lastly, our findings confirm the significance of organizational structure in digital transformation and simultaneously warn that too little is happening.

## Introduction

Industrial organizations are experiencing the transformative impact of digital technologies (Chanas & Hess, 2016; Porter & Heppelmann, 2015); meanwhile, little conceptual and empirical research has examined how industrial organizations are digitally transformed (Ivančić et al., 2019; Warner & Wäger, 2019). Digital transformation employs a combination of advanced digital technologies (technical systems) and organizational practices (social system) to enable major business improvements – better products and services, a competitive advantage, enhanced customer experiences, business model innovation, and new business processes (Autio et al., 2018; Ivančić et al., 2019; Niemi et al., 2021; Singh & Hess, 2017; Vial, 2019). In response to the potential of these positive business outcomes (Ivančić et al., 2019), digital transformation has become a strategic imperative on industrial organizations' agenda (Vial, 2019).

Digital transformation has not only affected the product and service offerings of industrial organizations but has also changed the way they operate (Vial, 2019) and, therefore, requires a company-wide transformation programme – the digital transformation of organizations. The relationship between technology implementation and organizational transformation is not new in the literature (Mumford, 2006). Trist and Bamforth (1951) studied how the interconnected nature of implementing new technologies affects organizations, which led to the emergence of sociotechnical system theory (STS). The STS theory considers both the technical and social factors affecting change within an organization (Cherns, 1976; Davis et al., 2014). Similarly, the concept of digital transformation can be divided into two main categories: technical systems (advanced digital technologies such as cloud computing, internet of things, digital platforms, big data, and analytics) (Gilchrist, 2016) and social systems (people, culture, goals, procedures, and structures) (Davis et al., 2014). Moreover, organizations are considered complex systems that consist of interdependent components (Davis et al., 2014); hence, designing a change for one system (implementation of digital technologies) without considering its effects on other parts of an organization (the social system) will limit its effectiveness (Hendrick, 1997). Therefore, we posit that the STS theory is a powerful lens for examining the digital transformation of industrial organizations, at a time when the expanding influence of digital technologies is disrupting business operations.

Most recent studies have focused on the technological aspects of digital transformation (Henriette et al., 2015; Porter & Heppelmann, 2015; Sony & Naik, 2020), while others have highlighted the need for organizational changes (Duerr et al., 2017; Gehrke et al., 2015; Matt et al., 2015) to accomplish digital transformation. In addition, there are calls to extend the application of STS theory to a wider range of complex problems (e.g. Davis et al., 2014; Sony & Naik, 2020; Verhoef et al., 2019), such as the challenges posed by digital transformation of industrial organizations. Additionally, Matt et al. (2015) have also called for empirical research to test four dimensions (the use of technologies, changes in



value creation, structural changes, and financial aspects) to discover commonalities or differences in organizations' digital transformation strategies. Prior literature remains insufficient for explaining the complex phenomenon of digital transformation in industrial organizations (Ivančić et al., 2019), which highlights the utility of applying the sociotechnical embedded paradigm (optimization of social and technical systems).

Although the digital transformation concept has been adopted broadly and our knowledge of digital practices has grown considerably over the past decade (Sony & Naik, 2020; Vial, 2019; Warner & Wäger, 2019), prior literature fails to provide a comprehensive understanding of organizational change (in terms of digital transformation) by offering an integrative perspective. Therefore, a holistic understanding of such a transition towards digital transformation is required to produce clear guidelines for both research and practice in organizational change management. Our literature review revealed the existing fragmented research on digital transformation; we learned that the seminal literature is missing a multiple case study (Sony & Naik, 2020) that explores the key enablers of digital transformation progression in a contemporary setting. Therefore, our study aims to identify and explore digital transformation enablers and performance outcomes by providing an integrative research framework for digital transformation in industrial organizations.

### **Digital Transformations**

Digital transformation has emerged as an important phenomenon for researchers (Bharadwaj et al., 2013) and practitioners (Fitzgerald et al., 2013). This is revolutionizing the way industrial organizations operate through the use of digital technologies (Parida et al., 2019), which is leading organizations toward a new era of industrialization, known as Industry 4.0. Thus, organizations have been forced to alter the value creation paths on which they have relied in the past to remain competitive by introducing a variety of digital technologies (Vial, 2019). These digital technologies include but not limited to the industrial internet of things (IIoT), cloud computing, advanced algorithms, artificial intelligence, hyper-connectivity, self-learning systems, automation, big data and analytics (Gilchrist, 2016). Organizations are now finding new ways to operate with the help of these technologies by devising strategies that embrace the implications of digital transformation and drive better operational performance (Hesse, 2018). These digital technologies are just a small part of the digital transformation of organizations (Vial, 2019), while it requires more effort by organizations to actually digitally transform themselves.

Researchers and practitioners use both terminologies, i.e. digital transformation and digitalization, when referring to the same phenomenon; however, some researchers have tried to differentiate the meaning of both terms (Bockschecker et al., 2018). Both terms are derived from digitization, which is the technological

transformation of analogue information into a digital format (Da Silva Freitas Junior et al., 2016). Parida et al. (2019, p. 12) defined digitalization as the 'use of digital technologies to innovate a business model and provide new revenue streams and value-producing opportunities in industrial ecosystems.' Hinings et al. (2018, p. 53) defined digital transformation as follows: 'By digital transformation we mean the combined effects of several digital innovations bringing about novel actors (and actor constellations), structures, practices, values, and beliefs that change, threaten, replace or complement existing rules of the game within organisations, ecosystems, industries or fields.' Moreover, (Vial, 2019) defined digital transformation as 'a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies.' These definitions show that the term 'digitalization' is used for business models, along with product and service digital features, while 'digital transformation' is a more holistic concept that covers the changes needed in the organization itself to be compatible with digitalization. Since the focus of our research is towards the organizational changes, we use the term 'digital transformation' in this article.

In recent years, scholars have explored the most important aspects of the digital transformation of organizations on a generic or conceptual level. Matt et al. (2015) highlighted the four most important dimensions of digital transformation strategy, i.e. the use of technologies, changes in value creation, structural changes and financial aspects. They argued that the alignment of these four dimensions lead organizations toward a holistic framework that can result in the formulation of a digital transformation strategy for organizations. Empirical study by Chanas and Hess (2016) suggests that organizations need to develop separate digital transformation units to create governance and collaboration mechanisms, which can help in developing successful digital transformation strategies. However, the focus of their study remained narrow, i.e. how digital transformation strategies have emerged in incumbent organizations. Gehrke et al. (2016) listed nine main challenges that organizations face in their digital transformation. These challenges include a lack of tools, methods and concepts for process digitization; unclear migration scenarios; a lack of structure and direction for the management of transformation; organizational structure; a lack of collaboration and cooperation; time and budget constraints; low awareness; an unsupportive culture and a lack of competencies. They argued that digital transformation involves overcoming these challenges. Moreover, the literature has addressed the links between digital transformation and business model innovation (Parida et al., 2019), digital innovation (Hinings et al., 2018), and building dynamic capabilities for digital transformation (Warner & Wäger, 2019; Yeow et al., 2018). Most of these studies are conceptual or remained to the literature reviews, which raises the need of empirical study that what actually industrial organizations are going through in their digital transformation journey.

### **Digital Transformation and Sociotechnical System Theory**

Since digital transformation is powered by advanced digital and hyper-connected technologies, it requires a reconsideration of human-technology interaction within an organization (Mitki et al., 2019). Therefore, digital transformation is considered a sociotechnical process that includes social and technical aspects that interact to achieve a common goal (Sony & Naik, 2020). The literature has addressed the relationship between technology and organizational transformation through several theories: sociomaterial theory (Leonardi, 2013), actor-network theory (Callon, 1999), structuration theory (Giddens, 1979), and technology affordances (Gibson, 1979). For example, sociomaterial theory refers technologies as group's localized experiences (Leonardi, 2012) as it argues that the material and social are inseparable; therefore, the distinction between technologies and humans is not acceptable (Orlikowski & Scott, 2008). Structuration theory lacks a consistent structuration account of technology (Jones & Karsten, 2008) and addresses very little about technology-led change. Likewise, technology affordances approach is limited to action potential of a technology, i.e. what people or organizations can do with a particular technology in order to achieve their goals (Majchrzak & Markus, 2012). However, digital transformation requires a holistic approach that can address organization as a whole in order to implement technology-driven change. Therefore, sociotechnical theory is considered to be a comprehensive theoretical stance to studying digital transformation (Mitki et al., 2019; Trist & Bamforth, 1951).

STS thinking emerged in 1951 when the UK Tavistock Institute discovered the interrelated nature of technology and social aspects of work while studying the introduction of coal-mining machinery (Trist & Bamforth, 1951). STS theory requires consideration of both technical and social factors when promoting change within an organization (Cherns, 1976); it considers an organization a complex system comprising many interdependent components. Thus, designing change in one segment of this system requires changes in other segments to enhance the effectiveness of this change (Hendrick, 1997). Moreover, STS theory provides a holistic overview of organizational transformation triggered by technological changes, covering organizational structure (Mumford, 2000), organizational culture (Pasmore et al., 2019), and skills and competencies requirements (Sony & Naik, 2020).

The principles of STS theory have been applied successfully in several key domains, especially concerning new technologies and the redesigning of work within organizations (Davis et al., 2014). Some scholars have reported that most studies on digital transformation focus on the technical aspects of this change (Palazzeschi et al., 2018; Sony & Naik, 2020), while others have called for research on the sociotechnical viewpoints of digital transformation (Avis, 2018; Davies et al., 2017). Thus, we argue that the STS theory provides an ideal foundation for studying the phenomenon of digital transformation in organizational change. This

study applies the STS theory to studying digital transformation in industrial organizations.

### **Method**

In this study, we adopted a qualitative approach by conducting a multiple case study to address the research objectives. A case study approach gives good justifications for questions of 'what,' 'how' or 'why' when a certain phenomenon occurs, and for obtaining a first-hand and in-depth understanding (Yin, Clarke, Cotner & Lee, 2006). Moreover, case study investigations are considered appropriate when the research is in the early stages and variables of the research topic need to be defined by employing a holistic vision (Matthews & Ross, 2010). It allows researchers to study practices and situations that are understudied and not yet completely described and comprehended, such as the topic of digital transformation (Ivančić et al., 2019). Therefore, a case study approach was chosen to gain first-hand insights and explore digital transformation processes in incumbent industrial organizations in a holistic manner.

### **Case Selection**

This research is conducted in four global industrial organizations with their headquarters in the Nordic countries. The selection criteria of all case companies were based on methodological expediency. Methodological expediency allows the selection of cases that are unique, easily accessible for researchers and provides the opportunity to study the phenomenon in question (Huberman et al., 2012). All case organizations are hard-core engineering companies and were established during the second industrial revolution or earlier (Imran & Kantola, 2018). They have experienced the necessary changes from the old way of doing business to the modern requirements of the digital age. Case selection, therefore, focused on companies that have started their digital transformation programmes in the past 5 years and are advocates of digital transformation in their respective business communities. Due to a non-disclosure agreement (NDA), aliases are used for all the case companies. [Table 1](#) summarizes the key details of case organizations.

### **Data Collection**

We relied on in-depth interviews and publicly available documents of case companies (web blogs, interviews, videos, reports, information on websites) to gain insights into the digital transformation programmes for this study. In total, we conducted twelve in-depth interviews with the experienced personnel who directly participated in the digital transformation programmes of their respective organizations. Six out of twelve interviewees were from the top-level management of their organizations. Marshall and Rossman (2011) call such participants 'interviewing elite.' These individuals are considered influential, prominent, and well informed, having acquired the status of 'elite' through achieving senior positions in their organizations (Delaney, 2007). Such participants can provide valuable information, broader views of organization strategy regarding the

phenomenon in question, and future plans of the company (Marshall & Rossman, 2011). On the other hand, the remaining six interviewees were from midlevel management, implementing or coordinating digital transformation strategies in their organizations. Therefore, this study emerges from the knowledge of elites who are devising digital transformation strategies and mid-level managers who are practically implementing these strategies, and both enhance the quality of the data. Moreover, there were six face-to-face and six online interviews. Table 2 provides the designation of each participant, along with the codes used for quotations. We followed a snowball-sampling strategy (Marshall & Rossman, 2014), in which the first informant suggested additional informants and facilitated access within the organization. The interview transcripts comprise more than 197 pages and 950 min of transcribed material. For the transcription of interviews, we used an online platform for converting speech into text. 'First author' proofread the transcriptions by listening to each recorded interview.

**Table 1.** Details of case organizations.

Case	Description
Case A	Renowned player in smart technologies and complete lifecycle solutions for the marine and energy sectors A separate dedicated digital organization was developed by hiring CDO to lead DT in the organization 5,1 Billion Sales in 2019
Case B	Market leader in its field and is a pioneer of variable frequency drives, cooling & heating solutions and energy management Digital transformation responsibilities were dedicated to business segment's heads 6,3 Billion Sales in 2019
Case C	Very big player in forest, wood, and papers industry. Also expanding their business in energy market Digital transformation responsibilities are dedicated to unit heads. 10,2 Billion Sales in 2019
Case D	Global leader in engineering and service solutions Created new digital innovation unit for digital transformation of itself. 9,9 Billion Sales in 2019

**Table 2.** Interviewees' designation and codes.

Profile of Interviewees	Code
Vice President (Digital Portfolio Mgt.)	VP
GM Digital Deployment and Support	GM
Director Digital Culture	DDC
Senior Manager Digital Transformation	SMDT
Senior Project Manager Digitalization	SPM
Manager Digital Transformation	MDT
Manager Digital and IT systems	MD
Project Manager	PM
Senior Manager Digitalization	SMD
Global Head of a business unit	GH
Global Business Program Manager	GBM
Vice President, IT Strategy and Governance	VPIT

## Data Analysis

We systematically coded and analysed the transcribed data (Gioia et al., 2013). We followed the data analysis technique of Gioia et al. (2013), in which raw data is organized into concepts and thereafter develops themes that facilitate the identification of digital transformation patterns in industrial organizations. We

used Nvivo 12 software that facilitated the coding approach and enabled us to keep a record of the emergence of concepts and relationships. Initially, we used an open coding approach where raw data was analysed and categorized (Huberman et al., 2012). In the second round, we grouped all coding into four main themes, i.e. leadership, structures, culture and performance outcomes.

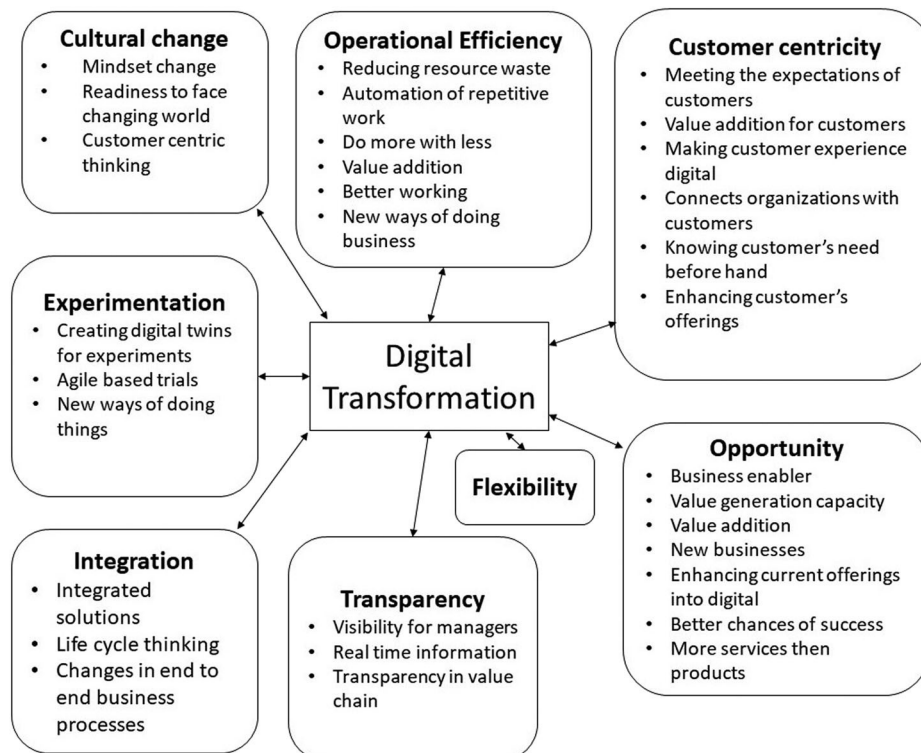
## **Findings**

### **Digital Transformation**

Before we provide details of the enablers and performance outcomes of digital transformation that the analysis identified, it is important to ask and answer: 'What does digital transformation actually mean for the case companies?' Our analysis identified seven different understandings of digital transformation. Approximately 66% of the interviewees mentioned that it is about customer centricity. For example, SMDT stated, 'It's basically everything and anything we're looking into digitalizing, or making the customer experience more digital'. SPM added, 'digitalization is actually the realization of transferring all this into real customer perspective.' GM put it, 'It connects us with customers more closely. I think this is the biggest difference.' MDIT mentioned, 'how I see the digitalization is that you start selling something that your customers don't even know that they need.' Similarly, an equal proportion (i.e. 66%) of participants thought that as a business enabler, digital transformation is a big opportunity for industrial organizations, in terms of valuegeneration capacity, value addition, creating new business, enhancing current offerings into digital, better chances of success, and providing more services than products. Moreover, 50% of participants perceive digital transformation as something that facilitates operational efficiency. For example, PM stated, 'It helps in reducing resource waste.' MDT mentioned, 'with digitalization, you can do more with less.' VPIT added, 'It is giving us a different playground. It goes more like agility-based trials, experimentation, new ways of doing things, new ways of solving problems, and bringing operational efficiency.'

We found that 25% of the participants viewed digital transformation as cultural change. MDT stated, 'It's more than tools and processes, it's really about the mindset change.' GM also stated similar views: 'It's a mindset change and cultural change that is happening right now.' MDIT added, 'It's change of culture. We need to be faster and we need to have more services than products.' Two participants mentioned that digital transformation brings experimentation capabilities to the incumbent originations. For example, PM stated, 'It allows experimentation; for example, you can develop a digital twin of a product for this purpose, to ensure that product value is deliverable.' An equal number of participants viewed it as something that integrates the whole value chain. SPM explained, 'It means integration. It's about integrated solutions and a way of thinking in the life-cycle coverage. It's not about just focusing on individual products but taking care of the

whole life cycle.’ Moreover, the same number of participants said that it brings transparency. DDC elaborated, ‘It brings visibility for the managers to see real time what’s happening in the organization, what are the bottlenecks, and where are the problems.’ GH explained, ‘this is a huge opportunity to bring transparency to the whole value chain.’ Lastly, one participant also viewed it as flexibility. PM said, ‘digitalization means flexibility; it does not mean standardization.’ **Figure 1** summarizes these findings regarding what digital transformation means for industrial organizations and how they view it.



**Figure 1.** Conceptualization of digital transformation in cases (interview based).

### Leadership

Leadership is one of the most important enabler for the successful digital transformation of industrial organizations among our cases. Every company develops its strategy according to its own needs and stage of the digital transformation process, but leadership remains a key enabler. Our data analysis strengthens this notion; incumbent organizations are paying special attention to leadership development for impactful digital transformation. Our data shows two different strategies that the case organizations adopted for this purpose. First, one of the case organizations developed a separate organization that provides digital support to the main businesses. Second, the remaining case organizations have allocated digital transformation tasks to the business/segment heads. However, the commonality between both strategies is that they have allocated digital transformation tasks to the top leadership of their organizations, whether they are

working in a separate support organization or as a head of any business segment or function. Moreover, we found that the leadership responsible for digital transformation emerges from both external recruitment and internal allocation of additional responsibility, or even through shuffling from among their main positions to the digital transformation-related positions. For example, VP mentioned, 'to accelerate this digital transformation, our organization has recruited a highly qualified digital leadership team and established a new digital organization with more than 400 existing employees.' On the other hand, SMD explained their strategy by saying, 'we have delegated digital transformation to the function heads. They are responsible for managing required resources to execute digital transformation strategy.'

We identified two main leadership areas on which incumbent organizations are primarily focusing for impactful digital transformation. First, implementing digital transformation requires several work roles of leadership. These include spreading awareness of digital transformation topics, promoting collaboration, driving digital change, driving cultural aspects of digital transformation, leading by example, promoting mentoring/coaching-style leadership, being smart followers, bringing transparency to their actions as well as throughout the organizational value chain, and being value-driven. In order to successfully play these roles, industrial-organizational leadership must work on certain competencies, the second identified leadership area in our study. These competencies include adaptability, the right attitude, communication skills, data-driven decision-making, empowerment, failing fast, experimentation, open-mindedness, risk-taking, trust, surface-level technical knowledge, and vision.

### **Leadership and Performance Outcomes**

**Agility:** Our results show that leadership has a key role in attaining organizational agility. We found that 50% of the participants gave their views on how leadership can play its role in attaining agility. A few of them related it to the leadership competency of adaptability and flexibility. For example, SMDT stated, 'there is one thing that is key, which is adaptability. You can also call it being agile or being flexible, but adaptability is basically strong change-leadership skills.' SMDT further added, 'It means that there is no more strategic planning or yearly plans, there is no more project linear execution. It's always about being able to adopt the change, based on the new information, changing markets, and changing situations.' SMDT also stressed that leadership should come out of the KPI mindset and think for the betterment of the overall organization as a whole. He added, 'It's not anymore about my team or my domain, but it could be that you as a leader are operating agile teams and willing to share the resources for innovation projects or specific projects that are not necessarily connected to your tight KPIs.' VP stated that 'Job of leadership is to challenge the existing processes of the organization by bringing new and agile ways of working'. GM said that 'they are using agile ways of



working now to manage the services'. MDIT shares similar views: 'We have the technology available and we can transform or change our processes, make them smart, fast, or agile, but then the biggest role of leadership required here is how they transform the people in order to adopt these changes.' So, leaders must play new work roles and develop those competencies that this study identifies, in order to make their organization agile for digital transformation.

**Customer Centricity:** Similarly, our data analysis shows that without the complete commitment of leadership, it is impossible to achieve customer centricity in the organization. We found that 75% of the participants mentioned the role of leadership in attaining customer centricity for impactful digital transformation. The responses of the participants can be categorized into two main streams. The first suggests that leaders should work to provide solutions to their customers and drive value for them. For example, MDT stated, 'different kinds of things are affecting our customers and their businesses. So, as leaders, we need to be ready to solve those future problems and give them solutions.' Chief digital officer (CDO) mentioned (in an online interview), 'my specific responsibilities include cyber security, all of IT, all of the innovation, processes, and capabilities, including working with start-ups and all digital product development. All of that translates into "how do we drive value for customers through digital?"' He further added, 'It starts with the leader's knowledge of products and customers, what they want, and where they're changing.' MDIT viewed it as 'you start selling something that your customers don't even know that they need.'

The second stream of responses on customer centricity spoke about the leader's role in co-creation with customers. For example, SMDT stated, 'leaders should be piloting together with the customers.' VP added, 'in innovation, we are trying to be customercentric. Leaders need to think about how we can involve much more the voice of customers, instead of thinking how to move from an idea all the way to the product.' PM added, 'a big challenge for leadership today is to stay technically updated about all new developments happening in the industry. It is also an opportunity to be on the frontline and shaping the future, together with the customers.' SMDT said, 'leaders have to involve customers in piloting. It requires leaders to balance the speed of execution with the level of quality needed.'

**Collaboration:** Furthermore, it is very important for leadership to promote a collaborative environment in the organization for impactful digital transformation. Our data analysis shows that 50% of the interviewees spoke about the role of leadership in promoting collaboration for digital transformation. MDT stated, 'we are promoting collaboration quite a bit here. We have a lot of hidden knowledge among the people who have been working for us for 20–25 years ... therefore, it is important to make collaborations (between experienced and novel employees) within different kinds of tasks.' SMDT added, 'you should know how to coordinate, how to network, and how to pull the

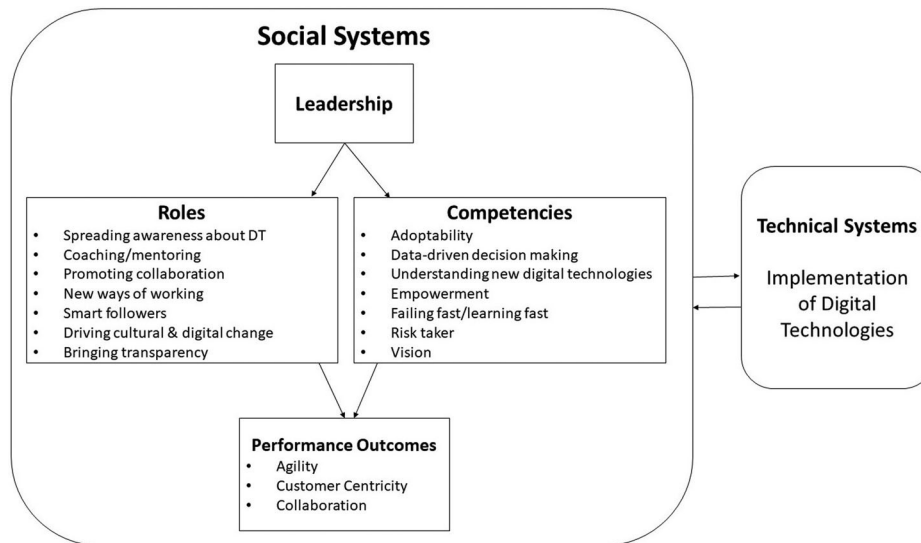


Figure 2. Leadership roles and competencies to achieve performance outcomes.

strings of knowledgeable people and connect them with others.’ He further associated this with the visionary competency that ‘leaders who have this long-term sense of giving direction while, at the same time, having the teams co-develop, create, and innovate within that main vision. And it’s the vision, which doesn’t just look inward to the company but looks to more of an ecosystem view of opportunities.’ SPM mentioned that ‘when it comes to the management, it’s all about connecting people.’ MDIT added, ‘so, basically, the data is available that we can start using, and then we need to put people together, so they are not competing in the wrong way.’ GBPM and SPM had similar views on leaders needing to find the right balance between digital and business people and mixing them well to generate the required results.

Figure 2 summarizes our findings on roles and competencies that leadership requires to achieve performance outcomes.

### Structure

Organizational structure emerged as the second enabler of digital transformation of our case companies. A general perception of industrial organizations is that they possess very rigid structures, mainly due to their long, successful history, traditional deep-rooted leadership, and product-oriented approach. We have found this to be true through our data analysis; however, we have also observed new structures popping up in these organizations to implement a digital-transformation agenda. As the previous section discusses, one of the case organizations developed a whole new structure (digital organization) in order to support digital transformation for its business organizations, while the rest of the organizations delegated digital transformation tasks to business/functional heads, who developed new teams to support digital transformation within their

businesses or functions. We also learned of some steps taken, when one of the case organizations developed a new organization-level team that stays in contact with all the businesses and keeps track of their digital-transformation initiatives, providing digital support as well. Thus, incumbent industrial organizations have formed new structures to support digital transformation. However, the extent to which it has impacted the existing structures of the organization is debatable. Our data showed that it has very little impact on the existing formal structures of case organizations, although informal structures arise.

The hierarchy of industrial organizations still consists of long chains. For example, as SPM explained,

If we take the example here of services, we have four team vice presidents (VP), every VP has six-to-eight directors under him with their own management teams, and every director has his own general manager under him, who also has his own management team. So, as an engineer, you can imagine that if you have an idea to run a project, it takes a while to get somewhere.

Similarly, SMDT stated that digital transformation has not yet impacted organizational structure, but it is shaking the informal structures of these organizations. For example, the VP stated, 'I have a team of 35 people; I have instructed all of them to report to one person, and that one person reports to me.' Similarly, GM added, 'we are working on becoming less and less hierarchical all the time, especially for digital transformation. But it goes hand-in-hand with company culture as well.'

As industrial organizations still possess a rigid hierarchy, and formalization is also high in the case organizations. The interviewees understand that they are still very processoriented organizations. For example, SMD said, '(we are) very much kind of a processoriented company.' PM explained, 'when we do some project, we have some gatemodels, we have decision-making points on how we have to make decisions. When we have to make a decision, it should be based on those points and what the decision should be.' MDIT added, 'within business organizations, it is much more bureaucratic.' While addressing the formalization and hierarchy, SPM said, 'the corporate structure actually defines that you cannot do things without approval. And approval can have several layers. Still, I would say that we, as a company, have quite a good focus on empowering people.' GBPM also shared his views that 'we have globally defined processes and ways of working, but it is more like a framework that managing directors can mold according to their needs.' He further added that 'personally, I like freedom with responsibility ... you take care of this part and I'll take care of that part. How you do it is up to you.' So, our data shows that leaders who are dealing with digital and related topics are more open toward less formalization and promoting a more goal-oriented approach.

### **Structure and Performance Outcomes**

**Agility:** We found that organizational structures play a key role in attaining organizational agility. Approximately 66% of the interviewees linked the role of organizational structure to attaining organizational agility. In our analysis, we found three main categories of ways that structural changes can bring agility to incumbent organizations. First, a few participants identified the process-oriented approach (formalization) as one of the hurdles in attaining organizational agility. They stressed the need to change that, in order to become agile. For example, MDT stated, 'we are a waterfall company and the way of doing things is very slow. It doesn't respond to the changes as fast as needed for this transformation.' SMDT stated that 'we are looking into how we move from a waterfall model to maybe a hybrid model, if not necessarily agile.' SMDT further explained the waterfall model as 'basically very long, rigid. It's not agile at all ... we must move away from this approach toward agile and iterative ways of doing things.' Second, VPIT indicated that they are becoming flexible in goal-setting now, to attain organizational agility, which, again, is linked with formalization. He stated, 'earlier we had yearly goals, but now we have adopted a more agile way than that. So, we can change goals during the year by analyzing the changing environment.' He further added, 'earlier, it was a taboo that you could not change yearly goals, but now we are becoming more flexible.' Third, interviewees linked flexibility in resource sharing and resource allocation as something that can promote organizational agility. DDC explained, 'we should adopt an agile working environment where we can utilize cross-functional resources. Currently, people are allocated to certain positions by function or organization, and cross-utilization of competencies is not very high.' MDIT stated that 'there should be no boundary lines between teams. You should be able to combine people and knowledge from anywhere in the organization into one team. ... The structure should be able to allow that; only then you can be agile.' She further added, 'You need to empower such teams (less formalization) and that's the key.'

**Customer Centricity:** If we analyse the topic of structures in relation to customer centricity, it ultimately falls under external collaboration or integration topics. In relation to collaboration, the topic of structures addresses both internal and external collaboration. Therefore, we are discussing results related to external collaboration (only customers/ no other stakeholders, e.g. suppliers) in this section. We found that 75% of the interviewees shared views on how their organizations are integrating their customers with their systems and structures, in order to attain customer centricity for digital transformation. One of the case organizations made major structural changes for this purpose. SMDT explained, 'from January next year, we are reorganizing ourselves in order to be more customer centric ... we understand that customer centricity is one of the principles that digital transformation is bringing.' VP expressed the same views:

One of the things pushing us to merge now from three divisions to two is around this whole transformation. Because if we want to be customer centric, there is no point in keeping the

services and business organizations separate. It is required if you really want to be customer centric and serve the customer throughout the life cycle, as one company.

SPM raised the need to break the silo-oriented approach toward customers and stressed the need for life-cycle thinking when delivering value to the customers. He stated, 'but the challenge is that we are still silo oriented. People have to focus on the whole package that we have to deliver to the customer.' This view is also aligned with previous views of VP and SMDT, on organizational restructuring to attain customer centricity. Similarly, the concept of co-creation with customers also requires close collaboration between the organization and its customers. It also raises the need for changes in organizational structures, to integrate customers with the organization. GM explained, 'we need to open up our landscape toward customers ... it means that we will co-create with customers much more.' GM further added that 'if somebody wants to test a new type of doing business or provide new services with the customers, we allocate a separate team for this purpose ... it's like an initial internal start-up setup.' CDO shared his views on that, 'even though we are focusing on digitalization within the company, the benefits will be reaped by the customers. Co-creation and co-innovation will be a standard process, and the new ways of working will show in everything we do, from sales to manufacturing.'

Collaboration: The topic of collaboration is very much interlinked with the third construct of structures, i.e. integration. All of the respondents shared their views on how structural changes can lead to enhanced collaboration in their respective organizations. The topic of collaboration in relation to structures can be divided into two main categories, i.e. internal collaboration and external collaboration.

Regarding internal collaboration, we have identified three types of collaboration affecting structures. First, case organizations are promoting collaboration between experienced and inexperienced personnel, by bringing them closer to each other on different topics. The purpose of such collaboration is to enhance the knowledge-sharing between them, on which MDT remarked. Second, the new setup of the digital organization works hand-in-hand with business organizations. It is a completely new structure for such industrial organizations, where a newly formed support organization is working closely with the business side, to provide digital competencies, although it has some challenges, such as trust between the business and the digital people, different leadership styles, and lack of understanding between them. GH, GBPM, VP, MDIT, VPIT, and SMDT stated these challenges; however, all of them agree on recruiting external digital experts and mixing them with business experts, to enhance digital transformation. None of them think that only recruiting external digital experts or only training internally for digital competencies is a good idea for digital transformation. VPIT put it, 'our target has been that we always will be together with the business (rather than starting our own business initiatives).' He further stated, 'we work strongly together with the businesses ... because basically the business sets the demand (for digital

competencies). Third, one of the case organizations created a new position, ‘senior manager of digitalization,’ in order to align different digital initiatives taken by different business segments. The purpose of this new role was to eliminate the silos among the business segments and enhance their collaboration on similar topics of digitalization, mentioned by SMD. He stated, ‘so I had the task of taking up this cross-functional role to bring people together and break the silos.’ VP also stressed the notion of eliminating the silos by stating that ‘we have created acceleration centers where we are pulling people from different parts of the organization to work together ... because everyone tends to work in their silos because of their profit-and-loss responsibilities.’ Similarly, GH stated, ‘what I see is a more collaborative model, a more cross-functional model, that takes relevant people from different functions together and drives it as an initiative.’

External collaboration consists of collaborating with external stakeholders, such as customers, suppliers, and even the integration of newly acquired companies (digital-native companies that brought new digital competencies to the case organizations). We have already discussed collaboration with customers in the last section on ‘customer centricity.’ Therefore, in this section, we discuss it with respect to other external stakeholders. We have identified three main streams of external collaboration in relation to structures. First is ecosystem integration. CDO stated that ‘ecosystem thinking is looking at the end-to-end value chain and asking ‘Where do we play a primary role?’’ Second is integration with suppliers. CDO explained, ‘our success depends on the partnership and collaboration of our customers and suppliers.’ Third, case organizations focused on

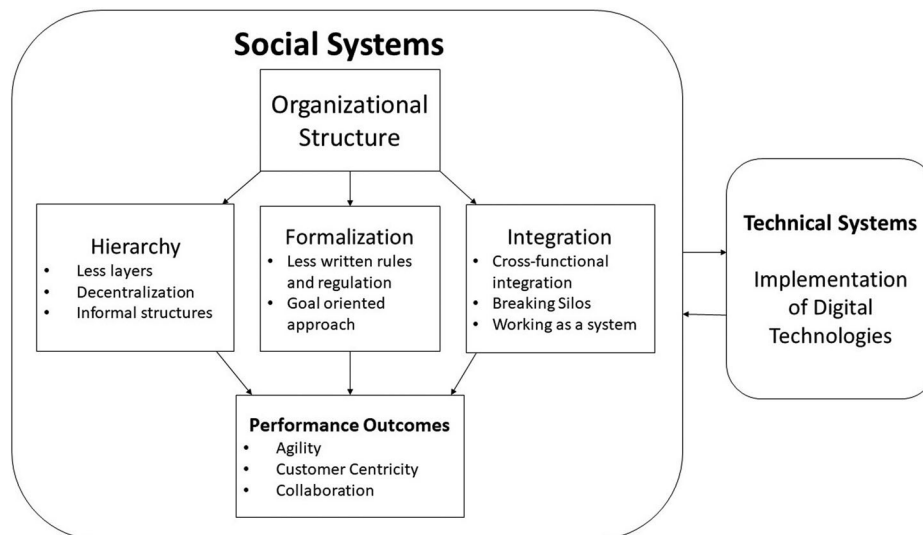


Figure 3. Structural elements to achieve performance outcomes.

acquisitions of ‘digital native companies, e.g. start-ups’ and emerged/collaborated with them to build their digital competencies. SMD explained, ‘we’re looking into

partnerships because we don't think that we can do all of it (digital transformation) ourselves. It's also an area where we are struggling a bit; we are not that fast at finding partners, but it's something we need to do more as a partnership and with acquisitions.' VP stated that 'we also work with external partners to actually sort of accelerate some of the stuff in the beginning (of digital transformation).'

Figure 3 summarizes identified structural elements to achieve performance outcomes for impactful digital transformation.

### **Culture**

Culture is perceived as third enabler for the digital transformation of industrial organizations. This remains the most-mentioned word by the interviewees and shows the importance of cultural change for digital transformation. The incumbent organization's digital transformation programmes pay special attention to cultural change. For example, PM stated that 'it is disrupting our organizational culture.' Similarly, SDT said, 'digital transformation has a huge impact on the company's culture.' GM stated, 'the biggest change happening now is cultural change and mindset change.' Similarly, SPM explained, 'the main thing is that the culture needs to be changed. It is not the development resources, not the development projects that could be done differently, OK, there are improvements in those as well, but it is the culture that needs to adapt as well.'

We have identified three main constructs of culture about which incumbent organizations are taking steps. First, case organizations are focusing on the development of new values in their systems. These values include bringing agility to actions, openness toward digital transformation, an experimentation culture, failing fast, co-creation and validations with customers, sharing culture, feedback culture, coaching culture, taking ownership, empowerment, collaborative mindset, support for everyone, promoting innovation, and ecosystem system thinking. Second, the development of new artefacts includes the development of new formal and informal structures, digital learning platforms, digital innovation platforms, utilization of robotic process automation, usage of artificial intelligence, intranets for digital collaboration, learning management systems, internet of things, big data and analytics, digital language, and celebrating failures. Third, we identified some assumptions that case organizations intend to remove for impactful digital transformation. These include that people are afraid of unknown possibilities of digital transformation, digital transformation is a threat to personnel positions or jobs, fear of asking customers, fear of making mistakes, and relying on past success.

### **Culture and Performance Outcomes**

**Agility:** Initiating agility is one of the key tasks for cultural-change initiatives in incumbent organizations. We found that 83% of participants gave their views on how cultural change can create agility for the case organizations. We identified three different categories that showcase organizations focusing on cultural change to increase agility. First, agility is one of the most important topics of cultural change for digital transformation, as SMDT mentioned. The main reason behind it is that the case organizations had been operating on waterfall-model bases, where things move very slowly. Now because of digital transformation, they are moving toward agility, which requires massive change in their culture, especially the ways of working. For example, MDT stated, ‘we need to have speed in our actions in order to answer the expectations of a younger workforce.’ He further said, ‘agility is one basic change in our way of working, as we have been a waterfall company.’ SMDT explained, ‘I would say that’s the concept of how you work in an agile way. I’m not talking about adopting any specific methodology of agility, but what really are the principles of the agile way of working and being able to adopt them at a certain level that makes sense for your organization is a must.’ We also found other participants like VP, CDO (secondary data), GM, and GBPM, who stressed the need for change in ways of working, to attain agility. Second, SPM raised the need for change in management design to attain agility. He said, ‘It (challenge) seems to be the design of management. They talk about rapid and agile delivery. The sad thing is that the culture needs to be changed.’ Third, GM recommended adopting failing fast and customer-centric thinking as the key to achieving agility. He said, ‘so, “fail fast” is one of the slogans ... so try something and if it works, go for it. Otherwise, stop and involve the customer in that.’ We also heard similar views from VPIT, who said,

Digital transformation is giving us a different playground that goes more like agile-based trials, which means that you start to try something that would be valuable, and you have to have a new way of doing to get over the business but, then, also be able to cancel and/ or reject the initiative if it seems that it is not going to be feasible to implement.

**Customer Centricity:** Similarly, bringing customer-centric thinking is another key task for cultural change, required for digital transformation. Our data analysis showed that 92% of the participants mentioned how cultural change can help in bringing customer centricity. First, one of the main problems with industrial organizations is that they assume that they already know what the customer’s problem is and what the solution should be. It is one of the biggest assumptions that industrial organizations must correct. They must adopt the customer’s validation culture, to be a genuinely customer-centric organization, as MDT said. CDO shared similar views in an online interview: ‘This is a digital mindset, the service-design approach, and it’s asking, “what are the end needs? Who is the customer and what are their needs?”’ SMD stated that in an ideal culture for customer centricity, ‘we would be working more from the outside in. We would be working with the customers on creating solutions ... we would have made proofs of concepts and gone out and tested these things with customers.’ He further



explained, 'customer-centricity would be our way of doing.' Second, VP mentioned that they are trying to promote such a culture, where people do not start any development without involving the customers upfront.

He said,

We are trying to promote such sort of mindset that whatever you do, you must involve customer co-creation. Only then we can move from being a product-oriented company to being a service-oriented company ... this is a fundamental shift that we are looking to do with digital transformation.

CDO also shares similar views that 'co-creation and co-innovation will be a standard process, and the new ways of working will show in everything we do, from sales to manufacturing.'

Collaboration: Furthermore, enhancing collaboration among the internal stakeholders, as well as with external stakeholders, is another key objective for cultural change initiatives in incumbent organizations. We found that all of the participants stressed promoting collaborative culture for digital transformation. We identified five different categories of such collaboration. The first is related to collaboration with customers, already discussed in the last section, in the form of customer validation, customer co-creation, and customer-centric thinking. However, here is one additional point on the usage of digital platforms to bring customers closer to the case organizations. Case organizations are integrating customers' systems with their digital systems, as well as using different digital platforms to enhance this collaboration. Second, case organizations are using different artefacts, such as intranets, innovation applications, and digital-learning applications, to promote collaboration among the internal stakeholders of the organizations. For example, SMDT said, 'most learning happens by doing and sharing and learning from others. So, in that sense, we are promoting it from a learning-culture angle, I think that the collaboration platforms that I mentioned earlier are helping in that way.' Third, the last statement by SMDT also shows that they are promoting a sharing culture in order to bring internal stakeholders closer to each other. Fourth, one of the case organizations has recently developed a physical artefact, i.e. a new campus to which they are bringing all the stakeholders (factory, lab, customers, suppliers, and academia) to co-locate and collaborate on R&D. Fifth, we identified one cultural problem in collaboration between digital people and business people, namely, the usage of technical language. For example, SMDT mentioned,

It is about using language that people understand and relate to, for example we talk about 'agile,' 'RPA,' etc. in digital transformation, and now the questions from people are, 'Hey, what language is this? What does it mean?' There is risk as well in speaking a language that people don't connect with.

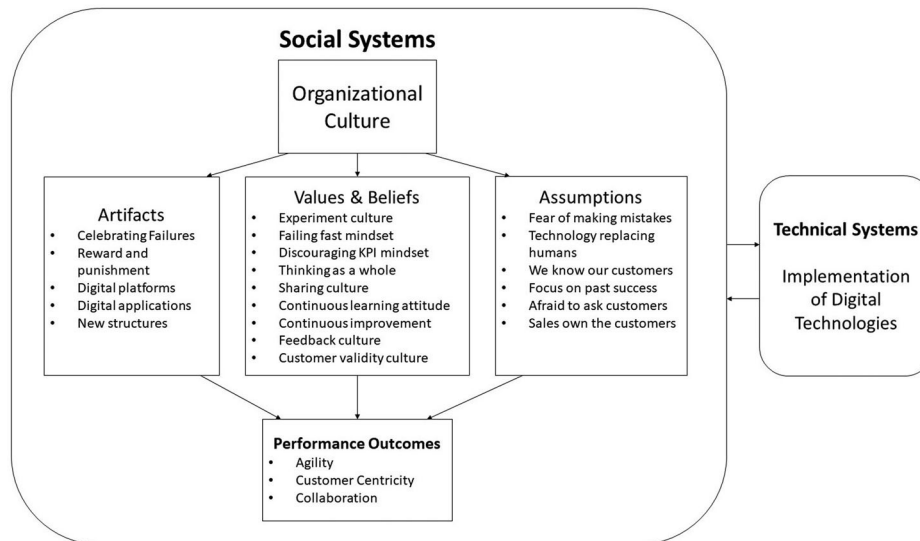


Figure 4. Cultural elements to achieve performance outcomes.

Therefore, it is very important to use a language that is understandable for all. It also requires a leadership role to make such language understandable for all by coaching and mentoring them.

Figure 4 summarizes the key-focus elements of cultural change happening in the incumbent organizations, to achieve performance outcomes.

## Discussion

We identified leadership, structure, and culture as the main digital transformation enablers in industrial organizations. According to our analysis, industrial organizations require transformation involving these three enablers to ensure organization-wide impact of digital transformation. The transformation of these three enablers leads industrial organizations toward agility, customer centricity, and collaboration, the main performance outcomes behind a digital transformation of these organizations. We discuss each of these enablers and performance outcomes in following.

We reported that digital transformation often starts with the emerging new work roles of leadership as they devise and implement a digital strategy in incumbent organizations (Haffke et al., 2016; Horlacher et al., 2016). It is a leadership task to ensure that digital technologies are properly leveraged and aligned with the objectives of the organization (Horlacher et al., 2016; Singh & Hess, 2017). Moreover, leaders have to ensure that the right organizational structure and culture (Reck & Fliaster, 2019) exist in their organization to align technical (digital technologies) and social systems (structure and culture) (Mumford, 2000). Furthermore, leadership roles that lead to digital transformation must be filled by leaders with the right set of competencies (Imran et al., 2018), who can align technical and social systems by implementing the required changes (Higgins &

Mcallaster, 2004; Mumford, 2000; Reck & Fliaster, 2019). Our study identified adaptability, the right attitude, communication skills, data-driven decision-making, empowerment, failing fast, experimentation, open-mindedness, risk-taking, trust, surface-level technical knowledge, and vision as the most important leadership competencies. However, our results show a mix of opinions on whether or not these competencies exist in incumbent organizations' leaders. As our participants are the ones who lead the digital initiatives, they strongly believe that traditional leadership in industrial organizations is lacking most of these competencies. Furthermore, we have identified links that how these emerging work roles and set competencies can help industrial organizations in achieving the performance outcomes. Based on this discussion, we propose the following.

Proposition 1: Developing identified leadership competencies facilitates the digital transformation of industrial organisations and enables them to be more agile, customer-centric, and collaborative.

Our research framework (Figure 5) reveals that organizational structure is another very important enabler that aids and hinders the successful digital transformation of industrial organizations (Gehrke et al., 2016). Since industrial organizations, such as incumbent firms, have a long and successful history in the field of engineering and product development, they have routines and processes that have been well-developed over the decades (centralized structures) (Brown & Magill, 1994; Mumford, 2000) and are very hard to transform. In this preview, organizational structure is one of the most rigid artefacts (Schein, 1985) in industrial organizations, which is very hard to transform. Our analysis shows similar results as most of the interviewees mentioned that the digital transformation projects have not yet affected the traditional organizational structures. However, they understand the importance of structures and the need for change.

Organizational structure has a major impact on the targeted performance outcomes (found in our study) of digital transformation. If we analyse the concepts of agility, customer centricity and collaboration (Earley, 2014; Luokkanen-Rabetino et al., 2017; Smet

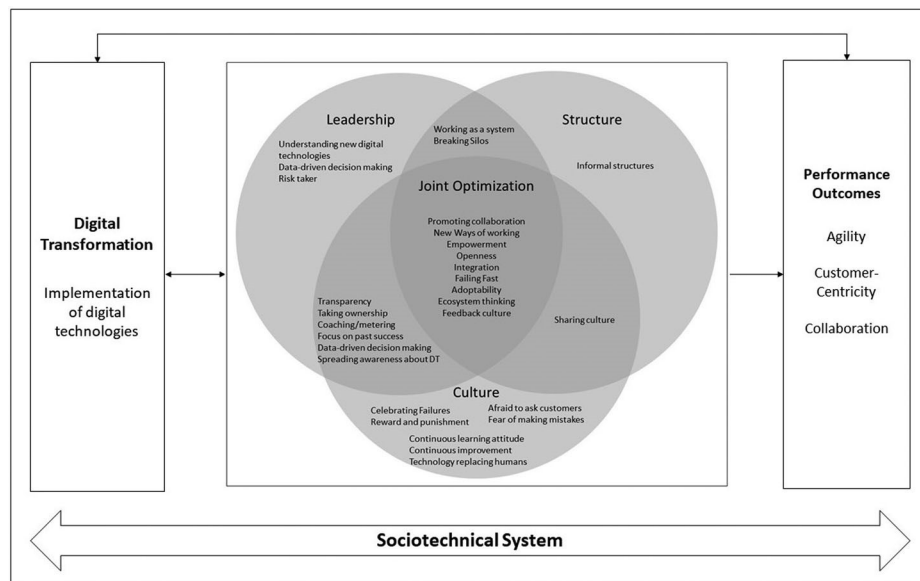


Figure 5. Research framework.

et al., 2018; Vial, 2019), it requires structure with de-layered or flatter hierarchy, decentralized power of command, less formalization and more cross-functional integration (Bernstein et al., 2016; Burton & Obel, 2018; Livijn, 2019; Mumford, 2000; Schwarzmüller et al., 2018). Moreover, digital technologies can lead organizations toward both centralization (by reinforcing classical power structures) and decentralization (as information becomes more distributed) (Schwarzmüller et al., 2018). On one hand, this enables a shift of power from legitimate profiles to those with expertise by identifying those with the most knowledge in the field (Leonardi, 2007). On the other hand, digital technologies allow increased managerial control and a strengthening of existing hierarchies by offering computer-aided monitoring tools (Dewett & Jones, 2001; Schwarzmüller et al., 2018). Therefore, structural changes must be planned very carefully for digital transformation (Vial, 2019). In our analysis, we also found similar views from interviewees that the structure of incumbent firms must find a right balance between centralization and decentralization. Based on this discussion, we propose the following.

Proposition 2: Flexible organisational structures (decentralisation, less formalisation, internal and external integration) drive the digital transformation of industrial organisations and enable them to achieve performance outcomes (agility, customer-centricity and collaboration).

Last, our results identified organizational culture as an enabler that incumbent organizations focus on the most for digital transformation. In the literature, culture is discussed as an enabler of transformation (Scheibe & Gupta, 2017) and an obstacle regarding the adoption of new digital technologies (Duerr et al., 2018; Hallikainen et al., 2017; Shahzad, 2020). Impactful digital transformation is not possible without changing the basis of the organization, which lies in its culture (Armenakis et al., 2011; Nambisan et al., 2017; Westerman et al., 2014). Additionally, industrial organizations develop their own culture over a long period of time, which is often very slow to change (Vincenti, 1993). Therefore, our results

identified a special focus on cultural change in the incumbent industrial organizations. Organizational culture provides unwritten and unspoken rules for how to cope in the organization (Duerr et al., 2018). Schein (1985) divided culture into three sub-parts: artefacts, beliefs and values, and assumptions. The artefact is the most visible aspect of the culture, e.g. new digital tools and technologies or organizational structures (Schein, 1985). In our analysis, we identified that digital technologies and tools (artificial intelligence, robotic process innovation, intranet, in-house innovation applications, collaborative tools, e.g. Skype) are being implemented, which shows that the artefacts are visibly changed in the incumbent organizations. On the other hand, structures are still not changed formally. Beliefs and values are one of the most important parts of transformation, because even the best-designed digital strategy may fail if the organization's values do not embrace the transformation (Duerr et al., 2018). Therefore, we see the main focus on value change in the digital transformation projects of incumbent firms, e.g. developing a failing fast mind-set to promote experimental culture, customer co-creation to enhance customer centricity and sharing culture to enhance internal collaboration and agility. Based on this discussion, we propose the following.

Proposition 3: Cultural aspects of values, assumptions, and artefacts underpin digital transformation to achieve performance outcomes (agility, customer centricity and collaboration) in industrial organisations.

Unlike the extant research that concentrates on technology adoption in digital transformations (Li, 2020), our analysis shows that the combination of leadership with the right set of competencies, changes in traditional organizational structures and refreshed organizational culture can lead industrial organizations to an impactful digital transformation by achieving performance outcomes i.e. agility, customer centricity and collaboration. Digital transformation enables close collaboration between the organization and its stakeholders (internal and external) by using advanced digital technologies, e.g. digital platforms (Klötzer & Pflaum, 2017). In addition, it helps organizations to involve customers in product development and concept development phases (also known as co-creation or coinnovation) (Lucas et al., 2013), which enhances customer centricity. Moreover, agility is another important performance outcome that industrial organizations target to compete in this fast-changing digital world (Vial, 2019).

This study examined the ongoing digital transformation of incumbent firms, which are hard-core engineering organizations with a history of over 70 years, and which we refer to as industrial organizations. To explain this digital context, we have drawn on sociotechnical system theory (STS). STS theory advocates that organizations need to consider technical and social factors to promote any transformation (whether it concerns the introduction of new technology or a business change programme) (Cherns, 1976). Davis et al. (2014) consider organizations to be complex systems, which comprise many interdependent factors that enable or disable digital transformation. Therefore, bringing a change to one part of such a system triggers the need for change in other interrelated parts.

We have found such evidences in our results as well, where making the changes in one part of any construct lead towards changes in other parts too. Because digital transformation starts with the implementation of new digital technologies (Gilchrist, 2016), consequently, this requires changes in the social part of industrial organizations that we have strongly observed in incumbent organizations.

In STS, the social and technical elements must work together to accomplish organizational goals, and the key issue here is to design change in such a way that both parts yield positive outcomes, called 'joint optimization' (Appelbaum, 1997; Di Maio, 2014). Our results demonstrate that the identified dimensions of enablers, i.e. leadership, structures, and culture, are jointly optimizing in order to achieve the performance outcomes for impactful digital transformation. The joint optimization within the social elements is happening due to the introduction of new digital technologies in the organization. Figure 5 presents this whole phenomenon, where the implementation of new digital technologies (technical systems) is integrating with social systems (leadership, structure, and culture). The social system is jointly optimizing within itself as well, and this whole interaction is leading toward common goals, i.e. performance outcomes (agility, customer centricity, and collaboration). We found that most of the identified constructs (in social systems) are interlinked with each other, which creates such scenarios that making changes/updates in one construct, lead toward changes in others as well, hence, leading our framework (Figure 5) towards joint optimization. For example, if leadership is developing its competency of empowerment, it inevitably leads toward less hierarchical approaches, a more goal-oriented approach, and a more open culture. Similarly, if leadership is playing the role of promoting collaboration in the organization, it requires making changes in the hierarchy to break silos, as well as promote openness so that people can collaborate on common topics. Therefore, based on our results, all three constructs of leadership, structure, and culture overlap with each other during organizational-change processes in many aspects, resulting in joint optimization of digital-transformation enablers. Figure 5 summarizes the research framework for this study.

## **Implications**

### **Theoretical Implication**

The findings of this study extend the extant research into digital transformation and sociotechnical system theory in a number of ways. First, the study introduces a sociotechnical systems perspective on the understanding of digital transformation, which aligns with a call for the application of STS theory in new domains (Davis et al., 2014). Such a perspective provides the digital transformation literature with a holistic viewpoint on the most important social elements (enablers) that need attention in order to achieve performance outcomes. Second, past literature on STS theory has highlighted that the critical system failures occur for 'non-technical' reasons (Di Maio, 2014). Therefore, our research

sheds light on the most critical social elements (non-technical), namely leadership, structures and culture, the kind of changes/updates required in these elements and how such changes can lead industrial organizations toward impactful digital transformation. Third, we have further explained how social elements are jointly optimized within themselves, leading digital transformation journeys of industrial organizations toward common goals, expressively contributing to the STS literature from a joint-optimization point of view (Appelbaum, 1997; Di Maio, 2014). Fourth, our study also contributes to the body of literature on leadership (Vial, 2019), structures (Matt et al., 2015), and culture (Imgrund et al., 2018), by explaining what kinds of changes these elements require in relation to the digital transformation of industrial organizations. Fifth, we explained in detail that how each enabler (leadership, structures and culture) is interlinked and impacting identified performance outcomes, (agility, customer centricity, and collaboration). Lastly, we have significantly contributed to the digital transformation (Sony & Naik, 2020; Vial, 2019; Warner & Wäger, 2019) and organizational change-management literature, by providing a holistic research framework and future research propositions.

### **Managerial Implications**

This study has several important managerial implications. First, it guides practitioners to the realization that the digital transformation should not be managed as an isolated technical project. As a variety of technical and social activities enable the contributions of the advanced digital technologies, it is critical to align and jointly optimize their social and technical systems to effectively capitalize on the digital-transformation initiatives. Second, we have learned from the literature that engineers or technical leaders, trained and rewarded for technical excellence, are frequently frustrated with ‘social design constraints’ (Di Maio, 2014) and, hence, can ignore the social part while implementing new digital technologies. Such tunnel vision can lead digital transformation to failure (Di Maio, 2014). Therefore, this study warns practitioners against ignoring the social elements and encourages them to utilize sociotechnical thinking while planning and implementing digital-transformation strategies. Third, this study specifies the most important social elements (leadership, structure, and culture) that need special attention from digital transformation practitioners while planning this change. Moreover, this study explains in detail how these social elements can contribute to attaining performance outcomes (agility, customer centricity, and collaboration) for impactful digital transformation.

Fourth, findings also emphasize the important role of organizational leadership in this change. Therefore, we call urgent attention to the development of leaders, as well as the further identification of digital transformation-supporting leadership competencies. Competent leaders assume a central role in correcting outdated and invalid assumptions, conceptualizing new ideas, and reinforcing cultural values. Lastly, the findings also illuminate the reality check regarding abundantly applied

inflexible approaches to structuring industrial organizations. Our findings confirm the significance of organizational structure in digital transformation and simultaneously warn that too little is happening in this dimension of digital transformation. To reap the benefits of digital-technology-enabled transformation, practitioners must transform organizational structures accordingly.

### **Limitations and Further Research**

It is important to also note the study's limitations. First, the study only captured scenarios from large, multinational, hard-core engineering organizations, which must be considered when seeking to transfer the findings to other types of organizations. Moreover, these findings should not be considered exhaustive, and the inclusion of other organizations may reveal further contributions. Second, the choice of method also has inherent limitations. Although the study mostly relied on high-profile interviewees to provide a rich perspective, more interviews could have further expanded the findings. Third, while the data was analysed, significant time was spent in consolidating the interpretations of the data; other researchers might have drawn additional conclusions. Fourth, STS theory is often labelled as a simplistic and prescriptive approach to studying organizational change. Therefore, we encourage future researchers to use empirically grounded studies and descriptive results based on an in-depth case study, multiple cases, and/or survey design (Scacchi, 2004). Furthermore, we call for further studies that investigate questions regarding leadership, structure, culture, performance outcomes, and the relationships between these constructs in the context of digital transformation, by employing more case companies and a larger sample of participants. Sixth, our study provides an important opportunity for future research by stating propositions based on the findings of this study. Lastly, future research should also focus on cross-case analysis to find the differences between unlike digital journeys of organizations.

### **Conclusion**

This study presents a multiple-case study of four industrial organizations, exploring how industrial organizations are organizing and managing their digital-transformation journeys. The findings shed light on the most important social elements (leadership, structure, and culture) that play a key role in the digital transformation of incumbent organizations. The findings provide more insights into how each identified social element plays its role in achieving performance outcomes (agility, customer centricity, and collaboration) for impactful digital transformation. Moreover, this study stresses the need for sociotechnical system thinking while implementing digital transformation strategies. It highlights how the joint optimization of each identified social element can help incumbent organizations achieve common goals. Last but not least, this study provides a holistic framework that will guide researchers, practitioners, and industrial organizations on how to embark on their digital transformation journeys.



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# **Preparing leadership for digital transformation: An empirical study on emerging roles and competencies of industrial leaders**

## **Abstract**

Digital transformation poses new challenges to leaders, who must now deal with disruptive changes in the business landscape. Moreover, strong leadership at the helm is required to manage this change and reap the benefits offered by new and advanced digital technologies. This study draws on semi-structured interviews with 41 industrial organizations' leaders involved in their organizations' digital transformation processes. Our findings identify key work roles that industrial leaders perform for impactful digital transformation. Moreover, this study explains key leadership competencies for performing these new work roles. Lastly, this study links identified leadership roles and competencies with targeted performance outcomes of industrial organizations, namely agility, customer centricity and collaboration.

Keywords: Digital transformation, leadership roles, leadership competencies, industrial organizations

## **Introduction**

In the past decade, digitalization has become crucial for societal and organizational survival and advancement (Pihlajamaa, Malmelin, & Wallin, 2021; Tsou & Chen, 2021). Emerging disruptive digital technologies offer numerous opportunities and challenges (De Waal, Van Outvorst, & Ravesteyn, 2016), which are reshaping organizations in meaningful and enduring ways (Liu et al., 2018). Digital technologies have not only altered industrial organizations' product and service offerings but also changed the way they operate (Vial, 2019). Therefore, they require a company-wide digital transformation (DT) programme (Imran, Shahzad, Butt, & Kantola, 2021; Vial, 2019). DT provides immediate access to information and advanced tools and techniques but at the same time puts up complex challenges, such as rapid developments in technology, changing customer expectations, lack of tools, structural issues, an unsupportive culture and a turbulent business environment (Agarwal, Johnson, & Lucas, 2018; Gehrke, Bonse, & Henke, 2016). To manage these opportunities and challenges, strong leadership is required at the helm (Kane, Phillips, Copulsky, & Andrus, 2019), as well as endorsement from top management that should be firmly entrenched in middle and lower level leadership (Saarikko, Westergren, & Blomquist, 2020). Therefore, leaders need to focus on developing new practices and competencies (Pihlajamaa et al., 2021) to create and capture the value of DT (Björkdahl, 2020).

Previous research has shown that the outcome of organizational transformation is highly dependent upon leadership (Caulfield & Senger, 2017). Leaders enable their followers to understand and adopt the required change (Caulfield & Senger, 2017), as well as drive positive results from investments in DT (Cortellazzo, Bruni, & Zampieri, 2019). The right leaders not only make critical choices about which technology is appropriate for their organization, but they also make sure that they know how to best use it effectively for their company (Liu et al., 2018). On the other hand, leaders can seriously be left behind if they lack understanding of the digital world and its impact on their businesses (McCauley & Palus, 2020). Björkdahl (2020) found that technological issues do not challenge business leaders, but the issue concerns how leaders can re-optimize their organizations to capture value from digital technologies in new and effective ways. DT requires new forms of organizing, new work practices, new work roles and updated leadership competencies (Björkdahl, 2020; Schiuma, Schettini, Santarsiero, & Carlucci, 2021).

As the strategic emphasis in industrial organizations shifts towards DT to gain agility, customer centricity and a collaborative environment (Eberl & Drews, 2021; Imran et al., 2021; Jäckli & Meier, 2020), organizations and their leaders must also change (Dess & Picken, 2000). Recent literature has partially addressed this issue by defining roles (El Sawy, Amsinck, Kræmmergaard, & Vinther, 2016) and competencies (Eberl & Drews, 2021; Tigre & Curado, 2022). For example, El Sawy et al. (2016) and Haffke, Kalgovas, & Benlian (2016) outlined the creation of the new positions of chief technical officer (CTO), chief digital officer (CDO) and chief information officer (CIO) for digitalization. However, their focus was not on the changing work roles of existing leaders. Similarly, ample research has focused on the competencies of digital leadership (Eberl & Drews, 2021; McCarthy, Sammon, & Alhassan, 2021; Tigre & Curado, 2022). However, the focus of such studies remains on the development of digital leaders, not on what competencies existing leaders have to develop for DT. Therefore, we argue that literature addressing how the existing leaders of industrial organizations change to adopt DT is lacking (Bartsch, Weber, Büttgen, & Huber, 2021; Smith & Beretta, 2020). Thus, the aim of this paper is to fill this gap by exploring how the existing leaders of industrial organisations change for DT.

This paper addresses this gap by exploring the new roles of leaders and related competencies. This is in line with the call for further research on leaders' new roles in DT (Haffke et al., 2016; Horlacher, Klarner, & Hess, 2016) and required competencies (Blanka, Krumay, & Rueckel, 2022; Fitzgerald, Kruschwitz, Bonnet, & Welch, 2013; Ngayo Fotso, 2021; Schiuma et al., 2021). Lastly, this paper addresses how the identified roles and competencies of leadership contribute to attaining performance outcomes (Eberl & Drews, 2021; Imran et al., 2021; Jäckli & Meier, 2020) for DT. The article proceeds as follows. First, we review the literature on DT, the need for change, and the leadership role in this digital era. A discussion of the research methodology follows before the article moves on to the



findings. In the final sections, we provide discussions as well as managerial implications and limitations.

## **Literature Review**

### **Digital Transformation**

In the last decade, DT has emerged as an important phenomenon for researchers and practitioners (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013; Imran et al., 2021). DT is “a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies” (Vial, 2019). It requires organizational-level changes to strategy, structures, processes, culture and leadership (Imran, Shahzad, Butt, & Kantola, 2020; Imran et al., 2021; Matt, Hess, & Benlian, 2015; Svahn, Mathiassen, & Lindgren, 2017; Vial, 2019). DT enables major business improvements, such as enhanced customer centricity and customer experience, new business models, collaborative environments and agile organization (Horlacher et al., 2016; Imran et al., 2021). However, it requires a company-wide digital strategy that should holistically address the opportunities and risks originating from digital technologies (Singh & Hess, 2017). Therefore, strong leadership at the helm is required to manage this transformation (Kane et al., 2019).

Moreover, DT is different from traditional forms of strategic change, as digital technologies have accelerated the speed of change, resulting in greater environmental volatility, complexity and uncertainty (Matt et al., 2015; Warner & Wäger, 2019). Past research shows that successful digitally transformed organizations can reduce costs, improve sales performance and customer satisfaction, better cope with digital challenges and have enhanced growth (Gale & Aarons, 2017). However, DT requires leaders to adopt different strategies (Warner & Wäger, 2019), perform new work roles and develop new competencies (Fitzgerald et al., 2013) to manage this change.

### **Leadership in the Digital Age**

Leaders face new challenges due to digital disruption (Reck & Fliaster, 2019), including an increased pace of doing business, shifts in organizational cultures, the need for flexible and distributed workplaces, greater productivity expectations and more environmental volatility, complexity and uncertainty (Matt et al., 2015; Reck & Fliaster, 2019; Warner & Wäger, 2019). Hence, they must adopt different approaches and attitudes to manage this transformation.

Leadership in the digital age requires combining heterogeneous organizational resources and developing business and digital strategies for impactful DT (Agarwal et al., 2018). Gale and Aarons (2017) report that leaders with a “get things done” attitude are key in the new digital world. Leaders need to train people differently, including developing decision-making and collaborative skills, provide an innovative and experimental environment and stay one step ahead in terms of

strategy development (Gale & Aarons, 2017). Similarly, Sebastian et al. (2017) stress leadership capability to develop a digital strategy, providing clear direction to their employees that will eventually lead to the development of difficult-to-replicate capabilities for their organizations. Schwarzmüller et al. (2018) stress network development as the most important aspect in the digital age. Leaders must be able to bring the best competencies within the organization together for a given task and work efficiently. Imgrund, Fischer, Janiesch and Winkelmann (2018) indicate that risk-taking and a high tolerance for ambiguity are the most important aspects of leadership in the digital age.

A few researchers toss around the term “digital leadership” (Benitez, Arenas, Castillo, & Esteves, 2022; Weber, Büttgen, & Bartsch, 2022) and attempt to define its required competencies. De Waal et al. (2016) explain that digital leaders are those aiming to achieve their goals with the help of digital technologies directed by human assistants. Similarly, Abbu, Mugge, Gudergan and Kwiatkowski (2020) state that digital leadership is a fast, cross-hierarchical, team-oriented and cooperative approach, with a strong focus on innovation. Moreover, they link it with transformative vision, forward-looking perspectives, digital literacy, and adaptability competencies. In addition, some researchers explain that the usage of digital technologies is just one part of this transformation, and enabling teams (Larson & DeChurch, 2020) that can support this transformation is more important for digital leadership.

A recent study by Lundgren et al. (2022) explored the changes in leadership from a DT point of view. They utilized the sociotechnical model of Davis, Challenger, Jayewardene, and Clegg (2014) to study those changes in the context of goals, people, processes, buildings, technology and culture. They second our argument for the need for new work roles and competencies for DT. However, their focus was restricted to maintenance managers of industrial organizations, and the scope of study was limited to Davis et al.’s (2014) model. Neumeyer & Liu (2021) also explored the most important managerial competencies in the context of DT, highlighting digital literacy and adoptability as the most important competencies for managers. However, their study was based on a literature review and recommended further empirical research on competency requirements for DT and what kind of paths managers take when implementing DT (Neumeyer & Liu, 2021). Erhan, Uzunbacak and Aydin (2022) suggest that leaders must leave their conventional style of leadership and adopt digital leadership to succeed in this digital age. They explain digital leadership as a combination of agile, participative, networking and open leadership. However, their study explored positive perceptions of employees towards digital leadership to enhance innovative work (Erhan et al., 2022).

Most recent research has addressed the current topic by reviewing the literature (Cortellazzo et al., 2019; Eberl & Drews, 2021; Tigre & Curado, 2022), while some scholars have focused on exploring digital leadership characteristics, styles and competencies (Bartsch et al., 2021; Benitez et al., 2022; Kane et al., 2019).

Therefore, how the existing leadership of industrial organizations changes for DT remains an open question. Thus, our study focused on industrial organizations to empirically explore the new work roles and competencies for organizational leadership to implement impactful DT. Moreover, this study also aimed to determine how these work roles and competencies help industrial organisations to achieve performance outcomes.

### **Method**

The empirical data for this study were collected using a multiple case study approach (Eisenhardt, 1989). The decision to adopt this methodology derived from the research scope (DT and leadership's new roles and competencies) and the type of cases (industrial organizations). Regarding the research scope, the case study methodology is consistent with research questions based on 'how'. Regarding the firm type, since industrial organizations tend not to disclose strategic and organizational information (especially when they are in the process of transformation), direct contact is essential for understanding these profiles. Moreover, multiple cases enable a more generalizable and robust theory than a single case (Eisenhardt, 1989)

We adopted a qualitative research method to identify the emerging leadership roles and related competencies. Qualitative research is appropriate when the emphasis is on the development of a conceptual framework and the identification of critical factors and other key variables. We followed a grounded theory approach (Glaser, 1992) that aims to develop inductive theory from data through incremental and systematic progression in knowledge and the derivation of conceptual deductions (Urquhart, 2012). We collected data from three multinational industrial organizations, which were selected based on their DT stages at the time of the study. We chose these organizations based on methodological expediency, selecting cases that are unique and easily accessible for researchers and provide the opportunity to study the phenomenon in question (Huberman, Miles, & Janet Ward, 2012). All three case organizations started their DT in the past five years.

### **Data Collection**

Discussions about data collection began in early 2019 when we approached potential case organizations. We conducted semi-structured interviews, lasting 0.8 to 1.5 hours each, with 41 respondents (once per person) between February 2019 and February 2020, comprising 13 face-to-face and 28 online (Skype and Zoom) interviews. Thirty interviewees were higher-level managers, such as vice presidents, directors, heads of departments/units/businesses and general managers. The remaining 11 interviewees were from middle-level management positions, such as senior managers, engineers, project managers and managers. All the participants were responsible for the DT of their respective responsibility areas. The same two researchers conducted most of the interviews to ensure dependability and maintain consistency (Guba & Lincoln, 1994). We designed a semi-structured interview guide to acquire an inclusive understanding of new work roles and leadership competencies. Although specific questions were formed

to reflect each interviewee's position and knowledge, the overall focus was on the respondent's experiences with the phenomenon in question. In addition to interview data, secondary data comprising publicly available documents, such as web blogs, online interviews, videos, reports and information on websites, were used to gain further insights. We ceased data collection upon saturation (i.e. when no further insights emerged).

Research quality was addressed by assessing construct validity, internal and external validity and reliability (Creswell, 2013; Silverman, 2013). Construct validity was ensured by employing data triangulation (interviews conducted with multiple respondents from different parts of the organizations). Internal validity was achieved by comparing situations arising at different points in time and suggesting inter-relationships between constructs. External validity was ensured by providing a clear rationale for the case study selection. Reliability was ensured by establishing a case study database for data analysis using NVivo software, and quality was maintained by forming a chain of evidence (Beverland & Lindgreen, 2010) through a rich set of interview quotes to illustrate key findings, preserving the circumstances of the data collection in the case study database (Yin, 2013) and ensuring that these circumstances were consistent with the study's initial aim. Table 1 summarizes the key characteristics of the case organizations and the interviewees.

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### **Data Analysis**

To analyse the qualitative data, a team of two researchers independently coded all the interview transcripts, which comprise more than five hundred pages and represent forty six hours of interviews. For the transcription, we used an online platform to convert speech into text. The first author proofread the transcripts while listening to each recorded interview. We followed a three-step coding process, as suggested by Gioia, Corley and Hamilton (2013). First, we analysed whole interviews and generated first-order concepts based on the interviewees' statements. The first-order concepts were then examined to identify more abstract second-order themes after iterative discussions between the researchers. Lastly, based on the second-order themes, we formed aggregated dimensions. Fig. 1 summarizes the whole data analysis process.

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### **Findings and Discussion**

DT had been on the strategic agenda of all three case organizations for the last five years, with two different strategies had been adopted by the case companies. Case A developed a new structure parallel to its existing business, hiring a CDO through external recruitment. The new CDO developed a completely new team by hiring the required internal and external resources. Cases B and C allocated DT tasks to their business/unit heads and developed a central small team to harmonize the DT initiatives across the organization. Both strategies recognize the leadership role as key to DT success. Our data show that DT has resulted in emerging new work roles of leadership, which are discussed later in this section. We also outline the key competencies identified for performing emerging work roles successfully. Our results also explain how identified work roles and competencies help industrial organizations achieve their DT performance outcomes.

### **Emerging New Work Roles**

Our study identified several emerging work roles of organizational leadership that existing leaders of industrial organizations are now performing to succeed in DT. Firstly, Leaders ought now to intervene in a coaching manner with their subordinates (Schwarz Müller et al., 2018) in order to work more closely. The coaching role not only helps personnel to deal with failure but also enables them to grow to their full potential (Tigre & Curado, 2022). Secondly, organizational leaders have a new role in developing digital competencies in their subordinates to enable them for DT. This not only includes developing technical competencies but also changing mindsets and attitudes towards adoption of new digital technologies (Vial, 2019). The third role identified is using the company's digital vision to inspire and motivate people to adopt DT. Inspiring and motivating involves leaders displaying motivating behaviours to encourage followers, which is one of the key characteristics of transformational leadership (Philip, 2021). Effectively employed, a digital vision helps in setting clear future direction and enhance employee participation and commitment (Dess & Picken, 2000). Fourth, our study identified that the leaders are promoting collaboration with internal and external stakeholders. They promote teamwork as well as collaborative ways of working for this purpose. By doing this, they not only bring internal stakeholders closer to work together, but they are also opening up their organization's landscape towards external stakeholders (Petrucci & Rivera, 2018).

Fifth, our results found that leaders have to work beyond their specific job description to achieve impactful DT. They must expand their understanding and knowledge beyond their expertise. In addition to that, leaders must also allow their teams to work outside their formal positions which is an important factor in fostering collaboration between different parts of the organization. Sixth, leaders need to be the digital champions of their organizations. They must be a role model in terms of adopting new digital technologies, using them in their work and spreading awareness among others. This is one of the most important parts of the digital strategy of organizations (Guinan, Parise, & Langowitz, 2019), as it helps to

prepare the right mindset for DT. Seventh, our study found that leaders have to be experimentation-oriented. They must try out new things as well as provide such an environment to their teams and subordinates that promote trying out new things. DT requires leaders to promote collective experimentation (Sebastian et al., 2017) to effect new ways of working and innovative products and services. Lastly the opportunity and challenge to transform the foundation of digital technologies is humungous. Behavioural adjustments are required at the grassroots of operations (i.e. in day-to-day interactions). Leaders cannot leave this challenge to specialized consultants and trainers; instead, they need to lead from the front to act as digital culture enablers. Figure 2 summarizes the results related to the emerging new work roles of leaders.

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### **Leadership Competencies**

Following leadership roles, our study identified several leadership competencies that are required to perform the above-mentioned work roles and to be a successful DT leader. Primarily, having a digital vision is vital for organizational leadership, as DT starts here (Fitzgerald et al., 2013). Leaders must be able to develop a digital vision and articulate to specify DT's clear goals and objectives (Fitzgerald et al., 2013; Sebastian et al., 2017). Some researchers further state that only having a digital vision is not enough; rather, leaders must create an environment where their employees can achieve their defined goals in the light of a specified vision (Reck & Fliaster, 2019). In alignment with a digital vision, organizational leaders must develop their digital knowledge to understand the impact, opportunities and challenges offered by digital technologies (Singh & Hess, 2017). The literature also refers to this as "digital literacy" (Santoso, Elidjen, Abdinagoro, & Arief, 2019), which is about being able to adapt to new and emerging technologies quickly and analyse their benefits and related challenges.

Risk-taking ability emerged as another vital leadership competency to succeed in DT. The literature addresses it with the "failing fast" competency of leadership related to experimental learning, risk-taking ability, using digital technologies to minimize risk and leaders' fail-and-learn attributes (Colbert, Yee, & George, 2016). Imgrund et al. (2018) state that risk-taking is one of the most important competencies for digital leadership, as leaders must be willing to take more risk to experiment and innovate (Abbu et al., 2020). Failing fast is an equally important competency for leader that helps them recognize conditions that indicate a potential failure and then cease work on that task/project rather than investing more time and resources on it (Friend, Ranjan, & Johnson, 2019). Furthermore, our results identified that leaders should be able to manage disruptions and ambiguous situations (Schwarz Müller et al., 2018). Barone (2019) identified valuable leaders as those capable of making good decisions in ambiguous

conditions to manage disruptions. In relation to risk-taking, failing fast and managing disruptions, leaders should be open-minded to promote experimentation and accept constant changes due to digital technologies. Open-mindedness helps foster the creativity and innovation required by DT (Imgrund et al., 2018).

Empowerment is identified as another must-have leadership competency to succeed in DT. Leaders cannot enable, inspire, coach and experiment if they do not empower their subordinates. Especially in the context of the adoption of new digital technologies, empowerment is vital (Sainger, 2018; Sebastian et al., 2017). Furthermore, a leader's ability to build and manage teams has gained importance recently, especially in this dynamic environment where new forms of teams (e.g. virtual teams and flexible work arrangements) are constantly emerging (Schwarz Müller et al., 2018). Being team-oriented is very important for digital leadership (Abbu et al., 2020), and leaders must enable teams by empowering them to support DT (Guinan et al., 2019; Liu et al., 2018). Moreover, leaders should have the ability to work effectively in teams to accomplish common goals (van Laar, van Deursen, van Dijk, & de Haan, 2019). In addition, we found that leadership should be able to use digital tools and data to back their decision-making in order to adopt modern ways of working. Lastly, leaders should be able to create trust among team members and the different stakeholders collaborating on projects. The ability to create trust affects followers' willingness to accept leadership decisions, which enhances the effectiveness of leadership (Höddinghaus, Sondern, & Hertel, 2021) in DT. Figure 3 summarizes the results related to identified leadership competencies.

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### **Leadership and Performance Outcomes**

Lastly, our results show that these emerging new work roles and the development of related competencies in leadership help organizations to achieve organizational agility, customer centricity and collaboration. The roles and competencies identified in this study supplement the traditional setting of industrial organizations and lead them to become agile (Busse & Weidner, 2020). The main purpose of becoming an agile organization is to be fast, efficient and effective in this fast and continuously changing world that is now powered by advanced digital technologies (Denning, 2018). It requires agile leadership, which should be proactive rather than passive (Busse & Weidner, 2020). Such proactiveness can be achieved by developing competencies such as digital vision, risk-taking, failing fast, open-mindedness, managing disruption and managing teams. Similarly, new work roles (i.e. enabler, leading by example and working beyond one's job title)

help leaders to stay ahead rather than being reactive (Busse & Weidner, 2020; L'Hermitte, Tatham, Bowles, & Brooks, 2016).

Collaboration has been discussed as a new leadership role and a competency in previous sections. However, here we discuss it as an overall organizational goal that case companies are targeting to achieve through DT and discuss how leadership's role and competencies can contribute towards achieving it. First, we found that the leaders of case organizations were now not only sharing success stories but also placing more stress on sharing failure stories to mitigate the risk of repeating similar decisions or actions. To recover from failure, leaders identify the right internal or external resources and collaborate to find the right solutions. Second, leaders are required to do more than just request collaboration. They need to put employees in concrete cases to collaborate to solve any internal or external challenge, which is very different compared to just saying, 'We need to collaborate more'" (as mentioned by an interviewee). Therefore, leadership can enhance collaboration by being a digital champion and leading by example. Third, we identified that leaders promote the ecosystem approach by utilizing digital collaborative platforms to enhance organizational collaboration. Digital strategies have necessitated the transformation of business ecosystems, requiring strong collaboration and coordination within a company, as well as with external stakeholders (Reck & Fliaster, 2019). Therefore, leaders with collaborative skills enhance knowledge sharing and engagement and help followers mitigate the dark side of transformation, such as resistance, fear and knowledge hoarding (McKenzie & Aitken, 2012). Moreover, digital tools support organizational leadership in collaborating in new ways (Petrucci & Rivera, 2018) that help respected organizations become more collaborative.

Lastly, being customer-centric is another main objective of DT in industrial organizations (Imran et al., 2021). The leader's job is to identify how they can affect their customer's businesses by bringing in new digital technologies. However, leaders are not required to be hardcore technical experts; rather, they need basic knowledge of digital technologies combined with a digital vision to identify new opportunities. Our data showed that leaders should involve their customers in piloting or experimenting with new products or services. Having digital vision and collaborative skills enhances leaders' capability to make their organization truly customer-centric (Pihir, Tomičić-Pupek, & Furjan, 2019). Moreover, with the help of digital technologies, leaders can provide better customer experiences and engagement (Fitzgerald et al., 2013). Figure 4 presents the results related to how identified leadership roles and competencies help organizations to achieve agility, enhanced collaboration and customer centricity.



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### **Conclusions**

The significant influence of digital technologies on industrial organizations is indisputable. This situation forces industrial organizations to transform digitally to follow the fast pace of technological developments (Blanka et al., 2022). The role of leaders is extremely significant in driving impactful DT in their organizations (Cortellazzo et al., 2019). In this research, we examined how the existing leaders of the case organizations are reanalysing their roles and competencies to fit into the digital world. Guided by qualitative research methods, we found that the case organizations are aiming to change traditional leadership approaches by adopting a coaching style of leadership, digitally enabling their employees, using a digital vision to motivate and inspire their subordinates, promoting internal and external collaboration, working beyond their given job title, being digital champions, trying out new things and learning from failure and enabling digital culture in their organizations. To perform these roles, industrial organizations' leaders are focusing on developing certain competencies, including digital knowledge, digital vision, risk-taking ability, empowerment, managing teams, failing fast, managing disruption, open-mindedness, collaborative capabilities and factual decision-making. This research further linked the identified roles and competencies with the overall goals of organizational DT (i.e. how these results help organizations in achieving organizational agility, customer centricity and an enhanced collaborative environment). Figure 5 presents the conclusions of this study.

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Insert figure 5 here  
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### **Managerial implication**

This study's managerial implications relate to the knowledge of how new leadership roles add up to support DT activities in industrial organizations and what the most important leadership competencies to carry out DT impactfully are. The findings have practical implications for organizational leaders who design and execute digital strategies where business decision-making is linked with the way business benefits from the use of technology. First, it has elaborated the most important work roles of leaders when industrial organizations are going through DT. Second, the findings suggest that organizational leaders have to develop certain competencies to succeed in the digital world and fulfil their roles successfully. Lastly, we linked our results with the DT goals of the case organizations (i.e. attaining agility, customer centricity and collaboration) by explaining how identified roles and competencies help to achieve these

performance outcomes for industrial organizations. Against this background, leaders of industrial organisations can contribute to the successful implementation of DT in their respective organizations. The results of this study may enable assessment of the distribution of leadership competencies across an organization and help practitioners to include identified roles and competencies in leadership development programmes. Moreover, the absence of particular roles and competencies may contrast with impactful DT.

### **Limitations and Future Research**

Our study has a few caveats that must be noted when interpreting the findings. First, the study only evaluated situations from large, multinational, hard-core engineering organizations, an aspect that must be considered when seeking to generalize these findings. These findings should not be viewed as exhaustive, and the inclusion of other organizations may reveal further contributions. Second, when the data were analysed, significant time was spent combining understanding of the data, and other researchers might have drawn different conclusions. Third, the choice of methodology also has integral limitations. Although the study mostly relied on high-profile interviewees to provide a rich viewpoint, more interviews conducted by different investigators could have expanded the findings further. Fourth, we adopted a thematic analysis approach in this paper to investigate commonalities in the context of organizational leadership. However, future research should employ cross-case analysis to draw more insights. Furthermore, future research should employ quantitative methods to further validate the present paper's findings. Finally, future research should compare different leadership styles to explore what suits DT most.

### **Disclosure Statement**

No potential conflict of interest was reported by the author(s).

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**Table 1. Case Organizations**

	<b>Case A</b>	<b>Case B</b>	<b>Case C</b>
<b>Industry</b>	Renowned player in smart technologies and complete lifecycle solutions for the marine and energy sectors	Market leader and is a pioneer of variable frequency drives, cooling & heating solutions and energy management	Large player in forest, wood, and papers industry. Also expanding their business in energy market
<b>DT Strategy</b>	A separate dedicated digital organization was developed by hiring CDO to lead DT	Digital transformation responsibilities assigned to business segment's heads	Digital transformation responsibilities are dedicated to unit heads.
<b>Sales in 2021</b>	4,8 Billion	7,5 Billion	9,8 Billion
<b>Number of Employees</b>	17000	40000	17000
<b>Number of Interviewees (Higher Management)</b>	14	8	8
<b>Number of Interviewees (Middle Management)</b>	5	3	3

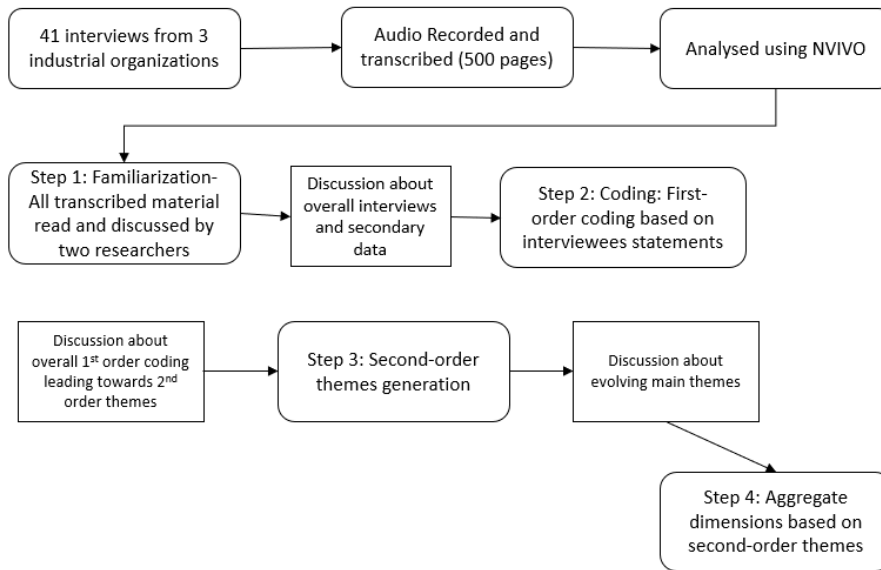


Figure 1. Data analysis process

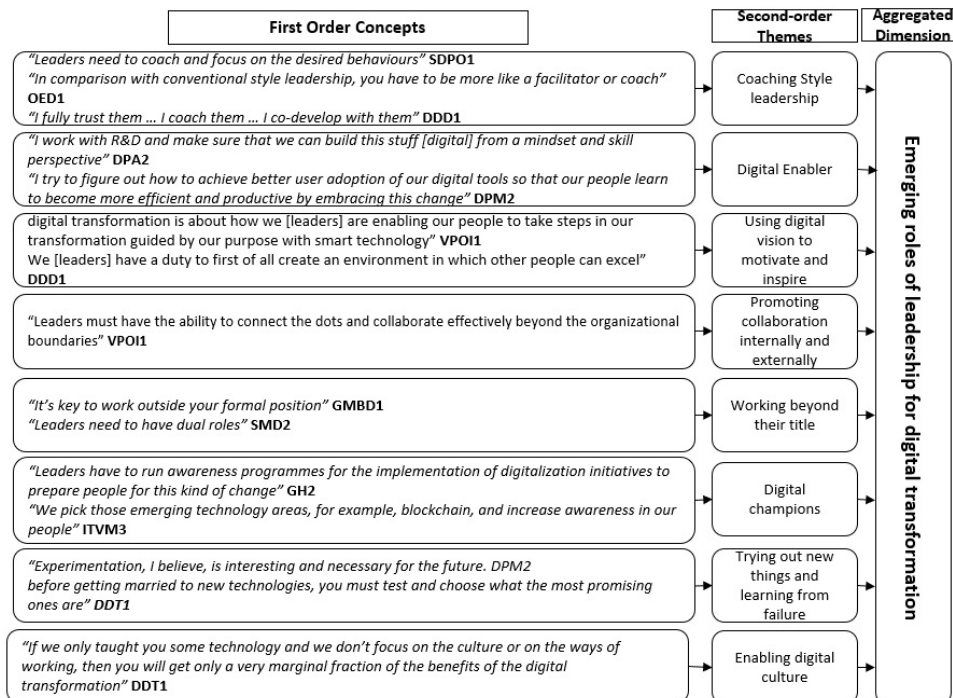


Figure 2 Emerging work roles

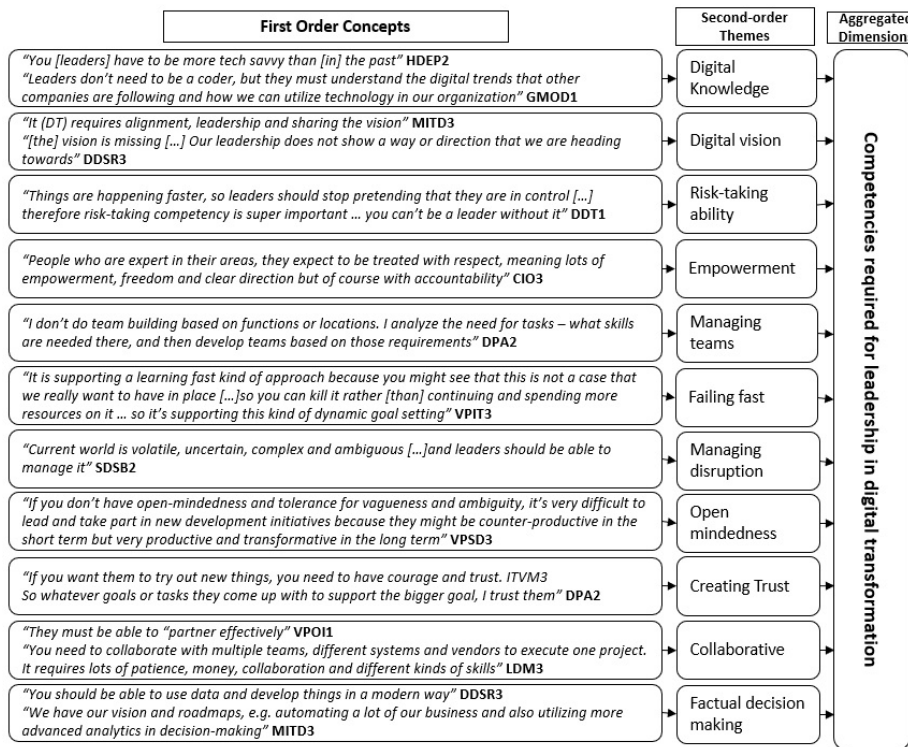


Figure 3. Leadership competencies

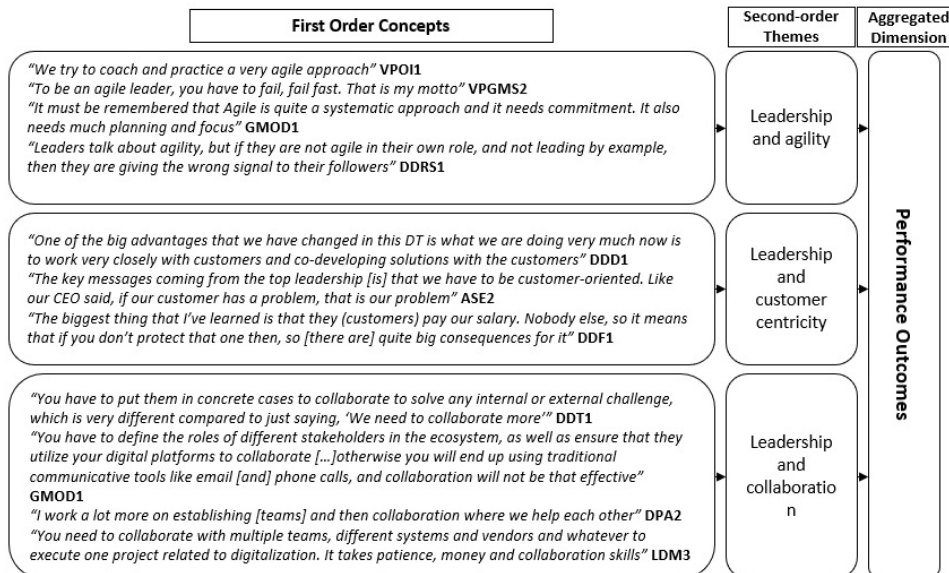
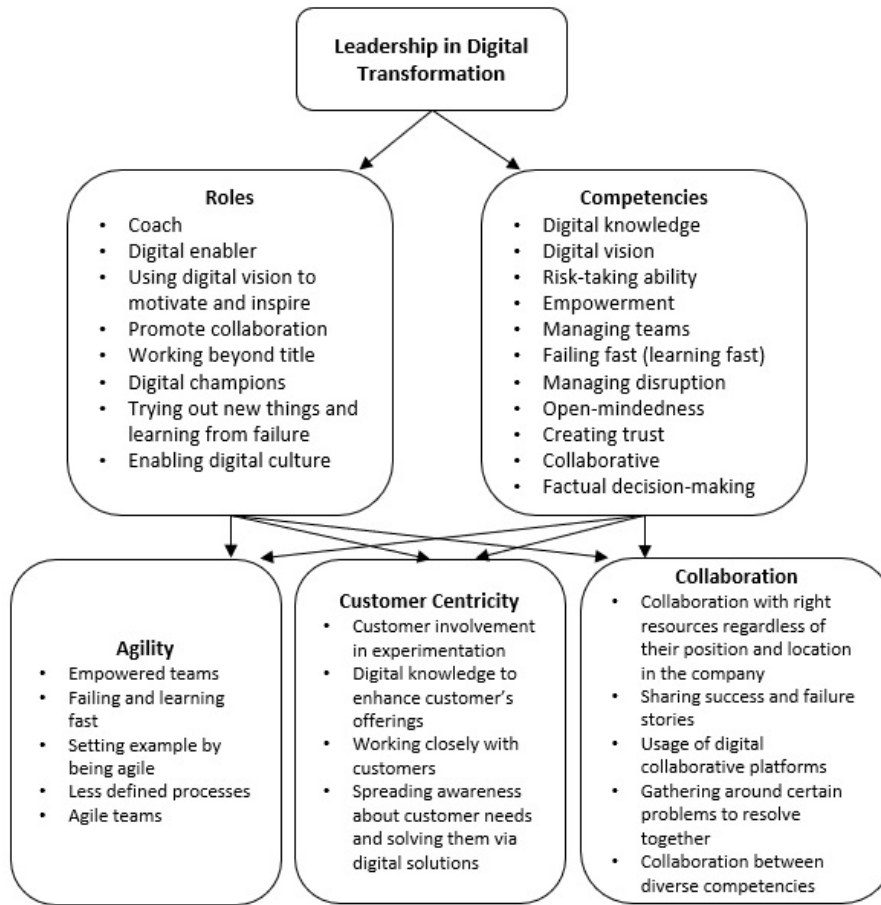


Figure 4. Leadership and performance outcomes



**Figure 5. Conclusions**

**Appendix 1**

<b>Case</b>	<b>Code</b>	<b>Title</b>
1	DDC	Director Digital Culture
1	MDT	Manager Digital Transformation
1	SPM	Senior Project Manager
1	MDIT	Managing Director IT
1	GM	General Manager
1	PM	Project Manager
1	SMDT	Senior Manager Digital Transformation
1	VP	Vice President
1	OED	Operational Excellence Director
1	DDD	Director Digital Development
1	GMOD	General Manager, Operational Development
1	DDT	Director Digital Transformation
1	GMBD	General Manager, Business Development
1	DAI	Director, Areas and Integrations
1	DRD	Director, Head of Digital R&D
1	SDPO	Senior Digital Product Owner
1	DDF	Director Digital Foundation
1	VPOI	VP Open Innovation
1	GMI	General Manager, Innovation
2	GH	Global head
2	SMD	Senior Manager Digitalization
2	ASE	Application Software Engineer
2	VPGMS	Vice President, Global After Market Service
2	HDBM	Head of Digital Business & Marketing I Digital Customer Experience
2	HDEP	Head of Digital Experience Program
2	DPM	Digitalization Project Manager
2	SDIT	Senior Director of IT Innovation
2	SDGT	Senior Director, Global Technology
2	SDSB	Senior Director eSteering business
2	DPA	Director Platform Architecture
3	VPITS	Vice President, IT Strategy and Governance
3	ITVM	IT Vendor Manager
3	DDSR	Director, Digital Stakeholder Relations
3	MMD	Manager, Maintenance Development
3	MITD	Manager IT and Digitalization
3	DSR	Director, Stakeholder Relations and Digital officer
3	VPS	Vice President Sourcing
3	VPSD	Vice President, Strategy and Business Development
3	DRME	Director, Raw Material Execution
3	LDM	Leadership I Data mgmt
3	CIO	Chief Information Officer

**Table 2. List of interviewees and their codes**

## **Achieving performance outcomes through digital transformation: An empirical study of structural changes in industrial organizations**

### **Abstract**

Despite increasing scholarly attention being paid to digital transformation, only limited insights have been realized concerning how industrial organizations' structures are changing to adopt digital transformation. Based on a multiple case study of three large industrial organizations, this article examines industrial organizations' changing structures in an effort to attain impactful digital transformation. Building on a sociotechnical perspective, this study employed three main structural dimensions to examine the structural changes: formalization; hierarchy; and integration. Moreover, the study applied a sociotechnical system view to examine the phenomenon in question. The results revealed what structural challenges industrial organizations face with digital transformation, as well as how they encounter such problems. Furthermore, this study examined targeted performance outcomes to explain how structural changes help industrial organizations achieve these outcomes. We also provided important insights for digital transformation practitioners to help them become aware of structural issues and how to tackle them. Finally, the article suggests different paths for further research on digital transformation and organizational structures.

### **1. Introduction**

In an era characterized by rapid technological advancements and evolving consumer demands, industrial organizations are compelled to undergo substantial changes to remain competitive and relevant (Sony & Naik, 2020; Vial, 2019). This shift simultaneously has challenged their existing setup (Mitki, Shani, & Greenbaum, 2019), forcing them to figure out how to organize and reap the full benefits of these digital technologies (Porter & Heppelmann, 2015; Sony & Naik, 2020; Vial, 2019). Digital transformation (DT) has emerged as a crucial strategy for these organizations to navigate the challenges and harness the opportunities of the digital age in facilitating informed decision-making. Digital transformation, as a sociotechnical process (Mitki et al., 2019; Sony & Naik, 2020), is considered the integration of digital technologies (technical systems) powered by cloud computing, the Internet of Things, digital platforms, artificial intelligence, big data, and analytics (Gilchrist, 2016) into all aspects of an organization's operations and practices (social system) to revolutionize traditional processes, enhancing efficiency, agility and innovation (Vial, 2019; Imran, Shahzad, Butt, & Kantola, 2021). Achieving successful DT requires more than just the adoption of new tools; it necessitates profound structural changes (Sony & Naik, 2020; Worley & Lawler, 2006) with lower level of hierarchy, bureaucracy, and higher level of cross-functional integration (Björkdahl, 2020; Gehrke, Bonse, & Henke, 2016) that encompass organizational culture, processes, and systems (Chaniyas & Hess, 2016; Kretschmer & Khashabi, 2020; Vial, 2019). However, organizations usually are slow to embrace change (Matt, Hess, & Benlian, 2015) as they cling to traditional approaches. Being strongly embedded with traditional structures (Mierzejewska, 2015), organizations face resistance to transformation (Worley & Lawler, 2006) that can affect their progress, and new ideas and innovations are viewed negatively

(Mierzejewska, 2015). Thus, the significance of investigating the structural changes necessary for DT lies in the enormous impact such transformations can have on an organization's competitive positioning, growth prospects, and survival in the digital age. Organizations that fail to embrace these changes can be marginalized by their more agile and adaptable competitors (Westerman et al., 2014). Consequently, understanding how to align the structural elements of an organization with the demands of DT becomes imperative for both researchers and practitioners.

Employing advanced technologies and their relationships with organizational structure has been a topic of debate for past several decades (Child & Mansfield, 1972; Mustafa, Solli-Sæther, Bodolica, Håvold, & Ilyas, 2022; Snow, Fjeldstad, & Langer, 2017). Several scholars (e.g., Lawrence & Lorsch, 1969) have considered organizational structure as function of the organizational environment and technology. Woodward (1965) linked the organic/mechanistic structures with the level of technological complexity. Ghani (2002) contends that technology plays a crucial role in determining the appropriate organizational structure, as it dictates the optimal utilization of technologies within the organization. Some recent studies have attempted to understand the requirements for DT, however, most of these studies have remained on the conceptual level, or have explored only overall organizational change requirements (Gimpel et al., 2018; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019; Björkdahl, 2020; Mustafa et al., 2022; Sony & Naik, 2020; Vial, 2019), thus missing the specific focus on required changes in structural elements of the organizations. In terms of structural changes, the extant research has examined some common patterns such as increasing service and customer orientation (Gebauer & Kowalkowski, 2012), separation, and integration strategies to adopt DT and emergent paradoxes (Smith & Beretta, 2020), and the effects of DT on organizational structures from an input/output perspective (Kretschmer & Khashabi, 2020). Several scholars (e.g., Nambisan, Wright, & Feldman, 2019; Ransbotham et al., 2015) outlined that the infusion of new digital technologies requires not only the acquisition of new tools but also the cultivation of a digital mindset and the alignment of organizational processes and outcomes with digital objectives. Similarly, Schwer & Hitz (2018) mentioned that traditional structures do not fit into this digital age, therefore, necessitates adjustments in order to promote agility, creativity and speed required by market.

While the field of DT has garnered significant attention, a notable research gap exists in understanding the specific structural changes required to effectively navigate this transformative journey. While existing literature highlights the importance of DT for organizations (Westerman et al., 2014), limited empirical studies delve into the intricate adjustments needed across different dimensions of structural elements to accommodate the demands of successful DT. Further, the dearth of multiple case studies that exemplify successful structural changes for DT in diverse industrial sectors is another significant research gap. While some studies offer conceptual frameworks (Smith & Beretta, 2020; Sony & Naik, 2020; Vial, 2019), empirical case studies demonstrating the alignment in structural elements and the resultant impact on DT outcomes are limited. Such case studies could provide tangible insights into the practical implementation of structural changes and their effects on various organizational functions. Similarly, several scholars have also called for future research to investigate organizational structures to enable seamless DT outcomes (Horlacher, Klarner, & Hess, 2016).

Scholars have also proposed to seek empirical evidence of how DT impacts organizational structures and which performance outcomes are missing from the literature (Björkdahl, 2020; Kuusisto, 2017; Nwaiwu, 2018; Smith & Beretta, 2020). Addressing these research gaps is essential to inform industrial organizations about the nuanced modifications required within their structures to drive successful DT initiatives.

Therefore, the purpose of this study is to identify the required changes in structural components for successful DT implementation outcomes. We ask the following research question: “*how do industrial organizations change their organizational structures in order to achieve targeted performance outcomes for DT?*”. We utilize sociotechnical system theory as a theoretical lens to explore such organizational changes for DT. Using the multiple case study method, we examined the phenomenon under question and argue that DT is a sociotechnical phenomenon that requires special attention concerning how social systems (specifically organizational structures) embrace DT to achieve performance goals. The focus on the sociotechnical system perspective provides a novel direction for DT research that better reflects the mattering of digital technologies for organizational structures. Moreover, we take social imperative approach (Comparing: (Sarker, Chatterjee, Xiao, & Elbanna, 2019)) i.e. DT outcomes are shaped by firm’s social factors including the formalization, hierarchy, and integration of its organizational structures. In advancing this perspective, the study responds to calls to expand the theoretical repertoire of sociotechnical systems into new domains (Davis, Challenger, Jayewardene, & Clegg, 2014; Eason, 2014), such as how industrial organizations can strategically adapt their structures to thrive in the digital era. To do this, we offer a comprehensive analysis of the structural dimensions and best practices in achieving effective DT, thereby bridging the gap between theory and practice in the realm of organizational change for the digital age.

## **2. Literature Review**

### **2.1. Organizational structures**

*Organizational structures*, which can be defined as “*variations in a firm’s organizational setup*” (p. 341) (Matt et al., 2015), mainly are concerned with the arrangement of people, departments, and other subsystems of an organization (Fry, 1982). They define how tasks are segregated, classified, and coordinated formally, as well as specify formal allocation of work roles, allocation of resources to units, administrative mechanisms to control and integrate work activities, and generally the breakdown of larger problems into smaller units (Burton & Obel, 2018; Islam, Jasimuddin, & Hasan, 2015). Organizational structures ensure the accuracy of functions (Mierzejewska, 2015), not only to help firms deal with uncertain situations (Resca, Za, & Spagnoletti, 2013), but also to enable them to achieve their set goals (Burton & Obel, 2018). Classical structures (originating from the concept of bureaucracy) (Dischner, 2015) have been viewed as hierarchical in nature (Mierzejewska, 2015; Mrówka & Pindelski, 2011). Modern structures, which emerged in the 1990s, are rooted in lean management, outsourcing, re-engineering, knowledge management, and process management concepts (Mierzejewska, 2015). Considering that modern technologies (Gilchrist, 2016) are modifying how organizational operations function significantly, structural adjustments have become imperative despite the existence of classical



structures that serve as a foundation to develop further structural solutions (Mierzejewska, 2015).

Several factors – such as organizational strategy, changing business environments, and unexpected contingencies, e.g., COVID-19 – require changes in organizational structures. However, technology has been viewed as a paramount reason to restructure industrial organizations so that they can achieve performance outcomes (Mumford, 2000, 2006; Trist & Bamforth, 1951). Worley and Lawler (2006) argued that even the most advanced transformation models could stumble when they face organizational design and management practices that are intrinsically anti-change, thereby necessitating wise planning. Kretschmer and Khashabi (2020) warned that digital transformation elicits key changes to organizational structures; therefore, structural alignment becomes necessary to remain competitive, or else even the industrial giants can be toppled (Saarikko, Westergren & Blomquist, 2020). Therefore, organizations must pay special attention to adjusting their structures while adopting digital transformation.

Prior literature has outlined different parameters and components of organizational structures. For instance, Mierzejewska (2015) reported five main parameters of organizational structures: specialization; standardization; formalization; centralization; and configuration. Similarly, several scholars have identified certain characteristics and components of structure in various combinations, i.e., vertical and horizontal participation and formalization (Alexander & Randolph, 1985); centralization, formalization, complexity, and specialization (Fry 1982; Ford & Slocum, 1977); and management bureaucracy, hierarchy, and workforce flexibility (Kleinknecht, Haq, Muller, & Kraan 2020). However, in this paper, we focus on three main components of structure – formalization, hierarchy, and integration – based on two main reasons. First, we conducted a pilot study from case organizations (eleven interviews) in order to explore DT effects on industrial organizations. From structural point of view, this pilot study yielded that formalization, hierarchy and integration as the main three components where the most changings are happening. Therefore, we chosen these three aspects of structure to investigate these further. Second, these structural dimensions cover prior literature comprehensively. *Formalization* is defined as the extent of job codification and rule observation within an organization, measuring the degree to which an organization uses its rules and procedures to prescribe behavior (Liao, Chuang, & To, 2011). *Hierarchy* deals with vertical layers – i.e., authority, autonomy, and decision making – within the organization (Ford & Slocum, 1977; Kleinknecht et al., 2020). *Integration* comprises internal interactions and horizontal collaboration, e.g., how closely different segments, departments, functions, and businesses work closely on any specific topic.

## **2.2. Digital Transformation: A Sociotechnical Perspective**

Sociotechnical system theory offers a theoretical perspective on the relationship between technology and organizational structures (Eason, 2014; Morgan-Thomas, Dessart, & Veloutsou, 2020; Trist & Bamforth, 1951) by examining the implications of digital technologies and offering distinct conceptions of how social systems should be adjusted for such new technical systems (Trist & Bamforth, 1951), particularly organizational structures (Baxter & Sommerville, 2011). Sociotechnical system theory considers both social and technical factors while organizing any change (Baxter & Sommerville, 2011; Trist & Bamforth, 1951), such

as digital transformation (Gehrke et al., 2016; Imran & Kantola, 2018), and promotes joint optimization of both systems (Appelbaum, 1997). According to Gehrke, Bonse, and Henke (2016), digital transformation's major obstacles are not technical, but rather the organization's social systems, and organizational structure is one of the main aspects that needs to be designed carefully for effective digital transformation (Imran & Kantola, 2018).

Digital transformation is a process that aims to improve an organization by initiating significant changes to it by using advanced digital technologies (Vial, 2019). Moreover, some scholars also view digital transformation as a sociotechnical process (Mitki et al., 2019; Sklyar et al., 2019; Sony & Naik, 2020) to change organizational forms so that they remain viable in this new digital landscape (Saarikko et al., 2020). Few scholars also addressed this phenomenon as digital innovation or digital innovation management. For example, Nambisan et al. (2019) defines "*as the creation of (and consequent change in) market offerings, business processes, or models that result from the use of digital technology*" and names it digital innovation. Similarly, Hinings, Gegenhuber, and Greenwood (2018) defines DT as "*combined effects of several digital innovations bringing about novel actors (and actor constellations), structures, practices, values, and beliefs that change, threaten, replace or complement existing rules of the game within organizations, ecosystems, industries or fields*". Since the focus of our research is on organizational transformation from sociotechnical point of view, therefore we find definitions of Vial (2019) and Mitki et al. (2019) and Sony and Naik (2020) closer to our positioning.

Digital transformation necessitates flat or less hierarchy, as well as a highly interconnected organization (Gehrke et al., 2016; Kopp, Howaldt, & Schultze, 2016) with flexible structures (Davies, Coole, & Smith, 2017). Mumford (2000) presented the concepts of "built to last" and "wired world" organizations. Built to last," linked with mechanistic structures, represents traditional organizations with rigid hierarchies and promotes efficiency and control to achieve organizational goals (Fry, 1982; Mumford, 2006). "Wired world" organizations, which operate within complexity, require flexible and organic structures to realize their objectives (Appelbaum, 1997; Fry, 1982; Mumford, 2006). We found the "wired world" organizations concept to be very close to the current digital age, in which complexity and uncertainty are very high, requiring industrial organizations to adopt flexible structures to transform digitally to succeed in such a competitive business environment.

Recently, various researchers have attempted to examine and specify the most critical "*significant changes*" essential for impactful digital transformation. Vial (2019) outlines that these significant changes are transforming the value-creation process, organizational structures, organizational culture, leadership, and employee roles and skills. Saarikko, Westergren, and Blomquist (2020) argued that digital transformation requires a re-evaluation of existing organizational capabilities, structures, and culture to capitalize on new digital technologies. Verhoef et al. (2021) linked it with changes in business models that indicate organizations need digital resources, changes in organizational structure, and digital growth strategies while keeping track of digital transformation goals for this purpose. Kretschmer and Khashabi (2020) found that digital transformation elicits key changes in business operations, processes, and organizational

structures. Similarly, Gimpel et al. (2018) found that it requires a major overhaul within organizations.

Along with studies that are focusing on overall changes into organizations for DT, we have found some recent studies, which specifically addresses structural changes for DT. For example, Nambisan et al. (2019) mentioned about the importance of changing processes and outcomes in result of infusion of new digital technologies that transforms the nature of uncertainty inherent in innovation. Schwer and Hitz (2018) highlighted about the issues of less focus has been paid on change leaders, silo parochialism, rules and procedures and pressures in result of DT which hinders organizational progress in the new digital age. However, his study mainly focused on hierarchical issues in this context. Similarly, Bonanomi et al. (2020) studies the impact of DT organizational structures, however, their aim was to explore formal and informal structures of engineering firms, and how to manage new organizational forms from the perspective of network theory. Most recently, Mustafa et al. (2022) researched on digitalization trends and its relationship with organizational structures, where they supported the notion of organic structural arrangements are most suitable for digitalization. Hence, most of recent literature has focused either on overall organizational changes (Kretschmer & Khashabi, 2020; Mitki et al., 2019; Sony & Naik, 2020; Verhoef et al., 2021; Vial, 2019), or to the specific structural dimensions to see the DT effects on organizations (Bonanomi et al., 2020; Mustafa et al., 2022; Schwer & Hitz, 2018), that leaves a room for such investigation that empirically explore overall structural changes in industrial organizations as well as how it helps in achieving the targeted performance outcomes of DT.

### **3. Methodology**

This research is based on a qualitative multi-case study of three industrial organizations. The nature of digital transformation and changing organizational structures is contemporary, social, and ongoing; therefore, a case study design fits this research type (Dubé & Paré, 2003; Yin, 2018). Yin (2018) also recommends using case study design when the aim is to contribute in theory, i.e., ask “what,” “how,” and “why” questions and seek several answers. Moreover, it allows researchers to study practices and situations that are understudied and not yet described and understood completely, such as the topic of digital transformation and its impact on industrial organizations’ structures (Björkdahl, 2020).

#### **3.1. Case Selection**

The empirical findings were drawn from a multi-case study of three leading industrial organizations, all of which are based in the Nordics and have been undergoing digital transformations at the organizational level over the past five years. We chose these organizations based on methodological expediency, which allows for selecting cases that are unique, easily accessible for researchers, and provide the opportunity to study the phenomenon in question (Huberman, Miles, & Janet Ward, 2012). From a structural perspective, these organizations were developed during the second industrial revolution (Imran & Kantola, 2018) and are viewed as traditional organizations with rigid organizational structures. This makes these organizations a very interesting case to examine in terms of how digital transformation has impacted their rigid structures, what measures they have examined, and how these organizations are coping with this transformation. Under non-disclosure agreements (NDAs), aliases were used for all participants

from the case companies. In following, table 1 provide more details about case organizations as well as about the interviewees.

**Table 1. Details of Case Organizations**

	<b>Case A</b>	<b>Case B</b>	<b>Case C</b>
<b>Industry</b>	Renowned player in smart technologies and complete lifecycle solutions for the marine and energy sectors	Market leader in its field and is a pioneer of variable frequency drives, cooling & heating solutions and energy management	Very big player in forest, wood, and papers industry. Also expanding their business in energy market
<b>DT Strategy</b>	A separate dedicated digital organization was developed by hiring CDO to lead DT	Digital transformation responsibilities were dedicated to business segment's heads	Digital transformation responsibilities are dedicated to unit heads.
<b>Sales in 2021</b>	4,8 Billion	7,5 Billion	9,8 Billion
<b>Number of Employees</b>	17000	40000	17000
<b>Number of Interviewees (Higher Management)</b>	14	8	8
<b>Number of Interviewees (Middle Management)</b>	5	3	3

### 3.2. Data Collection

Discussions about data collection began in early 2019, when we approached case organizations for permission to investigate digital transformation and its impact on their organizations. We conducted semi-structured interviews, ranging from 0.8 to 1.5 hours each, with 41 respondents (once per person) between February 2019 and February 2020, comprising 13 face-to-face and 28 online (Skype and Zoom) interviews. Thirty of the interviewees were from higher-level management holding positions such as vice presidents, directors, head of department/unit/business and general managers. Remaining eleven interviewees were from middle level management positions such as senior managers, engineers,

project managers and managers. All participants were responsible for DT of their respective responsible areas. Two same researchers conducted most of the interviews to ensure dependability as well as to maintain consistency in the process (Guba & Lincoln, 1994). We also designed a semi-structured interview guide to acquire an inclusive understanding of how digital transformation is affecting organizational structures. Although specific questions were formed to reflect each interviewee's position and knowledge, the overall focus was on the respondent's experiences with the phenomenon in question. In addition to interview data, secondary data comprising publicly available documents – such as web blogs, online interviews, videos, reports, and information on websites – were used to gain further insights. We ceased data collection upon saturation, i.e., when no further insights emerged.

The issue of research quality was addressed by assessing construct validity, internal validity, external validity, and reliability (Creswell, 2013; Silverman, 2013). Construct validity was ensured by employing data triangulation (interviews conducted with multiple respondents from different parts of organizations). Internal validity was achieved by comparing situations arising at different points in time and suggesting inter-relationships between constructs. External validity was ensured by providing clear rationale for the case study selection, enabling readers to appreciate the researchers' sampling choice. Finally, reliability was ensured by establishing a case study database for data analysis using NVivo software. Furthermore, quality was maintained by forming a chain of evidence (Beverland & Lindgreen, 2010) through a rich set of interview quotes to illustrate key findings, preserving the circumstances of data collection in the case study database (Yin, 2013) and ensuring that these circumstances were constant with the study's initial aim.

### **3.3. Data Analysis**

We started data analysis by reading and coding both primary and secondary data to identify key themes (Vale, Collin-Lachaud & Lecocq, 2021). The interview transcripts comprise more than 500 pages and 46 hours of transcribed material. For the transcription of interviews, we used an online platform to convert speech into text. The "first author" proofread the transcripts while listening to each recorded interview. For independent parallel analysis, two of the authors involved in data collection also participated in coding, following the guidelines formulated by Gioia, Corley, and Hamilton (2013). The initial coding was based on three main criteria: (1) Are interviewees' insights applicable to the phenomenon in question? (2) Do several informants provide insights? (3) Are the interviewees' insights interesting and useful? Based on these criteria, an initial analysis yielded 489 statements concerning the phenomenon in question (organizational structures). The coding process categorized all these statements into first-order categories that were assigned labels with phrases that retained the informants' terminology. Next, the first-order categories were examined to identify more abstract second-order themes. This process yielded seven second-order themes: structural challenges; formalization; hierarchy; integration; agility; customer centricity; and collaboration. To describe the data at an even higher level of abstraction, themes were divided into two aggregate sub-themes: organizational structures and performance outcomes.

## 4. Results

### 4.1. Structural changes' importance in digital transformation

Digital transformation had been on the strategic agendas of the industrial organizations examined in this study for the past five years. Our results indicate that the case organizations understand the need for radical changes, especially in their organizational structures, to elicit an effective digital transformation process. The case organizations understand that to elicit quick and impactful digital transformations, structural readjustments are very important. A vice president explained it this way: *“Some of this reorganization (that has) happened is really about making sure that we can make more impact quickly.... Many organizations reorganize themselves in this process (digital transformation) because you try to organize around a new reality.”* A general manager elaborated on this change this way: *“Whenever you are transforming, structural update is required ... because we change how we do business; therefore, we reorganize.... Digital transformation enable(s) us to do business differently; therefore, we adjust our structure accordingly.”* These views depict how structural change is one basic element that must be updated according to digital transformation's needs. In the next section, we discuss industrial organizations' digital strategy and what major structural changes they have made to initiate digital transformation.

### 4.2. Digital transformation strategy and new structures

Our findings demonstrate that two kinds of strategies have been adopted for digital transformation within the organizations examined. Case A formed a new digital organization as a completely new structure to carry out its digital transformation initiatives. Its main objective was to develop digital capabilities by leveraging related competencies from across the organization, as well as hiring external digital experts. Case A hired a chief digital officer to manage this new organization, while Cases B and C adopted a different digitalization strategy to harmonize their digital initiatives, instead allocating digital development tasks to business heads, rather than develop a separate digital organization parallel to their businesses. However, Case B developed a new digital team to harmonize digital initiatives in each of its business segments, while Case C developed a small digital team to harmonize digital initiatives across its businesses. Moreover, both moves' objectives were the same: to keep track of digital initiatives and provide digital capabilities where they were needed. These objectives were the same as those of Case A, which also aimed to provide its businesses with digital capabilities through this new structure. The only difference between these two strategies is the scale, i.e., Case A started it on a larger scale, making big investments, while Cases B and C started theirs on a smaller scale, with limited resources allocated. Table 1 summarizes the three cases' overall digital transformation strategy.

**Table 2. Case Organizations' Digital Transformation Strategies**

<b>Digital Transformation Strategies</b>		
<b>Case A</b>	<b>Case B</b>	<b>Case C</b>
Develop a separate digital organization	Delegate digital tasks to business heads	Delegate digital tasks to business heads
Hire new chief digital officer (CDO)	Create a new digital team to coordinate digital activities within different functions of business units	Create a new digital team to coordinate digital activities across business units
Employ a mix of internal and external digital experts (new teams in the digital organization)	Employ a mix of internal and external digital experts (within business units)	Employ a mix of internal and external digital experts (within business units)
Support business projects by providing them with digital capabilities	Provide digital capabilities and harmonize digital activities within each business unit	Harmonize digital activities across business units
Develop a completely new structure parallel to the main business structures	Develop a new structure embedded within business units	Develop a new structure embedded within business units

### 4.3. Challenges

We identified several challenges related to structural changes associated with several factors, such as a long successful history of industrial organizations, as well as longstanding, tried-and-true management styles that ensured success in the past. The first hurdle that we identified is organizational structures' rigidity. As these organizations were established during the Second Industrial Revolution, they still encompass command-and-control management styles. Second, industrial organizations are hierarchical, even in this modern age of digitalization, causing major difficulties for digital transformation. Third, different segments or businesses within each industrial organization still prefer to work in silos due to internal competition, cost allocations, and annual performance goals. The fourth challenge is associated with resource allocation. It is a significant task to gather different HR resources or competencies all in one place due to the silo approach of organizational segments or businesses. Fifth, these industrial organizations are massive in size and require a proper structure to manage properly, but the interviewees noted that the structure need not be rigid to manage a large organization. Finally, the three case organizations' leadership is also a major obstacle to structural changes, as most of these executives have been in key positions for decades, under a deep-rooted command-and-control management style. Table 2 summarizes identified challenges and provides interviewees' statements on each challenge.

**Table 3. Structural Challenges**

<b>Challenges</b>	<b>Statements</b>
Rigid structures	<i>"We are still having very old traditional organizational structures and processes."</i> –Director, Digital Transformation
Traditional hierarchy	<i>"There is a cultural element in it that we are (a) very traditional organization, with (a) long history and being more hierarchical all the time."</i> –Senior Director, Global Technology
Silos	<i>"All these business areas have worked pretty much independently (not only from the business side, but) also from processes, systems, and tools' point of view, and that is challenging."</i> –Director
Problems with resource allocation	<i>"In order to deliver a complex project, you will need to have the capability of building networks quickly, regardless (of) how you are organized structurally.... In fact, one should think less in terms of their organizational home (and) instead gather around the problem to solve it together with others."</i> –Director, Digital Development
Organizational size	<i>"We have 20,000 people; it needs to be structured one way or another... but if you want to meet the pace of (the) world, you need to give up old practices, for example, setting up five meetings for making a decision around a product."</i> –Director, Head of Digital R&D
Old-fashioned leadership	<i>"It has a lot to do with this '80s/'90s leadership style in the power game. They usually structure so they have the power.... Leadership needs to transform from power to empower (for digital transformation)."</i> –Director, Platform Architecture

#### **4.4. Formalization**

Our findings indicated that the case organizations generally are highly formalized and process-oriented, with all processes well-defined to carry out any task or project. However, digital transformation requires flexibility and goal orientation, necessitating as little formalization as possible to reap maximum benefits. Despite being process-oriented companies with high formalization, many changes are reducing formalization to allow for digital transformation. More specifically, we found that leadership's role is extremely critical in this transformation. Most of the participants are promoting less formalized and more goal-oriented approaches within their areas of responsibility. This is a very positive sign for the industrial organizations, as it will help them become goal-oriented organizations. We also found evidence that organizations are taking some steps regarding formalization, one of which is standardization of digital tools. Although it contradicts the concept of low formalization, industrial organizations want to standardize their digital systems and tools to operate harmoniously. According to case organizations, this notion will enhance integration among internal stakeholders and facilitate collaboration in terms of using similar tools across the organization. Tables 3 summarizes interviewees' statements related to formalization.



**Table 4. Formalization in Case Organizations**

<b>Formalization</b>	<b>Statements</b>
High formalization in industrial organizations	<i>"In our organization, one is given a very clear scope for a task and then you have to accomplish it accordingly."</i> – Director, Digital Stakeholder Relations
Digital transformation requires low formalization	<i>"Whatever internal bureaucracy and complexity you have, you have to avoid it (for digital transformation)."</i> –Senior Director, e-Steering Business  <i>"If you have bureaucracy and heavy organization, there will be no transformation."</i> –Vice President
Role of leadership in lowering formalization	<i>"I give them (team members) goals, and to some extent, they can achieve it in their own way."</i> –Senior Director, IT Innovation  <i>"Leaders should coach and guide, but not define the processes in details."</i> –Operational Excellence Director
Bringing flexibility to goal-setting	<i>"We set yearly goals for individuals.... Now we can change the existing goals based on how (the) environment has been changed.... Earlier, it was a taboo that you can't change yearly goals during the year, but now it's more flexible (due to digital transformation)."</i> –Vice President, IT Strategy and Governance
Standardization of digital tools (High formalization, but supports digital transformation)	<i>"Digitalization enable(s) us to operate in much more centralized way (across the businesses).... We need harmonized processes in place and only then we are able to be more centralized (in terms of systems and tools)."</i> – Director, Raw Material Execution

#### **4.5. Hierarchy**

Corresponding with formalization, industrial organizations generally are perceived as very hierarchical, comprising several layers, which increases bureaucracy and complexity, creating a logjam of managerial red tape that slows down progress and halts digital transformation. Our results contained mixed views regarding the hierarchical notion of organizational structure. First, most of the respondents viewed their organizations as very hierarchical. Second, few respondents believe that hierarchy is still needed to manage big organizations, and they stressed the need to loosen such structures at some level to support digital transformation. Third, few respondents viewed their business segments as less hierarchical compared with other parts of the same organization. Fourth, the respondents believe that there should not be any hierarchy in this fast-paced business environment.

Despite mixed views on industrial organizations' hierarchies, our data identified some key changes. Primarily, hierarchical change that we observed entailed the formation of new digital organizations or digital teams to harmonize digital initiatives. Second, these new functions are challenging existing traditional organizational hierarchies because they are formed by tapping different resources/competencies regardless of their current position and location. Third, digital transformation has encouraged them to revisit their traditional and long-term hierarchies, and remove as many layers as possible to reap the full benefits of

digital transformation. However, these changes are limited to individual functions or business segments – not the overall organizational level. Finally, as these initiatives are limited to the functional or business segment levels, we found that they are very much linked with the leadership of that particular area. Our data indicated that leadership’s role is very critical in reducing hierarchical layers and promoting flat or less hierarchy in their areas of responsibility. Table 4 summarizes our results on hierarchy, along with related statements by interviewees.

**Table 5. Hierarchy Overview of Case Organizations**

<b>Hierarchy</b>	<b>Statements</b>
Traditional hierarchy	<i>“This is a big company, and it’s hierarchical, having several group management layers and business management layers.”</i> –Vice President, Strategy and Business Development
Need for hierarchy	<i>“You will need hierarchy at some level, as it’s impossible to manage hundreds of teams doing everything (on) their own.”</i> – Senior Digital Product Owner
Fewer hierarchical segments	<i>“In the business area where I am working, there is very little hierarchy.”</i> –Vice President, Sourcing
No hierarchy school of thought	<i>“We can’t support hierarchy as 10 years ago. Because of digitalization, you connect daily and directly, and if you have bureaucracy and heavy organization, there will be no transformation.”</i> –Manager, Maintenance Development
New hierarchies	<i>“My team is working on (a) transformation aspect, which is sort of (a) pop-up function in the organization ... which is another layer of structure over the organization’s traditional structure.”</i> –Director, Digital Transformation
Allocation of resources regardless of hierarchy	<i>“Now they have been pulled out of their normal reporting structures and put into these functions.”</i> –Digitalization Project Manager
Cutting down the layers	<i>“Now it’s getting less hierarchical and more horizontally flatter.”</i> –Senior Director, IT Innovation
Role of leadership	<i>“Traditionally, big companies are hierarchical, but I do not promote that. So, I have different layers, and they (subordinates) can reach top manager easily; they are more independent and can (make) decisions by themselves.”</i> –Vice President, Global After Market Service

#### **4.6. Integration**

*“Digital transformation is all about integration,”* said one of the respondents, indicating the importance of this structural element. In our analysis, we found integration to be one of the notable structural elements in which the most changes have occurred due to digital transformation. We also found that digital transformation has helped organizations integrate effectively. First, it has provided digital collaborative tools that have made integration of different stakeholders much easier. Second, in relation to collaborative tools, digital transformation has started a trend of using collaborative platforms in which internal and external stakeholders collaborate on common initiatives. Third, it has created new communities in which different personnel across the organization collaborate and integrate on similar topics of interest regardless of their position and location within the organization. Fourth, and very importantly, it has led to the integration of digital and business personnel. The main objective of newly formed digital organizations and teams is to provide digital capabilities for business counterparts, which requires integration between both. Fifth, digital

transformation is helping to eliminate challenges related to resource allocation. Sixth, digital transformation is reducing silos by providing digital collaborative tools, bringing different competencies together regardless of their reporting lines, forming new communities, and enhancing collaboration between digital and business experts. Table 5 summarizes interviewees' views on integration.

**Table 6. Integration Views from Case Organizations**

<b>Integration</b>	<b>Statements</b>
Collaborative tools	<i>"I think probably the biggest contribution (that) comes in this regard (is) from systems like SAP that integrate whole organization(s). But also (the) biggest contribution comes from collaborative tools like video sessions on Zoom or Skype."</i> – Director, Digital Development
Collaborative platforms	<i>"We have integrated quite well; we have common (digital) platforms where we gather and share information."</i> –Manager, Maintenance Development
Formation of new communities	<i>"We are behind the biggest communities in our organization. For example, we started a community of software developers from five people, but it's now grown to 1,600 people.... So basically, we do community-driven approaches."</i> –Senior Director, IT Innovation
Integration of digital and business personnel	<i>"In data-driven projects, as a data scientist, you can prepare the pipelines, but this is just one part of the equation. You need business experts to be able to understand and comment if these models are valid or not. So, this is where integration of digital and business is required."</i> –Director, Digital Development  <i>"We are in the middle of IT and business; we glue them together."</i> –Head of Digital Experience Program
Elimination of resource allocation problems	<i>"We are now bringing (the) best of our organization on common projects for work and to make those successful. It does not matter what their reporting lines are; we are one company, and we should work for (the) same goals."</i> –General Manager, Innovation
Elimination of silos	<i>"Now, more and more, (we are) coming out of silos."</i> –Operational Excellence Director  <i>"We are hoping that through arranging people on common topics, we will break silos."</i> –Director, Chief Data Architect

## 4.7. Structural Changes' Objectives

### 4.7.1. Agility and structural changes

Our data found that the case organizations are very process-oriented and function based on the waterfall model, in which things move very slowly. However, to compete in this fast-paced digital environment, agility is a necessity for organizations to survive and thrive. Therefore, becoming an agile organization is a key agenda item in such organizations' digital transformation. Structural elements also play a very important role in this regard, as traditional and rigid organizational structures are one of the main bottlenecks that halt the journey toward organizational agility.

First, organizations are promoting agile teams that work in an agile manner to attain this objective. For this purpose, they have empowered such teams to work regardless of structures. A general manager explained it this way: *“We have these virtual teams who work around developments and in (an) agile manner... although they are tied with some basic structure in the organization, but they are empowered to proceed in (an) agile manner regardless of their cost centers.”* Second, organizations are working to modify their hierarchies to become more agile. One director of digital transformation stated: *“Over the traditional structure, there is coming another layer of structure which is more agile and more purpose-driven.”* Another director added to this, noting: *“You have to cut down those layers – that is the only way to be faster.”* Third, the role of leadership in making structures as lean as possible is a very important factor in becoming an agile organization. Our data found multiple instances in which leaders are promoting more goal-oriented approaches to become agile. One director stated: *“I keep structure as low as possible and try to operate in (an) agile manner for my team.”* Another director stated: *“If you start defining processes in details, then you are no longer agile.”* These statements demonstrate that the organizations are trying to reduce formalization, as well as promote less hierarchy to become agile for digital transformation.

#### **4.7.2. Customer centricity and structural changes**

Customer centricity is another important factor that requires structural changes for impactful digital transformation. Our data found that many respondents were focusing on structural changes to serve their customers better and more quickly. One vice president explained it this way: *“Some of this reorganization now happened is to make sure that we can make more impact quickly.... That’s why some people in (the) digital organization are not embedded into the business so that they can remain much closer to the customer projects.”* One director of digital transformation explained it this way: *“We try to look at this from (a) customer point of view, (i.e.,) what are their needs ... and it has impact on how we structure the business.”* Few respondents stressed the need for such teams on customer fronts, where every competency is combined so that they can respond to customers more efficiently. As one director put it: *“You need to be able to have (the) right people and capabilities (on a team) to understand the customer and to (be) able to offer (the) right product, regardless of hierarchical layers.... So, by layering (the hierarchy), you can create such (an) organization or team that is self-sufficient to answer your customers’ demand(s) quickly.”* Another director said they should organize around the customer’s problem, rather than some structure. These responses demonstrate how industrial organizations are refocusing to achieve customer centricity through structural changes.

#### **4.7.3. Collaboration and structural changes**

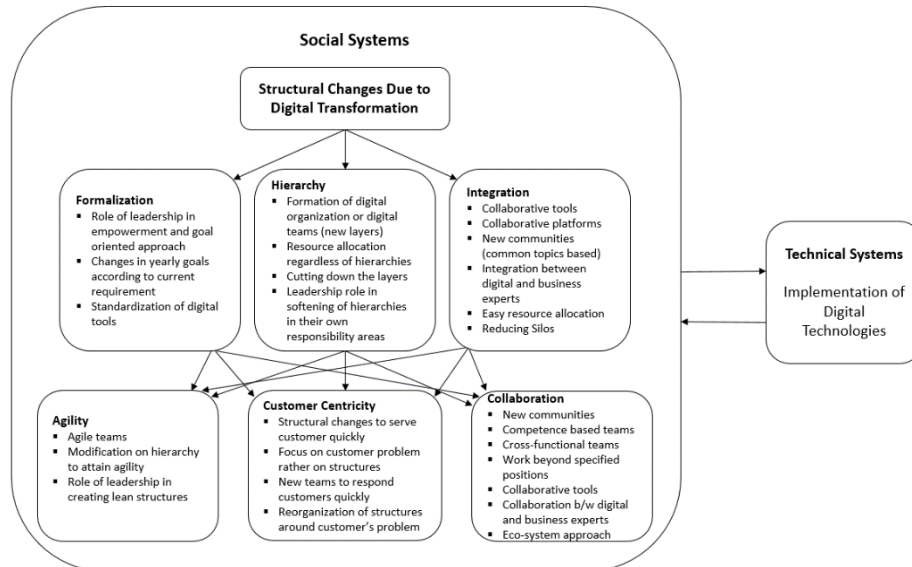
Finally, our data indicated that enhancing collaborations within organizations, as well as with external stakeholders, is another important objective to make structural changes for impactful digital transformation. Collaboration has a direct relationship with structures, as rigid organizational structures discourage collaboration. However, digital transformation requires close collaboration among all stakeholders to make it impactful. Our data found that ongoing structural changes within industrial organizations enhance their collaboration in several ways. First, the formation of different communities (based on common interests) is one good way to enhance collaboration among internal stakeholders. It not only lowers barriers among different functions/units/businesses of industrial

organizations, but also helps internal stakeholders share their problems with each other and find solutions together. It also creates a sense of achieving the overall organization's common goals regardless of their hierarchy and position within the organization.

Second, the case organizations are promoting cross-pollination of skills among personnel throughout the organization, regardless of official roles, to form the best possible project teams. This approach gives various internal stakeholders the opportunity to collaborate on dynamic projects, which serves overall organizational goals. As one interviewee noted: *"We are now bringing (the) best of our organization on common projects for work and to make those successful. It does not matter that what their reporting lines are. We are one company, and we should work for (the) same goals."* Third, the case organizations are promoting more cross-functional teams to enhance collaborations. One vice president stated: *"We are trying to open up our teams to drive more collaboration between different parts of the company, and more working in cross-functional teams."* Fourth, the case organizations are promoting working beyond specified roles so that personnel can collaborate more often, without always needing to think about their specific roles, reporting line, hierarchy, or position. A general manager described it this way: *"You need to be prepared and expected to work outside of your formal position, and it's key to fostering collaboration between different parts of the organization."*

Fifth, digital transformation has provided powerful collaborative tools that have made collaboration much easier. The case organizations are trying to implement common digital tools, which all functions and businesses will use. The use of common collaborative tools across the organization makes collaboration easier compared with when every function used its own specific tool. Sixth, the additional new structure of digital organizations or support teams also has promoted collaboration between digital and business personnel to achieve digital transformation. A global head explained it this way: *"What we do is the mixing of digital experts with business experts, so the combination of digital expert knowledge and business expert knowledge draws the path of digital transformation strategy."* Finally, case organizations are promoting an ecosystem approach by including external stakeholders from the same landscape to collaborate on common problems. One vice president described it this way: *"By working together in an ecosystem approach, we now work with our partners in new ways to solve different kinds of challenges.... So, you have to think beyond the boundary of your function or even organization, as the answer to your problem might lie at my customer's end or supplier's end."*

In the following section, Figure 1 details structural perspective of digital transformation based on sociotechnical system view. It summarizes the key themes identified in this study and their possible interaction with each other. The figures shows that how the identified ongoing changes in formalization, hierarchy and integration helps attaining agility, customer centricity and collaboration. Each of the tab summarizes the identified themes through the data analysis.



**Figure 1. Structural framework of digital transformation**

## 5.0. Discussion

Based on a sociotechnical system theory perspective, this study sets out to understand the structural changes (social systems) required for impactful digital transformation (technical system). We found that industrial organizations understood the importance of structural changes for digital transformation and took this notion into account while planning and implementing their digital transformation strategies. Organizational structure is one of the main mechanisms through which organizations deal with change, such as digital transformation, because it represents patterns and relationships with entities that allow for the accomplishment of performance outcomes. Our results show that organizations with rigid and traditional structures will no longer be viable in this digital age. Therefore, we now understand that industrial organizations are taking steps to modify their structures according to digital transformation needs.

Organizations face several challenges because of their mechanistic structures (Mumford, 2000), including rigidity, traditional hierarchical approaches, the existence of silos, problems related to resource allocation, organizational size, and old-fashioned leadership. In the past, rigid structural models prevailed when case organizations were operating in stable and predictable environments (Smet, Lurie, & George, 2018; Worley & Lawler, 2006). However, the pace and uncertainty of change in today's business world, spurred by disruptive digital technologies (Shahzad, 2020), strongly argue for a different structural approach (Worley & Lawler, 2006). For this reason, the three case organizations have taken several steps to modify organizational structures to support their digital transformation initiatives.

As the result of our case study direct that industrial organizations aim at low formalization of structures, however, higher formalization of digital systems while limiting to minimal critical specifications [sociotechnical system (STS) design principle (Cherns, 1976) ]. Building multi-skilled and multi-functional teams

within formal-to-informal structures supports digital transformation too [STS design principle (Cherns, 1976)]. Resulting minimal variants of technical system will facilitate compatibility across functions i.e. higher redundancy of functions. Thanks to the redundancy of functions; traditional industrial organizations who are believed to attain efficient operations through build-to-last structures have room for “Weird world” of structures with informalities, flexibility, and experimentation offered (Mumford, 2006). The interviewed experts agreed the lagged preparedness of organizational structures for digital technologies. However, they understand that rapid industrialization of digital technologies is leading to continuous evolution of business environment, competition, and performance expectations. They are avid for incomplete choices so to refrain locked-in to build-to-last organizational structures; otherwise, leading to inefficient operations while the business context are rapidly evolving (Cherns, 1976).

### **5.1. Structural Modifications for Digital transformation**

Our results support the notion that organizations require new structures (parallel to business organizations) to develop digital capabilities while supporting their business organizations, also known as “separation through dual structure” (Gupta, Smith, & Shalley, 2006), as well as helping steer digital transformation (Smith & Beretta, 2020; Svahn, Mathiassen, & Lindgren, 2017). This not only helps integrate various functional silos within the organization, but also accelerates change (Svahn et al., 2017). However, our results also demonstrate another approach – “integration within existing structure” (Hess, Matt, Benlian, and Wiesböck, (2019) – in which existing functions are responsible for digital activities by themselves (Smith & Beretta, 2020). Both approaches have its own pros and cons, however, we have analyzed and reported a common pattern of structural changes that is ongoing in both scenarios.

In the past, when organizations faced complexity, the idea of matrix organizations was introduced with more rules and regulations to facilitate better organizational control (Smet et al., 2018). It ensured that all personnel were fulfilling their tasks according to prescribed processes and rules. Furthermore, organizations implement administrative control mechanisms, known as management bureaucracy, leading to high formalization (Kleinknecht et al., 2020). To weaken formalization, leadership roles (Imran, Shahzad, Butt, & Kantola, 2020), in their own responsibility areas, become imperative by promoting empowerment and adopting goal-oriented approaches. However, on the organizational level, Industrial organizations are becoming flexible in goal setting, which can be adjusted based on needs. Regarding organizational hierarchy, digital transformation, which requires fewer hierarchical layers, promotes quick detection of valuable technologies to cope with fast-paced business environments (Verhoef et al., 2021), direct interaction between different stakeholders (Alavi, Abd. Wahab, Muhamad, & Arbab Shirani, 2014; Kolbjørnsrud, 2018), and autonomy (Pasmore, Winby, Mohrman, & Vanasse, 2019). However, rigid hierarchies function differently, though flat hierarchies can lead to chaos in large organizations (Mrówka & Pindelski, 2011). Therefore, it is very important for industrial organizations to find the right balance (Svahn et al., 2017) in their hierarchies so that they remain intact and do not create bottlenecks for digital transformation initiatives (Horlacher et al., 2016).

Moreover, digital technologies have made integration much easier by providing a new range of advanced digital collaborative tools (Duerr et al., 2018). Industrial organizations are utilizing such tools and collaborative platforms to form communities wherein people across the organization interact, regardless of their reporting line. Digital transformation enables interconnectedness, which allows for integration and relationship building among internal and external stakeholders (Beier et al., 2020). In addition, such interconnectedness enables flexibility, adaptability, and efficiency, and it increases communication efficacy among stakeholders (Beier et al., 2020). These communities bring large groups of participants together to solve problems by coordinating directly (Kolbjørnsrud, 2018; Pasmore et al., 2019). Despite vertical hierarchy's rigidity, horizontal mechanisms help remove cross-functional integration barriers, thereby facilitating information sharing, problem solving, and trust across the organization (Horlach, Drews, Schirmer, & Boehmann, 2017). Digital disruption has blurred organizational boundaries, which promotes integration with external stakeholders, e.g., customers and suppliers (Mitki et al., 2019). Organizations are no longer viewed as individual entities because they have morphed into networks connected with a diverse array of entities. Therefore, industrial organizations must interact with external stakeholders more frequently, and digital technologies play a very important role here in connecting with them by integrating organizational systems (Mitki et al., 2019; Pasmore et al., 2019). Gimpel et al. (2018) argue that integration with external stakeholders can boost organizational creativity and innovation by introducing industrial organizations to new ideas and competencies.

## **5.2. Structural Changes and Performance Outcomes**

Data analysis has revealed that agility, customer centricity, and enhanced collaboration are the main performance outcomes that the three case organizations aim to achieve through structural changes. First, tremendously increasing business clock speed through digitalization (Gimpel et al., 2018) has become a necessity to ensure organizational agility within contemporary organizations (Kuusisto, 2017), requiring flexible organizational structures (Verhoef et al., 2021). Organizational agility is the ability to respond to rapid environmental changes (Alavi et al., 2014), allowing industrial organizations to exploit opportunities for innovation and competitive actions (Chen et al., 2014). Conversely, the concept of a hierarchical organization with multiple management layers and a strong top-down approach that perpetuate management bureaucracy reduces response speed and innovativeness (Verhoef et al., 2021). Alavi et al. (2014) argue that organizations need to find the right balance in formalization, with fewer hierarchical layers, to enable organizational agility (Kuusisto, 2017). This is also evident from our results, which explain such structural changes.

Second, seminal studies have argued that customer-centric organizations outperform their competitors because such organizations nurture closer relationships with customers, enhance customer value, and improve customer satisfaction (Day, 2003; Shah et al., 2006). Industrial organizations traditionally structure themselves around their products (Gebauer & Kowalkowski, 2012) (Lamberti, 2013), while customer centricity requires industrial organizations to structure themselves around their customers (Lamberti, 2013) to enhance customer satisfaction and long-term relationship building (Day, 2003). Therefore, digital transformation plays an important role in achieving customer centricity, as it helps industrial organizations generate customer intelligence by gathering and processing data (Birch-Jensen, Gremyr & Halldorsson, 2020) and information to



build comprehensive data storehouses about interactions between the customer and the organization to support customized marketing activities (Sharma & Sheth, 2004). It also enables customer co-creation by involving customers in product development and innovation processes (Payne, Storbacka, & Frow, 2008; Snow et al., 2017), as well as provides a new customer experience (Lamberti, 2013). Moreover, it allows for system integration between customers and industrial organizations, through digital platforms, making interaction between both parties much more convenient. Therefore, industrial organizations are moving toward achieving customer centricity through digital transformation, which also is jeopardizing their existing organizational structures (Gebauer & Kowalkowski, 2012).

Finally, collaboration concerns how people interact, as well as assist and support work-related activities with organizational stakeholders (Islam et al., 2015; Shahzad, 2018; Shahzad et al., 2018). Digital transformation enhances collaboration by providing different collaborative tools, e.g., centralized cloud-based software with mobile computing and augmented reality technologies (Beier et al., 2020; Marion & Fixson, 2021; Oesterreich & Teuteberg, 2016). From a structural perspective, horizontal integration is one of the main enablers of collaboration, which not only enhances internal collaboration (across different functions and business), but also improves it with external stakeholders (Oesterreich & Teuteberg, 2016). It is also evident that industrial organizations are promoting cross-functional collaboration and facilitating resource reallocation to enhance internal collaboration horizontally (Beier et al., 2020).

## 6.0. Conclusions

This study builds upon the recent literature (Fjeldstad & Snow, 2017; Schwer & Hitz, 2018; Sony & Naik, 2020; Vial, 2019) that the digital technologies affect the organizations that require review and modifications of organizational structures. Therefore, the purpose of this research was to not only explore those structural changes (Gupta et al., 2006; Hess et al., 2019) when industrial organizations are adopting DT, but also to explore the related challenges, as well as how it helps in achieving performance outcomes. To accomplish this, we explored and analyzed structural changes of three global industrial organizations, which are leaders in their respective fields.

This study contributes to the research streams of digital transformation and organizational structures literature as well as to sociotechnical system theory. Particularly, it investigates the DT effects on formalization, hierarchy and integration as well as how it helps industrial organizations to achieve agility, customer centricity and collaboration. We identified that despite of having different approaches to implement DT in their respective organizations; the case organizations have a similar pattern of making structural changes in their firms. Regardless of several structural challenges in adopting DT, case organizations are moving into right direction by lowering the formalization, focusing on less layers of hierarchy as well as by bringing different departments closer to each other to enhance integration. Moreover, we adopted sociotechnical system (Cherns, 1976; Woodward, 1965) lens to understand this phenomenon.

The changes caused by DT powered by advanced digital technologies are as strong as caused by 1<sup>st</sup> industrial revolution (Schwer & Hitz, 2018), which require quick structural changes to adopt the rapidly changing world. We identified that the hierarchically managed industrial organizations can be made more agile, collaborative and customer centric by lowering the hierarchical layers. However, literature also supports the notion of keeping the hierarchical structures for the sake of organizational design (Kotter, 2014), while having informal structures can help in attaining the required flexibility for agility, collaboration and customer centricity. Another recommended form of organization is holocracy where the management is decentralized and employees are empowered (Schwer & Hitz, 2018) that also supports the notion of low formalization, low hierarchy and more collaboration.

This work is validated through the lens of sociotechnical system theory in the context of DT of industrial organizations. Sociotechnical system theory humanizes technology-driven changes in industrial organization. The results of our case study map the social shaping (Sarker et al., 2019) of organizational structures while in digital transformation (Davies et al., 2017; Gehrke et al., 2016; Gimpel et al., 2018; Vial, 2019). These findings on organizational structures describe the “joint optimization of social and technical systems” (Mumford, 2006). Digital competences of leaders (Imran et al., 2020) are required to balance this optimization as our results indicate that “you will need hierarchy at some level” but the leadership is jointly distributed (Pasmore et al., 2019).

### **6.1. Managerial implications**

This study holds several important implications for managers exploring digital transformation. First, it brings to their attention that organizational structure is one of the most rigid artifacts that must be examined carefully while implementing new digital technologies. However, digital technologies can strengthen existing centralization (i.e., reinforce classical power structures), as well as facilitate decentralization (i.e., enable distribution of information within the organization) (Schwarz Müller, Brosi, Duman, & Welp, 2018). Therefore, managers must define their objectives very carefully concerning what they aim to achieve through structural changes when implementing new digital technologies. Second, our findings emphasize leadership’s role in reducing formalization and hierarchical layers to facilitate impactful digital transformation. Considering that industrial organizations’ rigid and traditional structures have deep roots, the best place to begin structural change is at the leadership level. It is much more convenient to make structural changes in individual functional areas rather than from the organizational level. This case study’s findings have demonstrated this, as most of the leaders interviewed are creating flexible, agile environments under their own areas of responsibility, setting a very good example for managers. Third, we highlighted key structural changes that can help managers make their organizations agile, customer-centric, and collaborative.

### **6.2. Limitations and Future Research**

This study’s limitations also should be noted. First, the study only seized situations from large, multinational, hard-core engineering organizations, an aspect that must be considered when seeking to transfer these findings to other types of organizations. Moreover, these findings should not be viewed as exhaustive, and

the inclusion of other organizations may reveal further contributions. Second, when the data were analyzed, significant time was spent combining understandings of the data, so other researchers might have drawn different conclusions. Third, the choice of methodology also has integral limitations. Although the study mostly relied on high-profile interviewees to provide a rich viewpoint, more interviews conducted by different investigators could have expanded the findings further. Fourth, we have adopted only thematic analysis approach in this paper in order to investigate commonalities in the case organizations' structural changes. However, future research shall employ cross-case analysis in order to draw more insights from it. Future research should also focus on identifying the pros and cons of having a separate digital organization vs an integrated digital responsibilities approach, which lied beyond this paper's scope. Such further study can highlight the challenges and benefits of adopting either approach. Furthermore, future research should employ quantitative methods to validate the present paper's findings further. Future studies also should include other dimensions of organizational structures to study the phenomenon examined here in more detail.

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## **Strategic design of culture for digital transformation**

### **Abstract**

Although the digital transformation of industries, markets and societies have altered market realities and customer needs, businesses are unable to capitalize its intended benefits. Industrial organizations need a cultural leap to integrate social systems with rapidly evolving digital technologies. Subsequently, digital transformation enabled by organizational culture is ubiquitous; however, the guidance on enabling such a culture is underdeveloped. We conducted a diagnostic multi case study of the organization culture in three globally renowned industrial organizations enduring digital transformation strategy implementation. Through thematic analysis of qualitative data, we identified cultural artefacts, values in action and assumptions that enabled digital transformation in our case organizations. The research findings are presented as an exploratory framework for a strategic design of culture for purpose, governance, ecosystem, and organization of sociotechnical systems.

### **Highlights**

- - Review of the recent research on digital transformation and culture.
- Data from 3 large multinational industrial organizations pursuing digital transformation.
- Exploration of tangible and intangible constituents of culture at three levels of sociotechnical system.

### Key Words:

Strategic design, sociotechnical, digital transformation, organisational culture, strategy implementation

### **Introduction**

An organization's culture connects the people, work, work groups and their purpose (Coyle, 2018). Culture has social colors and diversities that are networked to pursue the business purpose of organization (Jelinek et al., 1983). Indeed, culture is the 'organization's mind' (Mintzberg et al., 1998, p. 265); culture furnishes a system of accepted meanings (Chatman & Cha, 2003) for the employees to interpret a strategy, the situation, and the associated actions (Pettigrew, 1979). Future-ready business firms thrive even in the changing business realities (Barney, 1986; Mintzberg et al., 1998; O'Reilly & Chatman, 1996; Parida et al., 2019) by strategically renewing the organizational culture (Schein, 1990; Warner & Wäger, 2019) in support to their *purpose, governance, organization, and ecosystem* (Pasmore et al., 2019; Volberda et al., 2021).

Digital technology advancements have altered the relationship between our cyber and physical realities (Sony & Naik, 2020; Vial, 2019) – the ‘what’, ‘who’, ‘why’ and ‘how’ of organizational work has transmuted. Despite two decades of upsurge, digital-technology investments are to increase (McKinsey, 2019; Statista, 2020). Whereas most businesses fall short of attaining their digital strategy targets (Kane et al., 2016; Tabrizi et al., 2019; Wade & Shan, 2020). Interestingly, the articulated strategies of most organizations are comparable (Barney, 1986; Gartner, 2020; Kane et al., 2016; Porter & Heppelmann, 2015). Although organizational culture cannot be ignored to enable successful strategic renewal in this disruptive digital age (Vial, 2019, Volberda et al., 2021; Warner & Wäger, 2019). Strong culture in traditional industrial organizations often challenges the technology driven strategy implementation (Mumford, 2006).

Traditionally, industrial organizations focused on superior manufacturing technologies to compete for higher market share and profitability – now digital technologies offer a new competitive spectrum for them (Porter & Heppelmann, 2015). Instead of solo run market-based approach, with digital technologies industrial organizations can transform business value complementarities within the whole ecosystems (Jacobides et al., 2018). Such transformation through digital technologies (aka digital transformation) encompasses not just technological change, however, all that organizations carry out – from the individual knowledge worker’s daily work routines to the entire business model. Therefore, digital transformation necessitates a sociotechnical systems perspective that incorporates the organizations’ goals, people, work tasks, physical infrastructure, processes, governance, culture, and strategy with the technology (Coyle, 2018; Davis et al., 2014; Imran et al., 2021; Kane et al., 2016; Kreutzer & Land, 2015; Mitki et al., 2019; Sony & Naik, 2020; Vial, 2019).

Adaption of digital technologies to bring meaningful work to the people is at the crux of sociotechnical systems – herein emphasis is on social and technical systems codesign (Pasmore et al., 2019; Trist & Bamforth, 1951). A hesitant approach to synchronize social and technical systems reaps limited benefit for industrial organizations (Mumford, 2006). While in altering technical, social, and environmental conditions, an unattended culture becomes a liability and a source of resistance to strategy (Barney, 1986; Gagliardi, 1986). Whereas deliberate preparedness of culture for digital technology adoption can make traditional organizations future-ready (Parida et al., 2019).

It is natural that organizations will renew their cultures (Pettigrew, 1979). Meanwhile, it would be naive undertaking that new values, explicit and tacit beliefs, and artefacts are just installed (like a widget) to make the culture supportive to the strategy implementation. Instead, cultures are strategically designed, carefully crafted, lived, and nurtured so that people can successfully execute the business strategy (Chatman & Cha, 2003). Strategically designed organizational culture enables innovativeness, flexibility and agility, ecosystem-

wide engagement, transparency, openness, and superior financial performance with customer success as outcomes of digital transformation (Kolagar et al., 2022; Vial, 2019; Warner & Wäger, 2019).

Organizational culture's significance for digital transformation is ubiquitously acknowledged in extant literature. However, guidance on 'how' business organizations build a culture that supports digital transformation as strategy implementation is remarkably limited. Mainstream research is either conceptual or inferred from a wide (and old) range of changes that business organizations have experienced (see the literature review on digital transformation mainstream research by Kiefer et al., 2021; Kolagar et al., 2022; Nadkarni & Prügl 2021; Verhoef et al., 2021; Vial, 2019). Furthermore, insufficient empirical research on culture in relation to digital transformation is offered in the strategy and sociotechnical systems literature (Table 10). Meanwhile, there have been worthy attempts to explicate the leaders' tasks in digital transformation (Singh et al., 2020) and furthermore to include culture in the strategy curriculum (Cepa & Schildt, 2022 *in press*). There are calls to identify organizational idiosyncrasies e.g., about culture which the manager and leaders must learn '*to find their way*' for strategizing in a digital age (Volberda et al., 2021, p. 15; Kolagar et al., 2022, p. 195). This research aims at addressing those repeated calls to explore the culture enablement of digital transformation.

Our research question is as follows: ***How can industrial organizations strategically design a culture in their pursuit of digital transformation (DT)?***

We performed a diagnostic multi case study (Janićijević, 2011) of digital transformation in three globally operating industrial organizations (Canato et al., 2013; Giorgi et al., 2017). Our findings unravel the deliberately learned ***values, assumptions, and artefacts*** (Schein's 1990, 2004) that form cultural behaviors to enable digital transformation. These research findings contribute to literature by highlighting culture as a strategic resource for digital transformation (Barney, 1996). We also demonstrate how leaders strategically prepare culture as a social control system for digital technology adoption. Furthermore, these research findings are modelled as an exploratory framework for the strategic design of cultural (Figure 25) for ***purpose, governance, ecosystem, and organization*** of sociotechnical systems (Pasmore et al., 2019). The strategic design of culture, especially in pursuit of digital transformation, is a novel scholarship pioneered by this research. These literature contributions also have sizable managerial implications for the executives and leaders involved in the strategic renewals of traditional industrial organizations.

## **Literature**

Culture is the untold code of conduct for the diverse individuals working in an organization (Coyle, 2018; Jelinek et al., 1983). It concerns '*all aspects*' of an

organization (Gregory, 1983), so the business strategies must attain fit with the culture (Chatman & Cha, 2003). Culture as collective cognition furnishes a shared meaning (Mintzberg et al., 1998, p. 264–5) of ‘why’ and ‘how’ the work tasks could be in pursuit of the organization’s purpose (Coyle, 2018). It is the culture that supplements or restricts the business strategy implementation (Mintzberg et al., 1998). For example, digital technologies bring must-do changes to the strategy because businesses are eager to take first-mover’s advantage of the value chain disruptions (Kane et al., 2016). Culture as a shared platform for learning and experimenting enables strategic renewals during such disruptions (Vial, 2019; Warner & Wäger, 2019).

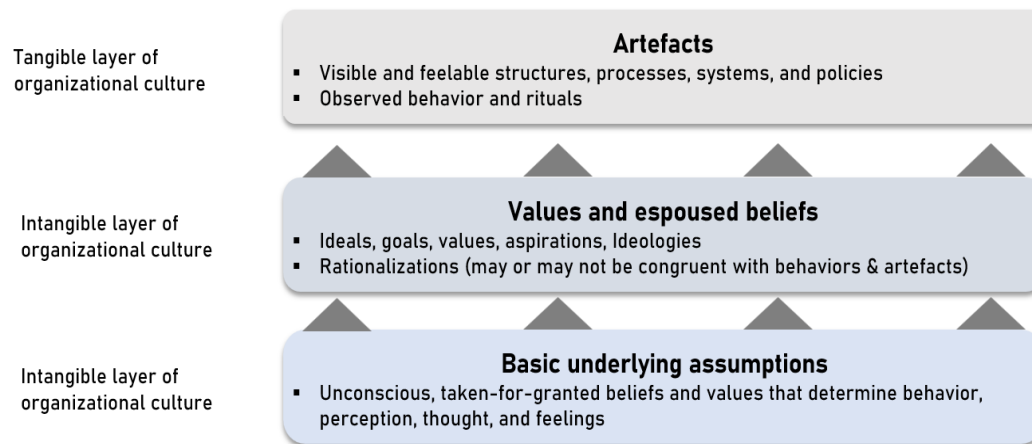
Individuals living a common culture formulate, learn, and transmit their ‘*symbols, languages, beliefs, visions, ideologies, rituals, and myths*’ of organizational actions (Pettigrew, 1979, p. 572) and strategies (Chatman & Cha, 2003). The result is a ‘*system of shared values defining what is important, and norms, defining appropriate attitudes and behaviors, that guide members’ attitudes and behaviors*’ (O’Reilly & Chatman, 1996). Therefore, culture brings a collectively ‘*learned response*’ to the business challenges and business value integrations as the people perform their day-to-day work tasks (Schein, 1990, p. 112). These learned responses encoded in individuals’ minds (Hofstede et al., 2010) tune the idiosyncratic interpretations of business environment, as well internal and external events around them. For example, individuals learn what does and does not work in an organization; the collectively accepted course of actions and the no-go approaches; the ways to correlate to and celebrate achievements; and appropriate ways to share knowledge from the learnings of successes and failures in implementing strategies.

### **Three layers of organizational culture; Artefacts, values, and assumptions**

An organization’s culture is always unique (Barney, 1986), and its manifestation occurs at multiple levels; therefore, culture cannot be nurtured just by a change manager or culture transformation program (Grugulis & Wilkinson, 2002). For example, the culture of an organization manifests at three levels (Figure 11): artefacts, values, and assumptions (Schein, 1990, 2004; Schein & Schein, 2017). A successful transformation needs a ‘*dynamic fit*’ between these levels of cultural manifestation by the people. With a dynamic fit, the social and technical subsystems of an organization sustain mutual support for the people’s values, assumptions and beliefs and artefacts (Osmundsen et al., 2018). Otherwise, the misfit of values, artefacts and tacit assumptions leads to cultural ineffectiveness, that is, the social failure to embrace the strategies for business longevity (Schein, 2009).

Schein’s (1990; 2004; 2009) well acclaim model of values, assumptions, and artefacts has been among the most widely deployed across various strands of scholarship on organizational culture (Giorgi et al., 2015). This model is lately

deployed in the context of digital transformation (Duerr et al., 2018; Hartl & Hess, 2017).



**Figure 1. Three layers of organizational culture, adopted from Schein (1990, 2004) and Schein & Schein (2017)**

**Artefacts** are the visible components in the tangible layer of an organization's culture. For example, structural configurations, business process models, technology and products, the common language and the work style and its environment and industry. Artefacts also include the '*solutions that have worked enough to be considered valid*' for the group of people who work together for a (business) purpose (Schein, 2004). Artefacts as routines and rituals satisfy the curiosity of the people about digital transformation that '*Why we do it that way*' (Schein & Schein, 2017, p. 19). It is established that changing organizational practices (Canato et al., 2013) and artefacts (Pettigrew, 1979) is an essential part of the coercive upbringing of culture. Renewing artefacts can help withstand approval or disapproval of the organizational values.

**Values** are the '*preferable modes of conduct*' guided by the principles for survival in a social circle (Rokeach, 1973). Organizations espouse certain cultural values as their preferred behaviors, including the ones that are publicly announced as vehicles to achieve vision and implement strategy (Maurer et al., 2011; Schein, 2004). Even though these espoused (i.e., publicly announced) values are continual targets for individuals to strive for. However, change-like transformations rely on actionable values to close the gap between aspired business outcomes, practices, and artefacts (Snell et al., 2020). In practice, alongside the publicly informed espoused values, organizations live with a set of actionable values, hereafter referred to as the *values in use* or *values in action*. Cultural values in use are learned from past successful survivals of an organization (Hatch, 1993). Meanwhile, individuals' own values and national culture values continuously shape the *values in action* (Hofstede et al., 2010).

An organization's **values in action** are continuously tested, validated, and learned by/from its people (Hatch, 1993). The people (knowledge workers) live these values while striving for the survival and success of the organization e.g.,



during digital transformation, as well as while trying to accomplish their own goals e.g., priority to learn new skills and get rewarded. Sustaining business success entails continual efforts to bridge the espoused values and values in action (Maurer et al., 2011). The leadership can make or break these bridging efforts (Schein, 2004). Living by the **values in action**, organizational actors learn '*shared tacit*' beliefs and perceptions of tasks, and they manage the interaction between work tasks and social relationships (Schein, 2009, p. 2009). In this sense, tacit refers to the taken-for-granted messages and silently consented beliefs from incentive, reward, and control systems that the organization promotes through its values and artefacts.

Although, shared **assumptions** at large remain tacit, metaphorically speaking, these are the '*DNA of organization*' (Schein, 2004, p. 21). Taken-for-granted assumptions facilitate mental maps in interpreting various situations, deciding the appropriate and acceptable actions and creating awareness of nonconforming shared values and artefacts (Schein & Schein, 2017, p. 23). Examples of cultural assumptions include '*meetings are waste of time*' (Schein, 2017 p. 25); machines will overtake humans 'so we must resist to such technology implementations'; by focusing on high performance, my manager want me to focus on business's bottom line; secrecy is important for a competitive position; our company does not guarantee employment security, so protect yourself—you are own your own; and sharing knowledge with colleagues from other departments will us with less work and can lead to lay-offs in our department. All such assumptions are made new, or existing ones get reinforced within a working community, in a team, in a function or in a department. This making and breaking of the underlying assumptions increases, especially during cross-functional work coordination and while executing a must-do strategy implementation (Schein, 1990).

### **Sociotechnical system's strategic design of culture for strategy implementation**

Human needs must be prioritized for technology driven strategy implementation; therefore, sociotechnical system designs pursue a '*joint optimization of social and technical systems*' (Mumford, 2006, p. 321; Pasmore et al., 2019; Trist & Bamforth, 1951). The target of sociotechnical design is to guide people towards collecting thinking of 'why' of a strategy and 'how' to take the required actions (Arz, 2017; Pettigrew, 1979). Culture holds this collective-thinking style of perpetual and dominant logic to enact the strategy (Mintzberg et al., 1998, p. 269) for technology-driven digital transformations (Jones et al., 2005). Schein's (1990) three layers of culture (values, assumptions, and artefacts) constitute an organization's mind (Mintzberg et al., 1998) to interpret strategy and let the leaders and people develop (digital) capabilities for the implementation of strategy (Abhari et al., 2021; Ghosh et al., 2022).

While implementing strategies, culture acts as a social control system for the building of shared values, assumptions, and artefacts (Chatman & O'Reilly, 2016).

It is not spoken and cannot be touched, yet through an invisible influence, culture determines how well an individual's (or group's) actions fit or do not fit in the organizational context—in this way, culture shapes collective attitudes and behaviors towards strategy (Chatman & O'Reilly, 2016; O'Reilly et al., 1991). Hence, culture looms the constellation of organizational activities equally for both the proponents and opponents of a strategy. Newly joining individuals bring in their own peculiarities to interact and perform tasks as they learn culture and strategy.

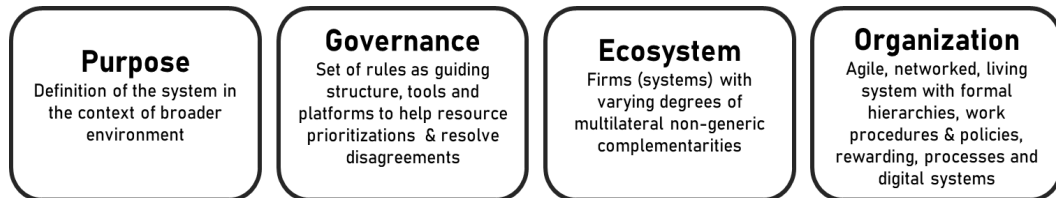
With cultural learning, organizations become idiosyncratic compilations of resources and the work they perform (Schein, 1990). Therefore, any two organizations operating in similar business settings and strategic priorities will have distinguishable cultures. For one organization, the culture may facilitate change to reorient the strategic intent, hence enabling a superior market position. For other organizations, their culture may resist change—leisurely boiling down the competitive parity gained over the years.

Disconnected from strategy; the culture's *artefacts, values, and assumptions* instill unwanted stability, that is stagnation, a form of resistance to the strategy implementation. Consequently, the organization's collective response mechanisms fail to maintain fit with the business environment (Mintzberg et al., 1998). Stagnated culture is just an unseen propulsion for loss-making business operations (Barney, 1986). Once a valuable, rare, inimitable, and non-substitutable resource, an organization culture without the ability to learn new behaviors becomes an (invisible) reason for a lost competitive advantage (Mintzberg et al., 1998). For example, Kodak's (the film company) sluggish cultural response to digital filming technologies led to lost market share, an 80% decline in workforce and stalled the futureproofing of the company (Lucas & Goh, 2009). Despite such recorded cases, the limited literature on cultural preparedness for digital transformation is a known dilemma (Hartl, 2019; Vial, 2019).

Shape and sharpen the culture to support strategy (Schein, 2004) by focusing on *purpose, governance, ecosystem, and organization* design (Figure 12). According to seminal research by Pasmore & co-authors (2019), the strategic design of sociotechnical systems evolves along with its external environment, as does the purpose of the system; it is a part of 'why' industrial organizations exist in the business environment (markets, industry, etc.). Although the purpose needs occasional changes, the strategies to live the system's purpose are subjected to more frequent adjustments coordinated by the governing rules (e.g., resource prioritization, data, information, and stakeholder decision making). These governing rules are relatively rigorous to support the purpose.

Whereas ecosystems thrive with a loosely controlled structure for business value complementarities and attain a competitive advantage; such value cannot otherwise be produced (operationally, economically, and strategically) just with internal governing rules, for example, hierarchical control of one single industrial organization (Jacobides et al., 2018). Ecosystem partners with their shared control

and inclusive decision making are likely to maintain alignment with the external environment (Pasmore et al., 2019). Here, digital technologies provide more opportunities for the contributing organizations (in the ecosystem) to coordinate, build mechanisms with their shared purpose, and prioritize resource investments (e.g., through purpose-built digital platforms).



**Figure 2. Four components of sociotechnical system's strategic design adopted from Pasmore et al. (2019)**

An organization's structure, work procedures and policies, rewards, processes, and systems network the people (Grugulis & Wilkinson, 2002) with its purpose, governance, and ecosystem. The embraced strategic design of culture leads to digital congruence (Kane et al., 2016) between people, policies, processes, structures, and the work required for strategy execution. In leading transformation, '*culture is all about execution*' (Chatman & Cha, 2003, p. 21). Strategically designing culture as a key resource mitigates the risk of '*embarrassing secrets*' (Rumelt, 2011, p. 209) and '*what can come into being*' during strategy execution (Mintzberg et al., 1998, p. 283) while leveraging digital technologies (Nadkarni & Prügl, 2021; Verhoef et al., 2021).

### **Empirical research on organization culture as an enabler for digital transformation**

Digital transformation success and organizational culture have been highlighted in the literature (Gurbaxani & Dunkle, 2019). In fact, such directives on new information technologies (IT) driven transformation and organizational culture have been studied for decades (Leidner & Kayworth, 2006; Olson, 1982). It has been recognized that culture moderates the development of information technology, the developers, the process of development and the users (Kappos & Rivard, 2008). However, in the digital age when '*the very nature of strategy is changing*', the leaders must consider both '*within the firm and in the ecosystem*' cultures (Volberda et al., 2022, p. 5). Failure to address organizational culture impedes the digital transformation of traditional organizations and their business ecosystems (Kolagar et al., 2022). Despite repeated emphasis on the need for culture-enabled digital transformation (Warner & Wäger, 2019), research on how organizations design such a culture is conceptual and advisory in mainstream journals (Kiefer et al., 2021; Kolagar et al., 2022; Nadkarni & Prügl, 2021; Verhoef et al., 2021; Vial, 2019; Volberda et al., 2021). Furthermore, business strategy scholarship's most guidance for the business practitioners is based on literature reviews and secondary data. Only a handful of empirical research on organizational culture in the context of digital transformation has been published

(see: Table 10). Insufficient articulation of culture enablement of digital transformation is also captured in the Table 10.

Early research on IT-supportive culture has identified social influence, performance expectancy, facilitating conditions and the expected effort impacts on individuals' behavior to adopt IT technologies (Dasgupta & Gupta, 2010). A qualitative analysis of secondary data by Berghaus and Bac (2017) shows the importance of top management's role in enabling such adoption through digital cultural. Deploying a conceptual framework (Ostroff et al., 2020) for Hofstede's framework for digital culture, Abhari et al. (2021) studied how employees' positive experience and digital governance support the digital transformation; they proposed that collectivism, power distance, uncertainty tolerance, long-term orientation, and indulgence influence digital culture.

Similarly, Rubino et al. (2020) deployed Hofstede's framework to find the national culture's impact on the European firms' digitalization. Their findings show significant (inverse) relationship masculinity, uncertainty avoidance, and individualism, while indulgence positively improves digitalization. However, power distance did not show significant impact to digitalization. According to their study a long-term orientation in national culture does not influence the digital technology driven transformations (Rubino et al., 2020) – however, this finding is not aligned with strategic management literature that advocates firms to focus on long-term digital success (Kane et al., 2016; Parida et al., 2019; Porter & Heppelmann, 2014, 2015).

With the Delphi method application, Hartl and Hess (2017) identified twelve (12) cultural values that have a role in the digital transformation of organizations: openness towards change, agility, tolerance towards failure, willingness to learn, participation, cooperation, customer centricity, entrepreneurship, risk affinity and innovation. Compared with the CVF (competing value framework), clan and adhocracy cultural types foster digital transformation (Hartl & Hess, 2017). Digital culture positively impacts the adoption of digital technologies and business value development (Martínez-Caro et al., 2020). Schein's (1990) three layered cultural model (Figure 11) for digital transformation has been proposed by Duerr et al. (2018) as one conceptualization of digital organizational culture artefacts, values and beliefs and underlying assumptions.

Table 1. Recent empirical research on digital transformation culture

Reference	Methods	Research focus and relevant findings	Opportunities for the current research
(Abhari et al., 2021)	Survey-based exploratory study; PLS (quantitative) analysis of 260 survey responses.	Theorizing the digital culture relationship with employee experience. Proposed the components of digital culture: collectivism, power distance, uncertainty tolerance, long-term orientation, and indulgence. The results indicate that expect a long-term orientation and digital culture to have a positive effect on employee experience.	Digital transformation and digital culture are used as synonyms. What values and assumptions could drive long-term strategic orientation towards digital transformation.
(Berghaus & Back, 2017)	Activity theory and activity system study. Qualitative analysis of <u>secondary</u> data about the digital transformation programs in 11 organizations.	Organizational activities that enact digital innovation transformation strategy as a disruptive change. In the early phase of digital transformation, top management has the responsibility of organizational culture change. Collaboration platforms promote work coordination between different parts of the organization, hence influencing the company culture.	Although their research did not adopt cultural centric adoption, the understanding on ' <i>how to navigate the fuzzy front end of digital transformations more successfully</i> ' was not addressed. Thus, the activities of cultural upbringing appear in isolation from the transformation itself. Rather than a rapid change event of a short duration, the digital transformation supported by cultural upbringing is a long-haul effort for aligning the organization's purpose and executing strategies.
(Dasgupta & Gupta, 2010)	Single case study based in a developing country; quantitative regression analysis of 102 survey responses.	Technology acceptance model study. Factors influencing the acceptance and adoption of information technologies and systems. Organizational cultural factors of social influence, performance expectancy, facilitating conditions and expected effort impact on individuals' behavior towards adoption.	Single case study in a government sector. Male dominance in responses. Influence of national culture and of government institutions with high power distance.
(Dubey et al., 2019)	Institutional theory; resource-based view; and organizational culture. Survey-based 127 responses;	Data for improved organizational performance and how external pressures affect the data culture. Big data culture significantly moderates big data and predictive analysis	Dubey et al.'s research ' <i>results provide an initial step for researchers to investigate how</i>

	quantitative data analyzed with structural equation modelling.	capabilities in manufacturing organizations.	<i>organizational culture can further explain the adoption'</i> (p. 355) of digital technologies. There is a call to understand how such culture develops.
(Duerr et al., 2018)	Exploratory study: eleven case studies and data collected via with 27 interviews.	Schein's mode to identify artefacts, values and beliefs and the underlying assumptions of digital culture. The first study with explicit identification of the facets of digital culture.	Their research opted for generalizability, which might have led to obscure understanding of the applicable facets. For example, the espoused values were investigated but not the values in action as a facet of digital culture. Contextual understanding of ' <i>digital organizational culture</i> ' is necessary. These researchers ' <i>see promising avenues for future research in looking deeper into these constituents</i> ' (p. 5134)
(Ghosh et al., 2022)	Exploratory study; five case companies; 25 interviews.	Dynamic capability perspective of digital transformation. Development of digital transformation capability (DTC) by specifically reconfiguring the existing capabilities is organizational culture dependent. Shifting from an old mindset to a new mindset is the responsibility of transformative culture.	' <i>Cultural transformation capability is a key to DTC</i> ', while there is a gap about how culture drive mindset reconfiguration, which makes digital transformation capability dynamic.
(Hartl & Hess, 2017)	Exploratory research; Delphi method; 25 respondents (15 practitioners; 10 researchers).	Twelve cultural values that have a role in digital transformation success. Positioned these identified values using the competing value framework (CVF). Research identified that the adhocracy and clan culture types contribute to digital transformation.	These researchers emphasize the call for future research that ' <i>how, and with what measures organizational values can be changed to reach the ideal target culture supportive</i>

			<i>of a successful digital transformation'</i> (p. 8).
(Martinez-Caro et al., 2020)	Quantitative study of a multinational company; survey data from 93 respondents.	Digital culture positively impacts the adoption of digital technologies for business value development. The research offered a potential definition of digital culture from the perspective of strategic planning: a means through which an organization can begin to plan for digital strategies in a rapidly changing environment.	The findings of their research are quantitative and ' <i>may not be relevant when addressing strategic aspects'</i> (p. 9). The apparent outcomes are attributed equally to the digital culture. A look at the specifics of digital culture, how digital culture design, cultivation, shaping, and nurturing happens in practice.
(Rubino et al., 2020)	Quantitative study of 27 European countries' secondary data on digitalization, cultural dimensions, and innovation from 2014 to 2018. Selected data was picked collected by four different databases.	Deployed Hofstede's national culture framework to show the national culture's influence on the firms' digitalization. The findings show significant (inverse) relationship masculinity, uncertainty avoidance, and individualism, while indulgence positively improves digitalization.	These findings are based on secondary data. Rubino and the co-authors highlighted, ' <i>second limitation is connected to the increasing level of globalization, which alters the cultural context in which firms operate in complex and obscure ways</i> (p. 1575).
Warner & Wäger, 2019	Qualitative study of dynamic capabilities for digital transformation. Data collected from 7 global firms located in Germany. Thematic analysis of data from published reports and 18 in-depth interviews.	Firms strategically build dynamic capabilities for digital transformation: digital sensing, digital seizing, and digital transforming capabilities. Digital Transformation is an ongoing process for the strategic renewal of business models, collaborative approach, and organizational culture.	Provides high level statements for the refreshed culture as strategically renewed by digital transformation process. These findings offer a foundation to examine culture as a resource to build strategic capabilities " <i>... and how corporate cultures can be refreshed...</i> " (p. 345).

In their seminal case study of dynamic capabilities for digital transformation Warner & Wäger (2019) identified culture as enabler for digital transformation. These authors brought high level statements from the incumbent case organizations who refreshed their cultures during the digital transformation process. Meanwhile, their study acknowledges the pressing demand from academia and practitioners to explore “*how corporate cultures can be refreshed*” (Warner & Wäger, 2019, p. 345) to enable digital transformation in traditional organizations. In another similar study Ghosh and co-authors (2021) conclude that how such culture can drive the mindset change for digital transformation dynamic capabilities.

### **Methodology**

The current research is a diagnostic multi case study of the cultural changes (Janićijević, 2011) in the context of digital transformation (Canato et al., 2013; Giorgi et al., 2017). The research aim is to understand how culture as a key enabler (Rumelt, 2011; Warner & Wäger, 2019) for strategy implementation can be designed for digital transformation of industrial organizations. While digital transformation is a contemporary, sociotechnical, and in-progress phenomenon; a qualitative case study best suits opening the black box of idiosyncratic characteristics (Yin, 2013) of three layers of organizational culture (Schein, 1990, 2004). Our starting point of digital transformation as an outcome of digital information technology adoption in business operations evolved as the research progressed. We learned digital transformation is an on-going phenomenon, rather than an end goal (like Warner & Wäger, 2019). During the data collection, we further discovered distinguishable paths each of the case organization embarked on their digital transformation journey. This essentially required our approach to seek for the applicable theories as the research progressed – the development of research case data informed us of the applicable theories, not vice versa. Such an abductive grounded theory approach allowed for the systematic combining of the exploratory findings from our three research cases (Dubois & Gadde, 2002). As a result, we unravel the deliberately learned values in action, reconstructing assumptions and prioritized artefacts that form novel sociotechnical behaviors to enable digital transformation in globally operated industrial organizations.

### **Research cases and the case selection process**

The case selection was based on methodological expediency (Schofield, 2012), which combines the elements of criterion sampling and convenience sampling (Fletcher & Plakoyiannaki, 2011). The foremost criterion for case selection was globally operating industrial organizations pursuing the adoption of digital technologies as strategic transformation initiatives or programs. The second criterion was a few common characteristics in the leadership, national/regional cultures, and organizational culture e.g., organizations where senior leaders are headquartered in Northern Europe, preferably from Nordic countries. The third, however, implied criterion was to focus on industries related to energy and the



environment. Just because these industries have a sense of urgency to act quickly to save our planet and digital technologies are one acclaimed opportunity for future business proofing. With inductive grounded theory method, we initiated our approach to a few industrial organizations who publicly report digital transformation as strategy.

Our discovery for the research case concluded with the identification of four globally operating multinational industrial organizations headquartered in the Nordic countries. However, one of the selected case companies apologized for continuing to share data after the first round of data collection. Hence, the data analyzed for this research is from three (3) globally operated industrial organizations. These organizations are world-renowned brands in their business segments. The footprint of their infrastructure (manufacturing plants, logistics centers, customer service units, and supplier and partner network) are spread over multiple locations in Asia, Africa, Australia, Europe, and North America. Hence, their organization cultures are complex enough to be learned from national culture dimensions.

For the year 2020, the combined business revenue of these three cases accumulated to over twenty billion euros (20B€). In the annual reports for 2022, these case companies have several mentions of successes in their digital transformation journey e.g., expanded end-to-end digital ecosystem, extended portfolio of digital service solutions, and end customer digital interfaces for operations & lifecycle support. All three case companies experienced business revenue growth increase to approx. twenty-four billion euros (24B€) in 2022. Introduction to the case organizations is presented in Table 11, and further contextual details are documented in Appendix A. Permission to conduct research in the case organizations was subjected to nondisclosure agreements (NDAs).

**Table 2. Contextual information about the case companies as of 2020**

<b>Research data origin</b>	<b>Case A</b>	<b>Case B</b>	<b>Case C</b>
<b>Business focus</b>	Offshore & Onshore Energy	HVAC and Electric Power	Wood Processing and Energy & Power
<b>Business footprints</b>	World-renowned brand in energy industry; multinational with six manufacturing sites across the globe; four business units; multibillion € annual sales; approx. 20,000 employees; main location of leadership and headquarters in Nordic countries.	World-renowned brand in its industry; multinational with 71 manufacturing sites across the globe; four business units; multibillion € annual sales; over 20,000 employees; main location of leadership and headquarters in the Nordics.	World-renowned brand in industry; multinational with 51 manufacturing sites across the globe; four business units; multibillion € annual sales; approx. 20,000 employees; main location of leadership and headquarters in the Nordics.
<b>History</b>	+150 years history of product and project engineering and manufacturing; Nordic company; multiple businesses units and segments; competitive product and service portfolio.	+ 80 years old product and project engineering and manufacturing; Nordic company; multiple business units and subunits; competitive product portfolio.	+120 years history as process and manufacturing; Nordic company; multiple business units and segments, most diverse product, and assets portfolio.
<b>Digital transformation strategy</b>	A separate dedicated digital organization was developed by hiring Chief Digital Officer to lead the digital transformation as a strategic priority.	Digital transformation strategy implementation responsibilities dedicated to the business segment's heads.	Digital transformation strategy implementation responsibilities dedicated to business unit heads.
<b>Business results 2020</b>	> 4.5 B€	> 7.5 B€	> 9.5 B€
<b>Conducted interviews</b>	Nineteen (19)	Eleven (11)	Eleven (11)

### Data collection and analysis

Data collection for the incumbent paper was accomplished within a wider scope research project wherein the researchers' aim is to explicate digital transformation phenomenon from a sociotechnical system perspective (Davis et al., 2014; Mitki et al., 2019). An inductive grounded theory approach (Gioia et al., 2013) of two-phase data collection was deployed for the whole project, and the data collection was accomplished during 2019 and 2020 (prior to the COVID-19 pandemic). The research data (interviews and secondary data) was recorded in *NVivo 12* project database, and the data analysis was performed in *NVivo 12*.

In the data collection 1<sup>st</sup> phase, we begin collecting publicly available documents (e.g., social media blogs, marketing materials, business reports, recorded interviews of executives and companies' websites). We initiated the search for the

key informants in these case companies based on their publicly revealed profiles at the globally reached social network for professionals, LinkedIn. The research team then deployed their own professional network to approach these short-listed experts, and emails were sent wherein we attached the research project objective and assured their anonymity during the process. Those who positively replied with the confirmation of their substantial role in the digital transformation were selected as key informants for the 1<sup>st</sup> round of interviews. In total, twelve (12) key informants participated in open-ended interviews face to face or via video calls (via Skype, Teams or Zoom). These key informants made prominent contributions to their digital transformation programs and held influential leadership positions in the case organizations. The first-phase findings led to the identification of common enablers and targeted performance outcomes of digital transformation in our case organizations. Organizational culture was identified as one of the digital transformation enablers.

The first round of the data collection, key informants also recommended the experts and leaders for the 2<sup>nd</sup> phase of data collection. In the 2<sup>nd</sup> phase, we contacted the recommended experts via emails that were attached with the research guide. Participation was on a voluntary basis and was not mandatory. Those experts who agreed to share their insights as anonymous respondents were interviewed face to face or via video calls (via Skype, Teams or Zoom). The 2<sup>nd</sup> phase of data collection primarily comprised of these semi structured interviews.

During interviews, the research team explicitly asked questions about how culture was enabling or restraining digital transformation. Naturally, initial discussion about culture for digital transformation was limited to narration of espoused cultural values written in the company's annual reports and on social channels. However, upon investigating how in practice those espoused values enable the whole culture; the interviewees acknowledged that communication around those (espoused) values alone was not enough. Instead, they urged that culture must be reconstructed by walking the leadership talks. Earlier referenced literature has the similar guidance that strategy implementation needs to go beyond *espoused values* and focus should be the *values in action*. Furthermore, our follow up inquiries into the operationalization of culture as an enabler for digital transformation as strategic initiative, let the experts elaborate with examples of the values in action and the underlying assumptions that leaders should strategically reconstruct the culture. It is relevant to mention explicitly that as the researchers were learning the digital transformation as a phenomenon and associated changes, learning the prioritized cultural artefacts did not require separate questions.

Most of the interviews (1<sup>st</sup> phase as well as 2<sup>nd</sup> phase) were conducted by two members of the research team to ensure dependability and consistency. The recordings from the interviews were transcribed with the help of a commercial service company. These interview transcripts comprised more than 500 pages. The list of interviewed experts is given in APPENDIX A.

The case study records in NVivo database helped the research team maintain a clear chain of evidence from data collection till the formation of findings (Beverland & Lindgreen, 2010). In the first stage of analysis, one of the authors proofread the transcriptions, and then, the research team did initial coding of the complete data by segmenting the statements related to cultural values, assumptions, and artefacts. In the next stage, following Gioia et al. (2013), excerpts from these coded statements were sorted as first-order **concepts**. Then these concepts were further categorized in the second-order **themes** of culture (Schein, 1990, 2004), and associated these themes with the **aggregate dimensions** of strategic design (Pasmore et al. 2019). These concepts, themes, and aggregate dimensions are the collective values in action, assumptions for reconstruction (of the culture) and artefacts, are prioritized by our case organizations as strategic design of culture that enables digital transformation. Our approach is aligned with Sætre & Ven De Ven's (2021) abductive (inductive-deductive) theory building. The data structure as the outcome of our thematic analysis (Gioia et al. (2013) is presented in APPENDIX B.

### Findings

Interestingly, all three case industrial organizations aim at **customer centrality**, **agility**, and extended **collaboration** as their main yet gradually attainable outcomes from digital transformation strategy implementation. Meanwhile, most the interviewees mentioned customer centrality as the prime target because they *'...really want to be customer centric and serve the customer throughout the life cycle, as one company'* [VP] and *'it's basically everything and anything we're looking into digitalizing or making the customer experience more digital'* [SMDT]. It is the people who enabled digital transformation starting from the strategy formation process: *'the mixing of digital experts with business experts, so the combination of digital expert knowledge and business expert knowledge draws the path of digital transformation strategy'* [GH]. This involves a new approach to strategy, as highlighted by an interviewee, *'that there is no more strategic planning or yearly plans, there is no more project linear execution. It's always about being able to adapt to change, based on the new information, changing markets, and changing situations'* [SMDT].

Digital technology-based business models are demanding for traditional industrial organizations whose success is primarily built up of product and/or transactional services. One of the interviewed vice presidents explained that *'we are trying to promote such a sort of mindset that whatever you do, you must involve customer cocreation. Only then we can move from being a product-oriented company to being a service-oriented company'* [VP]. Meanwhile, there exists the acknowledge that digital opportunities can be better capitalized to *'work with external partners to actually sort of accelerate some of the stuff in the beginning'* [VP]. Strategizing for *'digital transformation is giving us a different playground that goes more like agile-based trial'* [VPIT]. For a traditional industrial organization, *'it's a change of culture. We need to be faster, and we need to have more services than products'* [MDIT]. Leadership needs to engage people to this *'mindset change and cultural*

change that is happening right now' [GH]. The following subsections summarize the strategic design of cultural values in action, reconstructing assumptions, and prioritized artefacts in the case organizations.

a) Strategic design of cultural values in action

Our case industrial organizations are focusing on **approach holistically, co-creating with customers** and **aim at renewals** as their prioritized values in action for their business purpose (Figure 13). Digital transformation in a product-centric industrial organization needs upgrading the organizational purpose by cocreating the business value together with their customers because, in the end, the customer knows the best solution they expect. One contextual factor for the renewal of business purpose is that the energy and environment industries are going through transformation. Such an all-time service and solution value proposition needs a holistic approach to the different aspects of organizing people and the business stakeholders. Digital technology advancements are enabling this holistic (lifecycle service) approach, yet at viable costs.

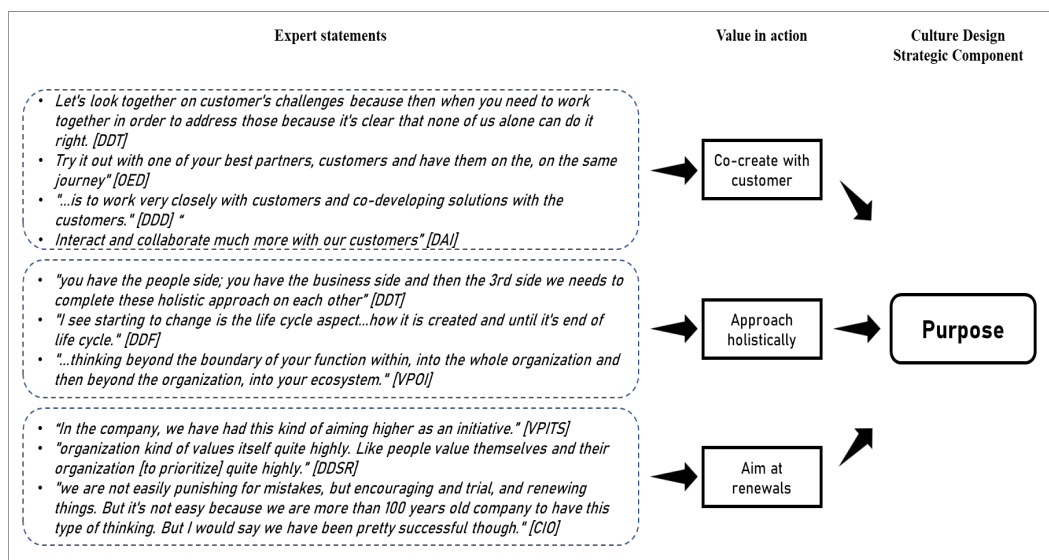
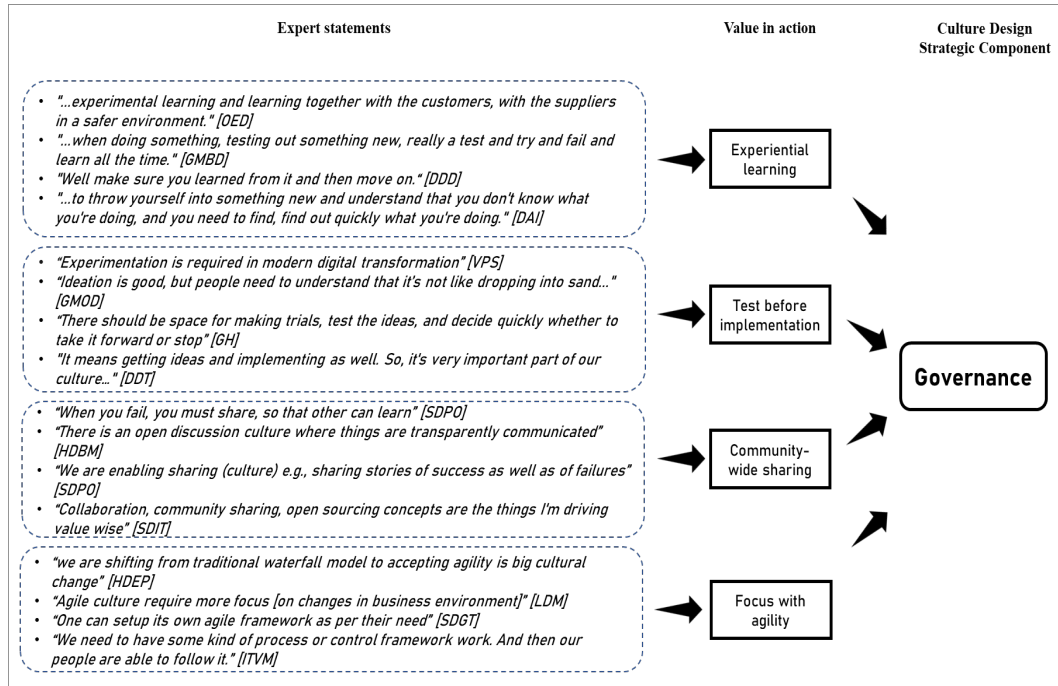


Figure 3. Cultural values in action to enable the 'purpose' of digital transformation.

Digital transformation governance needed **experiential learning, test before implement, community-wide sharing** and **focus with agility** as the cultural values in action (Figure 14). A culture for learning from experiments is inclusive of trying and failing. An experiment-focused inclusive culture also builds a testing mindset prior to implementation, that is, encouraging people to ideate in a way that the ideas for doing new things can be tested in a real-life setting, for example, by prototyping. Testing innovative ideas increases the success likelihood, gives deeper learning, however ideas fail, too. The pace of change that industrial organizations are experiencing is unprecedented; sharing successes, learnings, and failures openly and across the community is essential for digital transformation governance. An extended community-wide sharing reduces the

cost of experimentation and increases the likelihood of idea-to-value conversion. A mix of traditional governance mechanisms and agile approaches, frameworks, processes, and performance follow-up safeguard experiential learning. Agile must not create a distraction from governance, instead focusing efforts to capitalize and the best opportunities to the whole community.



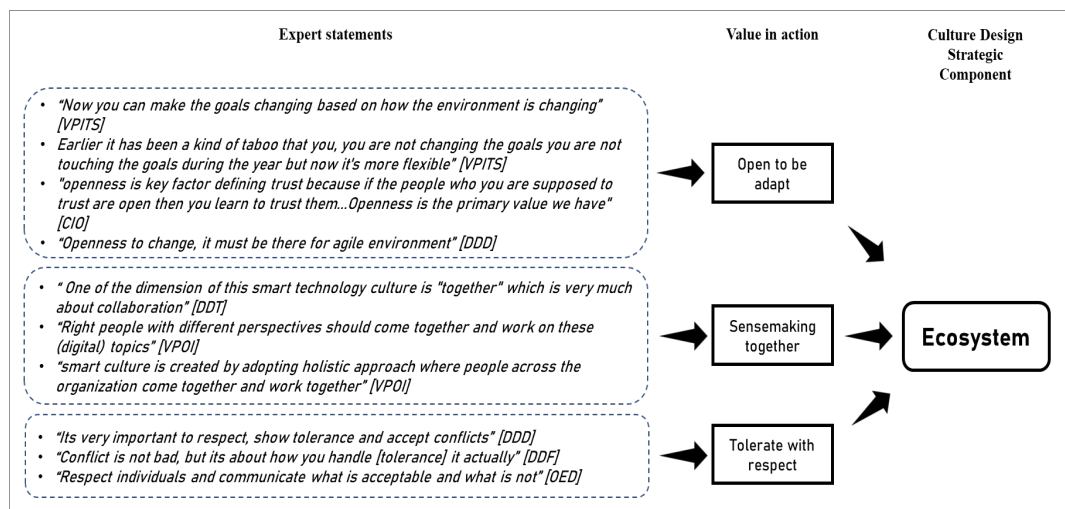
**Figure 4. Cultural values in action to enable the 'governance' of digital transformation.**

The case industrial organizations are positioning to 'serve the customer throughout the life cycle' [VP], by bundle-up the value offerings from multiple actors in their industries. Their culture for ecosystem collaboration is evolving by being **open to be adapt, sensemaking together, and tolerate with respect** as values in action (Figure 15). One of the interviewed executives highlighted,

*'... thinking beyond the boundary of your function within, into the whole organization and then beyond the organization, into your ecosystem. Because the answer of filling that gap may or may not lie right there in front of me. It might lie at my customer and my supplier somewhere else in the ecosystem that I need to bring in.'* [VPOI].

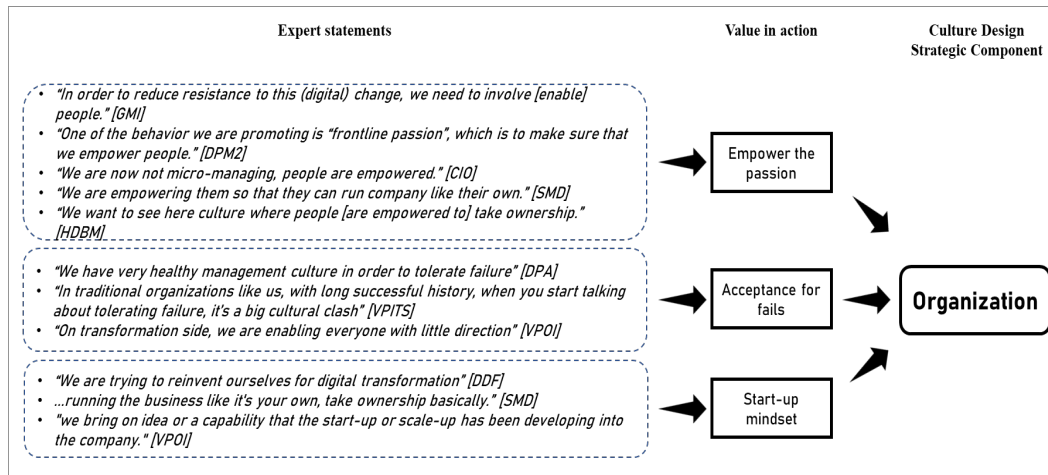
The ecosystem partners prepare their collaborative and dynamic response to the environmental changes without compromising the value generated by one industrial organization or value complementarities offered by partners. In the case organizations, the leaders see the ecosystem as a platform to give-and-take sense

of environmental changes through collaboration and conflicts during ideation, experimentation, implementation, and learning. Although openness to environmental adaptations is a prioritized cultural value, the walk the talk of this value (open to be adapt to digital solutions) is complemented with the shared sense of partners' adaptations, too. Collaboratively tolerating the opportunities with the best value complementarities for the ecosystem over one's own best interests. Toleration in ecosystem is flourishing with respect, listening and careful communication. This includes (both) agreeable and non-agreeable choices in the interest of the whole ecosystem.



**Figure 5. Cultural values in action to enable the 'ecosystem' for digital transformation.**

The new values of a **start-up mindset**, **acceptance for fails** and **empower the passion** (Figure 16 **Error! Reference source not found.**) are bringing in ownership, empowerment, and collaboration. The aim with a start-up mindset is that culture will support the rise of shared sense in people in case they detect misalignments between the actions and the desired future (purpose) towards which the case organizations must renew and reinvent. The interviewed experts mentioned that such reinventing involves crossing the chasm of the organization's history. With empowerment for passionate people, crossing the chasm and adapting to environmental changes is the way forward—it is accepted that a few attempts to cross the golden history chasm are not fruitful. The culture of accepting such fails, giving shared space and just enough direction so the empowered people are willing to try, and try again, with the same passion.



**Figure 6. Cultural values in action to enable the 'organization' for digital transformation.**

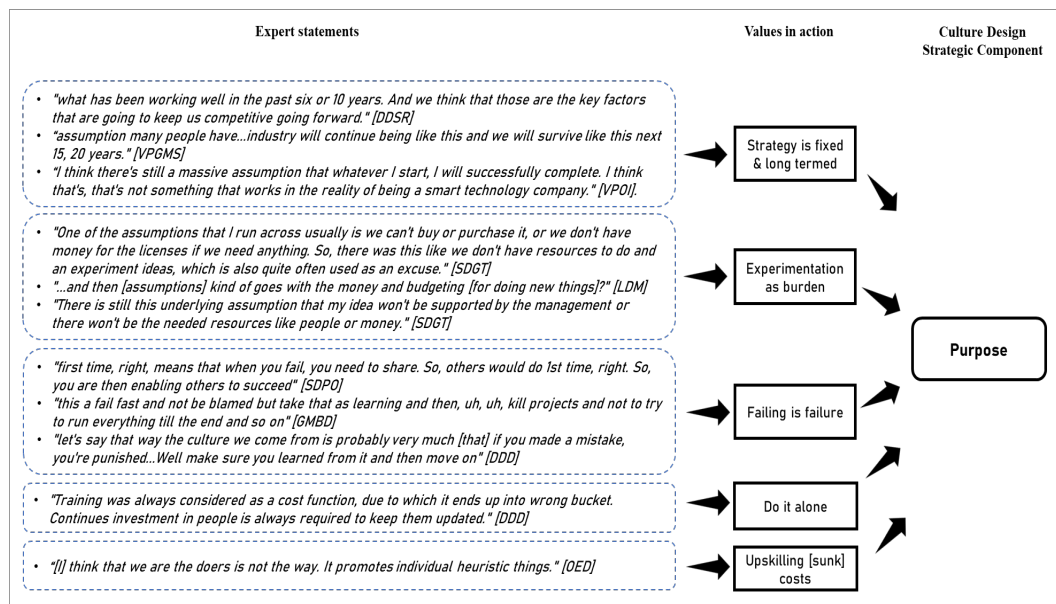
The newly injected culture promises the reconstruction of 'shared tacit' beliefs and perceptions in our case companies. These findings are as outlined in the succeeding sub-section.

b) Strategic design of targeted assumptions for cultural reconstruction

As per the findings, people assumed a growing role in setting the organization purpose. Themed assumptions related to the purpose are as follows: **strategy is fixed and long term, do it alone, upskilling [sunk] cost, experimentation as burden** and **failing is failure** (Figure 17). As the purpose of industrial organizations shifts from product-centric to service-oriented life cycle support to the customers. Leadership in our case companies have recognized that strategy is not company policy; instead, it is a dynamic set of choices they make amid multiple substitutes possible with digital technologies. Strategic choice-making is continuous, thoughtful, and built over small however rapid experimentation with digital opportunities. On the other hand, own people's upskilling is an opportunity investment rather than a sunk cost.

We learned that '**experimentation as burden**' is one fundamental assumption the leaders in the case company are reconstructing. Three cases in this research approached experimentation (exploration) differently. One of our case organizations established a separate resource unit dedicated to digital transformation, while the other two cases built the resource capacities within the individual business units and support functions. These resources were empowered to experiment and allowed to fail. Failing as a risk reduction strategy is considered a significant response to altering people's mindset from resource wastage and towards opportunity validation. An interviewee stated that '*fail often, fail fast. It's a risk reduction strategy. It's not a risk. You don't need to take more risks, as quite the opposite*' [SDIT].

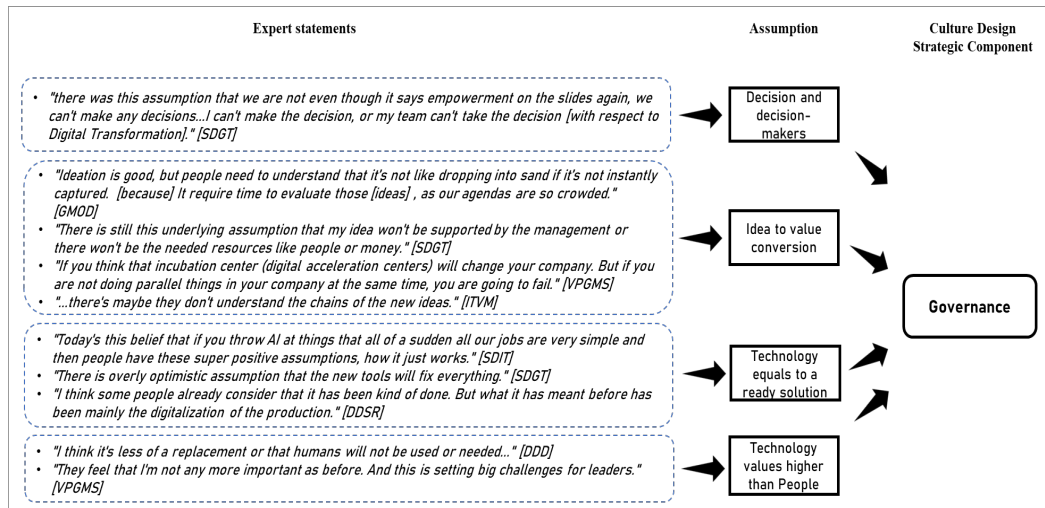




**Figure 7. Cultural assumptions under-construction to enable the 'purpose' of digital transformation.**

Digital brings (positive) uncertainty regarding the efficient running of operations (today) and strategies (tomorrow) as acknowledged by the interviewees; however, transformation cannot be implemented without functioning governance. The uncertainty-laden governance process is less known in (primarily) product-driven industrial organizations. The leaders saw a need for the deliberate inclusion of controlled uncertainty. Reconstructing the assumptions for **decisions and decision-makers, idea-to-value conversion, technology equals to a ready solution, and technology [does not] values higher than people** were found to support the governance of digital transformation (Figure 18). Not surprisingly, the assumption of knowing all (history long) customer needs made the idea to value generation suboptimal. Such assumptions do not leave room for detailing the unknown (or newly developing) expectations of customers and ideating with partners in the ecosystem:

*'A lot of people, you know, used to doing work at the same time as for the last 15 years, so it's kind of innovation and agility will take them out of their comfort zone, and there's maybe they don't understand the chains of the new ideas.'*[LDM]



**Figure 8. Cultural assumptions under-construction to enable the 'governance' of digital transformation.**

Empowerment is critical to the outcome of collaboration; however, resting on existing assumptions potentially slows down the idea-to-value generation process (i.e., decision making is slow). Another category of assumptions holding back collaboration is to doubt human decision making. Because the assumption is that technology offers more robust decision making with unmatched speed of processing data. Such tacit beliefs ploy fear among people of being redundant. Such fears are further fueled by the tacit belief that **technology values higher than people**, especially when leaders overwhelmingly advocate data-backed decisions. Overemphasis on technology as a superpower is holding back people's creativity. It is recognized that leadership and people's (assumed) expectations from digital technologies are demanding to be achievable in a shorter timescale. There is also the realization that digital technologies offer opportunities and that going digital can make serviceability faster and at lower costs; however, technology readiness does not mean the readiness to adopt as a ready-made solution.

The strategic design of culture in our case organizations contains the assumptions about working in an ecosystem. A fundamental reflection has been the historical pride in the ability to first define customer problems but also then solve those problems alone. Such cultural assumptions are ecosystem destroyers, for example, 'we know how to work this out ourselves'. Leaders in all three cases acknowledged that such assumptions need fundamental reconstruction. The 'reality is that we may not have all its takes' to satisfy the lifecycle needs of customers. Ecosystem approach is enabled by reconstructing assumptions around **customer expectations, complexity fear, collaboration costs, engineer and customer collaboration, inward orientation, and trust in the empowered** (Figure 19).

Digital technology enables reach to customer triggered arguments that 'who owns' customer. Assumption is that customers have 'diverse and demanding requirements', and that fulfilling their needs leads to costly products and services.

Whereas the leaders acknowledged that custom-built solutions are though complex, however, can bring a sustainable competitive advantage. Such competitive advantage builds up with nongeneralizable complementarities between the ecosystem partners. In practice, empowered experts should be able to lead collaboration with partners in the ecosystem to design and implement such complementarities together with customers. In ecosystem, assumptions holding back knowledge sharing can affect social acceptance and trust in the decisions made by these empowered experts.

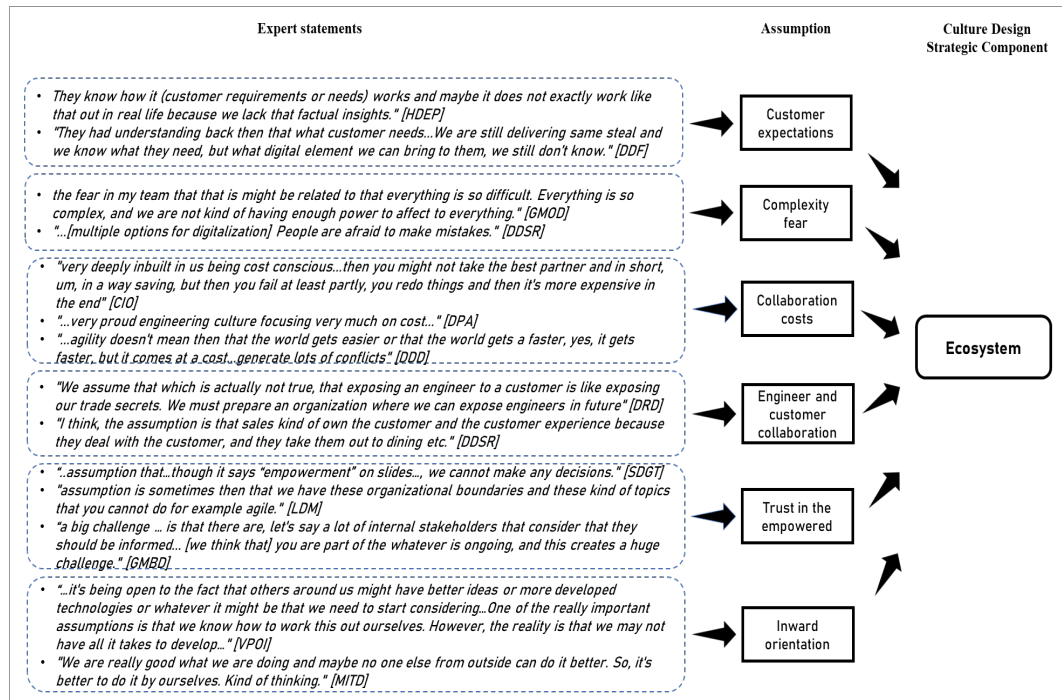
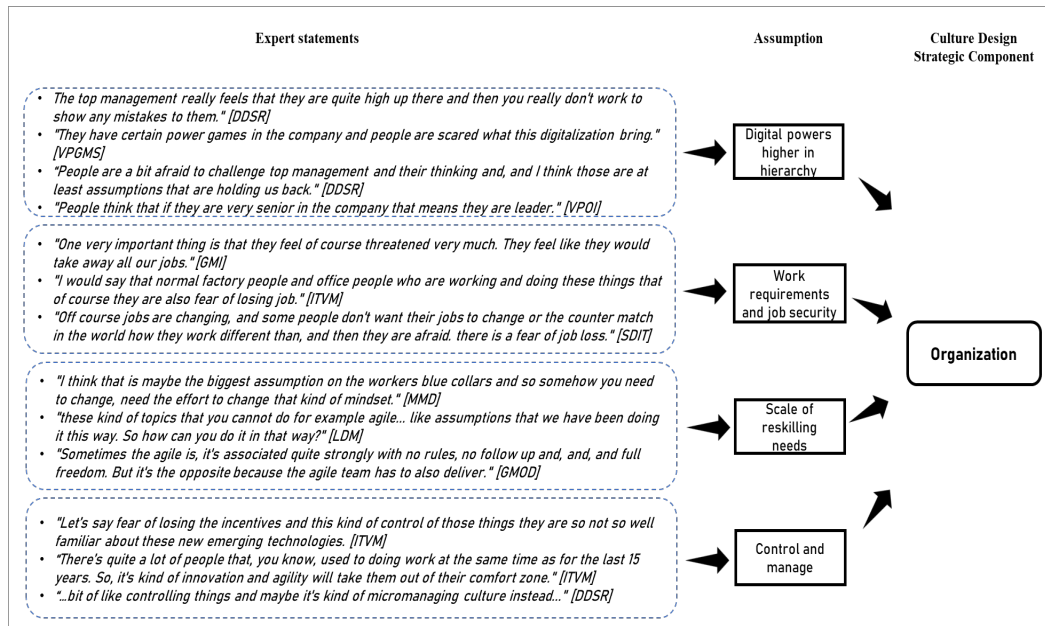


Figure 9. Cultural assumptions under-construction to enable the 'ecosystem' for digital transformation.

In our case organizations, the assumptions about **digital powers higher in hierarchy, work requirements and job security, scale of reskilling needs, and control and manage** were under reconstruction (Figure 20). In power-laden, top-down hierarchies, digital further cements the power with those managers at the top. In certain situations, 'to be digitally transformed' was taken by the people that the management wants more data. Poor data quality as a looming issue is in management meetings further rampart such assumptions that digital technologies are powering the top in the hierarchies. In return, people are feeling insecure at work.



**Figure 10. Cultural assumptions under-construction to enable the 'ecosystem' for digital transformation.**

Because digital brings new ways of working, eventually, people assume to bear the burden of adapting to the new work methodologies and maintaining high-quality data, all of which must be learned at an unprecedented pace. The assumptions of '**scale of upskilling needs**' reinforce the tacit beliefs that individuals are solely carrying heavy burden of their upskilling. The hiring and firing of people outweighing the digital competence and digital jargon is another pinch to the cultural design requirements. While limited people get involved in experimentation with digital technologies, for rest of the organization upskilling felt like the ask is to learn everything or leave the work to someone else. As leaders highlighted by the following:

*"We tried to propose and to suggest people let us help you in improving your processes and ways of working by implementing robotic process automation. Yeah. And you know, we have literally people commenting, why should I do this so that I lose my job?" [DDT]*

*"There is fear that if we implement now for example, robotic automation so some of those things happening with the manpower utilized own teams and functions will be totally let's say in the black box. So, they are not controlling anymore." [ITVM]*

Who is in control, people or digital? Fundamentally, this is a collective assumption around the human needs to feel secure in a sociotechnical system. Digital brings speed and leaves limited (not enough) time for the usual followed-up of details. Here, people assume that digitalization relinquishes their control and further

concentrates the power in the top hierarchies whereas their job incentives and security were already at risk.

c) Strategic design of prioritized cultural artefacts

The digital transformation driven artefacts are visible (identifiable) in our case companies. It has been acknowledged by the interviewees that renewing artefacts withstands approval or disapproval by the people. Artefacts' congruence with cultural values takes a considerable role. Hence, certain artefacts were prioritized while the new cultural values are lived by the leaders to reset the organizational tacit beliefs (assumptions). According to our findings, a prioritized focus is on making **celebration rituals** to bring a sense of belonging whether a team fails or succeeds. Such wholehearted celebrations, in conjunction with the **rewards for desired behaviors**, guide people to pursue an organization's strategic purpose (Figure 21).

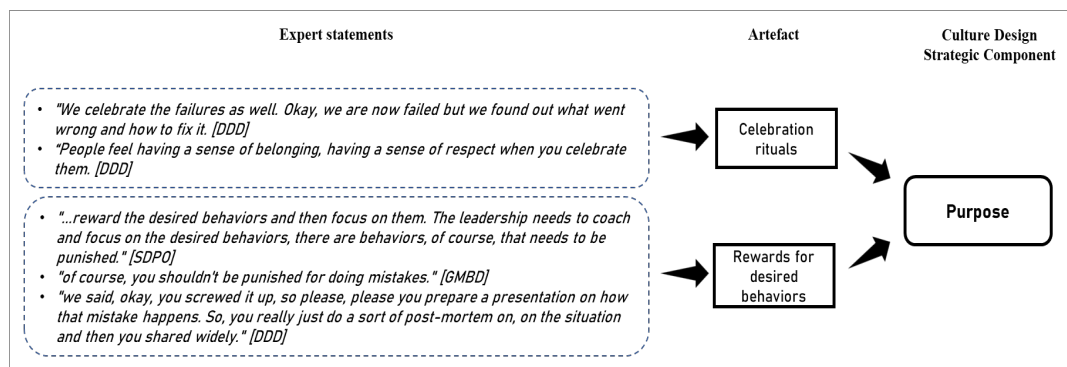


Figure 11. Cultural artefacts that enable the 'purpose' of digital transformation.

We found that **team incentives for value creation** and **punishment discouraged** are two governance artefacts (Figure 22). We learned that engineering-driven industrial organizations build a proud culture with assumptions like 'we are the doers'. Helping individuals to overcome the feelings of failing is crucial, as an expert stated the following about the approach:

*'People very often don't like to be exposed to the public and admit that they made something wrong...in modern IT companies where they say well, we made a mistake. Well, make sure you learned from it and then move on'. [DDD]*

An organization's ability to measure the value created/added by digital into the work culture is important to address the assumptions around who gets or does not get work done and, hence, qualifies for incentives. Remarkably, while individuals understand their own contributions, team-wise incentives are ranked higher in our case companies. From the collected data we couldn't conclude that team-wise incentives as artefacts are prioritized due to digital transformation. However, value creation as a whole team was more substantial with digital technology deployment.

The leaders saw that promoting team-wise value creation and incentivizing could enable a healthy culture with a balance between collectivism and individualism.

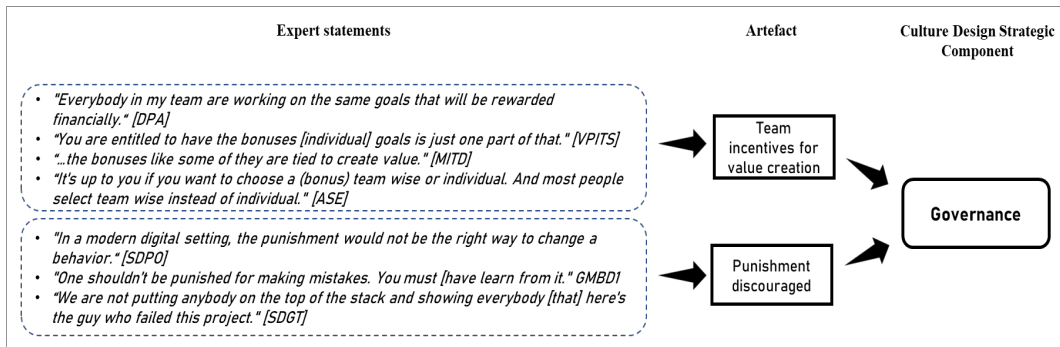


Figure 12. Cultural artefacts that enable the 'governance' of digital transformation.

In global industrial organizations, the tendency is to '*work in their silos because of their profit-and-loss responsibilities*' [VP]. Therefore, the strategic design of artefacts in the support of the ecosystem includes **physical spaces for accelerated collaboration** combined with **digital space for collaborative learning** (Figure 23). Digital purpose-built platforms accelerate collaboration and support the '*learning-culture angle*' [SMDT]. Bringing people (physically) into a common room with all the needed facilitations is crucial for collective decision-making, from ideas to the development of non-generalizable value complementarities.

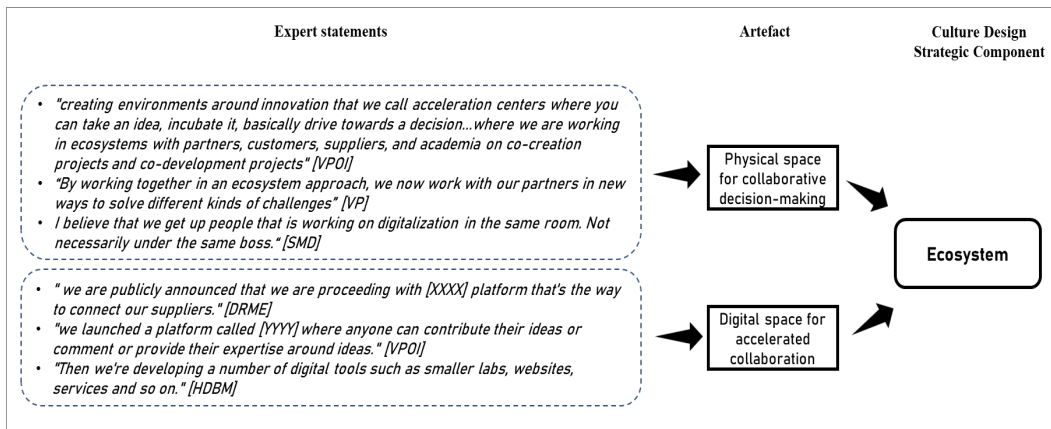


Figure 13. Cultural artefacts that enable the 'ecosystem' for digital transformation.

The cultural artefacts of a digital transformation must (i) '*bring transparency to the whole value chain*' [GH] and (ii) '*involve customer [in value] co-creation*' [VP]. Our research cases introduced new **formal functional hierarchies** and **purpose-driven informal structures** (Figure 24). Informal and purpose-driven hierarchies are agile because of less tie-ups with profit-and-loss responsibilities, and they can do experimentation on ideas, prioritize the upskilling of resources, and empower the passionate. However, these formal and informal functions need **digital supported way-of-working**, too. Above all, it is

considered invaluable to bring in a **customer-inclusive way of working**. The target is a state where resource investments receive guidance from the customer co-creation and co-invest exercises built within the corporate policies and work procedures.

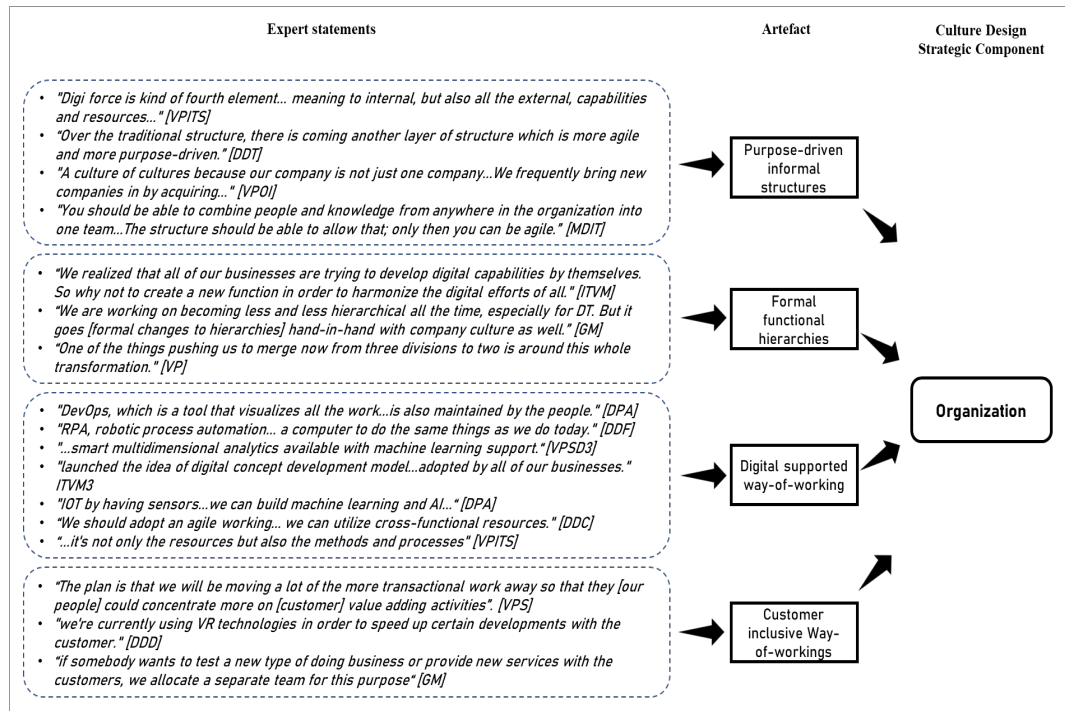
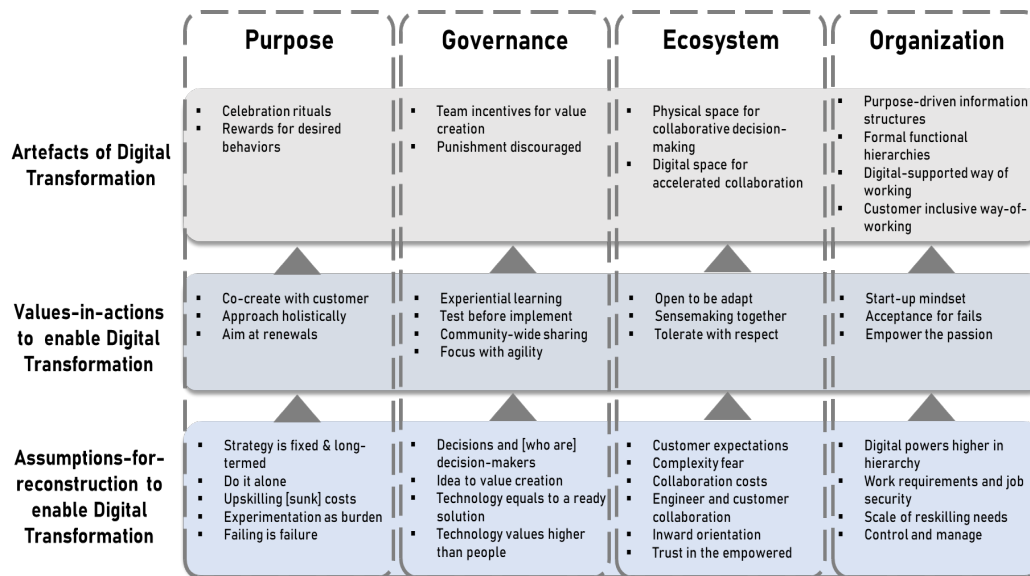


Figure 14. Cultural artefacts that enable the 'organization' for digital transformation.

#### d) Framework for the strategic design of culture

Digital transformation needs 'a different playground' [VPIT]. Modern digital technologies will change 'basically everything and anything' [SMDDT] within industrial organizations. In our research cases, the strategic design of culture for digital transformation has been driven by leaders living the values and prioritizing the required artefacts. In a digital transformation supportive culture, the apparent changes [artefacts] are celebrations, team rewarding and the physical and digital spaces for agile and collaborative decision making in customer-centric development initiatives. Customer-centric developments need customer-inclusive ways of working. In doing so, these cultures are neutral (not punishing), people are curious for experiential learning within formal and informal hierarchies. Hereunder, the research findings on the values in action, assumptions for the reconstruction and prioritized artefacts in our case organizations have been collected as an exploratory framework of the strategic design of culture (Figure 25).



**Figure 15. Exploratory framework for the strategic design of culture to enable digital transformation in traditional industrial organizations.**

The cultural values of a holistic (customer lifecycle value) approach and co-creation with customers need continuous renewals at the strategic, tactical, and operational levels. Such renewals are promoted with a start-up mindset. The passionate (people as knowledge workers and experts) are empowered to experiment with digital technologies. As all start-ups are not successful in scale up the business value of innovations, the digital transformation culture values the important role of failing attempts. The culture of testing (prototyping) and community-wide sharing of the experiential learnings helps our case organizations prioritize resourcing and help resolve disputes, here with a focus on agility within own organization and across business ecosystems. These new values are the preferred mode of conduct in shaping shared mental models and comprehending possibilities with digital technologies.

Old, taken-for-granted, and silently consented assumptions tacitly resist new cultural values. Such silently consented tacit beliefs about strategy, upskilling, failing, customer expectation, being doer only, technical complexity, trust and empowerment, ideation, value creation, technology versus solution, hierarchies, work requirements, job security, control and management of the work tasks need reconstruction. The case findings based exploratory framework (Figure 25) addresses the artefacts, values, and tacit beliefs to be strategically design culture for digital transformation.

## Discussion and Conclusions

### Culture inclusive strategy in sociotechnical business organizations

Our multi-case study findings present a complementing role of culture to the business strategy in sociotechnical organizations. These findings rejuvenate the organizational strategy literature by examining the cultural design for digital



transformation as a sociotechnical phenomenon (Davis et al., 2014; Imran et al., 2021; Karimi & Walter, 2015; Kiefer, 2021; Pasmore et al., 2019; Sony & Naik, 2020). Our research establishes that traditional industrial organizations who sustain competitive advantage could continuously renew the three layers of organizational culture. In these organizations, the leaders' approach to cultural renewal is inherently proactive than hasty. Their selection of new behaviors to be cultivated in the culture is strategic (Kane et al., 2016) rather than solely operational. In these case organizations leaders and people '*think, feel and act*' (Schein, 1996, p. 12) upon the strategy through the renewed cultural assumptions, values, and artefacts. Their culture first approach is propelling the success in digital strategy execution (Volberda et al., 2021).

While this research addresses recurring calls for an investigation of how industrial organizations prepare contextual idiosyncrasies including culture in their pursuit for digital transformation (Berghaus & Back, 2017; Dubey et al., 2019; Duerr et al., 2018; Ghosh et al., 2022; Hartl & Hess, 2017; Martínez-Caro et al., 2020; Volberda et al., 2021; Warner & Wäger, 2019), its findings are broader. These findings extend the social system design as a requirement for culture-inclusive business strategy (extending from Abhari et al., 2021; Ostroff et al., 2020). The leaders in our case organizations expound that digital transformation strategy, technology, and social are inseparable within the three layers (artefacts, values, and assumptions) of organizational culture. Hence, the design of these three layers demands coherent upbrings alongside the technology-laden strategy formulation as well as strategy execution (Chatman & Cha, 2003).

Based on the case findings, we argue that the grown-up cross-sectional view of culture [for example, digital culture (Martinez et al., 2020), digital innovation culture (Kiefer et al., 2021), big data culture (Dubey et al., 2019)] has led to a detached, limited, and reactive approach to digital transformation. As a result, organizations are attending culture preparedness in haste, and then dump it to the strategy execution program teams. It is not surprising that detaching culture design and strategy formation construes the embarrassing secret forces in culture that overthrow well-articulated digital strategies (Rumelt, 2011; Volberda et al., 2021), as the execution is excessively failing (Gartner, 2020; Kane et al., 2016). Contrarily, our research data evidences proactive reconstruction of long-lived cultural layers that could remain unattended resistance to digital transformation in our case organizations. This is in line with Kane et al. (2016, p.10) who found that leading organizations have supporting culture already at early stages of digital transformation.

### **Socio-cultural control system for digital strategy execution**

The case organization learned consistent and efficient scaling up of business operations over time. However, the multitude of disrupting changes required harmonic patterns of socially controlled response to the selected changes, for

example, digital technology adoptions for futureproofing their business (Parida et al., 2019). The extant literature discusses the less formal social controls, for example organizational culture, are vital to successful strategy execution ((O'Reilly & Chatman, 1996; Chatman & O'Reilly, 2016). Our findings have shed light on how such social control systems work (Chatman & Cha, 2003) in an organization's cultural layers of values, assumptions, and artefacts to enable digital transformation (Vial, 2019). These socio-cultural mechanisms are strategically designed for the purpose, governance, ecosystem, and organization (Pasmore et al., 2019). Our exploratory framework (Figure 25) lists the values, assumptions and artefacts that constitute the sociocultural control system for digital transformation in our case organizations.

The research findings also shed light on cultural understanding of embedded work practices in their organizations (Vial, 2019). In our case organizations, business leaders could better approach technology and social controls, instead of solely leaving it to short-timed hired strategy consultants. The leaders and managers in these case organizations proactively seek '*what can come into being*' (Mintzberg et al., 1998, p. 283) and how to prepare the culture as a social mechanism for possible future scenario with digital technologies.

Alike the guidance from Sony & Naik (2020, p. 8), they strategically build the culture for collaborative integration of end-to-end customer value processes. Hence their technology-laden strategy execution was rooted within the day-to-day work performed by people socially connected with shared values, assumptions, and artefacts. With deeper understanding of how their organization works (Chatman & O'Reilly, 2016), the leaders could go beyond the ascribed values and artefacts of digital culture (Martinez et al., 2020). Meanwhile, the reconstruction of cultural assumptions further reinforced social controls by promoting the desired values in action (Schein, 2004).

### **Culture as a strategic resource for digital transformation**

A well-established recognition of culture's role in the adoption of (digital) information technologies is recorded in the literature (Kiefer, 2021; Nadkarni & Prügl, 2021; Vial, 2019). Meanwhile, the findings of this research uplift the culture's role as a strategic resource (Barney, 1996). Throughout their successful histories, our case industrial organizations mastered the economics of operations' scale up with resource minimization. However, expounding opportunities for non-generalizable complementarities with ecosystem partners (Jacobides et al., 2018) and customers (Volberda et al., 2021) required new type of resources to maintain the economy of scale based superior competitive advantage (Barney, 1996).

Acknowledging efforts to attain culture enablement of strategy could be a slower process (Sony & Naik, 2020), the interviewees devised a strategic to their culture upbringing (Barney, 1996); the experts/leaders in the case organizations saw that the extent of the business transformation through digital technologies is much wider and continuous in nature. They wanted cultural resources (artefacts) for

wider, frequent, formal, and informal collaboration. For example, digital transformation requirements included a culture-supported ecosystem wherein the sales experts collaborate with potential partners and suppliers, while the engineering experts co-create with customers and end-users to resolve industry-, society-and global-level problems.

Aligned with Volberda et al. (2021), they deployed culture as a resource to promote more customer-driven assumptions, values, and artefacts. As discussed earlier, with the understanding of how their organization works, the routinising of newly developed artefacts (e.g., processes, procedures, structures, and digital platforms) promoted customer-centricity. With the routinization of these newly developed artefacts, the people could self-regulate their behavior towards ecosystem partners with mutual respect and trust (Kolagar et al., 2022).

Traditional industrial organizations could seek for a novel approach to build-up culture as a strategic resource that is a valuable, rare, imperfectly imitable, and nonreplaceable (VRIN) source of competitive advantage (Barney, 1986). Although culture is rooted deeper in the social systems, it is important to prioritize those values, assumptions and artefacts that can rampart a collective cognition (Mintzberg et al., 1998, p. 283) about the opportunities, and thus facilitate digital transformation as a coherent action for strategy execution (Rumelt, 2011, p. 268). This way culture as a VRIN resource could sustain superior business performance (Barney, 1996). For example, a VRIN culture with strategically designed artefacts, values, and assumptions (Figure 25) could contribute the digital transforming dynamic capabilities (Ghosh et al., 2022; Warner & Wäger, 2019). Our approach to organizational culture as a strategic resource brings fresh spectrum of possibilities for strategic management scholars, students, and practitioners (Cepa et al., 2023; Singh et al., 2020).

### **Managerial implications, limitations, and future research**

A first-hand insight of how leaders in our case company approach cultural design will be an asset to other practitioners. As managers and leaders in traditional industrial organizations juggle with a cross-sectional approach to culture, our case study provides the contextual depth of how cultural changes could be designed in the pursuit of digital transformation. The findings of this study can help managers understand the far reach of cultural assumptions as hidden and untold decisions which can restrict or permit strategic changes. The exploratory framework (Figure 25) give snapshot source to design supportive culture within the three layers of assumptions, values, and artefacts. They can approach culture as a means of social control to guide day to day work collaboratively by walking the talk i.e., live the values by their actions.

This diagnostic case study on digital transformation as a sociotechnical phenomenon brings rich insights for the scholars and practitioners, however, it has limitations (built in the research design). Culture as an enabler has its idiosyncrasies for each organization, as well the organizational context of digital

transformation as strategy can be different too. So, the findings of this research with reference to the values, assumptions, and artefacts in the case organization, especially the case specific approaches as mentioned by the interviews must not be mirrored in all other global industrial organizations. Thus, we do not claim universal generalization of our exploratory framework (Fig. 15). Relatedly, our cases were globally operated industrial organizations with rich histories. Younger industrial organizations, especially those with operations limited to one or a few geographical regions, may bring distinguishable insights regarding the strategic design of culture. Also, small- and medium-sized industrial organizations' cultures will need dedicated research.

Furthermore, we acknowledge that our pointed focus on digital transformation does not cover all that is included in organizations' strategies. For example, we noted that along with the digital transformation, *carbon neutral operations*, *environmental sustainability*, *gender equality*, and *circular supply management* are amongst the strategic priorities in all the three case industrial organizations. Meanwhile, we observed similar gap in literature to explicate the culture on such other burning points for industrial organizations. Future research could address such gaps. The strategic design of culture will help scholars and practitioners to fill such gaps. It will be fascinating to explore cultural design for multiple & competing targets of the wider strategy implementation initiatives.

Our case industrial organizations are headquarters in Nordic companies. Hence, the interviewed experts were from diverse cultural backgrounds and geographically located in multiple countries, across Europe. During the data collection on digital transformation as sociotechnical phenomenon, as well in the data analysis, we have discounted the effect of national and regional cultures. This leaves a limitation to this incumbent research, however, an opportunity for future research to combine the strategic design of culture from both the organizational and national cultural point of views. For example, how the in-built national behaviors in the globally operated organizations affect those organizational cultural values, assumptions, and artefacts which enable or constraints digital transformation.

Our knowledge about the strategic design of culture in the globally operated services-only sector organizations is another research opportunity to evaluate and extend our exploratory proposed framework. The sociotechnical phenomenon investigated in the present research is digital transformation, which is one of the multiple other realities transforming industrial organizations, for example, the technological advancements related to energy and environment. There is an opportunity for future research to investigate the strategic design of culture from multiple simultaneous transformations in an industrial sector. Our exploratory framework (Figure 25) furnishes a base point for such future research.

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## APPENDIX A

**1. Contextual information collected from the secondary data sources.**

**Case A** strategizes data and digitalization as mega-market trends. Digital transformation is taken as an opportunity to enhance customer value and increase options to enrich customer experience. Digital transformation is part of their business strategy; digital technologies are reshaping the business models. Digital Transformation program and related initiatives cover a sizable portion of R&D investments. Aim is to digitally connect multiple value chains and to be further close to their customers by developing digital intelligence, digital platforms and applications, and cloud-based virtual services. There is a specific focus on building ‘*innovation culture*’ where digitalization provides foundation for securing strong market position. The published materials on website suggest that continuous learning and development of people to explore and exploit digital technologies is presented along the innovation culture. The case company is also investing in building the infrastructures (physical and digital) with the aim to have innovation ecosystem which will foster collaborative innovation culture for external partners.

Digital transformation-built business strategy is actively promoted by **Case B**. Their digital transformation journey involves speeding up decision-making and getting further close to the customer. There found a focus to strengthen digital customer experience by adding digital dimensions to all operations: building-in their product-specific digital technologies, digital-service platforms and tools, digitalization of operations (digital factories), and digital customer experience interfaces. Transforming business with digital technologies has considerable portion of R&D investment. The secondary data (annual reports and recorded interviews) suggests that the adoption of digital technologies is even pacing-up R&D activities for product and service development. This case company reports that digital technologies are aimed at catering with operational complexity by providing lean and agile methodologies.

For **Case C**, the application of digital technologies is for sustaining business success in the future as well. Bringing digital interfaces to all aspects of business is strategic to *Case C*. Transforming business with digital technologies has considerable portion of R&D investment and focus is to build a rich portfolio of digital projects. The company created a data management office, digital and data strategy, building digital platforms for intelligent operation, digital learning and people’s engagement, digital supply chain management, digital sales, and digital customer experience. It was targeted that work culture of data utilization to speed up the quality decisions is excessively promoted. Understandably, the speed and approach of digital transformation varies between the different business units of *Case C*.

## 2. List of the interviewed experts and their key responsibilities in digital transformation

#	NVivo code	Expert position	Digital transformation key responsibilities	Recording (Minutes rounded to the dividend of 5)
1	DDC	Head of Digital Culture	Supporting business strategy and growth through changes in digital knowledge, skills and ways-of-working	50
2	MDT	Manager Digital Transformation	Planning competence development actions. Digital knowledge sharing	55
3	SPM	Senior project manager digitalization	Leading Digital Projects	95
4	MDIT	Manger ITSM	IT Service Management	86
5	GM	General Manager	Mobilization and operation of digital products and related cloud infrastructure	85
6	PM	Project Manager	Customer collaboration digital platform development	65
7	SMDT	Senior Manager Digital Transformation	Driving a people-first, customer-centric, smart-tech enabled, collaborative and innovative culture	60
8	VP	Vice President Digital Product Development	Key member of Digital Transformation team	65
9	OED	Operational Excellence Director	Lean and agile operational capability development, strategy implementation,	50
10	DDD	Director Digital Development	Co-creating digital products and services with customers	75
11	GMOD	General Manager, Operational Development	Operational Development portfolio management implementing business strategy and digitalization opportunities, site IT connectivity concept creation and implementation	70
12	DDT	Director Digital Transformation	Driving the Digital Transformation and Culture journey (Domenico Dargenio)	85
13	GMBD	General Manager, Business Development	Strategy roadmaps and strategy execution	60
14	DAI	Director, Areas, and Integrations	Transformation programs; IT operations; business mergers & acquisitions	75

15	DRD	Director, Head of Digital R&D	leading Digital Research and Development	40
16	SDPO	Senior Digital Product Owner	Supporting the digital and culture transformation	80
17	DDF	Director Digital Foundation	PLM (Product Lifecycle Management) and RPA (Robotic Process Automation).	80
18	VPOI	Vice President Open Innovation	digital culture and digital revenues	55
19	GMI	General Manager, Innovation	Leading the innovation activities	65
20	GH	Global Head	Global product management	60
21	SMD	Senior manager digitalization	Digital strategy work	80
22	ASE	Application Software Engineer	Model based design	80
23	VPGMS	Vice President, Global After Market Service	Leading the Global Aftermarket Service organization	70
24	HDBM	Head of Digital Business & Marketing	Innovative leader driving digital sales and improving customer experience	30
25	HDEP	Head of Digital Experience Program	Overall leader of the Digital Customer Experience (DCE) organization	55
26	DPM	Digitalization Project Manager	help organizations go digital	65
27	SDIT	Senior Director of IT Innovation	IT Innovation	65
28	SDGT	Senior Director, Global Technology	Plan and lead strategic development initiatives.	70
29	SDSB	Senior Director eSteering business	Head of a business unit	25
30	DPA	Director Platform Architecture	Develop and implement an IoT strategy	80
31	VPITS	Vice President, IT Strategy and Governance	Responsible of IT services	85
32	ITVM	IT Vendor Manager	IT Supply Management. Responsible for Governance Models	85
33	DDSR	Director, Digital Stakeholder Relations	Leading a team in Stakeholder Relations responsible for developing digital communications and marketing	70

34	MMD	Manager, Maintenance Development	led developments in maintenance and asset management in all areas of technology	45
35	MITD	Manager IT and Digitalization	Digital transformation projects and operational change management support	45
36	DSR	Director, Stakeholder Relations, and Digital officer	Responsible for Communications, Marketing, Environment & Responsibility	50
37	VPS	Vice President Sourcing	managing new supply chain and product ramp	45
38	VPSD	Vice President, Strategy and Business Development	responsible for strategic planning, commercial strategy, and sales development,	85
39	DRME	Director, Raw Material Execution	heading Raw Material Execution team	50
40	CIO	Chief information officer	Digitalization and IT strategy	70
41	LDM	Global Head Data management	Data management, data organization and governance	35

## APPENDIX B

## The summary of thematic analysis of the case data

Cultural Layer	1 <sup>st</sup> Order Concept (From interview excerpts)	2 <sup>nd</sup> Order Theme	Strategic design
Artefacts	<ul style="list-style-type: none"> <li>• Celebrating Fails</li> <li>• Celebration giving sense of belongingness</li> <li>• Sense of respect in learning from fails</li> </ul>	Celebration rituals	Purpose
	<ul style="list-style-type: none"> <li>• Leaders are coaching right behaviors</li> <li>• Rewards for building new behaviors</li> <li>• Rewards for sharing learning from mistakes</li> <li>• Mistakes not to be punished</li> </ul>	Rewards for desired behaviors	
	<ul style="list-style-type: none"> <li>• Work on same goals and get rewarded</li> <li>• Individual bonuses are part of full incentives</li> <li>• Bonus tied with business value creation</li> <li>• People prefer time-wide incentives</li> </ul>	Team incentives for value creation	Governance
	<ul style="list-style-type: none"> <li>• Learnings from mistakes</li> <li>• Discouragements to punish mistakes</li> <li>• Acknowledgments that punishment ruins digital transformation</li> <li>• Fame for learning from failed attempts</li> <li>• Failure postmortem reports to spread learning</li> </ul>	Punishment discouraged	
	<ul style="list-style-type: none"> <li>• Idea incubation with ecosystem partners</li> <li>• Acceleration centers to drive decisions</li> <li>• Co-creation and co-development projects</li> <li>• Together with partner, new ways to collaborate</li> <li>• Collaborate in same room, not necessarily under same boss</li> </ul>	Physical space for collaborative decision-making	Ecosystem
	<ul style="list-style-type: none"> <li>• Digital platform to connect partners</li> <li>• Digital platform for idea management</li> <li>• Websites and digital labs to work with partners</li> </ul>	Digital space for accelerated collaboration	
	<ul style="list-style-type: none"> <li>• Digi force</li> <li>• 2<sup>nd</sup> layer of structure to drive the digitalization purpose</li> <li>• Acquired businesses collaborate with old hierarchy</li> <li>• Combine people and knowledge from anywhere in the organization</li> </ul>	Purpose-driven informal structures	Organization
	<ul style="list-style-type: none"> <li>• Create new function in all businesses</li> <li>• Reduce/simplify traditional hierarchies</li> <li>• Combine functions and business units</li> </ul>	Formal functional hierarchies	

Cultural Layer	1 <sup>st</sup> Order Concept (From interview excerpts)	2 <sup>nd</sup> Order Theme	Strategic design
	<ul style="list-style-type: none"> <li>• Robotic process automation</li> <li>• Muti-dimensional analytics tool</li> <li>• Digital concept development model</li> <li>• Machine learning and AI deployment in solutions</li> <li>• New methods and processes</li> <li>• Development &amp; Operations in s</li> <li>• VR tool usage in day-to-day work</li> </ul>	Digital-supported way of working	
	<ul style="list-style-type: none"> <li>• Ways of working to concentrate customer value</li> <li>• VR for customer co-creation</li> <li>• A dedicated team for testing new services with customers.</li> </ul>	Customer inclusive way-of-working	
Values-in-action	<ul style="list-style-type: none"> <li>• Customer best know their challenges</li> <li>• Common journey with customer</li> <li>• Close to customer and collaborate</li> </ul>	Co-create with customer	Purpose
	<ul style="list-style-type: none"> <li>• People and business</li> <li>• Lifecycle approach</li> <li>• Cross functional thinking about ecosystem</li> </ul>	Approach holistically	
	<ul style="list-style-type: none"> <li>• Initiatives to create high and higher value</li> <li>• People contribution is high for organization</li> <li>• Encourage trail and renew</li> <li>• History of excellence</li> </ul>	Aim at renewals	
	<ul style="list-style-type: none"> <li>• Learn environments for all stakeholders</li> <li>• Trial &amp; Error to learn new</li> <li>• Learn and move forward</li> <li>• Get involved to understand possibilities</li> </ul>	Experiential learning	Governance
	<ul style="list-style-type: none"> <li>• Experimentation needs</li> <li>• Good ideas to be tested first</li> <li>• Put ideas on trail</li> <li>• Trail ideas then make decisions fast</li> </ul>	Test before implement	
	<ul style="list-style-type: none"> <li>• Share good, bad, and ugly</li> <li>• Discuss openly</li> <li>• Stories of failures and successes</li> <li>• Source concepts from all (stakeholder) communities</li> <li>• Collaborate to conceptualize 'value'</li> </ul>	Community-wide sharing	
	<ul style="list-style-type: none"> <li>• Gradual shift from waterfall to agile approach</li> <li>• Required focus to adopt agile frameworks</li> </ul>	Focus with agility	



<b>Cultural Layer</b>	<b>1<sup>st</sup> Order Concept (From interview excerpts)</b>	<b>2<sup>nd</sup> Order Theme</b>	<b>Strategic design</b>	
	<ul style="list-style-type: none"> <li>• Ability to adjust agile frameworks</li> <li>• Process to control the shift from waterfall to agile</li> </ul>			
	<ul style="list-style-type: none"> <li>• Open to change as the environment changes</li> <li>• Taboos of unchangeable goals</li> <li>• Bring flexibility</li> <li>• Openness to trust outsiders</li> <li>• Openness to learn from outsiders</li> <li>• Openness to bring agility</li> </ul>	Open to be adapt	Ecosystem	
	<ul style="list-style-type: none"> <li>• Collaborate on smart technologies</li> <li>• Different perspectives to approach holistically</li> <li>• People together in smart culture</li> </ul>	Sensemaking together		
	<ul style="list-style-type: none"> <li>• Conflicts are not bad</li> <li>• Learn to handle conflicts</li> <li>• Respect others' views</li> <li>• Show Tolerance</li> <li>• Communicate 'acceptable' and 'not acceptable'</li> </ul>	Tolerate with respect		
		<ul style="list-style-type: none"> <li>• Reinvent ourselves!</li> <li>• Run Business like your own</li> <li>• Take ownership</li> <li>• Start-up and scaleup capability</li> </ul>	Start-up mindset	Organization
		<ul style="list-style-type: none"> <li>• Reasons to tolerate failures</li> <li>• Long successful history</li> <li>• Guide to tolerate failures</li> <li>• Minimal directions</li> </ul>	Acceptance for fails	
		<ul style="list-style-type: none"> <li>• Change resistance catering by enabling people</li> <li>• Frontline passion</li> <li>• Empower people</li> <li>• Encourage sense of ownership</li> </ul>	Empower the passion	
<b>Assumptions-for-reconstruction</b>	<ul style="list-style-type: none"> <li>• Older key factors to remain competitive</li> <li>• Steady state for business survival</li> <li>• Always success in achieving plans</li> </ul>	Strategy is fixed long termed	Purpose	
	<ul style="list-style-type: none"> <li>• Know all possibilities with digital technologies</li> <li>• Solo explore of digital opportunities</li> </ul>	Do it alone		
	<ul style="list-style-type: none"> <li>• People skills costs</li> <li>• Accounting practice to count the skill building</li> </ul>	Upskilling [sunk] costs		
	<ul style="list-style-type: none"> <li>• Excuses to run experiments</li> <li>• Budgeting for experiments that may fail</li> </ul>	Experimentation as burden		

<b>Cultural Layer</b>	<b>1<sup>st</sup> Order Concept (From interview excerpts)</b>	<b>2<sup>nd</sup> Order Theme</b>	<b>Strategic design</b>
	<ul style="list-style-type: none"> <li>No resources for ideas not liked by management</li> </ul>		
	<ul style="list-style-type: none"> <li>First time right</li> <li>Discourage risk-taking</li> <li>Failing is a mistake</li> <li>Failing often fails the others</li> </ul>	Failing is failure	
	<ul style="list-style-type: none"> <li>Empowerment limited to PowerPoint slides</li> <li>Decision maker; it is not me!</li> </ul>	Decisions and decision-makers	
	<ul style="list-style-type: none"> <li>Idea-to-value conversion time</li> <li>Process of idea-to-value creation</li> <li>Ideas support (&amp; no support) by managers</li> <li>Supporting factors to implement the best ideas</li> </ul>	Idea to value creation	Governance
	<ul style="list-style-type: none"> <li>Apply AI to make work simple!</li> <li>Digital tools will fix all problems</li> <li>Digital technology can be deployed as-it-is</li> </ul>	Technology equals to a ready solution	
	<ul style="list-style-type: none"> <li>Jobs benefits from technology</li> <li>Importance of human contributions</li> <li>Feel of being valuable</li> </ul>	Technology values higher than people	
	<ul style="list-style-type: none"> <li>Customer problems are well-known</li> <li>Facts are available to fulfil customer need</li> <li>Customer expectations are unchangeable</li> </ul>	Customer expectations	
	<ul style="list-style-type: none"> <li>Digital technologies are complex</li> <li>Powerless to have an affect</li> <li>Fear of wrong deployment of digital technologies</li> </ul>	Complexity fear	
	<ul style="list-style-type: none"> <li>More partners more costs</li> <li>Cost of redoing</li> <li>Appreciation to get done more at low expenses</li> <li>Partner conflict bring more costs</li> </ul>	Collaboration costs	Ecosystem
	<ul style="list-style-type: none"> <li>Engineers may expose trade secrets</li> <li>Sales collaborate with customers,</li> <li>Sales make customer experience better</li> </ul>	Engineer and customer collaboration	
	<ul style="list-style-type: none"> <li>In procession of superior knowledge</li> <li>Make it work by yourself</li> <li>Doing better than anyone can</li> </ul>	Inward orientation	
	<ul style="list-style-type: none"> <li>Decision makers are someone else than those working with partners</li> <li>Crossing organizational boundaries with new methodologies</li> <li>Wait for all before making decision</li> <li>Functions owns decisions</li> </ul>	Trust in the empowered	

<b>Cultural Layer</b>	<b>1<sup>st</sup> Order Concept (From interview excerpts)</b>	<b>2<sup>nd</sup> Order Theme</b>	<b>Strategic design</b>
	<ul style="list-style-type: none"> <li>• High hierarchies need digital to see mistakes</li> <li>• Fear of challenging leaders</li> <li>• Power politics with digital</li> <li>• Higher in hierarchy are leaders</li> </ul>	Digital powers higher in hierarchy	Organization
	<ul style="list-style-type: none"> <li>• Threatened by digital technologies</li> <li>• Changing nature of work creates fear</li> </ul>	Work requirements and job security	
	<ul style="list-style-type: none"> <li>• Vast range of required skills</li> <li>• Time required to learn the change of work tasks</li> <li>• Agile methodologies with many options to master</li> </ul>	Scale of reskilling needs	
	<ul style="list-style-type: none"> <li>• Feel of control and impact of my work</li> <li>• Unfamiliar digital procedures: 'seeing is believing'</li> <li>• Comfort zone bias</li> <li>• Micromanagement culture</li> </ul>	Control and manage	