A Behavioural Perspective on Developing Digital Transformation Capabilities

The Roles of Continuous Improvement and Digital Transformation Readiness

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Abstract

Background. Digital transformation (DT) and continuous improvement (CI) are interconnected concepts that are seen as central to shaping organisational success. While many manufacturing firms have well-established CI capabilities, serving as a primary change mechanism embedded in their organisational culture, they are now faced with the duality of integrating novel digital technologies into their business models, while at the same time transforming their workforce to leverage digital opportunities. Extant research does not anticipate CI-DT tensions and fails to explain the impact of organisational culture on the readiness of individuals to engage in DT, and the success of DT initiatives. In response, this dissertation aims to conceptualise and examine the interplay of CI culture and DT dynamics. By drawing on the theory of planned behaviour, this research views this interface from a complex systems perspective, investigating novel interrelationships in the realm of organisational behaviour.

Methodology. To address the research gaps, a cross-sectional survey design was employed that focused on the high-value manufacturing sector. For hypothesis testing, structural equation modelling was applied in three inter-linked studies involving 300 respondents.

Results. Results suggest that enabling DT behaviours is contingent: self-efficacy uniquely influences the intention to engage in DT, and DT behaviours strongly influence DT performance. In the presence of CI, the dynamics influencing individual DT readiness changed, suggesting paradoxical effects. Additionally, the relationships between DT intention, DT behaviours and DT performance are moderated by CI maturity.

Contributions. This dissertation advances an understanding of the interplay between CI culture and DT dynamics by emphasising paradoxical effects. It presents novel insights into how individuals contribute to the success of DT by demonstrating the influential effects of competence, motivation and behaviours. Further, CI offers some explanation for paradoxical effects in developing DT capabilities. The findings have implications for the theory of planned behaviour by demonstrating theoretical recursiveness and contextual network reasoning supporting the principles of organisational learning.

Keywords: Digital transformation, continuous improvement, organisational behaviour, mindset, empowerment, survey design, high-value manufacturing

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Declaration

I confirm that no portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification at this or any other university or institution of learning.

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1 Introduction

With the rise of digital technologies, calls for new approaches to creating business value have become common-place. Digital transformation (DT) is changing the way businesses interact with external stakeholders, customer expectations and entire competition landscapes on a global scale (Verhoef et al., 2021). As a result, DT is forcing organisations to rethink their business models, involving value creation paths to ensure future competitiveness (Andal-Ancion et al., 2003). The need for DT is often associated with rapidly changing technology-driven environments, described as turbulent markets. Turbulence can be defined as 'the conditions of unpredictability in the environment because of rapid changes in customer needs, emerging technologies, and competitive actions' (Pavlou and El Sawy, 2010: 444). According to Sambamurthy et al. (2003), it is the company's capacity to act in a turbulent environment that determines its success. Digital technologies can both drive and result from turbulent markets by enhancing innovation (Nan and Tanriverdi, 2017).

Traditionally, changing requirements have been addressed by short-term change initiatives or the establishment of continuous improvement philosophies. This is especially the case for manufacturing companies who have attempted to establish continuous improvement capabilities in the form of lean management or total quality management. Continuous improvement (CI) is based on small incremental improvements that are systematic in nature and aimed at improving company performance (Boer et al., 2000; Bessant et al., 1994). While this change approach has proven successful over the last few decades, it is argued that CI is insufficient in highly dynamic environments.

Having established comprehensive CI systems and practices that have become embedded in a company's culture, manufacturing organisations are now faced with the necessity for DT and its integration into their organisational realities. However, DT not only involves a mere technological shift (Henriette et al., 2015), it also requires a sophisticated alignment of organisational culture, leadership and strategy (Goran et al., 2017). Consequently, considerations surrounding extant organisational culture and its fit with the requirements of DT need to be carefully taken. Current literature lacks an understanding of the impact CI cultures have on the integration of DT. Few studies have shown that CI principles can support the implementation of DT, while digital

technologies can promote the effectiveness of CI. However, extant literature fails to particularly explain the impact of organisational culture on the readiness of individuals to engage in DT and does not anticipate their effect on the success of DT initiatives.

In response to this major gap in knowledge, the overarching aim of this research is to understand the interplay of CI and DT from a behavioural perspective. Specifically, its objectives are to understand the behavioural characteristics of employees that contribute to the success of DT, to examine the effect of CI behaviours on the behavioural readiness for DT and to investigate how CI maturity as a representation of organisational culture influences the individual behavioural dynamics leading to DT performance.

Therefore, this thesis is positioned at the theoretical intersection of digital transformation, continuous improvement, and behaviours as illustrated in Figure 1, specifically concentrating on the role of the individual at this intersection.

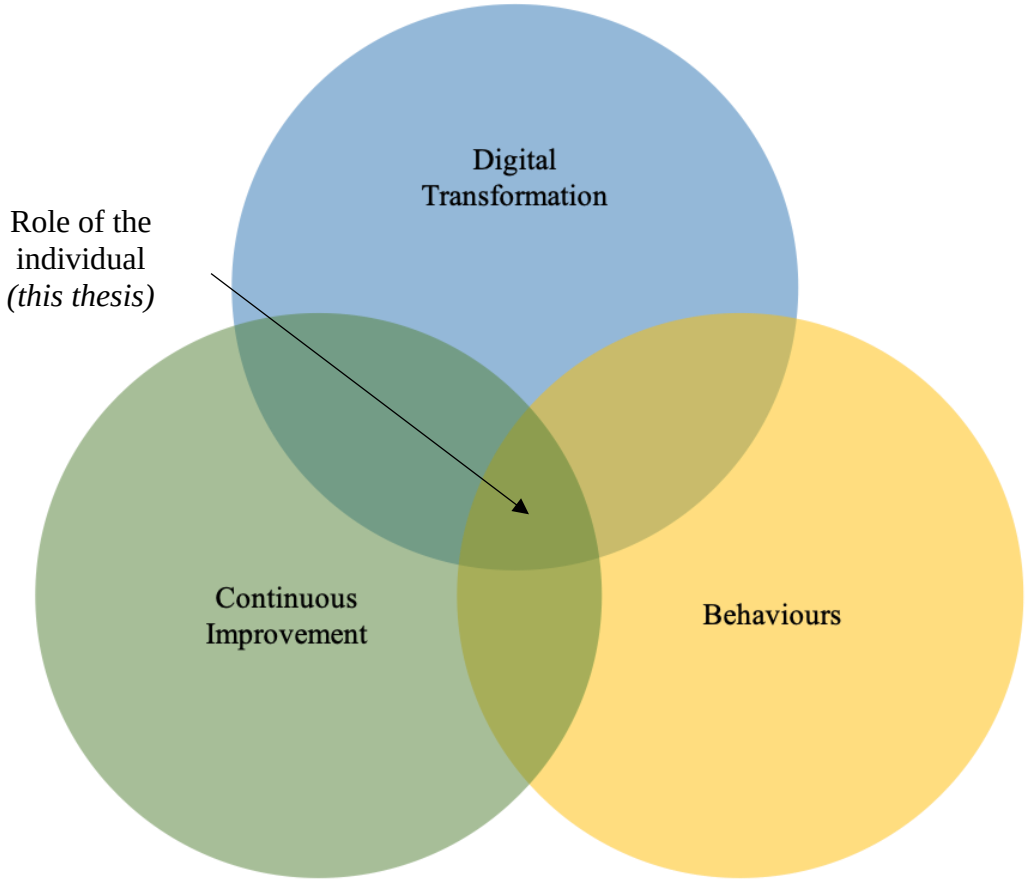

Figure 1. Situation of the thesis at the intersection of digital transformation, continuous improvement, and behaviours

Utilising a cross-sectional survey approach, three empirical studies have been conducted to address the research objectives, as outlined below.

1.1 Research studies and contributions

Based on the extant literature, the interplay between CI cultures and DT remains underexplored while being highly relevant for the success of DT initiatives. As researchers have primarily focused on technological synergies involving DT, this thesis adopts a behavioural perspective and examines the impact of CI culture on the development of DT capabilities and DT performance from the perspective of the individual by conducting three independent yet inter-related studies.

Study A, presented in Chapter 5, conceptualises and assesses individual behavioural elements influencing employees' perceived organisational DT performance in order to better understand how individuals contribute to the success of DT initiatives. In line with the theory of planned behaviour, the findings emphasise the importance of self-efficacy for increasing the intention of employees to engage in DT. Additionally, perceived DT performance is strongly influenced by DT behaviours, which confirms that individuals contribute to the success of DT by engaging in specific DT-supporting behaviours. Overall, the findings demonstrate that the theory of planned behaviour does not fully hold in a DT context, which implies contingency. By empirically validating the individual characteristics required for successful DT, scholarly understanding of the phenomenon is advanced.

The second study, Study B, presented in Chapter 6, aims to examine the interplay of CI culture and the DT readiness of individuals within an organisation. Reflecting the core driver for this thesis, the impact of CI on DT has only been considered from a technical perspective to date. However, organisational culture plays a crucial role in influencing organisational performance. Thus, this study views CI from a behavioural perspective and as a contingent factor in shaping individual DT readiness. The findings contribute to paradox theory as CI culture seems to decrease individual DT readiness directly, but also enables DT mindset to be effective in increasing individual DT readiness.

The third study presented in Chapter 7, Study C, follows up and builds on the findings from Study B and elaborates the strength and impact of CI culture on DT.

Specifically, it examines and challenges the role of CI maturity and how it influences individual DT capabilities for DT effectiveness. The results show that CI moderates the interplay of DT intention, DT behaviours and perceived DT performance, though in a paradoxical manner. Advancing the contingency of individual DT capability dynamics, this study confirms the powerful impact of organisational culture on the success of DT initiatives.

While this overview provides a brief insight into each study (see Table 1), Chapter 8 highlights the theoretical contributions of each study in more detail.

Table 1. Research focus and contributions

	Study A	Study B	Study C
Research Gaps	How individuals contribute to the success of DT	Lack of research on the interplay between CI culture and DT	Unclear if CI only impacts certain DT elements or their interactions as well
Research Question	What behavioural digital transformation characteristics might impact digital transformation performance?	How might CI behaviours influence the digital transformation readiness of employees?	How might CI maturity influence the effects that behavioural DT characteristics have on DT performance?
Primary contribution	Conceptualisation and validation of behavioural DT characteristics influencing DT performance	Change of DT dynamics through CI, highlighting a paradoxical occurence	Organisational culture as force influencing individual DT capabilities holistically

The following section (12) now introduces the logic of this thesis by outlining its structure.

1.2 Thesis Structure

After introducing the background of this study, the exploratory literature review provides insights into the rationale of the research questions raised and addressed by the empirical studies. Each empirical study zooms into their respective reasoning and elucidates further details in the individual chapters. A reflective summary then integrates the findings and demonstrates the key scholarly contributions. The thesis is concluded by providing an overall résumé, research implications, and further research potentials based on this work's limitations. A summary of the thesis's structure is provided in Table 2.

Table 2. Dissertation outline

Chapter	Focus	Purpose	Summary Key Outcome
Chapter 1	Introduction, relevance, scope	Problem statement	Manufacturing organisations need to handle the duality of CI and DT, while the effect of CI cultures on the implementation of DT remains open
Chapter 2	Literature review	Research gaps	RQ1. What behavioural digital transformation characteristics might impact organisational digital transformation performance? RQ2. How might CI behaviours influence the digital transformation readiness of employees? RQ3. How might CI maturity influence the effects that behavioural DT characteristics have on DT performance?
Chapter 3	Theoretical framework	Theoretical foundation	Research model development based on the theory of planned behaviour
Chapter 4	Research design	Systematic procedure	Quantitative survey research
Chapter 5	Empirical Study A	Empirical validation	DT self-efficacy influences the intention to engage in DT, while DT behaviours have a major impact on perceived DT performance
Chapter 6	Empirical Study B	Empirical validation	CI paradoxically influences individual DT readiness by both reducing and promoting it
Chapter 7	Empirical Study C	Empirical validation	CI maturity moderates the relationships between DT intention, DT behaviours and perceived DT performance
Chapter 8	Integration of findings	Contributions	Theoretical advancement of the interplay between CI culture and DT
Chapter 9	Conclusion	Implications	Future research on factors strengthening the synergy between CI and DT from the lense of paradox theory

2 Exploratory Literature Review

Since the innovation of the transistor, digital technologies have frequently challenged the status quo and enabled novel ways of thinking in business. With the rise of digitalisation, the world of data has reached new heights, accelerating organisational change and reinforcing complexity, uncertainty and volatility (Autio et al., 2018; Bharadwaj et al., 2013; Dattée et al., 2018).

Digitalisation (and digitisation) are considered foundational for digital transformation, a distinctive change towards a digital-inclusive business model. Verhoef et al. (2021) define digitisation as conversion activity from analogue to digital information without changing value creation processes. This translates into turning physical data into 0s and 1s, making it possible for computers to process them. Going beyond digitisation, digitalisation describes the action of modifying present business processes based on the integration of digital technologies. In this context, digital technologies can support process improvements and thus, enable cost savings (Verhoef et al., 2021). Some authors define it as a wider sociotechnical process (Tilson et al., 2010) or pace of change (McAfee, 2009) that is driven by the application of digital technologies which will again trigger the creation of new digital technologies. Ambiguities in definition often makes distinguishing the concepts of digitalisation and digital transformation difficult.

Digital transformation (DT), on the other hand, is said to holistically reshape business organisations based on its ability to digitise extant capabilities and digitalise systems to enable new forms of value creation. When screening extant literature on DT, discrepancies and different perceptions exist on what the notion of DT entails (Vial, 2019). Some merely view it as the "use of new technologies to enable major business improvements to augment customer experience, streamline operations, or create new business models" (Fitzgerald et al., 2013:2) while others define it as "organisational change that is triggered and shaped by the widespread diffusion of digital technologies" (Hanelt et al., 2021:1160). However, there seems to be common agreement on digital technologies having the capacity to create novel possibilities. Verhoef et al. (2021) emphasise it as changing the *logic* of an organisation as digital technologies enable the utilisation of the firm's ecosystem, rethinking business processes beyond organisational borders. This goes as far as to altering business

models to account for changing circumstances in the business environment, and to develop new value creation paths.

Research on DT has begun to span across many disciplines including, for instance, quality management (Silva et al., 2022). Within the operations management field, attention is paid to the interconnection of products, services and production systems to global product networks (Verhoef et al., 2021) and research papers tend to focus on the concept of Industry 4.0 to address opportunities and challenges within the manufacturing context. Industry 4.0 is associated with the DT of production and concerned with the enhancement of production performance utilising advanced technologies (Frank et al., 2019). Originally termed by a German group of researchers, the concept comes with a double-meaning: indicating the fourth industrial revolution and a strategic plan to advance manufacturing maintaining its competitiveness (Culot et al., 2020). The advancement is based on the introduction of emerging technologies that facilitate new working environments, socio-technical structures and roles (Frank et al., 2019). It integrates physical and digital worlds to enable flexible and collaborative manufacturing approaches (Culot et al., 2020; Frank et al., 2019). Such digital technologies include interface technologies (e.g. Internet of Things and visualisation technologies), data processing (e.g. Big Data analytics (Sahoo, 2022), machine learning, artificial intelligence, and simulation), network enablers (e.g. Cloud computing and blockchain), and interface processes (e.g. 3D printing, energy management solutions, new materials and advanced robotics). Considering the development of technological advancements, Culot et al. (2020) argue that it is impossible to define a final stage of Industry 4.0. Their claim is consistent with the mechanisms of DT, which can be described as a disruptive digital snowball.

Combining connectivity, information, computing and communication technologies, digital technologies embody the capacity to fundamentally transform the current business landscape holistically and can thus be viewed as of high strategic importance (Singh et al., 2020; Bharadwaj et al., 2013). The resulting transformation endeavour not only impacts business processes, products and services, but increasingly transforms organisational capabilities and promotes ecosystem thinking, while fundamentally altering business models (Rogers, 2016; Culot et al., 2020; Verhoef et al., 2021; Hess et al., 2016). The ability of an organisation to exploit opportunities arising from digital technologies is considered essential for future competitiveness.

Thus, agility has been emphasised as a core mechanism for the ongoing strategic renewal of organisations (Warner and Wäger, 2019).

In this research, a process or organisational change (Hanelt et al., 2021) perspective is adopted, considering DT as a radical change on a continuum for strategic purposes. Therefore, the definition by Warner and Wäger (2019:344) is utilised who define DT as "an ongoing process of strategic renewal that uses advances in digital technologies to build capabilities that refresh or replace an organization's business model, collaborative approach, and culture". Their definition is in accordance with Gong and Ribiere's (2021:12) conceptualisation who summarised the variety of extant definitions and concluded with their proposal of DT being "a fundamental change process, enabled by the innovative use of digital technologies accompanied by the strategic leverage of key resources and capabilities, aiming to radically improve an entity and redefine its value proposition for its stakeholders." Such capabilities not only need to be leveraged, but also need to be newly established to account for novel requirements in a digital world.

2.1 Digital Transformation Capabilities

Recent research has begun to examine capabilities required for DT. Capabilities are the abilities, the power or the qualities required to perform a certain act. In the context of DT, these often describe the enabling means to drive DT as an organisation. One of the most crucial capabilities according to current literature is that of continuous adaption or agility (Hanelt et al., 2021; Verhoef et al., 2021), which describes the ability to sense new opportunities and turn them into value-adding assets. Agility allows organisations to quickly adapt to changing conditions. This requires a respective organisational design that facilitates it (Konopik et al., 2022; Verhoef et al., 2021) and all other capabilities to be nurtured.

Closely linked to agile mechanisms is the innovative power of organisations. Particularly in light of speedy changes, innovation thinking plays a key role in maintaining competitiveness (Konopik et al., 2022). Innovation orientation is often supported by co-creation and collaboration activities to jointly resolve mutual needs.

Similarly, digital networking capabilities are considered important abilities to fully benefit from DT activities (Verhoef et al., 2021) because they involve close interaction with the external environment, growing the scope for potential impact.

In the centre of DT lie the digital assets that are necessary for a company to digitally transform in the first place (Verhoef et al., 2021). These not only include technologies such as the Internet of Things (IoT), but enabling IT infrastructures as well, that allow data to flow from its source to its point of use. In order to benefit from the data generated, big data analytics capabilities have been pointed out (Verhoef et al., 2021).

However, without a fitting digital strategy, organisations will find it challenging to decide on where to invest. A digital strategy needs to fit the purpose, the organisation, and be clearly communicated. It needs to point out how digitalisation may be used to grow or enable value for the business.

Finally, organisational culture, in particular DT leadership can be considered a key DT capability (Konopik et al., 2022) as it supports the realisation of DT strategies.

Some scholars have examined DT from a dynamic capability perspective which views dynamic capabilities as a source of competitive advantage (Konopik et al., 2022). Dynamic capabilities are understood as ability or capacity to create, integrate, modify and reconfigure an organisation's resource base purposefully (Zollo and Winter, 2002). In their conceptual framework, Konopik et al. (2022) argue that organisational capabilities differ in their relevance for dynamic capabilities. For instance, while innovation thinking and DT technologies are mainly associated with sensing capabilities, organisational design, and DT leadership are primarily considered transforming capabilities. In this context, Vial (2019) highlights the importance of microfoundations and calls for research on individual actions supporting the development of dynamic capabilities. Microfoundations are underlying processes, structures, skills and decision rules that support dynamic capabilities (Sousa-Zomer et al., 2020). In their research, Sousa-Zomer et al. (2020) investigate micro-level factors that determine DT capability development. Besides organisational aspects such as organisational structure, external partnerships and digital investment decisions, they highlight the importance of a risk-taking culture and digital skills for developing DT capability, and thus, for promoting firm performance.

Overall, examining the DT capability literature, it becomes apparent that extant research mainly focuses on the organisation, while the impact of the individual remains largely unexplored. Some recent work has focused on the individual level by assessing

the impact of digitalisation *on* the individual. For example, digital structures allow employees and other stakeholders to act in a more flexible manner, both in space and time (Schwarzmüller et al., 2018; Gregory et al., 2018). As digitalisation blurs organisational boundaries, individuals gain better access to information and choices (Berman, 2012), increasing expectations on organisations. Such effects have sometimes been referred to as the digitalisation of the individual (Hanelt et al., 2021).

Moreover, the changing digital work environment has raised questions about existing roles and responsibilities, and consequently, in defining new ways of working (Stock et al., 2018). While traditionally, IT was separated as unique function responsible for driving technological progress, DT expands this responsibility to the entire organisation, requiring previously IT-unrelated job roles to be able to handle advanced technologies and data. This includes production workers on the shop floor, whose roles shift from simple tasks to complex data-driven responsibilities (Holm, 2018). Employees are empowered by data to make their own well-informed decisions and solve problems (Rossini et al., 2021). However, these discussions often concentrate on the effect of specific technologies in specific contexts.

Nevertheless, there seems to be some evidence on individual competences explaining performance differences at the organisational level (Fallon-Byrne and Harney, 2017; Rothaermel and Hess, 2007). Scholars have identified that the knowledge and experience of individuals matter, and previous research has posited that individual skills and abilities are central for understanding organisation-level outcomes (Felin et al., 2012). Implementing digital technologies without considering the individual may backfire. In fact, productivity gains can only be expected if the changes in processes are implemented together with changed work practices (Schuh et al., 2014; Brynjolfsson et al., 2017).

Although there are only few studies that investigate the impact of DT on the individual, even less involve the impact of the individual on DT. In this research, how individuals contribute to the success of DT is explored and this forms the basis of the first research question:

> *RQ1. What behavioural digital transformation characteristics might impact organisational digital transformation performance?*

The changes associated with DT cannot be examined in isolation. In most cases, DT affects extant organisational cultures and processes that have been established over a long period of time. Equally considered a transformation, continuous improvement philosophies have been attempted to be established over the last decades to ensure sustainable competitiveness, particularly in manufacturing organisations.

2.2 Continuous Improvement Behaviours

Within the field of manufacturing, continuous improvement (CI) is a well-established concept and considered essential for business survival in changing environments. It has proven successful in supporting the achievement of manufacturing targets such as productivity, quality, cost, delivery, safety and morale, and thus, overall business performance (Singh and Singh, 2015).

With its paradigm in the form of kaizen (i.e. small improvement activities), CI aims to ensure continual organisational development to meet changing customer demands. Nowadays, due to its system complexity and wide-reaching applications, it leaves plenty of room for interpretation and implementation approaches. Overall, however, academic investigations tend to lean towards viewing CI either as a process (Imai, 1986) and defining it as "planned, ongoing and systematic process of ongoing, incremental and company-wide change of existing practices aimed at improving company performance" (Boer et al., 2000:xxi), or as a behaviour which ultimately supports the development of dynamic capabilities (Anand et al., 2009; Bessant et al., 2001). Latter research perspective defines CI as "company-wide process of focused and continuous incremental innovation" (Bessant et al., 1994:18), highlighting the behavioural foundation for CI. Both perspectives draw on key conceptual characteristics following the kaizen ideology: continuity, increment, and participation (Singh and Singh, 2015).

Continuity CI is associated with a never-ending change process within the entire organisation (Berling, 2000; Galeazzo, Furlan, and Vinelli, 2017; Lodgaard et al., 2016). It follows a disciplined systematic approach (Anand et al. 2009; Galeazzo et al. 2017; Garcia-Sabater et al., 2012; Lam et al., 2015; Lodgaard et al. 2016) by implementing adequate improvement processes, procedures and activities using appropriate tools (Berling, 2000; McLean et al., 2017). This is necessary as to ensure

continuity and regularity in improvement activities which, ideally, result in a culture of sustained improvement (Bhuiyan and Baghel 2005; Galeazzo et al. 2017; McLean et al. 2017). The principle of continuity also encompasses the process-orientation of CI as opposed to result-orientation (Imai, 1986).

Increment CI is an organic or incremental endeavour focusing on internal capabilities (Bhuiyan and Baghel, 2005; McLean et al., 2017; Singh and Singh, 2010). With its purpose to strive for continual business excellence and creating competitive advantage, it requires constant adaptions from within the organisation. It does not overburden, but advances an organisation step-by-step through continuous cycles of improvement and stabilisation of standards. This approach ensures lasting improvements (Imai, 1986).

Participation CI draws on the necessity to involve all organisational members. Employees are viewed as valuable resources who own creativity and learning needed to facilitate changes. It is also based on the belief that people are inherently motivated to accomplish quality and create value (Imai, 1986). As a change process, CI particularly builds upon evolutionary and continuous organisational learning (Mohd-Zainal et al., 2018). Change requires the development of the current stage to a future stage, hereby recognising the need to constantly learn new processes and procedures.

CI research depends on the philosophical stance taken by the studies. For instance, CI is regarded a management philosophy (Mohd-Zainal et al., 2018), approach (Singh and Singh, 2010) or methodology (McLean et al., 2017) with the principle of improvement (Bhuiyan and Baghel, 2005). For the purpose of this thesis, CI is viewed as philosophy that drives organisational settings and behaviours.

Despite differences in CI definitions and interpretations, some key CI principles should be noted. First, it is a customer driven concept that targets customer satisfaction. Since customer requirements change, organisations need to continuously accommodate new demands and change processes accordingly. Second, leadership is essential for effective change management. Communicating the right values and establishing a CI mindset are key responsibilities of leaders in their effort to develop CI. Along with leadership goes the participation of everyone in the organisation. People need to participate in CI, otherwise new processes will neither be developed

nor accepted. Furthermore, the principles of process approach and systematic approach highlight the need for a clearly defined integration into organisational systems and the disciplined procedure for CI. This is supported by the principle of data-based and factual decision-making which emphasises an objective and well-grounded improvement philosophy. Moreover, the prevention of mistakes plays a key role in CI, which is often realised through the use of product or process design improvements. Lastly, partnership development counts towards the more mature CI principles. CI reaches across the entire supply chain and, in an ideal case, involves the strive towards CI by all stakeholders.

Summarised and considered as kaizen principles, CI is characterised by process orientation, the harmonisation of small improvements, innovation and stabilisation, and people orientation. Berger (1997) bases his view on the kaizen principles and argues that product design and the choice of process define the level of required standardisation and that CI needs to be adapted accordingly. This will ensure that CI is effective. However, organisational design for CI needs to also incorporate alternative approaches to work standards such as quality control circles, wide-focus CI, organic CI, expert taskforce CI and individual CI, depending on the organisational context. These approaches may avoid the motivational costs of strict standardisation.

Both in theory and practice, CI is operationalised through a lean philosophy and other quality approaches such as Total Quality Management (TQM), Total Productive Maintenance (TPM) or Six Sigma. Thus, most extant research has focused on lean manufacturing, six sigma, balanced scorecards or hybrid approaches such as lean six sigma (Bhuiyan and Baghel, 2005). Some of the tools associated with CI are single minute exchange of die (SMED), kanban, 5S, poka yoke (mistake proofing), standardised work, value stream mapping (VSM) and 7W (waste) (Singh and Singh, 2015). Improvements are targeted at every facet of the company including, for example, products, processes, employee and supplier relationships, strategy and quality, aiming to continuously identify and eliminate waste in all systems (Bhuiyan and Baghel, 2005; McLean et al., 2017).

Most research on CI is grounded in learning theories. As CI involves a routine or habit of continuously improving, it requires an organisation to constantly learn new processes and unlearn old ones. For instance, Boer et al. (2000) illustrate that CI as mechanism and organisation structure facilitates the transmission from individual

learning to organisational learning. Organisational learning can be defined as a process of improving behaviour through better understanding and knowledge (Oliver, 2009).

In this context, Dixon (1994) views the search for improvement opportunities as a learning commitment and argues that the six sigma DMAIC cycle leads to CI and learning. Likewise, Seaker and Waller (1996) highlight the importance of utilising the latent talents of employees which will be facilitating CI. Their viewpoint draws on the use of human capital in knowledge, creativity and experience for CI. In order to achieve CI, it is thus crucial for organisations to enable voicing ideas of employees.

The most comprehensive study in regards to developing CI capability is that of Bessant et al. (2001). Their research centres around the involvement of people and investigates how behaviour patterns can be developed in regards to continuous involvement in innovation. In their proposed model, CI is built through routines, which ultimately develop CI as a strategic capability. Again, building such routines is associated with learning. In contrast to other studies, however, they focus on developing CI over long-term and thus, advancing the maturity of CI by going through five levels. Level 1 is described as pre-CI interest and characterised by occasional improvements through trying out ideas. Level 2 involves structured problem-solving and comprises structured and systematic CI. Level 3 is defined as goal-oriented CI and is realised through formal deployments of strategic goals and CI measurement, highlighting CI as strategic. With high levels of experimentations and autonomous innovation, pro-active CI can be reached in level 4. The final level is considered full CI capability through acting as a learning organisation. Here, systematic problem-solving and manifest learning behaviours are in place. Their model describes a generic roadmap for developing CI, but neglects radical innovation behaviour as counterpart to small incremental improvements. In 2015, Jurburg et al. examined to what extent organisations reached the maturity levels of Bessant et al.'s model. Their findings show that in practice, none of the studied companies had reached the highest level and only 20% had reached level four. Key barriers were the lack of learning mechanisms, no sound CI strategy and insufficient process visibility.

Supporting the capability perspective, Anand et al. (2009) argue that CI infrastructure promotes the development of dynamic capabilities. According to their research, CI can be considered a dynamic capability if it involves an extensive organisational context and infrastructure that facilitates the coordination of resources

towards process improvement (Glover et al., 2015). Its main purpose is to improve operational effectiveness through repeated cycles of collective learning by which extant resources are constantly examined to find the best-fit configuration for current business requirements (Anand et al., 2009). Ambrosini et al. (2009) support this view by stating that CI should be regarded as incremental dynamic capability since CI concerns the incremental improvement of extant resources. In the context of CI, the infrastructural domains of purpose, process and people are considered essential, particularly that of change culture (Anand et al., 2009).

Besides developing CI as a dynamic capability, much research has been dedicated to examining CI enablers. For example, Galeazzo et al. (2017) investigate CI infrastructures that consist of strategic alignment, teamwork for problem-solving and goals management whereby merely the latter is negatively related with CI. One possible explanation by the authors is the insufficient ability of goals management to promote learning behaviours.

Likewise, Bessant et al. (1994) identify the factors of strategy, strategic management, supportive culture, enabling infrastructure, process management and supporting tools as relevant CI enablers. Moreover, Gonzalez and Martins (2016) examine capabilities to support CI consisting of the following factors: understanding of organisational goals, management system for CI, management involvement and support, involvement of employees, improvement developed in group, autonomy for improvement practice, development of competences by employees, CI-oriented culture, learning culture, knowledge sharing and intra-organisational interaction.

Prior to the development of their maturity model, Bessant and Caffyn (1997) argued that two levels of abilities are crucial for CI: (1) organisational ability which encompasses the capability to adopt a certain CI approach with constitutive behaviours and (2) facilitators which includes procedures and techniques for CI.

Although CI has spawned a vast amount of literature, some key aspects are still unresolved and require further purposeful research. CI implementation has more often than not failed to meet organisations' expectations due to its system complexity (Jurburg et al. 2018). In order to counteract this issue, investigating the reasons for CI failure is still a popular topic amongst CI researchers (McLean et al., 2017; Sunder and Prashar, 2020; Tavana et al., 2020). In fact, failure reasons mainly include human

factors (e.g. leadership, employee empowerment, training, trust, motivation, teamwork, communication, etc.) as well as structural issues (e.g. organisational infrastructure, dedicated resources, reward system, short-term focus, measurement, customer focus, strategic plan for change, etc.) (see Singh and Singh, 2015; Sunder and Prashar, 2020; Tavana et al., 2020, for detailed lists).

CI is based on utilising resources most efficiently which requires all human resources to make use of their creativity and expertise to improve performance, safety, quality, availability and reliability. In other words, effective organisations utilise their human resources to facilitate continuous performance improvement through their active involvement, knowledge sharing and innovation powers. Although both human and structural factors are key for enabling CI (Bhasin and Found, 2020), this research focuses on the soft factors as one of the main barriers is that of achieving a sustainable improvement culture (Jurburg et al., 2015; Bhasin and Found, 2020; McLean et al., 2017). In order to establish such culture, CI must form the mindset and routines of an organisation's activities - people must believe in, and 'live', CI. Therefore, mere involvement and participation in CI activities may not be sufficient for sustainably developing CI capability.

2.3 Linking Digital Transformation and Continuous Improvement

Organisations that have been attempting to implement a CI culture over many years are now faced by the era of digitalisation. Given the nature of change, DT and CI both embody continuous adaption. However, digital technologies seem to alter traditional change processes as changes no longer impact single areas, but the wider ecosystem of an organisation (Hanelt et al., 2021). Both exploration and exploitation activities which are sometimes referred to as innovation and integration mechanisms are essential for successful DT (Hanelt et al., 2021). Innovation refers to the creation of something new, while integration focuses on the alignment between something new and something existing. Such ability, the simultaneous management of both mechanisms, is understood as ambidexterity in the extant literature and considered a dynamic capability for DT (Schuchmann and Seufert, 2015). A similar phenomenon can be found in the CI literature, whereby CI builds on incremental phases of improvement and standardisation. Here, new improvement ideas are implemented followed by a phase of stabilisation through standardisation. Both in a DT and CI

context, learning capabilities are of particular importance for successful integration (or stabilisation) phases (Schuchmann and Seufert, 2015).

As opposed to the continuous strive for improvement, digital technologies puts pressure on organisations in reinforcing a need for radical or fundamental changes. However, as companies aim to maintain a strategic fit with their contexts, socio-organisational configurations may also gradually evolve, making the nature and necessity of change highly dependent on context (Hanelt et al., 2021). In their paper, Hanelt et al. (2021:1178) argue that "overall DT leads to a shift towards continuous change" whereby radical changes lead to continuous change.

As mentioned above, DT favours adaptive organisational structures. Some studies argue that such organisation design is congruous with approaches of lean management practices (Barreto et al., 2017; Hofmann and Rüsch, 2017) as lean reinforces flexibility and customer focus. However, whether CI enables the required malleable organisation structures has not been empirically verified.

According to Verhoef et al. (2021), organisations gain competitive advantage by leveraging their core competences or by developing new ones which can be accelerated by digital technologies. Thus, interestingly, little is known about the interaction of CI cultures and DT efforts. Some studies suggest that lean manufacturing approaches are seminal environments for DT (e.g. Tortorella et al., 2019). However, empirical evidence of the relational strength between the two paradigms is also lacking.

Therefore, how extant organisational cultures impact DT remains vague and has been highlighted as important research avenue by Hanelt et al. (2021). While some research examines how DT accelerates lean manufacturing, how CI contributes to DT is unclear and is the focus of this study. Thus, the second research question is stated as follows:

> *RQ2. How might CI behaviours influence the digital transformation readiness of employees?*

As CI behaviours change across time due to learning processes, organisations are faced by DT being in different stages, namely maturity levels. Maturity levels not only indicate a certain level of behaviours, but also assume advanced supporting structures, expanding the ability pool of a firm. Consequently, the preconditions as

well as the approaches of how organisations tackle DT may differ. Kane (2017) refers to this phenomenon as capacity to respond to change in a digital context. Such capacity seems to become even more important when the company advances in DT. In their study, Blanka et al. (2022) highlight the exponential relevance of DT competences the further an organisation progresses in DT.

Furthermore, using a multiple case study, Rossini et al. (2021) explore the effect of lean on how manufacturing firms shape their DT paths. Their findings suggest a positive influence of lean production systems on DT, implying a healthy sustainable approach, whereas companies with weak lean production systems tend to opt for disruptive DT approaches.

This raises the question if maturity in CI impacts DT readiness and ultimately, DT performance, and is the focus of this study's third (and final) research question:

> *RQ3.* How might CI maturity influence the effects between behavioural DT characteristics and DT performance?

2.4 Summary and theoretical concepts

DT reshapes organisations and business landscapes by enabling new ways of value creation through digital technologies. This transformation endeavour requires for organisational capabilities to be adjusted or newly built to fit the new requirements. The extant literature highlights some of the organisational capabilities required for DT, but barely involves the individual and its role in developing these capabilities. As previous studies elsewhere emphasise the importance of individual abilities for organisational performance, the first research question challenges how individuals can contribute to the success of DT.

Furthermore, changes associated with DT cannot be examined in isolation. Many manufacturing companies have established CI as part of their organisational culture. As DT requires an organisation to adjust their capabilities, CI can influence this resource base. However, little is known about the interaction of CI and DT. In particular, there is a lack of understanding on how CI culture influences the readiness of individuals for DT.

In line with this intersection, organisational cultures can pose different preconditions depending on their maturity. Thus, it requires further research on how CI maturity influences the behavioural dynamics of DT.

In order to advance the research field, the key theoretical concepts adopted in addressing the research questions need to be clarified. This section provides a brief summary of the main concepts used in this research, while detailed elaborations can be found in each of the three studies (Study A – Chapter 5, Study B – Chapter 6, Study C – Chapter 7).

Digital transformation. As explored above, DT can be seen as a multifaceted concept and has been defined as *"an ongoing process of strategic renewal that uses advances in digital technologies to build capabilities that refresh or replace an organization's business model, collaborative approach, and culture"* (Warner and Wäger, 2019:344). While the concept has been described differently in the literature, this definition was specifically selected because it explicitly emphasises the human factor (e.g. culture) and its perceived role in DT, which is central to this research.

Digital transformation behaviours. DT behaviours are considered a form of microfoundations for DT capabilities in this research. This concept is novel, and a key contribution of this research, in explaining the performance of DT. Given this gap in the current literature, we develop this concept based on tDT competences research, which focuses on developing abilities for DT. Based on their orientation (Blanka et al., 2022), the logic of systematic change and organisational learning (Oliver, 2009), DT behaviours can be defined as individual behavioural patterns that enable the DT of organisations and consists of concrete behaviours that support and drive DT according to existing knowledge.

Perceived digital transformation performance. DT performance refers to measurable transformation targets that indicate how well an organisation is progressing in their digitalisation path. However, the extant literature remains vague on defining the concept as it is highly dependent on context and application. Overall, DT performance should be viewed as multi-dimensional construct. As per this study's research design, aspects of DT performance were selected that could be classified and

evaluated by employees through ‘subjective judgement’ (i.e. process improvement, reputation, digital vision and social interaction). To date, there is no valid measure that links digitalisation activities to organisational performance indicators in an isolated manner (e.g. improving profitability through digital technology implementation). Therefore, instead of implying objective figure-based measurements of DT performance, this research uses the term of ‘perceived’ DT performance and draws on extant DT performance indicators relevant to the manufacturing context. Based on Hanelt et al. (2021) and considering its importance for DT (Fernandes and Burcharth, 2024), perceived DT performance can be viewed as the extent to which organisational members perceive a new digital business model, or aspects of it leveraging digital technologies, to be creating value for their organisation.

Continuous improvement. The concept of CI is often seen as an inherent business philosophy which has been described in section 2.2 and follows a systematic incremental approach. Although well established in both theory and practice, it still lacks one commonly agreed definition. Mostly grounded in learning theories, CI involves the habit of continuous adaption and is thus frequently defined as “*planned, ongoing and systematic process of ongoing, incremental and company-wide change of exisiting practices aimed at improving company performance*” (Boer et al., 2000:xxi). This definition is adopted by this research to both align with the literature and to stress the learning orientation needed for the continual process of changing organisational practices.

Continuous improvement behaviour. Similar to behaviours supporting the DT of organisations, the behavioural patterns promoting everyone in the organisation working together using a scientific approach to improve organisational processes and routines are referred to as CI behaviours. This definition of this concept underlies previous studies by Bessant et al. (2001) and Kovach and Fredendall (2013) and contributes to the development of strategic CI capability and organisational evolutionary stages of CI (Bessant et al., 2001).

Continuous improvement maturity. In line with the development of CI behaviours, the concept of CI maturity is grounded in learning. Bessant et al. (2001) view CI as organisational capability that follows an evolutionary path, integrating

individual behaviours into routines and subsequently organisational abilities. CI maturity is seen to correlate with organisational performance because it builds upon organisational learning, which inherently creates competitive advantage. Overall, CI maturity reflects the level of CI culture and, thus, describes the strength of embedded behviours and routines in an organisation. In this research, the concept of CI maturity plays a crucial contingent role as it impacts the capacity of organisational members to learn new practices.

Empowerment. Empowerment can be explored from different angles and should thus be regarded as multifaceted and multileveled concepts. For the purpose of this research involving CI and DT, the focus will be on combining structural and psychological empowerment into one construct. Structural empowerment refers to the formal authority of decision-making given by the system of an organisation (Kanter, 1977), whereas psychological empowerment involves the perceived feeling of being empowered, which includes the perception of competence, meaning, impact and self-determination (Thomas and Velluthose, 1990; Conger and Kanungo, 1988).

Besides these key concepts, some other reported terms play an important role in describing the relational dynamics between the concepts. In the context of this research, *interplay* refers to the way in which two or more latent constructs affect each other when they co-exist (see Cambridge Dictionary for a generic definition). The term is particularly utilised when measuring the impact of one construct on another, or others. Moreover, another key component of this research study is the phenomenon of paradoxes. A *paradox* can be defined as "*persistent contradictions between interdependent elements*" (Schad et al., 2016:6) and are often described, in simple terms, as dualities of extremes (Smith and Lewis, 2011). Here, the paradoxes term emphasises contradictory effects between conctructs, driven by a third, interrelated construct. In contrast, *synergy* describes the strength of the linkages between contrasting or paradoxical activities (Koryak et al., 2018). It strengthens the relational effect by emphasising similarities of otherwise conflicting constructs.

Table 3 provides an overview of these conceptual definitions.

Table 3. Conceptual definitions

Concept	*Conceptual definition*	*Supporting literature*
Digital transformation	"*an ongoing process of strategic renewal that uses advances in digital technologies to build capabilities that refresh or replace an organization's business model, collaborative approach, and culture*" (Warner and Wäger, 2019:344)	Gong and Ribiere (2021); Hanelt et al. (2021); Verhoef et al. (2021)
Digital transformation behaviours	Individual behavioural patterns that enable the digital transformation of organisations (author's own definition)	Blanka et al. (2022); Sousa-Zomer et al., (2020); Vial (2019)
Perceived digital transformation performance	The extent to which organisational members perceive a new digital business model, or aspects of it leveraging digital technologies, to be creating value for their organisation (author's own definition)	Hanelt et al. (2021); Fernandes and Burcharth (2024); Singh et al. (2017)
Continuous improvement	"*planned, ongoing and systematic process of ongoing, incremental and company-wide change of exisiting practices aimed at improving company performance*" (Boer et al., 2000:xxi)	Bessant et al. (2001); Anand et al. (2009); Singh and Singh (2015); Bhuiyan and Baghel (2005)
Continuous improvement maturity	Evolution of CI capability (Bessant et al., 2001)	Jurburg et al. (2015); Garcia-Sabater et al. (2012); Dabhilkar et al. (2007); Jurburg et al. (2018)

Concept	*Conceptual definition*	*Supporting literature*
Continuous improvement behaviours	Behavioural patterns that "*promote everyone in the organisation working together using a scientific approach to improve organisational processes and routines*" (Kovach and Fredendall, 2013:6)	Bessant et al. (2001); Lirazelli et al. (2022); Jurburg et al. (2018); Oliver (2009); Bhuiyan and Baghel (2005)
Empowerment	An individual's perceived and actual freedom and autonomy of employees to take their own decisions as well as assuming responsibility for their actions (Spreitzer, 1997)	Pradhan and Panda (2021); Kanter (1977); Thomas and Velluthose (1990); Conger and Kanungo (1988)
Interplay	Describes how two or more psychological constructs affect each other when they co-exist (based on Cambridge Dictionary)	Blanka et al. (2022); Soosay and Hyland (2008)
Paradox	"*Contradictory yet interrelated elements (dualities) that exist simultaneously and persist over time; such elements seem logical when considered in isolation, but irrational, inconsistent, and absurd when juxtaposed*" (Smith and Lewis, 2011:387).	Schad et al. (2016); Qin (2023); Maalouf and Gammelgaard (2016); Bernstein (2012)
Synergy	The strength of the linkages between contrasting or paradoxical activities (Koryak et al., 2018)	Sanders et al. (2017)

The described theoretical concepts, amongst others, build the foundation for developing the overall research framework, which will be outlined in Chapter 3 (Theoretical Framework).

3 Theoretical Framework

3.1 Aim and methodology

Current knowledge in the realms of DT and CI lack integrative theoretical discussion that goes beyond singular technological applications, principles or organisational units. By exploring the interaction between CI and DT, focusing on behaviours, we envisage a better understanding of the development of individual DT capabilities and their synergies with CI as well as their joint effect on DT performance. Conceptualising a research model is based on the research aim at hand. Following the research questions, this conceptual model draws on the premise that relational inferences can be made. It is attempted to constitute effects between variables that help to explain observed realities. Therefore, the conceptual model is a theoretical response to explaining reality. By simplifying complex realities using structural models, small portions of actualities can be tested and verified (Bertrand and Fransoo, 2002).

In order to conceptualise this model, thorough consideration is required on which variables to include. Using theory, causal relationships between variables can be established (Mitroff et al., 1974). The construction of a conceptual model thus includes both a mathematical description (i.e. equations) and a description of flow processes, representing the theoretical propositions. "*An important consequence of the fact that relationships are causal and quantitative is that the models can be used to predict the future state of the modelled processes rather than be restricted to explaining the observations made*" (Bertrand and Fransoo, 2002:249).

This model is an abstraction of the theory of planned behaviour (Ajzen, 1991). Stemming from the field of psychology, the theory of planned behaviour (TPB) is a widely recognized framework for understanding and predicting human behaviour. Developed by Icek Ajzen in the late 1980s, this theory has been extensively studied and applied in various domains, including manufacturing. By examining the factors that influence an individual's intentions and subsequent actions, the TPB provides valuable insights into human decision-making processes. The TPB posits that human behaviour is determined by three key components: attitudes, subjective norms, and perceived behavioural control.

Attitudes. Attitudes refer to an individual's evaluation of a particular behaviour. These evaluations are based on beliefs about the outcomes and consequences associated with the behaviour.

Subjective Norms. Subjective norms capture the social influence on an individual's behaviour. They reflect the perceived expectations and opinions of significant others, such as colleagues. If an individual perceives that their social network values a specific behaviour, they are more likely to conform to those expectations.

Perceived Behavioural Control. Perceived behavioural control refers to an individual's perception of their ability to perform a specific behaviour. It encompasses both internal and external factors that may facilitate or hinder the execution of the behaviour. In this research, the focus is primarily on internal factors and thus, the notion of self-efficacy rather than perceived behavioural control is adopted.

According to the TPB, an individual's intentions to engage in a particular behaviour is the primary determinant of their actual behaviour. Intentions are influenced by attitudes, subjective norms, and perceived behavioural control. Higher levels of intention are generally associated with a greater likelihood of engaging in the behaviour. However, it is important to note that intentions alone may not always translate into actual behaviour. External factors, such as situational constraints or unexpected events, can influence the final outcome. Accordingly, the theory assumes that individuals have complete control over their behaviours, which may not always be the case. However, TPB has been instrumental in measuring organisational culture in the sense of behavioural routines because it shows strong validity for accumulated behaviours (i.e. shown behaviours on various occasions as opposed to predicting single behaviours), but also to predict context-specific behaviour.

Instead of embracing idealistic rationalities in verifying the model, the aim is to evidence ‘truth’ through validation. Verification connotates the assertion of truth whereby an absence of uncertainties is a prerequisite and all system components are considered true. Yet, investigating behaviours within socio-technical conditions requires us to accept some degree of error. Legitimising the model using the TPB will be at the core of this research, classifying the findings as valid representations of reality.

3.2 Development of the research model

According to the research questions and the underlying theoretical propositions with which the questions are attempted to be answered, the core interest lies in investigating the impact of CI on DT from a behavioural perspective. Since intentional behaviour is driven by individual characteristics of attitude, subjective norms and self-efficacy, these variables are included in the model for both constructs. As specified in Study A, attitude, subjective norms, and self-efficacy are integrated into the concept of mindset as overarching term. In addition, literature highlights the concept of empowerment as core mechanism of and for CI and DT, connecting both constructs. Study B further elaborates this proposition. Therefore, empowerment is included as a mediating construct for psychological and structural empowerment in the conceptual model. Aside from empowerment, several studies have shown that maturity (Δ) effects the impact between variables. In exploring behaviours, the collective performance levels of individuals need to be considered as an indication for maturity. Specifically, understanding the impact of CI on DT necessitates an understanding of the maturity of CI behaviours (i.e. low versus high implementation levels). Furthermore, this research attempts to link individual behaviours with DT performance. Thus, perceived DT performance as a dependent variable is adopted.

Overall, this theoretical research model is based on the assumption that mindsets and behaviours can influence each other. It is also based on the assumption that individual behaviours can impact organisational performance. Figure 2 presents the initial conceptual research model, constituting the hypotheses assumed for this research.

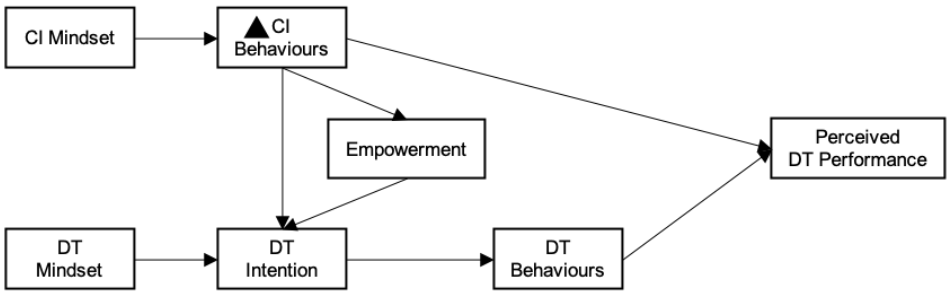

Figure 2. Conceptual research model

Each study discusses their respective hypotheses in depth, resulting in a set of individual and specific conceptual models. It is also important to note that the research model is applicable to the manufacturing context and validated as site-specific construction of reality, ensuring the model's adequacy (Schlesinger et al., 1979).

3.3 Limitations of the Research Model

Concurrently, these boundary conditions '*place limitations on the propositions generated from a theoretical model*' (Whetten, 1989:492). Although this conceptual model is generic from the theoretical point of view, it was developed with manufacturing-specific conditions in mind. They gave rise to the research questions in the first place, but also defined the hypothesised relationships between variables and their operationalisations.

A second limitation involves the selection of variables. The proposed model is limited to elected theoretical propositions and factors that are considered essential for answering the research questions. Continuing the research should involve extending this model to include additional factors.

Having established the theoretical backbone and framework, the following chapter elaborates the methodological approach on how the framework for conducting hypothesis-driven research to generate meaningful results is designed.

4 Research Design

Deciding on the research design highly depends on the aim of the research (James and Thayer, 1975), the object of research (Saunders et al., 2019), and the researcher conducting the research (Easterby-Smith et al., 2015).

The decision on how to conduct research is typically driven by research philosophies that can be drawn from the research aim and from the construct variables relevant to the research (Anderson et al., 2009). The aim of this research is to understand the inter-dynamics of CI behaviour and DT readiness and their joint effect on DT performance. Specifically, Study A establishes and evaluates the impact of DT behaviours on perceived DT performance. Study B explores the influence of CI behaviours on DT readiness by considering their underlying mindset and the mediating role of empowerment. Lastly, Study C investigates the 'triangle' effect of CI behaviours, DT behaviours, and perceived DT performance by determining the relational strength (i.e. moderating role) of CI maturity.

This chapter outlines the overall research design and the methodology used to achieve the research objectives that guided the empirical studies. Due to the nature of this research, the overall aim is to ensure theoretical and methodological rigour while maintaining relevance for practice, hereby striving towards evidence-based management (Rousseau, 2006).

4.1 Research philosophy and methodology

In order to guide this research in a cohesive and structured way, Saunder's research framework (i.e. research onion) is followed, consisting of the sequential layers of research philosophy, approach to theory development, methodological choice, research strategy, time horizon, and techniques and procedures (Saunders et al., 2019).

Research philosophy

Before commencing research, reflecting on how reality needs to be studied is essential. Based on the purpose and context of the research aim, epistemological, ontological and axiological considerations should be assessed. Ontological assumptions reflect the perception of the nature of reality, while epistemological assumptions incorporate the constitution of knowledge, and how acceptable and valid knowledge is defined.

Axiology refers to the role and perception of values. These considerations are often made under the umbrella of research philosophies. Deciding on the research design begins with defining a research philosophy as a northern star throughout the research journey.

This research aims to identify and measure relationships between variables that are proposed by theory-driven hypotheses. It is not the intention to merely explore factors of constructs, but to assess causes and effects between variables. The interest lies in the variation of causal relationships. Therefore, this research is carried out through the lenses of objectivism, which considers the research context as external to social actors (Bryman and Bell, 2015). Objectivism promotes an independent unbiased existence of physical and social phenomena with a tendency towards universality and endurance (Saunders et al., 2019). Identifying effects between variables, findings are envisaged that are generalisable, replicable and unbiased as a result of the studies.

In light of the objectivist angle in ontology, epistemology and axiology, a positivist-functionalist perspective is followed which considers the research object as "observable social reality to produce law-like generalisations" (Saunders et al., 2019:144), looking for value-free research and independence of the researcher. In accordance with Burrell and Morgan (2016), rational explanations are aimed for as well as attempting to offer generable recommendations based on universally valid results. The research focuses on observable and measurable facts with emphasis on quantifiable observations to establish causal relationships. In order to determine these relationships, the TPB is utilised as universal rule to help explain or predict behaviour. The researcher distances herself from the research object and seeks to remain neutral.

Approach to theory development

Following a positivist-functionalist research philosophy, the research is guided through a deductive approach, which tests theoretical propositions and revises theory based on the research outcomes. The TPB provides the research framework which guides an understanding of the relationships between the research variables. Testing for generalisable results applying theory, close attention to the careful selection of construct measures, and sample definition, was paid.

Methodological choice

In line with a deductive approach and considering the research objectives, a quantitative mono-method was applied to numerically measure the relationships between the variables. A standardised data collection technique underlines the ambition to create measurable observations whereby meaning is generated from numerical data. The explanatory studies are facilitated by combining probability and non-probability sampling techniques to enable statistically valid and reliable inferences to be made.

Research strategy

As a research strategy, a survey procedure consistent with a positivist philosophy and deductive approach is applied in order to quantify and measure the variables in a standardised manner. Surveys allow the collection of such standardised data, hereby facilitating comparisons between individual cases or groups (Saunders et al., 2019). Using a thorough data analysis method, the data is utilised to carry out descriptive and inferential statistics to answer the research questions.

Time horizon

The survey is designed to enable cross-sectional research (i.e. social survey design) which measures data at one point of time across multiple cases, industries and locations. For all three studies, the aim is to determine the co-existence of CI and DT at one point in time, and to measure their correlation. A cross-sectional study aims to quantify variation and it can yield valid and reliable results if the measures are correct (Bryman and Bell, 2015). Therefore, reliable construct measures are selected that have been verified in previous research. Further studies may apply a longitudinal approach to measure the effect over time.

Techniques and procedures

In order to collect data using a survey strategy, an online self-completion questionnaire is opted for in line with the research philosophy and approach. This technique enables the collection of standardised questions from a large number of respondents, allowing for statistical analysis. Self-completion questionnaires reduce personal bias of the researcher and eliminate a potential Hawthorne effect. The section below provides more insights into the questionnaire design.

4.2 Operationalisation of Constructs

This research involves eleven latent constructs which are measured by sixty items overall. Each study makes use of its respective constructs described in their own sections. The following part lays out the measurement for our entire research model and is summarised in Table 4.

Table 4. Construct operationalisation

Construct	***Operational definition***	***Scale source***	***Number of items***	***Item description***
Continuous improvement attitude	Degree to which a manufacturing employee has a favourable or unfavourable evaluation or appraisal of continuous improvement activities	Liu et al. (2006) Yen-Tsang et al. (2012)	4	Continuity Learning Teamwork Leadership commitment
Continuous improvement subjective norms	Perceived social pressure to perform or not perform continuous improvement behaviours	Yen-Tsang et al. (2012)	3	External pressure Peer pressure Competitive pressure
Continuous improvement self-efficacy	Perceived ease or difficulty of performing continuous improvement behaviours	Jurburg et al. (2017) Yen-Tsang et al. (2012) Trang (2024)	4	Autonomous implementation Implementation competence Idea finding Resilience
Continuous improvement behaviours	Behavioural patterns that promote everyone in the organisation working together using a scientific approach to improve organisational processes and routines	Bessant et al. (2001) Lizarelli et al. (2022) Jurburg et al. (2018)	14	Contribution belief Blame culture Structured problem-finding Participation Strategic alignment Strategy communication Integration Recognition Management support CI system Process evaluation Interdisciplinary teams Stakeholder cooperation Senior management support / system improvement Knowledge management

Construct	*Operational definition*	*Scale source*	*Number of items*	*Item description*
Empowerment	An individual's perceived and actual freedom and autonomy of employees to take their own decisions as well as assuming responsibility for their actions	Pradhan and Panda (2021)	8	Goal internalisation Unconventional thinking Autonomy Communication Purpose Competence Self-determination Impact
Digital transformation attitude	Degree to which a manufacturing employee has a favourable or unfavourable evaluation or appraisal of digital transformation behaviours	Muehlburger et al. (2022)	4	Reservation Positivity Risk propensity Entrepreneurship
Digital transformation subjective norms	Perceived social pressure to perform or not perform digital transformation behaviours	Seifert (2023)	3	Organisation & Co-workers Exclusion Competitive forces
Digital transformation self-efficacy	Perceived ease or difficulty of performing digital transformation behaviours	Muehlburger et al. (2022)	3	Usage Understanding Leading
Digital transformation intention	Motivational factors influencing digital transformation behaviours (i.e. indication of how hard people are willing to try to perform DT behaviour)	Meske and Junglas (2021)	3	Support Participation Feedback
Digital transformation behaviours	Individual behavioural patterns that enable the digital transformation of their organisations	Blanka et al. (2022)	10	Benefit belief Data handling Vision creation Pro-activeness Experimental learning Training Teamworking Innovative ideas Value identification Management support Self-organising teams Adaption

Construct	*Operational definition*	*Scale source*	*Number of items*	*Item description*
Perceived digital transformation performance	The extent to which organisational members perceive the new digital business model to be creating value	Trischler and Li-Ying (2022) Tortorella et al., (2023) Hanelt et al. (2021) Nicolás-Agustín et al., (2022)	4	Process improvement Digital reputation Digital vision Social interaction

Continuous improvement attitude. In line with the TPB, the attitude towards CI is defined as the degree to which a manufacturing employee has a favourable or unfavourable evaluation or appraisal of continuous improvement activities (Ajzen, 1991). This construct was measured by four items. Two items from the CI scale of Liu et al. (2006) were adopted who modified Flynn et al.'s (1999) original eight item scale. The reliability and validity of this scale has been established in previous research (Huang et al., 2011; Peng et al., 2008). Two more items were included based on Yen-Tsang et al. (2012) to emphasise attitudes towards leadership commitment and teamwork. All four items were measured on a 7-point-Likert-scale (1=strongly disagree; 7=strongly agree).

Continuous improvement norms. Besides CI attitudes, CI behaviours can be predicted by their underlying subjective norms according to the TPB. This perspective defines subjective norms as the perceived social pressure to perform or not perform CI behaviours (Ajzen, 1991). CI norms are operationalised using the definition of social pressure and three respective measures: external, peer and competitive. This approach is supported by Yen-Tsang et al. (2012). The same 7-point-Likert-scale (1=strongly disagree; 7=strongly agree) was used.

Continuous improvement self-efficacy. Instead of the description of perceived behavioural control proposed by theory, the focus is on perceived capabilities and thus, the notion of self-efficacy is adopted (Bandura, 1977). This construct is operationalised as perceived ease or difficulty of performing CI behaviours measured by four items: autonomous implementation (Jurburg et al., 2017), implementation competence, idea finding (Yen-Tsang et al., 2012) and resilience (Trang, 2024). To better support the research, wording was adjusted to fit the context. Participants were asked to state their perceptions on a 7-point-Likert-scale (1=strongly disagree; 7=strongly agree).

Continuous improvement behaviour. CI behaviour is seen as behavioural patterns to incrementally improve work tasks. The measurement scale is based on the work of Bessant et al. (2001) which has been frequently cited in previous research. In order to reduce the number of items, the original scale was compared with items used by Lizarelli et al. (2022), Jurburg et al. (2018) and Dabhilkar and Bengtsson (2007).

Overall, fourteen items were selected for final inclusion based on factor loadings in previous research, research context fit and the emphasis on a learning organisation (Bessant and Caffyn, 2006). Some of the items were rephrased for improved understanding. The participants were asked to evaluate the statements using a 7-point-Likert-scale (1=strongly disagree; 7=strongly agree).

Empowerment. The concept of empowerment is multi-faceted and can be studied from various angles. For our purposes, empowerment is described as an individual's perceived and actual freedom and autonomy of employees to take their own decisions as well as assuming responsibility for their actions (Spreitzer, 1977). For the purpose of this research, empowerment is viewed as a bipartite construct which is measured through psychological empowerment and structural empowerment. Psychological empowerment is viewed as an individual's subjective sense of having control over themselves and the environment, and is measured by four items. On the other hand, structural empowerment focuses on creating an organisational environment in which individuals have the agency to make decisions on their work lives. This construct is also measured by four items. The scale of Pradhan and Panda (2021) is adopted as it combines both psychological and structural empowerment, and indicates good validity and reliability. However, due to high item quantity, their items reduced to count eight overall which were measured on a 7-point-Likert-scale (1=strongly disagree; 7=strongly agree).

Digital transformation attitude. The construct of DT attitude refers to the degree to which manufacturing employees have a favourable or unfavourable evaluation or appraisal of DT activities (Ajzen, 1991). The individual DT readiness measurement scale developed by Muehlburger et al. (2022) was utilised as it integrates both information system perspectives and behavioural change foundations. Their scale is based on change readiness and fits the research purpose. The construct was measured by four items using the dimensions of reservation, positivity, risk propensity and entrepreneurial attitude. For each item, statements were defined for participants to assess using a 7-point-Likert-scale (1=strongly disagree; 7=strongly agree).

Digital transformation norms. Analogical to CI norms, DT norms reflect an individual's perceived social pressure to perform or not perform DT behaviours

(Ajzen, 1991). This construct is operationalised using three items that indicate social pressure: co-workers, feeling of exclusion (Seifert, 2023) and competitiveness in alignment with the TPB. Participants were asked to indicate their personal perception on a 7-point-Likert-scale (1=strongly disagree; 7=strongly agree).

Digital transformation self-efficacy. Following the TPB and Bandura's concept of self-efficacy, the intention to perform a behaviour is partially predicated by one's perceived behavioural control or self-efficacy (Ajzen, 1991). Within a DT context, DT self-efficacy is operationalised as perceived ease or difficulty of performing DT behaviours. In order to measure this construct, the dimension of technological affinity of the individual DT readiness measurement scale is adopted (Muehlburger et al., 2022). With some linguistic modifications, three items are utilised to measure this construct on a 7-point-Likert-scale (1=strongly disagree; 7=strongly agree).

Digital transformation intention. The construct of DT intention is a modified version of the behavioural intention concept from the TPB. According to Ajzen (1991) and adapted to the digital context, the intention to perform a behaviour reflect motivational factors influencing DT behaviours and indicate of how hard people are willing to try to perform DT behaviours. To measure DT intention, the scale of Meske and Junglas (2021) was adopted. Based on this understanding, the construct was measured using three items, which respondents assessed on a 7-point-Likert-scale (1=strongly disagree; 7=strongly agree).

Digital transformation behaviours. While some discussions revolve around required skills and capabilities in a digital environment, there is a gap to identify respective behaviours of individuals within manufacturing companies to enable their DT. To operationalise this construct, DT behaviours are viewed as competency driven individual behavioural patterns to (systematically) enable DT in organisations. The measurement items were formulated based on the competency framework by Blanka et al. (2022) as it links competencies to implied behaviours and abilities, which are later combined with individual digital maturity levels of organisations. Ten items were selected to measure DT behaviours and assessed on a 7-point-Likert-scale (1=strongly disagree; 7=strongly agree).

Perceived digital transformation performance. DT can be viewed as a continuous process of integrating technologies and organisational practices to create a digital culture. Its performance depends on many factors and currently lacks a common understanding and definition. Therefore, there is a need to select appropriate measures that underlie research-specific requirements. Here, DT performance is seen from a process perspective and operationalised as multidimensional phenomenon that triggers significant changes using "*advances in digital technologies to build capabilities that refresh or replace an organization's business model, collaborative approach, and culture*" (Warner and Wäger, 2019:344). From this standpoint, extant literature was summarised and indicators were selected to measure DT performance in line with the research context, i.e. from the perspective of the individual. Considering the varying level of maturity within the organisations, items were selected that are applicable to both beginners and very mature organisations in respect to DT, and can be understood, articulated, and evaluated by employees of an organisation through subjective judgement. The construct was measured by four items, digital vision (Tortorella et al., 2023; Hanelt et al., 2021), social interaction (Nicolás-Agustín et al., 2022), process improvement and digital reputation (Trischler and Li-Ying, 2022).

In addition to the latent constructs, the additional variables age, gender, job role, tenure and type of company were controlled for as these factors have shown to impact the utilised variables (e.g. the influence of age on the feeling of digital exclusion; Seifert, 2023; or age, gender and tenure as predictors for technology adoption; Venkatesh et al., 2003; Garcia-Sabater et al., 2012).

4.3 Procedure and quality assurance

The procedure for conducting this research study follows a systematic and partially iterative process. The unit of analysis (i.e. the individual) for this study is based on the purpose of the research and the defined research objectives, and a sampling strategy selected to allow for a well-grounded and targeted questionnaire design. The questionnaire was then tested in a pilot study and modified to better fit the main data collection procedure. During the main study, respondents were asked to complete the final questionnaire through Qualtrics. 105 gatekeepers were asked to distribute the questionnaire amongst 10 people in their organisations and a reminder was sent after

two weeks. Overall, out of 428 started questionnaires, 303 were completed in time. The remaining 125 questionnaires had too many missing data making data imputation techniques invalid or respondents did not consent to participate. The standard deviation for each case was reviewed to identify respondent misconduct and cases below a 0.25 std. were excluded (n = 3; STD = 0,128). In total, 300 valid cases remained in the final sample.

Thus, the survey demonstrated a response rate of 40% which corresponds with other similar studies. Likewise, while the dropout rate was 30%, dropout could not be associated with a particular variable, indicating random dropout. Missing data was not an issue in this survey. An overview of some data modifications can be found in Appendix B as well as a final sample demographics overview in Appendix C.
Figure 3 visualises this procedure.

Figure 3. Research procedure and timeline

Each step of the research procedure will be described in detail below.

4.3.1 Unit of analysis

Considering the research aim is to understand the interplay of CI and DT from a behavioural perspective, particularly recognising the characteristics of employees that contribute to the success of DT and examining the effect of CI behaviours on the behavioural readiness for DT, this research concentrates on the role of individuals in developing organisational DT capabilities. Using the TPB as a framework, the approach taken explores the process of developing individual DT behaviours and how they are shaped by cognitive mechanisms and organisational context. Therefore, the unit of analysis is the individual in each of the three studies and individual employees are selected for the sample rather than organisations.

4.3.2 Sampling and research sites

The manufacturing industry is a major contributing factor to both the economic success of Europe and the employment of its citizens. According to Statista, the value added is forecasted to generate US$15.36tn in 2024 with a compound annual growth rate of 3.56% over the next four years.

CI shares a long history with the manufacturing industry, particularly since the rise of TQM and lean manufacturing. On the other hand, DT originated in the field of information systems and computing, but has resulted in new opportunities for many industries including manufacturing.

As this research investigates the twin topics of CI and DT, manufacturing is deemed to be an ideal research context that can draw on a broad range of experience of CI, but has also already taken on the journey of DT. Thus, in today's business environments, manufacturing employees are now likely to be simultaneously engaged in CI efforts and DT activities.

The application of a survey method requires appropriate measures to ensure research validity and reliability, and therefore, a large representative sample will be required.

The focus for this research centres around the high-value manufacturing sector (Livesey, 2006). A multi-stage sampling approach is chosen to combine the benefits of probability and non-probability sampling. Considering the target population (i.e. high value manufacturers), the first step involved a simple random selection of manufacturer types based on the Standard Industrial Classification (SIC) codes (see for example Appendix B). In total, 15 out of 161 high-value manufacturing types were selected.

Next, organisations with headquarters in Europe as well as demonstrating CI and DT initiatives or experience were identified. Manufacturing companies with headquarters in Europe were chosen to facilitate a global representation while maintaining a common European link. Participation in the study (i.e., selection criteria) required that individuals were working in a high-value manufacturing company which was either pursuing, or had established, CI and DT initiatives to ensure suitability and fit for the purpose of the research.

The third step involved a random selection of 105 gatekeepers from the identified organisations, who were then asked to distribute the survey amongst 10 of

their employees (i.e. snowball sampling) whom they considered to be most suitable. Snowball sampling is particularly useful if access to a large population is challenging (Bryman and Bell, 2015). Here, this approach was chosen as the gatekeepers were considered most knowledgable about the right participants for this research due to their inter-organisational insights. The key criteria communicated to the gatekeepers was to target experienced employees in both CI and DT. While all functions and hierarchical levels were nominated as potential participants, the higher likelihood of response and the ability to answer all of the questionnaire questions were with individuals with production-related responsibilities, such as quality management and operations management. Finally, due to language restrictions, only individuals with a good understanding or fluency in English, German or Hungarian, could participate.

In order to ensure statistical analysis feasibility using SPSS Amos, an adequate sample size is required. Sample size is dependent on many factors such as research approach, analytical method, number of variables or model complexity, time and resources, completion rate, sample size used for similar studies and the data analysis programme (Memon et al., 2020). Based on statistical power analysis for each of the studies, a sample size between 119 and 184 is sufficient to detect an effect (Westland, 2010; Cohen, 1988).

4.3.3 Questionnaire design

The way questionnaires are designed can affect response rates, dropout rates and the answers given by the respondents. Therefore, the design phase of the questionnaire was carefully designed and tested prior to, and during, a pilot study (Dillman et al. (2014). A self-completion questionnaire was selected to achieve the required sample size within the research timeframe.

Utilising an online self-completion questionnaire offers several advantages. It allows to efficiently collect data from a large number of participants, ensuring that the desired sample size is achieved. Additionally, online questionnaires provide convenience for respondents, as they can complete the survey at their own pace and in their preferred location. This flexibility often leads to higher response rates and reduces the likelihood of dropouts. This is specifically important for participants who follow strict work schedules like in this study.

However, it is important to consider potential drawbacks associated with online self-completion questionnaires. For instance, there may be concerns regarding the representativeness of the sample, as certain demographics may be less likely to participate in online surveys. Additionally, the lack of direct interaction between researchers and respondents could potentially result in incomplete or inaccurate answers. These limitations are taken into account when analysing the data.

Overall, the questionnaire included all constructs that were required for all three studies. Therefore, it was rather extensive and took about 15 minutes for participants to complete. Previous research has shown that the impact of questionnaire length had mixed results in regards to completion (De Vaus, 2014). Thus, the focus was on essential questions to be able to measure all constructs without information overload.

Using valid scales, some of the items were rephrased to improve understanding. As the questionnaire was distributed across different hierarchical levels, job functions and ages, the questions were formulated as clearly as possible and irrespective of workplace context.

In order to be able to distribute the questionnaire across various global locations, the questionnaire was translated into German and Hungarian. By carrying out the survey in three languages, questionnaire items were carefully selected and described. Translating items into other languages helped to challenge wording and to question understanding as meaning (i.e. lexical, idiomatic, experiential) had to be the same in all three languages (Usunier et al., 2017). A professional translator, native industry experts, and the researcher made sure that translation was correct including grammar and syntax.

The structure of the questionnaire consists of five major parts. First, the research was introduced by explaining its purpose and providing the most important information regarding participation as brief summary of the participant information sheet (see Appendix D). By consenting to participation, participants could move to the next page. Then, a brief instruction was provided which included the structure of the questionnaire. If no consent was given, the questionnaire was closed.

The second part reflect the control variables and asked for the participant's individual working context, including organisational role, tenure, type of company, country, gender and age group. These questions were started with as they encompass

low complexity and are easy to answer, hereby aiming to leave the participants with a feeling of success early on.

This part was then followed by questions on empowerment, which measure the construct of empowerment.

Next, participants were asked to assess statements that indicate their perception of CI and their actual CI behaviour. Participants were free to leave additional comments on CI in an open-text field.

DT was chosen to be last as questions were most complex and more difficult to answer, depending on an individual's digital literacy. Again, the opportunity was given to leave additional comments on DT in an open-text field. Lastly, general comments could be made if required. The questionnaire concluded with a thank you to participants, and a note that the researcher can be contacted for study results.

In order to minimise risks and maximise data quality and respondent engagement, some measures were taken for (1) prompt: clear instructions and contact e-mail for clarification if needed, (2) respondent fatigue and boredom: every effort was made to only include essential questions for the research and a maximum of five questions per page (3) elaboration of answers: optional comment boxes throughout the questionnaire were included for respondents to add any additional information they deemed necessary, (4) loading: use of rating scales instead of open-ended questions, (6) influence: the questionnaire is not readable as a whole, partial use of reversed scales to reduce response bias, and no biased language, (7) respondent: screening questions and utilising gatekeepers, (8) length: pilot test with a small sample to identify any unnecessary questions or areas for improvement, (9) literacy: attempt to use clear and simple language, avoid double-barrelled and ambiguous questions and three different language options to choose, (10) missing data: use of mandatory questions and use of a progress indicator to show respondents how far they are in completing the questionnaire, encouraging them to complete all questions, (11) response rate: personalised invitations and reminders for the gatekeepers, communication of benefits and conducting non-response bias analysis.

In sum, by complying with questionnaire design principles, the aim was to design a questionnaire that effectively captures the information required to answer the research questions while providing a positive participant experience. Awareness of potential drawbacks encouraged improving the questionnaire for main data collection.

4.3.4 Pilot study

Prior to full data collection, it is important to ensure contextual construct face validity, a good understanding for participants concerning questions asked, and to test a number of assumptions that are required for data analysis. A pilot study refers to a small-scale research study conducted before the main study. It serves as a trial run to identify and address any potential issues or challenges, allowing necessary adjustments to be made before committing to a full-scale investigation.

For the pilot study, 44 participants were recruited by convenience to complete the questionnaire and to provide feedback over a two-month period. Using three rounds of interviews with different groups of participants, the quality of a research questionnaire could be established, as detailed below.

First, two academics for each language (i.e. English, German, Hungarian) were consulted to review the scales, highlight potential construct validity issues and report on cognitive load. All academics were either knowledgeable in industry or well-experienced with surveys. After completing the online survey in their own time, all academics provided feedback either through e-mail or verbally over the phone. Based on their responses and feedback, a number of minor adjustments were made. For example, instead of measuring the construct of empowerment as a single factor, the scale was expanded to account for both structural and psychological empowerment. In addition, the length of the questions was substantially reduced.

In a second round, experts in the field of CI and DT were asked to verify the meaning of questions, validate content validity and report on potential redundant items. Valid results require common understanding of the questions, which also reduces dropouts. This shared understanding refers not only to all statements and keywords, but across all three languages. Using virtual focus group-type interviews for each language, nine experts were asked to complete the survey during two-hour sessions and to report back what they understood after each statement. Their understanding was ranked on a scale from 0 to 10 (0 equal not understand at all, 10 equals understand perfectly) by the researcher, resulting in a final face validity of 8.2 (SD = 1.5). In a subsequent discussion, items were evaluated for their richness and four items were removed due to overlapping statements after all three interviews.

The last round was carried out with individuals from the manufacturing sector that share the same characteristics as the targeted sample to provide general feedback on the questionnaire (e.g. accessibility, look, and feel) and to ensure the statements can be easily understood. During a two-week period, the online survey was sent to 30 participants, out of which 29 completed on time. The pilot questionnaire contained additional feedback questions and free-text boxes for the participants to provide feedback throughout the survey. After closing the survey, the results were consolidated and reviewed in depth. Consequently, wording was adjusted for the final questionnaire as well as certain design features for ease of use (e.g., questions shown per page limited to five). In addition to consulting the feedback of the participants, another aim of the pilot study was to test if the response patters meet the requirements for the analytical methods. By adopting a 7-point-Likert scale, variances were accounted for rather than respondents opting for extremes. The results indicate a normal distribution pattern amongst the respondents of the third round. Due to the limited number of respondents and considering the complexity of the research model, any initial analysis such as confirmatory factor analysis (CFA) does not, however, accurately confirm scale validity and could not be tested in the pilot study.

Finally, the last aim was to enable the estimation of required sample size. With a desired statistical power of 0.8 and probability level of 0.05, power analysis was used to determine the minimum sample size to detect an effect. The results confirm that a sample of 200 will be sufficient for the studies (Cohen, 1988; Westland, 2010)

Post- the pilot study, the modified final questionnaire was considered suitable for main data collection as data saturation during the interviews was reached.

4.3.5 Data collection process

CI activities and DT both change in time, moving across stages of maturity. As this research attempts to measure the relationship of CI and DT, data collection was carried out in October 2023 as a cross-sectional study which manifests the relational effect at one specific point in time. This design allows for the collection of data from a diverse group of participants, who exist in particular maturity levels at that time. Figure 4 demonstrates the overarching main data collection process.

Figure 4. Data collection process

To gather the required data, an online questionnaire was created based on the pilot study using Qualtrics and distributed to participants through gatekeepers over a four-week period. This timeframe was chosen to ensure that a sufficient sample population was achieved. In order to reach the gatekeepers, various methods were utilised, including contacting individuals through company websites and leveraging social media platforms such as LinkedIn. These avenues provided a wide reach and allowed for the recruitment of a diverse range of participants. The following snowball principle facilitated the recruitment of otherwise unreachable participants. A reminder was sent to the gatekeepers after two weeks. Having reached the required sample size in the end of October, the survey was closed after four weeks of data collection.

It is important to note that although all three empirical studies utilised the same data set, they focused on different sections of the data. This approach allows for a comprehensive analysis of the collected information and ensures that all aspects of the research questions are addressed.

4.3.6 Data analysis

In conducting the analysis, the focus was on addressing the research questions and objectives. The aim is to evaluate and test the relationship between a complex system of variables. Therefore, structural equation modelling (SEM) is used to analyse the data which enables simultaneous analysis of variables. SEM draws on various foundational methods, including regression analysis from statistics, path analysis from epidemiology, measurement theory from psychology, factor analysis from both psychology and statistics, as well as simultaneous equations from econometrics. By integrating these interdisciplinary tools, a comprehensive understanding of the data can be gained and meaningful conclusions can be drawn.

Thus, SEM is particularly well-suited for examining complex constructs, such as psychological latent factors, and for investigating causal relationship systems and

mediated effects. Compared to multiple regression analysis, using SEM offers greater robustness and flexibility (Collier, 2020).

The analysis is based on both categorical (control variables) and ordinal data (indicators) and our unit of analysis is the individual.

To facilitate the analysis, the data was transferred from Qualtrics to IBM SPSS for initial data screening. This included screening the data for outliers, missing data, errors, and any instances of respondent misconduct (Collier, 2020). Multiple imputation for missing data was not required (Eekhout et al., 2013).

In addition, coding was reviewed to ensure the correct representation and usefulness of data.

Once the dataset was ready for analysis, the data was transferred to SPSS© AMOS© 29. Using this software, it is possible to specify, assess, estimate and present the research model in a causal path diagram to indicate the hypothesised relationships between constructs.

For data analysis, a SEM four step approach was followed in each of the empirical studies:

1. Establish satisfactory measurement model for key concepts using latent variables
2. Fit regression paths between concepts
3. Test hypotheses on model parameters
4. Assess model fit

The foundation of structural equation models lies in its integration of factor analysis for the measurement of latent constructs and a regression model for examining the proposed relationships between the latent constructs. The following equation formula 1 represents the approach to measurement model estimation:

$$y_i = \alpha + \Lambda\eta_i + \varepsilon_i$$

Equation 1. Measurement equation

In alignment with Muthén and Muthén (2002), y is a vector of observed indicators with dimensionality p, corresponding to an m-dimensional vector of latent

variables η. The factor loading of the observed indicators is represented by Λ, a p x m parameter matrix of coefficients. Additionally, ε is a vector of disturbances associated with the observed indicators, and its covariance matrix is denoted by θ. The model encompasses a *p*-dimensional vector α, representing a set of measurement intercept parameters.

For the measurement model, confirmatory factor analysis (CFA) is utilised which is widely used statistical technique to analyse the degree to which indicators measure their latent constructs, and if the latent constructs are unique. The resulting factor loadings represent the statistical estimates of the direct effects between latent construct and reflective indicator, and are interpreted as regression coefficients.

The structural model follows a similar logic and the structural equation 1.2 is as follows:

$$\eta_i = \beta + C\eta_i + \zeta_i$$

Equation 2. Structural equation

In the structural equation 2, β is a vector of dimensionality *m*. The parameter matrix of regression slopes among latent variables is denoted by C, which has dimensions *m* x *m*. Additionally, τ is a matrix of dimensions *m* x *q*, capturing the regression relationships between latent variables and observed variables. In this context, ζ is an *m*-dimensional vector representing the residual variance for the latent variables, while ψ denotes the covariance matrix of ζ. However, such equation incorporates the phenomenon of recursiveness. Therefore, the equation is adjusted as follows:

$$\eta_i = (1 - C)^{-1}\beta + (1 - C)^{-1}\zeta_i$$

Equation 3. Non-recursive structural equation

Integrating the structural equation 3 into the measurement equation, the holistic equation follows:

$$y_i = \alpha + \Lambda(1 - C)^{-1}\beta + \Lambda(1 - C)^{-1}\zeta_i + \varepsilon_i$$

Equation 4. Integrative equation

The approach of structural equation modelling allows to assess theory-driven hypothetical models by comparing them to collected data. This comparison involves analysing the mean and covariance matrix of observed variables and contrasting them with the specified or theorised matrix (Muthén and Muthén, 2002). Log likelihood ratios, anticipating a models' degrees of freedom (Hu & Bentler, 1995; 1999), are used to evaluate differences between these models. When the observed matrix is shown to be significantly different from our hypothesised model, it can be concluded that the model does not fit the data. In simpler terms, fitting the theoretical model to the observed data involves the solution of equations in a way that the data aligns with the model (Hox & Bechger, 1998).

In order to assess the fitness of the research models, robustness-of-fit statstics are utilised. The robustness-of-fit in structural equation modeling refers to the model's ability to maintain its validity and reliability across different conditions and datasets. It assesses how well the model performs and holds up when faced with variations in data or potential departures from the assumed model specifications. A robust model exhibits stability and generalisability, indicating that its findings are not overly influenced by specific characteristics of the dataset and can be applied to diverse situations. In this research approach, indicators commonly used in previous studies are used. This includes the Comparative Fit Index (CFI) which compares the fit of the specified model to the fit of a baseline or null model, and it takes into account the complexity of the models being compared. A CFI value close to 1 indicates a good fit, suggesting that the specified model is relatively better at explaining the observed data compared to a more restrictive baseline model. Generally, a CFI value above 0.90 is considered acceptable, and values closer to 0.95 or higher are indicative of a very good fit.

Moreover, the Incremental Fit Index (IFI) was utilised as an additional fit indicator. Like the CFI, the IFI values range from 0 to 1, where a higher value indicates a better fit. An IFI value above 0.90 is generally considered acceptable, and values closer to 0.95 or higher suggest a very good fit. The Standardised Root Mean Square Residual (SRMR) as well as the Root Mean Square Error of Approximation (RMSEA)

were also evaluated. The SRMR assesses the discrepancy between the observed and predicted covariance matrices, standardising the residuals by dividing them by an estimate of the population standard deviation. In simpler terms, SRMR provides a measure of the average standardised discrepancy between the observed and model-implied covariance matrices. A lower SRMR value indicates a better fit, with values close to 0 considered indicative of a good fit. RMSEA estimates the average discrepancy per degree of freedom, considering both the lack of fit and model complexity. It is particularly useful for penalising models that are overly complex, and it provides an indication of how well the model might generalise to new data. In terms of interpretation, lower RMSEA values suggest better model fit, with values close to 0 indicating a good fit. Commonly accepted thresholds are around 0.05 for a close fit, 0.08 for a reasonable fit, and 0.10 for a marginal fit.

Instead of using the chi-square (χ^2) as additional indicator, the relative chi-square (χ^2/df) is utilised because it takes sample size into account. It is a ratio of the chi-square statistic to the degrees of freedom, providing a normalised or standardised indicator of fit. Values below 3 are considered good fit while values below 5 are still considered acceptable (Schumacker and Lomax, 2004).

Overall, it is important to note that models with more indicators tend to have weaker model fit statistics.

4.4 Ethical Considerations and Data Protection

Throughout the research process, close attention was paid to ethical considerations. Before commencing data collection, the research project and the questionnaire was thoroughly reviewed and approved by the Ethics Committee of University of East Anglia.

The research was originally triggered by Mercedes-Benz Hungary Kft. with no funding involved. However, due to the Covid pandemic, the research distanced itself from a specific organisation and was carried out independently. Therefore, and equally in light of ethical considerations concerning the research and individual organisations, a cross-sectional design was chosen rather than a case study.

During the data collection process, adherence to UK regulations and human protection was a matter of course. This study complies with GDPR, UK GDPR and UK DPA 2018. Neither the participants nor the researcher was adversely affected which was ensured through anonymity of accounts and confidentiality of records. Gatekeepers have played an important role in facilitating the study. During data collection, communication strategies were developed in order to build collaborative networks which are required for research realisation (e.g. see Buchanan et al. (1988) and Johl and Renganathan (2010)). Factors that were considered included, for instance, the transparency on value of the research, adherence to ethical considerations and the confirmation of UEA thereof, a clear description of the research process and potential impact on business operations, evaluation of any potential risks, and a statement on the benefit of this research.

The method for obtaining permission of the gatekeeper was dependent on the individual gatekeeper. A detailed participant information sheet in all three languages was attached to the first page of the online questionnaire and sent alongside the invitations for participation (see Appendix D). The information sheet and the first page of the questionnaire highlighted the key research information (e.g. research purpose, necessity of participation, data management, report of findings and research process). The participants could make an informed decision on whether or not to participate in the study. By clicking on the consent button, participants agreed that they were voluntarily participating, working in a high value manufacturing company, understood the anonymity of responses and the withdrawal options.

Privacy was respected through anonymity and the avoidance of sensitive questions. Each case was treated equal, fair and with sensitivity. Participants were free to withdraw from the study at any point, before submitting the questionnaire. Withdrawal after questionnaire completion was not possible as individuals could not be identified.

In addition, honesty about the research purpose and the data collected is part of research integrity and the researcher condemns any deception attempt. At all times, it was attempted for this research and the researcher to be trustworthy.

Reduce personal bias was aimed for by random selection of participants, use of gatekeepers and online surveying. The researcher is aware that personal values can influence what and how data is interpreted. Therefore, countermeasures to minimise personal bias at any stage of the doctoral research were taken. For instance, the findings were reviewed with the supervisory team.

Moreover, the questionnaire was kept as short as possible due to the time constraints of manufacturing employees.

Due to online data collection, some additional ethical matters were considered. Throughout the sampling process and follow-ups with respondents, the research complies with the Research Involving Social Media guideline set out by the University. Data Privacy regulations and the Social Media guideline of the University were followed.

The collected data will not be stored in a repository due to a single study permission of the companies and the agreement to not further use the data for other purposes. Data and file encryption techniques are used to secure the storage of the data. According to the UEA Research Data Management policy, the data will be securely stored and kept for 10 years for access by the researcher, unless stated otherwise by the participating organisations.

4.5 Summary

The process of establishing DT behaviours and how they are linked to the organisational performance of DT is not well understood. Additionally, the interplay of CI culture and DT remains unexplored. Considering these research gaps, the angle of objectivism is followed and a positivist-functionalist perspective is adopted to carry out deductive research using the theory of planned behaviour. A quantitative survey

strategy is adopted using an online self-completion questionnaire for cross-sectional research. The questionnaire was designed based on the research objectives and tested in a pilot study prior to main data collection.

Utilising a thorough research design and carrying out three empirical studies, research gaps are addressed by aiming to theoretically rationalise and test: the process of developing DT behaviours and how they are linked to DT performance; the influential condition of CI behaviours and the mediating effect of empowerment; and the triangle effect of CI behaviours, DT behaviours and DT performance by exploring the explanatory role of CI maturity for DT dynamics.

5 Study A: Developing Individual Digital Transformation Readiness and Exploring Its Impact on Digital Transformation Performance

5.1 Introduction

In today's fast-paced and highly competitive business landscape, digital transformation (DT) has become a critical driver of growth and innovation. DT involves the integration of digital technologies into all areas of a business, fundamentally changing how it operates and delivers value to customers. However, achieving successful DT requires more than just implementing new technologies. It involves a holistic approach that encompasses changes in organisational structure, culture, leadership, and value creation paths. Since the beginning of discussions revolving around DT, practitioners, organisations and scholars have departed on a journey for a search of digital capabilities. Noteworthy, the focus is almost always on the organisation as a whole (e.g. Stentoft et al., 2021 on industry 4.0 readiness) while neglecting the importance of the individual. However, few remarks have been made. For example, Warner and Wäger highlight that „*digital sensing capabilities require digital mindset crafting*“ (2019:345) and refer to it as a new thinking approach within a digital context, particularly with a strategic orientation. Thus, digitally transforming an organisation naturally necessitates a transformation of the workforce in order for it to be successful (Eden et al., 2019). Tortorella et al. (2020) argue that simply implementing digital technologies will not be sufficient to achieve superior organisational performance. Sociocultural systems and elements such as learning must be developed to thoroughly benefit from digital technologies. Consequently, developing a digital culture must consider the individual.

In contract, much research to date has explored the impact of digital technologies on employees (e.g. Malik et al., 2022) putting the individual in a passive position. Here, digital technologies are considered something that *happens* to individuals. However, in many cases, organisational members take the lead and commit to their agency (Colbert et al., 2016; Butschan et al., 2019). This research takes a rather pro-active stance whereby individuals are able to influence and shape the digital transformation of their organisations (Ostmeier and Strobel, 2022).

Although few studies exist that explore human-related matters such as digital culture or digital mindset, how individual behaviours can be developed and how they influence the performance of digital transformation remains unexplored.

This study addresses this research gap by investigating the concept and process of individual digital transformation characteristics and relating them to the notion of digital transformation performance. Thus, conducting an empirical study, we aim to (1) conceptualise the constructs of digital mindset, digital transformation behaviours and digital transformation performance, (2) theorise the process of framing individual digital transformation behaviours, (3) establish the effect of digital transformation behaviours on organisational digital transformation performance and (4) empirically validate our assumptions using a quantitative survey method, by answering the following research question:

> *RQ1. What behavioural digital transformation characteristics might impact organisational digital transformation performance?*

Addressing this research question, this study contributes to the nascent field of individual DT capabilities and identifies behavioural factors that contribute to the success of DT.

The remainder of this work first highlights the theoretical framework required for understanding the research field before developing hypotheses. Next, the methodology is described. The results are provided therafter, followed by a discussion and conclusion.

5.2 Theoretical framework

Some scholars highlight the importance of developing a digital mindset to succeed in digital transformation (e.g. Hanelt et al., 2021). A digital mindset is an inherent prerequisite for a digital culture that effectively copes with the rapidly changing and turbulent business environment due to digitalisation. Organisations that achieve a fit between digital vision and respective culture adapt easily with the ever-changing operating models (Forsythe and Rafoth, 2022) while individuals with a digital mindset perform better in their job and are more likely to develop resilient teams

(Neeley and Leonardi, 2022). However, very little is known of what a digital mindset actually entails.

As the notion suggests, a mindset inherently involves cognitive processes and mechanisms. Drawing on cognitive psychology, different perspectives can be found in the extant literature.

Some scholars define it as filter through which people perceive the world around them (Rhinesmith, 1992) or as a result of knowledge structures (Gupta and Guvindarajan). Others refer to it in the sense of merely reflecting the collection of cognitive mechanisms in order to accomplish a task (Gollwitzer et al., 1990). A third perspective grounds the concept of a mindset on inherent values and beliefs (Dweck, 2006). For all perspectives, put simply, a mindset is a way of thinking and orientation towards the world we live in, which impacts our perceptions, feelings and behaviours.

Due to its nature, digital environments place specific requirements and demands on the individual and its organisation, affording and necessitating a change in mindset (Fitzgerald et al., 2013). Digital environments are characterised by continuous and disruptive change dynamics that require adaptive minds, structures and processes. Consequently, such change dynamics demand a strong learning orientation in order to acquire the knowledge needed in a changed environment. Additionally, it includes unlearning out-dated practices that no longer effectively serve their purpose. Moreover, due to the nature of digital change including its complexity and speed, organisations can no longer rely on one single function to drive digital transformation. Expertise and responsiveness are required throughout the organisation, leading to a dispersion in decision-making and the necessity to fully utilise available human capital. Since individuals are encouraged to both spot digital opportunities and merge them with the extant organisation context, a digital mindset must incorporate both innovation and integration perspectives (Hanelt et al., 2021) which enables organisational exploration (i.e. creating and sensing new opportunities) and exploitation activities (i.e. seizing and transforming extant conditions).

In their attempt to consolidate cognitive psychology perspectives, Hildebrandt and Beimborn (2022) define a digital mindset as “thinking patterns, epitomized through cognitive processes, filters, and core convictions of humans constituted of cognitive mechanisms and knowledge structures that affect and foster the use and

application of digital technologies and cope with their consequences in contexts of individuals, organizations, or society." (p. n.a.). According to their perspective, developing a digital mindset involves a coping strategy with the changing environment towards an increasingly digital one. From a practice-oriented perspective, a digital mindset can also be defined as a "set of attitudes and behaviours that enable people and organisations to see how data, algorithms, and AI open up new possibilities and to chart a path for success in a business landscape increasingly dominated by data-intensive and intelligent technologies" (Neeley and Leonardi, 2022).

The existence of a digital mindset is closely intertwined with an individual's readiness for digital transformation because it presumes the likelihood of an individual to engage with digital transformation. This is based on the assumption that digitalisation changes inter- and intra-organisational dynamics that lead to alterations in roles (Dumeresque, 2014), tasks and competences (Murawski and Bick, 2017). The individual readiness perspective argues that specific abilities and characteristics are required for the fulfilment of such new tasks and environments, but also to actively drive DT activities (Muehlburger et al., 2022). Essentially, such characteristics determine the degree to which individuals are motivated to engage in DT activities (Becker, 2020). The concept of individual readiness for digital transformation suggests three key values. First, the ability and willingness to change. The frequency, speed and complexity of change distinguish digital transformation from past changes and necessitates highly change habituated individuals who pro-actively and creatively solve problems. Second, the understanding of digital technologies and the intention to use them. The ability to understand and use computers, data and digital infrastructures is becoming more prominent (i.e. digital literacy) (Martin, 2005) and represent a foundational readiness factor. Third, innovation attitude and entrepreneurial thinking. Acknowledging the impact of digital technologies on the business and its wider eco-system while turning them into new opportunities will be crucial in maintaining competitiveness and fully benefiting from digital transformation efforts.

Our view is that digital mindsets evolve in line with the digital transformation of an individual's surrounding. Accordingly, the way we think is different when confronted with the early phases of digital transformation (i.e. digitization or digitalisation) as opposed to working in a highly digitised, digitally mature organisation.

For the purposes of our research, we utilise the theory of planned behaviour to conceptualise the phenomenon of digital transformation mindset using the cognitive elements of attitude, subjective norms and self-efficacy. We explicitly incorporate the transformation term to not only emphasise the "end state" of being digital, but acknowledging the change process leading towards it. Simultaneously, we consider these cognitive mechanisms to indicate the predisposition of individuals (i.e. readiness) to digital transformation and thus, draw on respective readiness theories. In addition, we consider DT intention as important motivational readiness factor which links DT mindset with DT behaviours.

Although attitudes towards disruptions have long been studied (e.g. Chao et al., 1986), digitalisation creates entirely new systems and ways of working, which demands new perspectives. DT attitudes are adopted thinking patterns that influence the evaluation or appraisal of digital transformation activities favourably or unfavourably. The way digital transformation is perceived strongly depends the attitude towards change, whether it is seen as beneficial in working life or harming extant work practices (e.g. replacing routines by robots, making the individual redundant). In an extreme binary case, one person views digitalisation as positive and useful, making work life easier and more productive, while the other is rather reserved and attempts to resist, perceiving digitalisation as harmful and unsafe. Moreover, DT subsists on an innovation orientation and entrepreneurial attitudes. This includes both the ability to fully utilise digital technologies and integrating them to create new business systems, and rethinking business models. Experimenting with digital technologies and the willingness to take risks go hand in hand with an innovation orientation and are also considered important attitudes if an organisation strives to remain competitive.

Besides individual attitudes, social pressure can significantly influence the way people think and consequently their behaviour. This phenomenon is well known from the concept of peer pressure (i.e. Ash conformity experiments) or obedience to authority (i.e. Milgram's experiment). In a digital context, DT norms are defined as perceived social pressure to perform or not perform digital transformation behaviours. Besides disciplinary orders from superiors, colleagues pose an important influential factor in DT involvement as both work-related structures, collaborative tasks and work

relationships can force the adoption of digital technologies. Increasingly, the notion of digital exclusion is becoming more prominent in the literature, particularly in the context of different age groups (Seifert, 2023). The perceived social pressure to engage in DT due to an otherwise feeling of exclusion can cause a compelled response. In addition, from an organisational standpoint, individuals may be encouraged to participate in DT activities to contribute to ensuring the company's competitiveness.

A third behavioural driver for digital transformation is what we refer to as DT self-efficacy. Originally defined as perceived behavioural control, it describes one's own perceived ease or difficulty of performing a particular behaviour. In the context of digital transformation, the perception or belief in one's own ability is partially linked to digital competences and the perception of one's ability to work with new digital technologies. Individuals with high DT self-efficacy are knowledgeable and skilled in digital technologies and find it easy to understand and use new technologies. However, DT self-efficacy also refers to the belief in being able to cope with the ever-changing environment. Although technologies dominate DT discussions, it is the resulting organisational changes that employees must master and drive as well.

However, without the motivation to genuinely engage in DT activities, behaviour is not performed. These motivational factors are indicated by the cognitive mechanism of DT intention, which involves the intrinsic willingness to perform DT-driving behaviours. Höyng and Lau (2023) coin this concept intentional digital readiness. The intention to support and accept the changes of digital transformation is a directional concept which determines DT behaviours. As such, individuals who are willing to contribute to digital transformation are more likely to perform DT-driving behaviours.

Digital mindsets seem crucial because they shape perceptions and behaviours in a digital transformation context. So far, however, the digital mindset has not yet been linked to specific DT behaviours and therefore, remains a rather isolated phenomenon. Nevertheless, understanding the impact of a DT mindset on actions taken that promote the success of DT initiatives is key for placing the concept of DT mindset in the wider research spectrum.

In order to examine the impact of a DT mindset on DT behaviours, the latter needs clarification. The substance of DT behaviours lacks theoretical and empirical examination and has not yet been addressed according to our best knowledge.

Nevertheless, one related research stream explores the required skills and competences within DT environments. Most research on digital competencies recognises the need for innovativeness in order to exploit and drive technological advancements. While this is certainly valid, computer and data skills also play a crucial role (Gekara and Nguyen, 2018). Digital competence can be defined as 'the ability to adopt and use new or existing information technology to analyse select and critically evaluate digital information in order to investigate and solve work-related problems and develop a collaborative knowledge body while engaging in organisational practices within a specific organisational context' (Vieru et al., 2015).

Having the right skillset to survive in and drive DT is essential, but applying it is equally important. Therefore, we consider skills and competences foundational to behaviours and draw on the competence literature to conceptualise DT behaviours. Against this background, we define DT behaviours as competency driven individual behavioural patterns to (systematically) enable digital transformation in organisations.

Deriving the needs for individual DT behaviours from organisational requirements, some observations can be made. The speed and complexity in changes increases the necessity for agility. Agility can be considered a core mechanism for DT (Warner and Wäger, 2019; Verhoef et al., 2021) because it enhances organisational value identification and realisation. Agile structures allow for flexibility, sensing and seizing new digital opportunities, and fast decision-making, and rely on adaptive individual behaviours and resilient mindsets. Moreover, the capability for networking becomes increasingly important including both internal and cross-company structures (Verhoef et al., 2021). For example, building digital platforms for interorganisational collaboration has been recognised. Organisational members are encouraged to jointly work on solutions and to use networking potentials for new value creation paths. Needless to say, digital capabilities such as big data analytics (Verhoef et al., 2021) also need to be in place if an organisation is to succeed on their DT journey.
All these characteristics call for an innovative and adaptive culture.

Our conceptualisation of DT behaviours is primarily based on Blanka et al.'s (2022) competency framework. In their study, they apply a behavioural perspective on determining required digital competencies, defining competency as "a construct describing individual behaviour that integrates skills and knowledge, and results in

superior performance" (p.3). Recognising the need for an innovative culture within digital settings, their work is based on intrapreneurial research and highlights the need for competencies in strategic management, proactiveness, idea generation, opportunity evaluation, interpersonal mobilisation and market foresight, alongside digital competencies such as technical and computer skills.

Digital behaviours are learned and developed in time. They represent the new normal, the way people are acting in a digitalised organisation, thus shaping organisational culture. Accordingly, they become increasingly relevant the further an organisation progresses in digital transformation (Blanka et al., 2022).

Previous research has highlighted the importance of developing dynamic capabilities for DT. Although dynamic capabilities tend to be explored from an organisational perspective, individual behaviours contribute to development of sensing, seizing and transforming capabilities.

We have collected key characteristics shaping DT behaviours from the literature and categorised them based on the dynamic capability's perspective. Table 5 indicates the derived behaviours for DT.

Table 5. Theoretical underpinning of DT behaviours

Abilities	Behaviours
Proactiveness	▪ Taking action ▪ Staying focused ▪ Striving for the better with self-determination ▪ Learning by doing ▪ Assessing consequences
Interpersonal mobilisation	▪ Networking with empathy ▪ Inspiring others ▪ Collaborating
Opportunity evaluation	▪ Seizing ideas ▪ Envisioning the value of new digital opportunities ▪ Strategising for new digital opportunities ▪ Developing options for exploitation
Idea generation	▪ Generating new ideas ▪ Identifying new possibilities ▪ Utilising one's own imagination and abilities ▪ Scanning the business environment
Market foresight	▪ Identifying markets and emerging customer needs ▪ Developing purposeful and targeted products or services
Management insight	▪ Assessing strengths and weaknesses of strategic plans ▪ Prioritising ▪ Working toward a vision of the future ▪ Making decisions related to uncertainty, ambiguity, and risk ▪ Developing a plan to achieve digitalisation goals ▪ Developing economic know-how for digitalisation ▪ Managing necessary digital resources

Adopted from Blanka et al. (2022)

DT behaviours are important because they underpin and fuel the DT of an organisation. However, their impact on DT performance lacks empirical evidence. This is partially because extant literature fails to agree on a common understanding of what DT performance means. The phenomenon of DT is still in its infancy and evolving (Culot et al., 2020), resulting in vague definitions. Besides the connotation of performance, some scholars addressing the same issue are using the terms of outcomes, effect, success, impact, result, benefit or value. After all, the question is how DT progress can be measured and what the target state should be. Acknowledging that digital transformation is an ongoing change process, the performance of DT is highly contingent on context, purpose and maturity level. As DT is a very complex phenomenon involving the entire organisation and its ecosystem, the contextual constraints and opportunities determine the aspired DT performance. DT is a means to several ends. Some organisations utilise digitalisation to improve sustainability while others shift their business model from producing physical products to selling digital services. For instance, Savastano et al. (2022) Considering the mechanism of change, DT maturity models tend to inherently posit performance criteria which indicate success criteria for each stage or phase. Organisations that have just started to digitise some of their process may perceive DT performance differently than organisations operating as digitally mature entity. Therefore, DT performance should be viewed as multi-dimensional construct.

Some attempts to clarify the multidimensionality have been made. For example, Barthel (2021) categorised current information systems perspectives into four clusters: company value and performance, digital business performance, external transformation and internal transformation. A similar pattern can be found in the manufacturing literature, although mostly very specific outcomes are discussed in the extant literature (e.g. improving sustainability or quality).

Company value and financial performance

Successfully transforming into a digital age includes taking advantage of digital technologies to improve the value of the organisation. Value is mostly measured in financial terms including return on investment (ROI), profitability, revenue growth, investor value, financial performance and firm growth (Hanelt et al., 2021; Verhoef et al., 2021; Vial, 2019). Likewise, DT performance may also consider the tendency of growth including customers, users or sales (Verhoef et al., 2021). In addition, value is also

demonstrated by reputation (Matarazzo et al., 2021; Trischler and Li-Ying, 2022; Vial, 2019) positioning companies along the early innovator – adopter – laggards scale. Organisations that highly engage with new technologies are perceived as frontrunners or innovative, increasing company value from an innovative power perspective (Ferreira et al., 2020). Company value can also be determined from an external standpoint, whereby performance is measured by the degree to which an organisation contributes to the growth of employment due to their digital transformation (Vial, 2019). However, it is challenging to measure the direct effects of DT on company performance as effects may be caused indirectly. For instance, by reinventing an operational process through digital technology implementation, lead-time and delivery can be improved, resulting in improved cash flow, reputation and revenue. Cash flow, reputation and revenue, however, are dependent on my factors and cannot necessarily be drilled down to the implementation of digital technologies which led to the reinvention of the process. In other words, the performance of an organisation does not necessarily uniquely reflect DT performance. To counteract this challenge, some effort encourages the quantification of digital business by extracting the revenue or profitability generated from digital business, or by indicating the relative importance of the company's digital business (Bathel, 2021).

Smart Manufacturing and operational efficiency

Exploring the manufacturing context, DT performance may be measured by the extent to which Industry 4.0 or smart manufacturing is implemented and effective. Frank et al. (2019) distinguishes the concepts of smart manufacturing, smart working and smart supply chain. Smart manufacturing involves key concepts like vertical integration, energy management, traceability, automation, virtualization, and flexibilization. Moreover, taking the developments of physical-digital-world integration into account, smart working is an essential characteristic DT towards manufacturing of the future. Smart working on the shop-floor includes remote monitoring and collaborative robots, remote operation, augmented and virtual reality. Going beyond a particular production site, smart supply chain involves digital platforms with other business units, suppliers or customers. Similar to the performance factor of company value, the operational performance targets can also be considered criteria for measuring DT performance (Tortorella et al., 2020; Vial, 2019). Amongst others, these include improvements in quality, speed (lead-time), dependability, cost (operational efficiency and productivity), flexibility (mass customization) and sustainability (environmental impacts) (Culot et al., 2020; Sjödin et

al., 2018). In sum, digital technologies can promote and realise process improvements and their automations.

Organisational Structure and Culture

One of the critical elements of DT is the rethinking of organizational structure and culture. This includes cross-functional collaboration, promoting an innovation culture, encouraging risk affinity and experimentation, and establishing agility (Vial, 2019). As mentioned above, fostering a digital mindset and creating agile organisational structures are at the core of DT paths (Hanelt et al., 2021; Verhoef et al., 2021). Additionally, employee roles and skills need to be redefined to create a digital workforce capable of leveraging new technologies (Vial, 2019). In this regard, leadership play a vital role, acting as facilitator and role model, and empowering the workforce (Vial, 2019). Indeed, technology-focused management capabilities need to be developed as part of DT and thus indicate a significant performance indicator (Ritala et al., 2021; Hanelt et al., 2021). Some organisations may benefit from setting up a DT-specific functional area and appointing a Chief Digital Office (CDO) which ensures that IT knowledge is spread within the organisation and which can act as dynamic organisational unit sensing and seizing digital advancements (Verhoef et al., 2021).

Value Creation Paths

DT is particularly recognised because it can involve finding new ways of value creation. In exceptional forms, digital technologies allow changes in business models based on new value propositions (Verhoef et al., 2021; Vial, 2019). In this regard, servitisation is an emerging trend in expanding the creation of value, where companies offer services in addition to their products (Vial, 2019). For example, automotive manufacturers not only focus on selling vehicles, but on expanding their value with a car-as-a-service concept facilitated by digital platforms and channels. Besides servitisation, value creation can also incorporate new forms of collaboration and networking. Digital platforms and channels allow for physical-independent co-creation of products, services and concepts, hereby improving efficiency (Verhoef et al., 2021; Vial, 2019). Additionally, they allow to better engage with customers and partners, and capture online sentiments (Verhoef et al., 2021). Thus, the digitalisation of the stakeholder network and digital networking capability can be seen as DT performance indicators (Ritala et al., 2021; Verhoef et al., 2021), emphasising an ecosystem orientation (Hanelt et al., 2021).

Here, innovativeness contributes to a competitive advantage which set high performing organisations apart. Digitalising new or existing products or services may be a result of the innovation power and can constitute new value propositions.
Most importantly, a clear digital vision is required that embodies how an organisation wants to leverage digital technologies for their specific purposes, and what path of value creation will be followed (Hanelt et al., 2021).

Digital technologies

Enabling technologies are an essential component of DT. Although mainly considered a driver for and facilitator of DT, digital technologies evolve and build on each other. Frank et al. (2019) argue that cloud computing, IoT, Big Data, and analytics are some of the base technologies that underpin DT and are used to enhance decision-making. Base technologies enable additional technologies to be implemented. Thus, looking from a technical perspective, the application of more advanced technologies reveals some success in DT. In ensemble with its data information infrastructure, digital technologies form part of an organisation's digital resources and need to be exploited for DT to be successful (Verhoef et al., 2021).

Many of these factors can be regarded as enablers or success factors, though they also measure the progress of DT (Barthel, 2021). For the purpose of this research, factors are taken into account that can be subjectively judged and evaluated by individual organisational members. Therefore, the aspects of process improvement, reputation, digital vision and social interaction (i.e. collaboration) as foundational DT performance characteristics are included in this construct. In order to account for this limitation, the notion of perceived DT performance is adopted in the research framework. Overall, how DT performance can be influenced is the main question of this research.

5.3 Hypotheses Development

Using the theory of planned behaviour, we aim to establish the process of developing DT behaviours and extending the theory to theorise their impact on organisational DT performance. As extensively delineated in Chapter 3, the theory of planned behaviour is a well-accepted framework to understand and predict specific

behaviours. The elements of attitude, subjective norms and self-efficacy are considered to be the main behavioural drivers. In the context of DT, we expect the theory to hold.

In their study, Trenerry et al. (2021) found that the perception of technology usefulness leads to a better acceptance of new technologies. Similarly, factors causing resistance including lack of organisational support, the perception of digital technologies as a threat and personal switching costs tend to result in unwillingness to engage in changes (Mete and Eyel, 2021). Moreover, positive attitudes towards change have been found to positively influence engagement in DT (Gfrer et al., 2021) and proactive adaption to new technology implementations (Vakola, 2014; Ritala et al., 2021). Individuals with optimistic viewpoints also see change as an opportunity to learn and thus become more open to change. The willingness to learn is seen a crucial prerequisite for developing digital capabilities (Osmundsen, 2020). In line with positive attitudes, DT environments depend on entrepreneurial conceptions, experimentations and the willingness to take risks. Indeed, risk-taking has been shown to positively impact the contribution of employees in DT (Ritala et al., 2021).
These findings lead us to propose our first proposition:

H1a. DT attitudes positively influence the intention to engage in DT activities.

In comparison to attitudes, far less attention has been paid to the impact of social pressure (i.e. subjective norms) in the spheres of DT. Particularly in a later stage of DT, the need to use digital technologies and to drive DT initiatives becomes more apparent. Even operators on the shop-floor are expected to make use of available data to make operation-related decisions. The increasingly digitised working environment forces organisational members to adopt digital technologies. Especially in the context of collaboration, adopting digital technologies may be a prerequisite. For example, the work of one person may be dependent on information communicated through digital applications, which forces the person to adopt these technologies in order to ensure constructive collaboration, and to carry out their work effectively. Previous studies have shown that the pressure felt from co-workers can significantly influence behaviour. In addition, the notion of digital exclusion has been mostly overlooked in the manufacturing context, but is considered an influential factor. For example, Seifert (2023) found that the feeling of digital exclusion increases with age. Interestingly, possessing a positive digital

attitude compensates for this effect, decreasing the feeling of digital exclusion. Therefore, we hypothesise that the feeling of exclusion is a powerful driver, pressuring individuals to adopt digital technologies while acknowledging that compensatory factors may exist. Another potential reinforcing factor is that of organisational strive for competitiveness. If an organisation is to embark and embrace DT as a means to remain competitive, the entire organisation must be involved, which exerts influence over organisational routines. Individuals may feel the 'wind of change' and are persuaded to think innovatively and to support the implementation of digital technologies in order for the organisation to remain successful. Overall, we predict that DT norms influence the intention to support DT activities.

H1b. DT subjective norms positively influence the intention to engage in DT activities.

Engagement in DT activities feeds on the perception of one's own abilities. The highly technical periphery demands readiness of minds and the ability to cope with the changing environment. Much of it is concerned with the concept of self-efficacy. The technology-driven change requires individuals to continuously adopt new digital technologies. Gfrer et al. (2021) point out that engagement in DT is more likely with a self-perception of readiness to cope with new digital technologies. This is confirmed by Trenerry et al. (2021) who argue that the easier technologies are perceived to use, the more new digital technologies are accepted. The authors also highlight the concept of resilience as a contributor to DT and indicate its relationship with self-efficacy. Closely linked with positive attitudes, resilience grounds on adaptive performance – the ability of adaptability. Being able to cope with the ever-changing environment promotes pro-activeness as change is considered positive. Accordingly, then again, the success of an organisation in DT depends on its ability to take advantage of digital technology by innovatively and pro-actively driving technological change. This puts individuals in an active position, requiring them to take the lead. In this light, self-efficacy is expected to positively influence the readiness to lead change (Alos-Simo et al., 2017). Considering the importance of self-efficacy, we therefore put forward the following hypothesis:

H1c. DT self-efficacy positively influences the intention to engage in DT activities.

According to the theory of planned behaviour, the willingness to engage in behaviour mediates the effects of attitudes, subjective norms and self-efficacy on performing the behaviour. The capacity of the impact of intention on behaviour implies overcoming potential organisational constraints, as the willingness to perform a certain behaviour is stronger than organisational boundaries for a behaviour to be performed. Within the context of DT, the willingness to support DT initiatives is likely to influence DT-supporting behaviours. Using the term of intentional digital readiness, Höyng and Lau (2023) confirm the determining effect of intention on the use of digital technologies and acceptance of digitalisation. Recognising the strength of motivation in driving behaviour, we propound a positive effect of DT intentions on DT behaviours.

H1d. Individual DT behaviours are positively influenced by the intention to engage in DT activities.

DT behaviours play a vital role in realising DT as they incorporate competences necessary to turn digital technologies into value-adding potentials. Some research work has demonstrated the positive impact of individual behaviours on organisational performance. For instance, innovative employee behaviours have been shown to influence company performance (Ferreira et al., 2020; Kuratko & Audretsch, 2013; Parker, 2011). Moreover, drawing on the organisational learning perspective, Tortorella et al. (2020) found that organisational learning capabilities mediated the effect of base technologies on operational performance. This suggests that in order for individuals to have an effect on performance, their learning must be accelerated and engrained into organisational levels. Viewing DT behaviours as capacity for and result of individual learning capability infers an accumulating effect of DT behaviours on DT performance. Therefore, we estimate a positive relationship between DT behaviours and DT performance.

H1e. Individual DT behaviours positively impact perceived organisational DT performance.

Based on our hypotheses, our research model links DT mindset with DT behaviours and DT performance, whereby DT intention and DT behaviours inhibit mediating roles. The following section lays out our strategy on how we approached hypothesis testing.

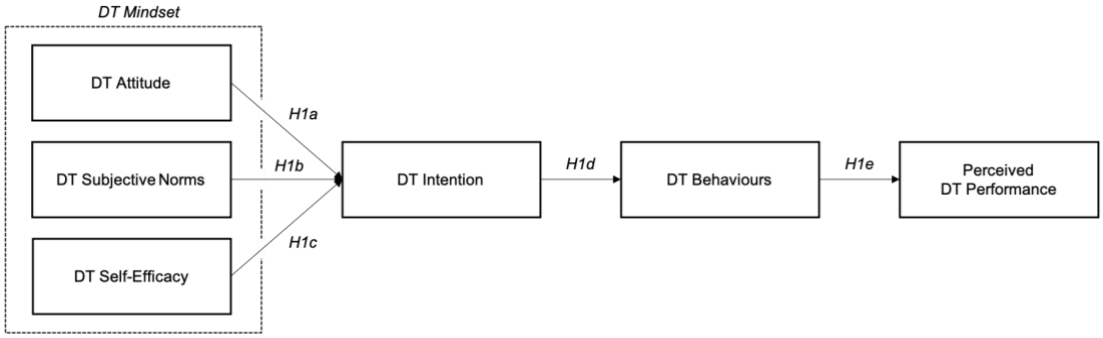

Figure 5. Theoretical Model Study A

5.4 Methodology

A survey approach was employed to test the model amongst manufacturing employees across high-value manufacturing industries as described in chapter 4. Manufacturing employees are increasingly confronted with DT activities and thus contribute to a better understanding of DT readiness from an individual's perspective. Data was collected over a four-week period using an online questionnaire to account for convenience in responding. This is particularly relevant for operators due to the often fixed shift models, barely allowing them to participate in research studies during work hours.

The sample included diverse job roles to account for differences in perspectives according to hierarchical level. The job role most often indicated was specialist/expert with 43% followed by 26.7% managers in production-supporting functions and 13.7% executives. Production managers accounted for 8.7% of the sample, 5% operators and 3% carrying out other roles such as administration. Overall, 106 responses were given on behalf of automotive OEM, representing 35.3% of the sample. Automotive suppliers account for 25.3% (Tier 1 n = 22; Tier 2 n = 38; Tier 3 n = 16) while 118 responses belong to non-automotive manufacturing companies. The survey stretched across four continents, Europe (72%), Asia (25.7%), North America (2%) and South America (<1%). Most participants were male (76.3%), 23.3% female and one person identifying as non-

binary, with a mean organisational tenure of 4-6 years (median = 7-10 years, mode = over 10 years). The mean age group was 30-39 years.

Prior to data analysis, we conducted a drop-out analysis using logistic regression to identify potential effects on data bias. The results showed that the control variables did not predict drop-out nor any of the variables relevant for this study. As participants were expected to answer all questions (i.e. mandatory questions), missing data was not an issue, particularly that of random order. As mentioned in chapter 4, three samples were excluded due to response bias. Using SPSS Amos for data analysis, 300 cases were validated for hypothesis testing.

In order to determine individual digital transformation characteristics impacting organisational digital transformation performance, six variables were used in this study all of which are measured as latent variables, namely DT attitude, DT subjective norms, DT self-efficacy, DT intention, DT behaviours and DT performance. We utilised validated and reliable scales as outlined in chapter 4. DT attitude was measured using four items adapted from Muehlburger et al. (2022). A sample item included *'Digital technologies make me more productive at work'*. For DT subjective norms, we relied on the theoretical proposition of TPB and included the notion of digital exclusion (Seifert, 2023). Three items like *'I feel excluded if I do not participate in technological advancements'* were used to measure this construct. DT self-efficacy was measured using three items from the individual DT readiness scale by Muehlburger et al. (2022), including items like *'I feel confident to use new digital technologies without help from others'*. For DT intention, we opted to utilise the scale employed by Meske and Junglas (2021) with three respective items. Indicating respondent's willingness to engage with DT activities, a sample item was *'I will try to actively participate in the change processes that may lead to a digitally transformed organisation'*. The construct of DT behaviours was measured as modified version of the DT competency framework from Blanka et al. (2022). Our scale included ten items aiming to capture the breadth of the concept, with exemplary items such as *'I can access and use digital data to make well-informed decisions'*. As our dependent variable, perceived DT performance was measured using four items based on proposed DT outcomes (Trischler and Li-Ying, 2022; Tortorella et al., 2023; Hanelt et al., 2021; Nicolás-Agustín et al., 2022). For example, one item read *'My company has improved processes because of its introduction of digital technologies or digital transformation initiatives'*. All items were measured on a 7-point-Likert scale.

As a second model, we utilised DT mindset as a second-order construct measured by DT attitude, DT subjective norms and DT self-efficacy.
In addition, we controlled for organisational role, organisational tenure, type of company, country, age and gender.

5.5 Results

Using SEM for analysis, a measurement model was initially developed to assess the relationships between latent variables and their observed indicators. Confirmatory Factor Analysis (CFA) was employed to validate the measurement model and to determine how well the defined indicators align with our theoretical framework. The results indicate the overall goodness of fit of the model. First, factor loadings were assessed as part of the CFA to measure the strength between each observed indicator and its underlying latent construct. One item (DTA1) was removed due to very low factor loading (<.30). Despite some factor loadings below .50 and potential adverse effect on model fit statistics, all other items were kept to account for the multi-faceted nature of the constructs. In addition, we measured DT mindset as second-order construct in our second model, indicated by the underlying latent constructs DT attitude, DT subjective norms and DT self-efficacy. Next, the measurement model was tested for goodness of fit using respective measures. Overall, the results indicate a good fit (CMIN/df = 2.211, IFI = 0.9, CFI = 0.9, RSMEA = 0.06, SRMR = 0.07). Therefore, we purport that the model fits the data well.

In order to examine construct validity, Composite Reliability (CR) and Cronbach's Alpha (α) were used. All values were above the recommended benchmark of .70 for the latent constructs. Composite Reliability values were found in the range of .79 to .93 while Cronbach's Alpha ranged between .79 to .92. Thus, construct reliability is demonstrated for all four constructs in this study.

The validity of the constructs was assessed using the estimates of Average Variance Extracted (AVE) for convergent validity and Heterotrait Monotrait Ratio (HTMT) for discriminant validity. The AVE values indicate acceptable validity, indicating that a substantial proportion of the variance in the latent construct is explained by its measured observed indicators. Although AVE estimated .38 for the DTB construct, this result was considered acceptable, because its respective Composite Reliability estimation was strong (CR = .85). For discriminant validity, we opted for HTMT as assessment method. It compares correlations between indicators of different constructs (heterotrait

correlations) with the correlations between indicators of the same construct (monotrait correlations). Similarly, the Fornell and Larcker criterion involves the comparison of the square root of AVE for each latent construct with the correlations between the construct and other constructs in our measurement model. If the square root of the AVE for a construct is greater than the correlation between the construct and other constructs, discriminant validity is established as it implies that the construct shares more variance with its respective indicators than with other constructs and can thus be considered a distinct and separate identity. Overall, the test for discriminant validity indicates very good values, all below the commonly used threshold of .85.

Table 6 summarises the results of factor loadings, construct reliability measures and validity measures.

Table 6. Measurement model Study A factor loadings, construct reliability and validity

	Factor loading	**α**	**CR**	**AVE**
Digital Transformation Mindset		.798	.834	.27
DTA	.734			
DTN	.798			
DTE	.840			
Digital Transformation Intention		.924	.927	.809
DTI1	.934			
DTI2	.938			
DTI3	.822			
Digital Transformation Behaviours		.866	.854	.376
DTB1	.670			
DTB2	.468			
DTB3	.650			
DTB4	.715			
DTB5	.707			
DTB6	.694			
DTB7	.691			
DTB8	.534			
DTB9	.410			
DTB10	.498			
Digital Transformation Performance		.791	.794	.497
DTP1	.555			
DTP2	.732			
DTP3	.869			
DTP4	.626			
	HTMT			
DTM ↔ DTI	.765			
DTM ↔ DTB	.830			
DTM ↔ DTP	.292			
DTI ↔ DTB	.647			
DTI ↔ DTP	.066			
DTB ↔ DTP	.417			

We tested for common method bias to account for potential inflations (or deflations) of true correlations between variables. According to Harman's Single Factor test, all items require to be loaded on a single factor. If model fit statistics indicate a good fit, common method bias is impacting the true correlations. Compared to the original model, the one factor model indicates weak model fit values (CMIN/df = 4.96, IFI = 0.69, CFI = 0.68, RSMEA = 0.12, SRMR = 0.11). As a confirmatory method, we employed latent common method factor analysis. Introducing an additional latent variable in a third model, chi-square and degree of freedom values were compared with the original model. The

difference between these two models was 1DF and -47,62 CMIN. Therefore, this test achieved a level of significance, indicating a common method bias.

Before proceeding with the structural model, an additional test was run to assess data normality and outliers. The absolute skewness ranged between -0.298 to -1.863 and their respective critical ratios were below the recommended 8.0 threshold. However, kurtosis values ranged between -0.979 to 5.579, going beyond the recommended 3.0 threshold. Thus, p-values were examined to identify outliers, whereby p-values below .001 can be considered outliers (Collier, 2020). Eliminating the 13 cases, however, worsened the results. Recognising the non-normal distribution in much social research, we decided to proceed with the analysis with the extant dataset.

Turning to the assessment of relationships between constructs to test for significance, the structural model was developed while accounting for common method bias. The structural model accounts for measurement error as indicated by the error terms while simultaneously assessing the relationship between constructs.
Despite a non-normal distribution, Maximum Likelihood Estimation (MLE) was applied to test the relationships. Alternative estimation techniques indicated similar results which led us to the acceptance of MLE.

This study examines individual DT characteristics and their impact on DT performance. Based on the TPB, we postulated five hypotheses, which were assessed as a structural model using SPSS Amos. Overall, the model indicated good fit statistics, all within their respective acceptance levels.

Squared multiple correlation for DTI was 0.184, indicating a 18% variance in the intention to engage in DT accounted by DTA, DTN and DTE. Similarly, the squared multiple correlation for DTB was 0.271, accounted by DTI and 0.513 for DTP accounted by DTB.

H1a predicted a positive impact of DT attitudes on the intention to engage in DT. The results indicate a negative, but insignificant relationship (b = -.13, t = -91, p = .36). Thus, this hypothesis was rejected. The impact of DT subjective norms on the intention to engage in DT was positive, but insignificant (b = .19, t = 1.28, p = .2), implying for H1b to be rejected. The third hypothesis, H1c, postulated a positive impact of DT self-efficacy on the intention to engage in DT. This claim was also accepted based on positive and significant values (b = .29, t = 2.71, p = .01). The impact of DT intention on DT

behaviours was found to be negative and significant (b = -.5, t = -4.32, p < .001), only partly supporting H1d as we predicted a positive direction. The final hypothesis predicted a positive impact of DT behaviours on perceived DT performance. Indicating a strong correlation, this relationship was found to be positive and significant (b = .9, t = 4.41, p < .001), thus, supporting H1e. A summary is presented in Table 7.

Table 7. Study A hypotheses testing summay

Hypothesised relationship	Standardised Estimates	t-value	p-value	Decision
DTA → DTI	-.131	-.912	.362	Rejected
DTN → DTI	.186	1.284	.199	Rejected
DTE → DTI	.286	2.709	.007**	Accepted
DTI → DTB	-.501	-4.316	***	Partially accepted
DTB → DTP	.895	4.408	***	Accepted

Model fit CMIN/df = 2.216, IFI = .907 , CFI = .906 RMSEA = .064 SRMR = .086

*** p < 0.001 ** p < 0.05

In our second model, we constructed DT mindset as a second-order variable with DT attitudes, DT subjective norms and DT self-efficacy as lower order constructs. Here, DT mindset did not significantly impact the intention to engage in DT (b = -.192, t = -1.654, p = .098). This model indicated slightly better model fit statistics (CMIN/df = 2.157, IFI = .911, CFI = .91 RMSEA = .062 SRMR = .1015). All other values remained the same.

5.6 Discussion

At its core, this study examines the development of individual DT behaviours and their impact on organisational DT performance. It is thus located both in the field of organisational culture in the context of DT as well as in the intersection between individual performance and organisational performance. Our findings demonstrate novel insights into the dynamics of DT.

According to TPB, the intention to engage in certain behaviours is driven by respective attitudes, subjective norms and self-efficacy. Translating this equation into the

digital context, the intention to engage in DT-promoting behaviours is influenced by the extent to which employees perceive DT as favourable or unfavourable, experience social pressure and sense of efficacy of performing DT behaviours. Our results show that only DT self-efficacy significantly influenced the intention to engage in DT. Although this finding contradicts TPB, it supports current research in the context of DT. The intention to perform a behaviour describes the intrinsic motivational facets that bridge cognition and actual act. Having a positive attitude towards DT may not be sufficient if the underlying supportive structure is not in place, that allows for intrinsic motivation to prosper. In their study, Höyng and Lau (2023) found that a growth mindset negatively influenced the intention to engage in DT. Within a DT context, a growth mindset involves the willingness and open-mindedness of employees to adopt new digital technologies (Dweck, 2006). According to their findings, the authors assume a potential gap between employees' perceptions and expectations. As people with a growth mindset often belong to the group of innovators or early adopters, they may be more advanced in their use of digital technologies, while DT progress does not match their speed, hereby hampering employees' motivation. Thus, they are less likely to be willing to engage in DT.

In addition, leadership can play an important role in navigating attitudes, intention and behaviours. Transformational leadership has been shown to positively influence DT (AlNuaimi et al., 2022). Digital leadership moderates the relationship between employee performance within a digital environment and organisational performance (Chatterjee et al., 2023).

Moreover, subjective norms did not significantly influence the intention to engage in DT. Social pressure was slightly increased in our sample, indicating weak organisational urgency or priority of DT amongst their workforce. Technology adoption has been shown to be more salient in mandatory organisational settings compared to voluntary ones (Venkatesh and Davis, 2000). Considering the progress of DT, employees are only beginning to be faced with digitalisation in their organisations where the pressure to adopt digital technology is still considerably low. Thus, we presume that subjective norms must reach a certain level for it to have an impact on intention.

On the other hand, our study supports the importance of competence for DT. It is a primary driving factor influencing the motivation of employees to engage in DT. Given the technology-oriented nature of DT, most research exploring micro-foundations for DT, particularly the role of individuals, emphasise competences for DT. A pro-active personality is associated with an increased intention to engage in DT (Höyng and Lau,

2023). People with a pro-active personality tend to have higher self-efficacy scores and are more likely to engage in risky behaviours.

Measuring DT attitude, DT subjective norms and DT self-efficacy as lower-order constructs for DT mindset, results demonstrate that DT mindset does not significantly influence the intention to engage in DT. Here, DT attitude and DT subjective norms may overrule the positive effect of DT self-efficacy on DT intention.

Interestingly, our study also shows that the intention to engage in DT negatively impacts actual DT behaviours. This result could have multiple reasons. Firstly, the higher the motivation of an individual, the more willing they are to perform a behaviour. However, it can also lead to higher expectations, and the precondition to be able to perform a certain behaviour must be present. Particularly in a digitally growing environment, initial motivation may be too high for an organisation to do them justice.

Second, according to TPB, the intention to engage in an activity is associated with its respective single behaviour. In our study, we utilised a range of behaviours to measure the latent construct of DT behaviours. Therefore, the intention to engage in DT may not correspond with *all* behaviours embedded in the construct of DT behaviours. Rather, some behaviours may be performed in the initial phases of DT while others are adopted once DT progresses, arguing that behaviours accumulate over time (Blanka et al., 2022).

Nevertheless, our findings indicate a strong, almost concurrent relationship between DT behaviours and perceived DT performance. This evidences the importance of individuals' contribution to DT success.

As most research examines the role of organisational capabilities for DT, this finding is particularly valuable, adding to the current body of knowledge.

5.7 Conclusion

In order for organisations to fully benefit from DT, developing organisational capabilities relies on the contribution of individuals. Despite the recognised importance of transforming the workforce alongside digital technology integration, individual characteristics required for the success of DT is unexplained. This study addresses this research gap by investigating the concept and process of behavioural digital transformation characteristics and relating them to the notion of perceived digital transformation performance. This study draws on the theory of planned behaviour as well as on the research fields of DT competences and individual DT readiness to investigate

the establishment of DT behaviours and their impact on organisational DT performance. The study found that individual characteristics such as self-efficacy, intention, and behaviours directly or indirectly influenced DT performance. The results highlight the crucial role of individuals in enabling successful DT and contribute to clarifying the characteristics necessary for DT success. It also contributes to extant knowledge by integrating the concepts of DT mindset and DT readiness into the theory of planned behaviour, emphasising the need for structural conditions and support systems, including leadership and training, for effective realisation of behavioural DT characteristics for DT performance.

Theoretical implications and contributions

By applying the theory of planned behaviour in demonstrating influential factors of DT behaviours and their impact on DT performance, our study contributes to current knowledge in the intersection of CI and DT.

In response to Verhoef et al.'s (2021) inquiry into how firms can cultivate specific digital resources, particularly the underlying behavioral capabilities, our study delves into the integration of the TPB with the concept of digital mindset and individual DT readiness. Recognising the importance of subjective norms, we enhance the individual DT readiness concept to provide a more comprehensive understanding of the factors influencing DT behaviours.

One notable challenge in the current discourse is the tendency to address DT mindset and DT behaviours (or competencies) in isolation. Our research breaks down these silos, connecting and empirically validating both the impact and relationship of DT mindset on DT behaviours. This approach emphasises the intricate interplay between mindset and behaviours, shedding light on how one influences the other in the DT landscape.

Moreover, our study contributes to the ongoing discussions surrounding DT performance, particularly in the manufacturing context. By adding digital technologies to the discourse on DT performance, we acknowledge that the success of DT is not solely reliant on the technologies themselves. Instead, our focus is on the implementation patterns and roadmaps, which signify a form of dependency.

To address the call by Trenerry et al. (2021) for investigations across all hierarchical levels, our research considers perspectives from both executives and operators. By

encompassing diverse viewpoints, we aim to provide a holistic understanding of how different organisational roles perceive and contribute to the success of DT initiatives.

In summary, our study serves as a bridge in the current DT research landscape. We integrate established theories, enhance existing concepts, and break down disciplinary barriers to offer a more comprehensive understanding of the dynamic relationship between digital mindset, individual readiness, and actual behaviors in the context of DT. As organisations navigate the complexities of DT, our research provides valuable insights into developing the essential capabilities for ongoing success.

Limitations and further research

This study enhances the current understanding of the development of DT behaviours and their impact on DT performance by examining their relationships using a quantitative survey method.

This research is based on the aspects of mindset and behaviours of manufacturing employees to address the question on how individuals contribute to the performance of DT. To assess the relationships from an organisational culture perspective, artefacts should be taken into account. For instance, affordance theory can be applied to investigate how organisational environments affords DT behaviours.

Moreover, we conceptualised the notion of DT mindset but did not investigate how a digital mindset can be established best. Further research can contribute to this understanding by involving factors such sense of urgency and trainings.

Although cross-sectional research designs can offer valuable insights into the interplay between concepts, longitudinal studies can confirm causal effects such as the change in DT behaviours or DT intention. We also advice for a measurement scale improvement of DT attitudes and DT subjective norms.

Lastly, we found that DT self-efficacy uniquely influenced the intention to engage in DT. This raises the question how DT attitude, DT subjective norms and DT self-efficacy interact. It would be interesting to investigate potential hierarchical effects, whereby DT self-efficacy is foundational to developing attitudes and perceiving social pressure.

6 Study B – Unifying Continuous Improvement and Digital Transformation: Linking Continuous Improvement Culture and Digital Transformation

6.1 Introduction

The philosophy of continuous improvement (CI) has become well established in many manufacturing organisations over the last decades. Using approaches such as lean manufacturing, CI can be considered a continuous transformation effort driven by the need for maintaining competitiveness. Although attempts to implement CI often result in failure (Jurburg et al., 2018), following a CI approach can generate substantial benefits for the firm. These include improvements in productivity, quality and morale amongst others, and thus, overall performance improvements (Singh and Singh, 2015).

With the rise of digital technologies, companies are now confronted with both the opportunity and the challenge of digital transformation (DT). If used effectively, digital technologies can support process improvements, process re-designs and entire business model modifications. As a phenomenon, DT inhibts distinctive characteristics such as the speed in change, the kind of change, scope and scale of change as well as change process factors such as organisational inertia, agency and ambidexterity. In addition, DT is considered to lead to a fundamental redefinition of value-creation. Therefore, DT can be seen as a unique transformation mechanism which provokes new change approaches.

Looking at the extant literature, CI is primarily associated with incremental improvements whereas the field of DT primarily connotates disruptive changes.
Despite few studies investigating the interaction between CI and DT, it is not well understood how DT interacts with other transformations or change behaviours. While the significance of organisational culture for successful CI has been frequently emphasised (Fadnavis et al., 2020), the same has been mostly neglected for DT. In their study, Meske and Junglas (2021) highlight the importance of organisational factors for DT, in particular work design characteristics which have been shown to impact attitudes towards digital workplace transformation.

Previous research has explored the conjunction between CI and DT in mostly technical terms. One frequently direction is the digitalisation of lean (i.e. Digital Lean), and how digital technologies can support and enhance the adoption of lean principles (Buer et al., 2018). This includes the effect of single technologies on performance

measures (Gillani et al., 2020; Pecas et al., 2022). Many of these papers point at the importance of developing CI practices for DT adoption (e.g. Dinis-Carvalho et al., 2023) and the essential factor of humans for both CI and DT implementation (Gallo et al., 2021). However, none of these papers has empirically validated this theoretical statement to date. This study looks at the cultural dimension of the CI-DT interconnection, specifically at the cognitive and behavioural level.

Since CI is engrained in many manufacturing companies, not only on a process level, but equally on a mindset and behavioural level, the question remains how such philosophy influences DT initiatives and in particular, whether CI supports or hinders DT readiness. Therefore, our study is driven by the following research question:

RQ2. How might CI behaviours influence the digital transformation readiness of employees?

Utilising a quantitative research design, we aim to (1) establish and examine the relationship between CI and DT readiness, (2) follow a novel research direction by focusing on mindsets and behaviours, (3) empirically validate empowerment as CI outcome, (4) contribute to the scarce extant literature by examining how CI influences DT and (5) view CI as organisational change factor influencing DT readiness.

6.2 Theoretical framework and hypotheses

The importance of the human factor has been acknowledged for sustainable CI. While tools are beneficial in the short run, people can create lasting mindsets and habits that maintain CI long term (Costa et al., 2019). In his study, van Assen (2018) fortifies this idea by arguing that soft factors enhanced the effect of technical factors.
Organisational culture can be seen as competitive advantage as it involves complex behavioural patterns that cannot be easily copied by others (Bessant et al., 2001; Garcia-Sabater et al., 2012).

CI behaviours

Developing a CI culture is complex as it involves many tangible and intangible facets that need to be harmonised under the umbrella of a well-described CI strategy. Central to CI culture is the behaviour and routines of its members. The current literature

uses CI behaviours and CI practices interchangeably which hampers common understanding and streamlined research. Nevertheless, CI behaviours are said to be generic while the approach towards their development is context dependent (Bessant et al., 2001; Lizarelli et al., 2022). CI behaviours frequently mentioned, include, amongst others, management commitment, creating a CI strategy, following a CI methodology, employee commitment, communication structures as well as management and measurement system (Eguren et al., 2012; Jurburg et al., 2018). A constant reinforcement of these behaviours is required in order for them to become second nature and thus, embedded in the organisational culture (Jurburg et al., 2018).

In their prominent work, Bessant et al. (2001) investigate how involvement in CI can be developed and sustained as organisational capability. Their research centres around clusters of behavioural changes that establish innovation routines within an organisation. By establishing individual behaviours, routines are developed which generate organisational abilities and ultimately, CI as a strategic capability. Their model is based organisational learning theory and acknowledges the gradual process of adopting CI behaviours for improved CI capability. Overall, they define 36 behaviours that distinctively contribute to the development of eight abilities: the ability to articulate basic values of CI (i.e. understanding CI), the ability to generate sustained involvement in CI (i.e. getting the CI habit), the ability to link CI activities to corporate strategic goals (i.e. focusing CI), the ability to lead, direct and support the creation and sustaining CI behaviours (i.e. leading the way), the ability to create consistency between CI values, behaviours and organisational context (i.e. aligning CI), the ability to move CI activity across organisational boundaries (i.e. shared problem-solving), the ability to strategically manage the development of CI (i.e. CI of CI) and the ability to enable learning and capture it at all levels (i.e. the learning organisation). However, their work does not explain how individual CI behaviours can be developed and it also neglects innovation behaviours as counterpart to small incremental improvements.

Similarly, Lizarelli et al. (2022) explore the impact of CI behaviours on innovation performance and also highlight the importance of involvement. Using a survey amongst manufacturers in Brazil, their results indicate better innovation performance when CI and innovation are complemented, arguing that CI creates a suitable environment for innovation to thrive. Their work utilises 14 CI behaviours that are commonly found in the literature.

Some studies have looked into the conditions and factors required for developing CI behaviours. For instance, Yen-Tsang et al. (2012) analyse CI capability from a behavioural perspective in a multi-case study. Their results show that normative motivations play an important part in influencing CI behaviours, while the intention to perform CI behaviour, contrary to predictions, may not be a mediating factor of the predicted driving variables. Others highlight the importance of training for changes in attitude towards CI and consequently, promoting CI behaviours (Jurburg et al., 2018; Cavallone and Palumbo (2022).

Using the theory of planned behaviours (see Chapter 3) and based on the scarce extant literature, we expect attitudes, subjective norms and self-efficacy to be impacting CI behaviours. For the purpose of our study, we operationalise CI mindset as a collective of attitudes, subjective norms and self-efficacy in the context of CI.

H2a. CI mindset positively influences CI behaviours.

The field of CI behaviours is very limited in its scope and applications. CI behaviours are mostly investigated from the angle of CI capability development, increasing the capacity of organisations to fully benefit from CI. However, once established, they may play an important role in conditioning other practices and initiatives.

CI and DT readiness

Extant practices and values impact the way an organisation takes action (Sardi et al., 2020). As some studies emphasise, a CI culture can be a nourishing environment for creativity, skill development and organisational performance improvement (Lizarelli et al., 2022). It has also been argued that CI can be considered a dynamic capability if the right infrastructure is in place (Anand et al., 2009). Considering modern developments such as digitalisation, insights into how CI behaviours are contributing to DT are still missing. Few studies have approached the link between CI and DT, although the majority of research is looking into the reverse relationship, i.e. how DT can support CI. For instance, Tortorella and Fettermann (2018) examine the relationship between lean production practices and Industry 4.0 implementation. Their findings suggest a positive association, whereby a concurrent implementation of both approaches leads to larger performance improvement. Reflecting a similar perspective, Vinodh et al. (2021) support the integration of both concepts by conceptually proposing CI strategies to enable

Industry 4.0, such as lean and lean six sigma. Furthermore, Hambach et al. (2017) question how digitalisation can support a CI system and solve challenges associated with it. Their Delphi study proposes a potential for increasing efficiency in process improvements through digitalisation. Moreover, Cifone et al. (2021) investigate how digital technologies can support lean practices by identifying eight waste reduction mechanisms. In addition, they argue that the modern world may be too complex for traditional lean to be effective, and that digitalisation may compensate the shortcomings (Rosin et al., 2020; Sanders et al., 2016). Dinis-Carvalho et al. (2023) argue that effectiveness in lean and Indsutry 4.0 implementation is dependent on contextual factors such as top management commitment, expertise and value-add.

Only recently, Powell et al. (2024) have explored the interplay between digitalisation and lean manufacturing from the lense of a cumulative capability development perspective. Their findings emphasise the development of learning capabilities by integrating digitalisation and lean. According to their study, lean should be considered a base capability. While digitalisation subsequently enables the development of multiple additional capabilities, learning encourages the synergy between digitalisation and lean.

On the other side of the spectrum, it has been argued that lean principles can support the implementation of a DT process (Romero et al., 2019). These include for example PDCA cycles for improved change management, just-in-time orientation for digital technology management and value stream mapping for process re-engineering management. In their study, Kumar et al. (2022) highlight the importance of people for Quality 4.0 (e.g. leadership, culture and competency) and suggest that lean management can support change management for Quality 4.0 on a micro-level. However, this statement was not empirically validated.

DT relies on the ability to continuously adapt to changing conditions which suggests CI systems to be advantageous. However, many studies highlight the difficulty in establishing a suitable infrastructure for CI coordination (Jurburg et al., 2018; Sousa-Zomer et al., 2020).

The extant literature indicates a predominantly positive outlook on the relationship between CI and DT. Sousa-Zomer et al. (2020) emphasise the cultivation of certain conditions for transformation to take place. Therefore, the ‘readiness’ of such conditions

may play an important role in determining DT success. In our study, we consider DT intention as determining factor for behavioural DT readiness.

As CI may support the behavioural readiness of employees to engage in DT by providing an adaptive and change-driven environment as well as a respective mindset and thinking, a positive relationship between both concepts can be suggested. On the other hand, organisational culture can be a hindering factor for adopting certain practices. CI is known to follow a systematic incremental approach that may interfere with the strong innovation orientation of DT that is often described as rather disruptive. Either direction, we believe that CI behaviours have a significant impact on DT readiness.

H2b. CI behaviours influence the intention to engage in DT.

The connecting link of empowerment

The notion of empowerment is frequently discussed in the extant literature. It is a multifaceted construct which is often defined differently across different sources. As a comprehensive term, empowerment reflects the perceived and actual freedom and autonomy of employees to take their own decisions as well as assuming responsibility for their actions (Spreitzer, 1997).

However, there are two major forms of empowerment that can be distinguished: structural and psychological empowerment. Structural empowerment refers to the formal authority of decision-making given by the system of an organisation (Kanter, 1977). Psychological empowerment involves the perceived feeling of being empowered, describing the perception of competence (i.e. belief in one's own capabilities), meaning (i.e. seeing purpose in one's work), impact (i.e. influencing work outcomes) and self-determination (i.e. having the choice of actions to be taken) as four cognitions (Thomas and Velluthose, 1990; Conger and Kanungo, 1988). A third form, empowerment through leadership, will not be addressed in this research (Burke, 1986).

The concept of empowerment has attracted attention over the last years as companies are struggling to take adequate action in an increasingly complex and turbulent environment (Pradhan and Panda, 2021). De-centralised decision-making and thus, empowerment, enables organisations to effectively anticipate change and promote expertise and creativity amongst their workforce. Amongst personal development benefits, CI behaviours are said to support empowerment (Lizarelli et al., 2022).

Employees trained in CI take on the responsibility to drive CI in their organisations and are given both the autonomy and the power to take decisions for the benefit of the company. This necessitates an underlying system that fosters psychological empowerment. According to Tortorella et al. (2021), CI environments can promote motivation by empowering employees. CI is thus sometimes seen as a structural form of empowerment (Hirzel et al., 2017) or a form of responsible autonomy (de Treville and Antonakis, 2006). At the same time, these structures nourish all components of psychological empowerment by training employees in CI,
Although the claim of CI supporting empowerment has been frequently emphasised, it is not yet empirically verified as a combination of structural and psychological empowerment to the best knowledge of the authors.

Furthermore, involvement and engagement often associated with empowerment as employees are expected to shape decisions for the organisation (Cavallone and Palumbo, 2022; Jose and Mampilly, 2014). This is also the case in a DT environment. Here, empowerment was emphasised as a prerequisite for enabling DT. As DT requires an innovation oriented and adaptive workforce with the ability to make fast decisions, empowerment can play a crucial role in facilitating DT progress. However, Cifone et al. (2021) critically state that digital technologies may reduce empowerment over long term as many processes become automated or otherwise redesigned, reducing the scope for workers to act.

Given the theoretical predispositions of empowerment involving the outcome of CI and the prerequisite for DT, we posit the following hypothesis:

H2c. Empowerment mediates the effect of CI behaviours on DT intention.

According to our assumptions, DT intention is influenced by CI and empowerment. As detailed in Study A, developing a digital culture and thus employees' readiness to engage in DT is also based on many building blocks such as digital mindset, innovation, adaptability and data orientation (Romero et al., 2019). Given the complexity of CI environments, CI may influence the perception of DT and the approach taken to adopt digital technologies. Thus, CI may change the dynamics of DT within an organisation. Although previously tested in Study A, we assume that impacts between DT variables can differ in the presence of CI. In order to test our presumption, we follow up on the

relationship between DT mindset and DT intention, defining DT mindset as driver for DT intention.

H2d. In the presence of CI, DT mindset influences the intention to engage in DT.

Figure 4 shows the entire hypothesised model which will be tested using a quantitative survey method and structural equation modelling (SEM) for data analysis and hypothesis testing.

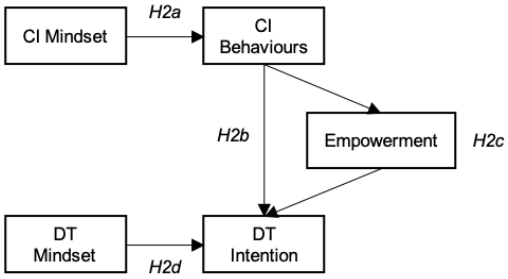

Figure 6. Research Model Study B

6.3 Methodology

As we interested in the relationship between CI and DT as well as empowerment as mediating factor, a quantitative approach is appropriate to measure the strength and direction of predicated relationships. In order to test our hypotheses, the dataset of our large-scale survey is made use of, which is explained in chapter 4 and utilised in Study A. The sample involves 300 cases with a majority of manufacturing employees working in the automotive sector (60.6%).

For our study, we draw on the constructs of CI attitudes, CI subjective norms, CI self-efficacy (measured as first-order constructs of CI mindset), CI behaviours, empowerment, DT attitudes, DT subjective norms, DT self-efficacy (measured as first-order constructs of DT mindset) and DT intention. All measures and scales are presented in chapter 4. For CI attitudes, we used four measures of Liu et al. (2006) and Yen-Tsang et al. (2012). A sample item was '*We strive to continuously improve all aspects of products and processes, rather than taking a static approach*'. The construct of DT subjective norms was measured by three items in following Yen-Tsang et al. (2012) including items such as '*My co-workers expect me to participate in continuous improvement activities*'. As a third indicator for CI mindset, CI self-efficacy was

measured by four items (Jurburg et al., 2017; Yen-Tsang et al., 2012; Trang, 2024) including the item '*I am able to come up with new ideas for improvement at my company*'. Using items such as '*In my company, we make use of some formal (structured) problem-finding and problem-solving cycle (e.g. PDCA)*' or
'*When there are unwanted results, the natural reaction of people at all levels is to identify the causes of the problem, and not to blame individuals*', CI behaviours were measured by fourteen items based on Bessant et al. (2001). For empowerment, we included both psychological and structural empowerment items to measure the construct (Pradhan and Panda, 2021). One of the eight items was 'I *can decide on my own how to go about doing my work*'. The constructs already measured in Study A include DT attitude, measured by four items (Muehlburger et al., 2022); DT subjective norms, measured by three items (Seifert, 2023); DT self-efficacy, which was measured using three items (Muehlburger et al., 2022); and DT intention, measured by three items (Meske and Junglas; 2021).

In addition to these constructs, we controlled for co-variates that could have some effect on DT intention, which include age, gender, job role, tenure and type of company.

For data analysis, we applied structural equation modelling (SEM) using SPSS Amos. As our study involves mediation analysis, bootstrapping was utilised. Bootstrapping is a resampling technique used to estimate the distribution of a statistic by resampling with replacement from the observed data. This method allows to approximate the sampling distribution of a statistic without making strong parametric assumptions. Thus, with this nonparametric procedure statistical significance can be tested.

6.4 Results

Before testing the hypotheses, the measurement model was assessed using Confirmatory Factor Analysis (CFA) to determine model fit as well as construct validity and reliability values. Considering the complexity of our theoretical model, the model indicates acceptable fit with the observed data (CMIN/df = 1.928, IFI = .88, CFI = .88, RSMEA = .056, SRMR = .07). Due to low factor loading, one item (EMP4) was removed, leaving seven items indicating the construct of empowerment. All remaining factors were kept with suitable factors loadings.

Construct validity and reliability were measured using Cronbach's Alpha (α), Composite Reliability (CR) and Average Variance Extracted (AVE). All respective

values were in their recommended range except for AVE of empowerment. However, due to high reliability measures, it was accepted. In addition, the Heterotrait Monotrait Ration (HTMT) was used to measure discriminant validity. All values were well below the recommended threshold of .85.

The summary of the fit measures can be found in Table 8.

Table 8. Measurement model Study B factor loadings, construct reliability and validity

	Factor loading	**α**	**CR**	**AVE**
Digital Transformation Mindset		.798	.839	.635
DTA	.748			
DTN	.815			
DTE	.826			
Digital Transformation Intention		.924	.927	.808
DTI1	.938			
DTI2	.935			
DTI3	.820			
Continuous Improvement Mindset		.854	.925	.805
CIA	.983			
CIN	.894			
CIE	.806			
Continuous Improvement Behaviours		.934	.935	.509
CIB1	.704			
CIB2	.679			
CIB3	.696			
CIB4	.714			
CIB5	.762			
CIB6	.810			
CIB7	.642			
CIB8	.710			
CIB9	.727			
CIB10	.777			
CIB11	.696			
CIB12	.733			
CIB13	.503			
CIB14	.790			
Empowerment		.836	.842	.435
EMP1	.663			
EMP2	.715			
EMP3	.727			
EMP5	.667			
EMP6	.498			
EMP7	.656			
EMP8	.664			
	HTMT			
DTM ↔ CIM	.395			
DTM ↔ DTI	.759			
DTM ↔ EMP	.337			
DTM ↔ CIB	.230			
CIM ↔ DTI	.342			
CIM ↔ EMP	.786			
CIM ↔ CIB	.530			
DTI ↔ EMP	.283			
DTI ↔ CIB	.100			
EMP ↔ CIB	.599			

Utilising Harman's Single Factor test as well as the latent common method factor analysis, we identified a common method bias in our analysis. Consequently, an additional common method factor was included in the structural model analysis to account for some of the variance.

Moreover, data normality was assessed before proceeding with the structural model analysis. Drawing from the same dataset as in Study A, but assessing partially different constructs, we still detected a non-normal distribution of the data. As countermeasure, we compared estimation techniques and used bootstrapping. Alternative estimation techniques to the Maximum Likelihood estimation indicated similar results. Bootstrapping can be used to obtain more accurate standard errors and confidence intervals for model parameters, especially in the presence of non-normality. Due to our aim to test for mediation, bootstrapping is considered a double tracked approach in our study.

Overall, our aim was to test the impact of CI on DT, and to test empowerment as mediating factor. CI behaviours are patterns that have been learned and internalised. Our first hypothesis questions the characteristics predicted to influence CI behaviours. Based on the TPB, H2a predicated a positive impact of CI mindset on CI behaviours. As the results show, CI mindset did not significantly impact CI behaviours ($b = -17.237$, $t = -1.011$, $p = .312$). Therefore, our first hypothesis was rejected.

Hypothesis 2b involved the direct effect of CI behaviours on the intention to engage in DT. Our hypothesis did not predict the direction of the relationship as our study is the first to establish a connection between CI behaviours and behavioural DT readiness. The results indicate a significant and negative impact of CI behaviours on DT intention ($b = -.165$, $t = -2.333$, $p = .02$), which denotes that the stronger established CI behaviours are the weaker the intention to engage in DT.

To test our third hypothesis, we performed mediation analysis using bootstrapping (sample of 5000) with a bias-corrected confidence interval of 95. Our hypothesis predicted a mediating role of empowerment on the relationship between CI behaviours and DT intention. The results did not reveal a significant indirect effect ($b = .036$, $t = .9$, $p = .19$) as empowerment did not have a significant impact on DT intention. Thus, H2c was rejected. However, the direct effect of CI behaviours on DT intention remained significant in the presence of the mediator. The squared multiple correlation for empowerment was 0.188, indicating a 19% variance accounted by CI behaviours.

The mediation analysis is summarised and presented in Table 9.

Table 9. Study B mediation analysis

Relationship	Direct Effect	Indirect Effect	Confidence Interval		p-value	Conclusion
			Lower Bound	Upper Bound		
CI Behaviours → Empowerment → DT Intention	-0.165 (p<0.05)	0.036	-0.022	0.152	0.19	No mediation

Our final hypothesis aims to re-assess the relationship between DT mindset and DT intention in the presence of CI. Contrary to Study A, our results including CI in a larger model demonstrate a positive and significant impact of DT mindset on DT intention (b = 1.423, t = 6.162, p = .000). Therefore, H2d was accepted.

Overall, 51% variance in DT intention is explained by its predicting variables CI behaviours and DT mindset (R^2 =.513).

A summary of the predicted relationships and test results are provided in Table 10.

Table 10. Study B hypotheses testing summary

Hypothesised relationship	Standardised Estimates	t-value	p-value	Decision
CIM → CIB	-17.237	-1.011	.312	Rejected
CIB → EMP	.276	4.867	***	Accepted
EMP → DTI	.129	1.073	.283	Rejected
CIB → DTI	-.165	-2.333	.02**	Accepted
DTM → DTI	1.423	6.162	***	Accepted

Model fit CMIN/df = 1.824, IFI = .893, CFI = .892 RMSEA = .052, SRMR = .0815

*** p < 0.001, ** p < 0.05

6.5 Discussion

Our study is the one of the first to examine both CI and DT from a behavioural perspective. It is built on the premise that extant organisational cultures with their respective practices inhibit the natural power to influence future, potentially novel, practices. Such logic stems from organisational learning theories, which argue that learning is a dynamic and accumulative process essential for sustainable business performance. Adapting to the ever-changing conditions in a business environment necessitates the capability to expand the knowledge base and to unlearn practices that no longer serve their purpose.

In our case, we examined the impact of CI behaviours on the readiness of manufacturing employees to engage in DT under the conditions of mindset and empowerment.

Our first aim was to establish the concept of CI mindset as driving factor for CI behaviours based on TPB. The results indicate an insignificant relationship between the two variables. According to Yen-Tsang et al. (2012), the intention to perform a behaviour may not always be a strong mediator between cognition and behaviours. As our study did not focus on the development of CI behaviours, the theoretical mediating factor of CI intention was not included in our research. However, our findings suggest that a mediator could still be required to translate cognitive mechanisms into actions.

The second hypothesis involved the main predicted relation of this study. Based on extant literature, we assumed a direct impact of CI behaviours on employees' intention to engage in DT. Our findings support this mechanism, although the impact was negative. Consequently, CI behaviours decreased DT readiness. This outcome is somewhat surprising as extant literature predominantly argues for a positive relationship between CI and DT.

Our findings contradict the results by Lizarelli et al. (2022) who found a positive relationship between CI behaviours and innovation performance including both incremental and radical innovation. DT is strongly associated with an innovation orientation that is capable of rethinking entire business models. Compared with CI, DT involves disruptive changes that are unique in their speed and scope. Although CI naturally supports change including both incremental and radical phases, it follows a stepwise systematic approach that may not be able to keep up with the demands of DT. Therefore, the people-driven CI system as such may be insufficient or incompatible in its approach to promote DT readiness.

Moreover, current knowledge on the interaction between CI and DT is primarily based on technical terms. For instance, amongst others, CI supports the integration of information technology on the shop floor by involving operators (Silva et al., 2022). Digital technologies can counteract the shortcomings of CI systems, while CI principles support the implementation of digital technologies. From a human perspective, matters become much more complex. Habits and routines are acquired over time to an extent they become second nature or '*the way we do things around here*', thus embedded in the organisational culture. Changing routines then becomes more difficult – a phenomenon attended to in the field of change resistance. Roth (2011:119) argues that "*human systems are predisposed for reaching a quasi-stationary equilibrium*" which equivalates the natural desire to hold onto the status quo. In their work, Hambach et al. (2017) comment that digitalisation can be challenging for workers as it may lead to product alienation and a decreasing ability to solve problems in a digital environment. Digitalisation not only changes the physical environment, but also human interaction and demands. If DT is seen as a threat to the organisational culture, employees tend to resist which could explain a negative impact of CI behaviours on DT readiness.

Besides the direct impact of CI on DT, we assessed empowerment as a mediator. Empowerment is emphasised both as enabler and outcome in the CI and DT literature. However, empirical validation is scarce. Our hypothesis is based on current convictions that CI promotes an empowering environment. On the other hand, empowerment is considered a crucial factor for enabling DT. Our results show that CI behaviours do impact empowerment, but empowerment does not influence the intention to engage in DT. Hence, empowerment does not mediate the impact of CI behaviours on DT readiness. While CI behaviours promote an empowering working environment, it may not cover aspects that would be required for encouraging DT readiness.

Some studies also challenge the positive relation between DT and empowerment. For instance, Cappelli (2020) highlights that artificial intelligence may disempower people as digital technologies take over some of their responsibilities. Likewise, Cifone et al. (2021) suspect that digital technologies decrease process engagement whereby employees are no longer involved in each detail of the process due to automation. In this sense, digital technologies reduce empowerment as the scope for employees to act lessens.

Lastly, this study reassessed the impact of DT mindset on DT intention in the presence of CI. Interestingly, the results demonstrate a strong positive and significant

relationship between the two concepts. Confirming a component of TPB, this finding promotes the presence of CI for DT dynamics. By negatively impacting DT intention, CI might strengthen the mechanisms supporting DT readiness.

Our overall findings can be viewed using the lens of paradox theory. Paradox theory offers a framework that explores the assumption that organisations often face contradictory and competing demands or tensions (Lewis and Smith, 2014). These tensions create paradoxes, which are situations where two or more seemingly contradictory elements coexist. In comparison to either-or theories, the paradox theory acknowledges ambidextrous situations which are resolved in balancing the opposing concepts. Therefore, attention is paid to the synergies of concepts rather than their conflicting elements (Papachroni et al., 2015).

Paradoxes have previously been found in the lean management field. Maalouf and Gammelgaard (2016) explore paradoxes in lean implementation and found organising, performing and belonging paradoxes. Their findings suggest that learning paradoxes are potentially foundational to other paradoxes. Meanwhile, ambidexterity has gained increased attention in the DT literature.

CI and DT can be perceived as opposing in their approach orientation (i.e. incremental versus radical) while sharing their transformative power. A CI culture can create a prosperous environment for change including digitalisation as employees strive to constantly improve existing processes and products. Their learning behaviours support open-mindedness, pro-activity and curiosity. All aspects that are favourable for DT. Simultaneously, rigid and highly systematic CI processes discourage the agility, flexibility and speed required for DT. The outcome of our study endorses such phenomenon. While CI behaviours decrease DT readiness, it enables the effect of DT mindset on DT readiness to be significant. It thus strengthens the cognitive power of employees and its effect on their motivation to engage in DT.

6.6 Conclusion

This study investigates the interaction between CI and DT, highlighting a gap in understanding the impact of organisational culture on this intersection. Unlike previous studies that primarily focus on technical aspects in explaining their synergy, this research

explores the relationship between CI culture (i.e. CI mindset and CI behaviours) and individual DT readiness (i.e. intention to engage in DT driven by DT mindset).

Examining CI as a contextual organisational change factor, the study predicted that CI behaviours influence individual DT readiness. The findings confirm a significant but negative impact on individual DT readiness and a positive effect on empowerment. Interestingly, while empowerment was expected to mediate the effect, it did not directly influence individual DT readiness. The study reveals a paradoxical effect where CI behaviours both decrease and indirectly promote individual DT readiness by enabling DT mindset to be effective.

Contrary to a commonly accepted synergy between CI and DT, this study takes a critical standpoint, highlighting challenges between CI behaviours and DT readiness. It emphasises that CI changes the dynamics of individual DT characteristics, suggesting that a CI environment may overall support the establishment of DT readiness, but can also act as barrier to DT in certain aspects. The research also contributes to the literature by demonstrating the influence of CI behaviours on structural and psychological empowerment, adding insights into CI outcomes.

7 Study C – The Role of Maturity in Continuous Improvement's Capacity to Impact Digital Transformation

7.1 Background

Established organisational cultures influence the way an organisation operates. Organisational culture is a concept grounded in shared values, beliefs, attitudes, and behaviours that characterise an organisation. It embodies the collective mindset and social environment within a company, shaping how employees interact, make decisions, and perceive their work. Hence, organisational culture is a pervasive force that influences the way individuals within an organisation think, act, and collaborate. These collective mindsets and behaviours influence organisational performance as shown in Study A. The stronger this collective mechanism, the stronger an organisational culture.

Developing a continuous improvement (CI) culture entails the reinforcement of collective actions to pursue a CI philosophy. Depending on the developmental level, the strength of an organisational culture can be assessed (i.e. maturity). Naturally, organisations indicate different levels of maturity in CI.

Digital transformation (DT) can represent a significant change in adjusting organisational cultures. However, extant literature fails to explain the impact of extant organisational practices on the success of DT initiatives, particularly those that are deeply embedded in an organisation's culture.

This study draws on the findings of Study B which indicate paradoxical effects of CI on DT. From an organisational culture perspective, the question arises if a different CI maturity level matters and whether the relationship between CI and DT becomes weaker or stronger.

For the purpose of this study, we view CI culture as a combination of CI mindset and CI practices, while CI maturity concerns the level of implementation of CI behaviours, hereby reflecting an essential part of organisational culture.

This study follows up on the paradox tendencies found in Study B by posing the following research question:

> *RQ3. How might CI maturity influence the effects that behavioural DT characteristics have on DT performance?*

The first objective is to determine the current state of CI maturity amongst manufacturing employees. The second objective is to theorise and empirically test the impact of CI maturity on DT dynamics.

7.2 Theoretical framework and hypotheses

The phenomenon of CI is often associated with a culture of continued and incremental change. It assumes a systematic development of behaviours contributing to the continuous improvement of an organisation. Driving these behaviours require a vision or 'end goal' that reflect a perfect continuously improving organisation. Such a roadmap can be described as maturing process, whereby the organisation goes through distinctive developmental stages. Maturity, in general terms, indicates the level of capacity to act in a changing environment (Aloini et al., 2011)

Bessant et al. (2001) were the first to develop a comprehensive model that lays out a structured approach to mature CI capability. In contrast to other studies, they focus on developing CI over long-term and thus, advancing the maturity of CI by going through five levels. Level 1 is described as pre-CI interest and characterised by occasional improvements through trying out ideas. Level 2 involves structured problem-solving and comprises structured and systematic CI. Level 3 is defined as goal-oriented CI and is realised through formal deployments of strategic goals and CI measurement, highlighting CI as strategic. With high levels of experimentations and autonomous innovation, pro-active CI can be reached in level 4. The final level is considered full CI capability through acting as a learning organisation. Here, systematic problem-solving and manifest learning behaviours are in place.

Many studies draw on their maturity model. For instance, Jurburg et al. (2015) assessed the CI maturity level in Spain and demonstrate a lack of company-wide focus on CI. Although most companies had structured CI processes in place, lacking a holistic CI strategy amongst others hindered organisations to reacher higher maturity levels. Considering hindering factors, Garcia-Sabater et al. (2012) linked CI implementation barriers and facilitators to the CI maturity levels proposed by Bessant et al. (2001). Jørgensen et al. (2006) criticise the linear fashion of the CI maturity model which implies equal importance of behaviours for CI capability development.

As the extant literature shows, CI maturity is mostly examined in a very isolated manner, without exploring the effect of it on the wider organisational context aside CI.

Based on the findings in Study B, the understanding of organisational culture and CI maturity, paradoxical effects are expected for the impact of CI maturity on DT dynamics.

An established CI culture can pose a barrier in realising new initiatives as habits and routines are deeply engrained in individuals' minds. Thus, it leaves little space for new initiatives to prosper and be effective. Therefore, we predict that CI maturity negatively moderates the impact of DT behaviours on DT performance (Figure 5).

H3a. CI maturity negatively moderates the relationship between DT behaviours and perceived DT performance.

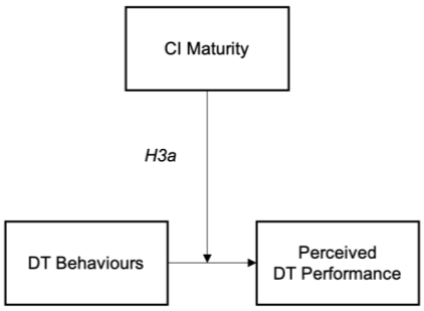

Figure 7. Study C research model 1

However, we also predict that an established CI culture can draw on their learning capabilities and established systems to turn ideas into action. Thus, we predict that CI maturity positively moderates the relationship between DT intention and DT behaviours (Figure 6).

H3b. CI maturity positively moderates the relationship between DT intention and DT behaviours.

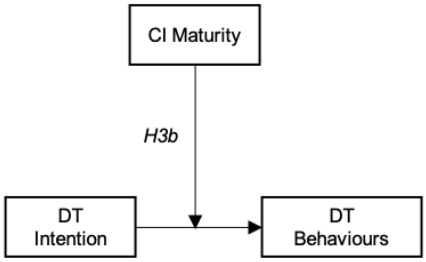

Figure 8. Study C research model 2

The following section outlines the specific methods applied to address our research objectives and to test the hypotheses.

7.3 Methodology

As discussed in chapter 4, this study was conducted amongst high-value manufacturing employees with corporate relations to Europe. A comprehensive summary of the respondents' demographics can be found in the Appendix. Closing the survey after a 4-week period, the final sample involved 300 cases with complete data and no indicative response bias.

As this study aims to capture the role of CI maturity, we utilised the construct of CI behaviours to measure the level of CI maturity. Thus, higher scores of CI behaviours indicate a higher maturity level, while lower scores indicate a lower maturity level. A similar approach has been taken by previous studies.

In order to accomplish our first research aim, we carried out hierarchical cluster analysis using centroid clustering with squared Euclidean distance. This method is particularly beneficial in categorising extant datasets into related groups. Sorting cases into clusters, the mean scores of CI behaviours were then calculated and compared to differentiate maturity levels. However, a consecutive multi-group analysis could not be carried out due to limited sample size (Collier, 2020).

Besides CI behaviours, the constructs of DT intention, DT behaviours and DT performance were included in this study. Items like "*I intend to actively support the change processes that may lead to a digitally transformed organisation*" were used to assess DT intention, whilst "*I experiment with digital technologies and learn as I go*"

assessed DT behaviours amongst ten items in total. For perceived DT performance, a sample item was "*The digital vision of my company in what digital transformation will deliver in terms of performance benefits is always clear and transparent to me*". Their scales were adopted from previous studies and tested for reliability as demonstrated in chapter 4. All measures were assessed on a 7-point-Likert scale (7=strongly agree, 1=strongly disagree).

To test our hypotheses predicting a moderating role of CI maturity, structural equation modeling was applied utilising composite variables.

7.4 Results

Our first aim was to assess the current maturity level of the sample to gain a better understanding of the status-quo in CI amongst manufacturing employees. As the cluster analysis reveals, two clusters can be identified, with high CI maturity and low CI maturity respectively. Cluster 1 (n=270) shows a more advanced stage of CI with an overall mean score of 5.2. Cluster 2 (n=30) presents a low level of CI with an overall mean score of 2.8. For Cluster 2 this implies that a CI culture is not in place or only starting to develop.

However, the vast majority of the sample depicts an advanced stage of CI. Figure 9 compares the two clusters based on their item mean score on a 7-point-Likert scale.

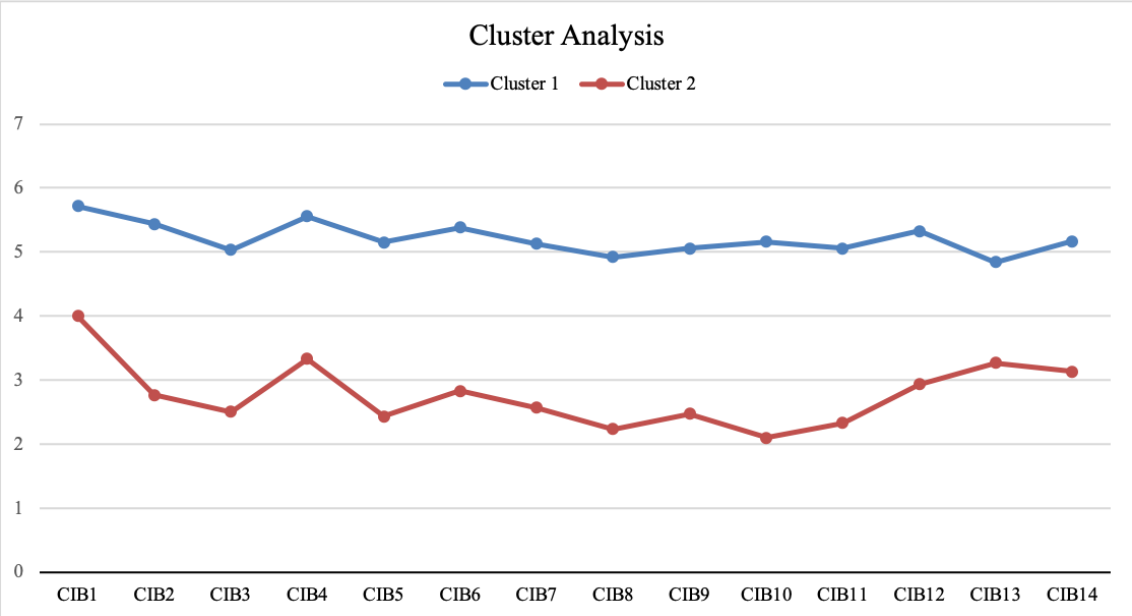

Figure 9. CI maturity cluster analysis

Having advanced our understanding of the current CI maturity level amongst manufacturing employees, our hypotheses were considered valid to be tested.
Before proceeding with hypothesis testing, we conducted an analysis of the measurement model to ensure all constructs were reliable and valid. Using confirmatory factor analysis (CFA), validity of of the constructs were confirmed.

In order to test our hypotheses, two measurement models were developed. Measurement model 1 included the constructs of DT behaviours, DT performance and CI behaviours, which are required to test H3a. The overall model fit statistics indicate good values (CMIN/df = 2.1, IFI = .92, CFI = .92, RSMEA = .06, SRMR = .07). Measurement model 2 addressed H3b and involved the constructs of DT intention, DT behaviours and CI behaviours. Demonstrating similar values, the values show good model fit (CMIN/df = 2.16, IFI = .93, CFI = .93, RSMEA = .06, SRMR = .08).

Our first hypothesis predicted a negative moderation of CI maturity on the relationship between DT behaviours and DT performance. The results confirm a negative and significant moderation of CI maturity on the relationship between DT behaviours and DT performance (b = -0.1, t = -2.02, p = .04). Thus, the more mature employees are in CI, the weaker the impact of their DT behaviours on DT performance. In addition, although not representing our research focus, we also found a positive and significant impact of CI behaviours on DT performance (b = .428, t = 7.252, p = .000).

The results of the slope analysis carried out to enhance our understanding of the nature of the moderating effect are demonstrated in Figure 10. The illustration shows that with low CI maturity levels, the relationship between DT behaviours and DT performance is much stronger compared to high CI maturity levels, as indicated by a steeper slope.

Thus, the relationship between DT behaviours and DT performance is weakened by CI maturity.

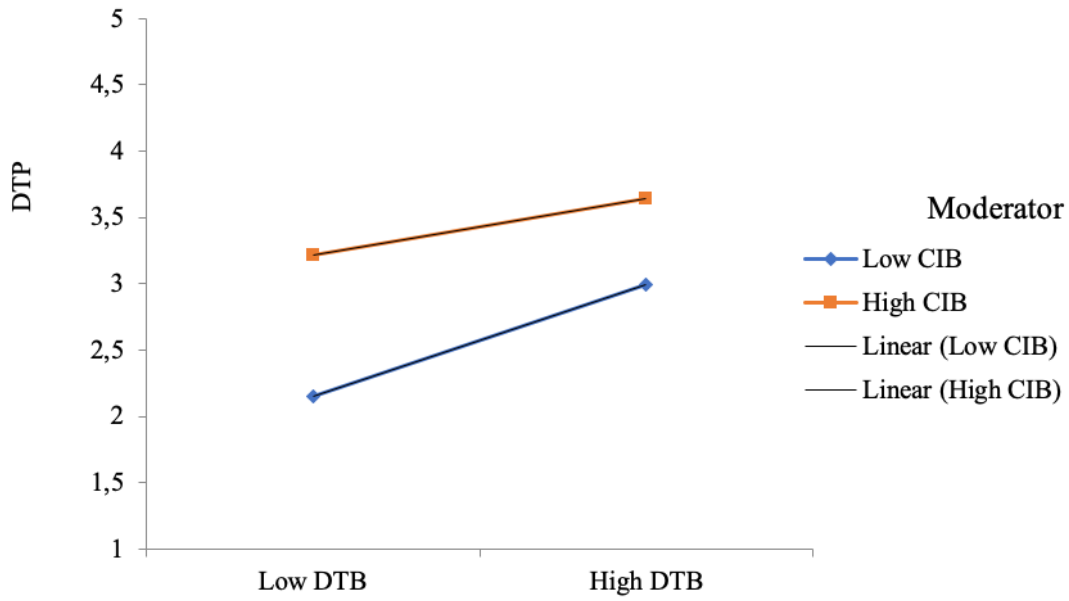

Figure 10. Slope analysis moderation DTB-DTP

Contrary to our first hypothesis, our second assumption was a positive moderating effect of CI maturity on the relationship between DT intention and DT behaviours. The results reveal that CI maturity positively moderates the relationship between DT intention and DT behaviours (b = 0.12, t = 4.6, p = .000). Thus, the more mature in CI, the stronger the impact of DT intention on DT behaviours.

The respective slope analysis emphasises the effect by highlighting the steeper slope for high CI maturity (Figure 11). The relationship between DT intention and DT behaviours is much stronger with high CI maturity.

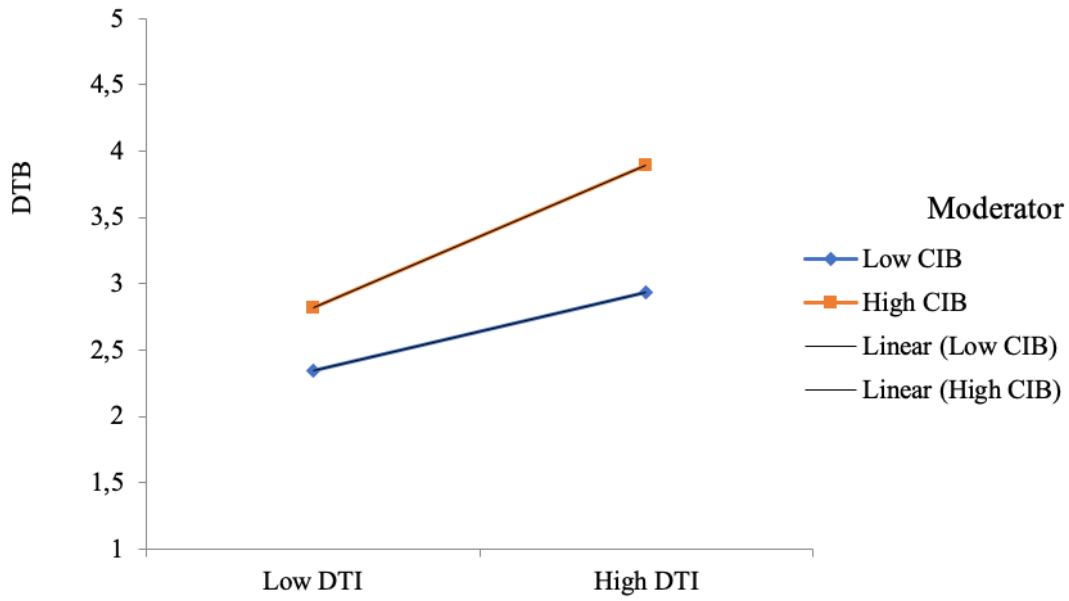

Figure 11. Slope analysis moderation DTI-DTB

A summary of the statistical moderation analysis can be found in Table 11.

Table 11. Moderation analysis summary

Relationship	Beta	C.R.	P-value
DTB → DTP	0.315	4.527	***
CIB*DTB → DTP	-0.103	-2.015	0.044**
DTI → DTB	0.415	12.094	***
CIB*DTI → DTB	0.121	4.605	***

7.5 Discussion

This study further explores the paradoxical tendency of CI impacting DT. Until now, research advocates a predominantly positive interaction between CI and DT. As Study A has shown, this is not always the case when looking at the human factor. Therefore, this study follows up on this finding and examines whether a CI culture changes the dynamics of DT. In our case, we defined CI culture as a combination of mindset and behaviours.

We first assessed the maturity level of CI to understand the current implementation level, and to compare our sample with previous studies. As the results reveal, the majority of respondents have adopted a good level of CI behaviours across all measured items which aligns with Cifone et al.'s (2021) survey study that also indicate a high degree of lean maturity. However, implementation levels are still low in respect to the maturity model proposed by Bessant et al. (2001). Especially the practices indicating problem-solving with external partners and identifying one's company as learning organisation were ranked low. The second cluster demonstrated that CI was not much of a concern or only just beginning to take root. None of CI behaviours were present in this cluster except for a general corporate encouragement to participate in CI activities. Having identified these two clusters, our findings align with Lizarelli et al. (2022) who also found two clusters in a similar range in Brazil. Their findings highlight that innovation was influenced by CI maturity.

As the main objective of our study, we examined the role of CI maturity in the context of DT. Specifically, we investigated the moderating role of CI maturity in influencing DT dynamics. Going beyond innovation, DT involves a revolutionary change in the way business is shaped.

While having a positive direct effect on DT performance, CI maturity also dampens the positive relationship between DT behaviours and DT performance. This insight poses questions as to how this dynamic evolves. One potential cause could be the conflicting practices and competences required for CI and DT. CI embodies highly structured and incremental activities with strong operational focus. Their main target is to constantly improve the status quo. Conversely, DT practices are based on a strong innovation orientation aiming to leverage digital technologies whereby the outcome of actions can involve revolutionary consequences for the entire organisation and beyond. If an organisation is too focused on small, incremental improvements, it may struggle to embrace the larger-scale changes associated with digital transformation.

In addition, establishing DT practices besides a CI-driven culture necessitates ambidexterity. When CI maturity is high, organisations may find it more difficult to develop practices that exceed the scope of extant habits. Hence, DT behaviours become limited in their effect.

Moreover, if an organisation has a high level of CI maturity but a low tolerance for change, it may resist adopting new digital technologies or transforming existing processes. The entrenched culture of improvement might clash with the disruptive nature

of digital transformation, impeding its progress and reducing its overall effectiveness. Being mature in CI is associated with its successful implementation, which could also obscure the need to engage in DT.

Although CI encourages collaboration, improvements are often limited in their scope and area of application. A highly mature CI organisation may have developed silos within different departments or functions. Digital transformation often necessitates cross-functional collaboration and integration of various aspects of the business, and a lack of collaboration across the entire company can impede the success of digital initiatives.

One of the key hindering aspects is that of inflexible processes or standardisation practices. Organisations with a mature CI culture may have well-established processes that are resistant to change. Standardisation is a core principle in the cycle of CI which encourages stabilisation. Digital transformation often requires a more agile and flexible approach, which may be hindered by rigid structures built around CI practices.

Similarly, high CI maturity organisations may have invested heavily in existing systems and technologies. These legacy systems can pose challenges during digital transformation, as they may not easily integrate with new technologies or impede the adoption of more modern, innovative solutions.

Lastly, a culture of CI may foster a mindset that values stability and risk avoidance. In contrast, digital transformation often involves embracing uncertainty, taking risks, and experimenting with new approaches. If employees are not open to this shift in mindset, it can negatively impact the success of digital transformation initiatives.

Testing our second hypothesis, we found that CI maturity strengthens the impact of DT intention on DT behaviours. Thus, when CI maturity is high, employees tend to better translate their intentions into actions to facilitate DT. CI maturity often entails having established processes, feedback mechanisms, and a culture of adaptability within an organisation. When the intention to engage in DT aligns with these advanced CI practices, it is reinforced by the organisation's readiness to embrace change, implement new technologies, and optimise existing processes. Essentially, the positive effect is strengthened because the organisation has the capability to effectively translate intention into action through its mature CI practices.

Such capability is based on leadership supporting creativity and experimentation as well as the presence of learning behaviours. Employees within highly mature CI

organisations are conversant in learning and skilled in pro-actively implementing changes. Reward systems further encourage engagement and the implementation of ideas.

7.6 Conclusion

Following the findings in Study B, a more in-depth investigation was conducted to comprehend the strength and impact of CI culture on DT. Recognising a lack of insights in the current literature on how CI cultures influence organisations in integrating various initiatives and transformation efforts, this follow-up study aimed to assess the interplay between CI maturity and DT dynamics from a behavioral change perspective.

Building on prior findings, CI literature, and organisational culture foundations, the study predicted converse effects of CI maturity on DT. Hierarchical cluster analysis categorised the sample into two CI maturity levels, revealing an overall advanced CI maturity level of the observed manufacturing employees.

The subsequent examination unveiled a negative moderation of CI maturity on the relationship between DT behaviours and DT performance, alongside a positive moderation on the relationship between DT intention and DT behaviours. These contradictory effects support paradox theory and align with the results from Study B. The study also demonstrated that in the presence of CI, the effect of DT intention on DT behaviors becomes positive, contrary to the findings in Study A. In essence, the research revealed that CI maturity strengthens the effect of DT intention on DT behaviors but dampens the effect of DT behaviors on DT performance.

This study introduces a new perspective to the existing knowledge on the intersection between CI and DT by investigating their interplay from a behavioural change standpoint. It establishes that CI maturity not only influences DT readiness but also impacts behavioural DT dynamics by altering their relationships. The confirmed paradoxical effects emphasise the significant role of organisational culture in determining the effectiveness of new initiatives.

Hence, to maximise the positive impact of digital transformation, organisations need to balance their CI efforts with a willingness to embrace change, foster collaboration, and adopt a more agile mindset. It is important to recognise that DT often requires a different set of behaviours and capabilities compared to traditional CI practices.

8 Reflective integration

To advance the digital transformation literature as well as the continuous improvement literature, the motive of this dissertation was to examine the process of establishing DT behaviours and their impact on DT performance, as well as the interplay of CI and behavioural DT dynamics. This research views this interface from a complex system perspective, addressing novel interrelationships in the realm of organisational behaviours. Furthermore, it aimed at investigating the effect of CI maturity as a respresentation of organisational culture on the readiness of manufacturing employees to engage in DT.

In order to systematically analyse the nature of DT behaviours and their interaction with other constructs, three empirical studies were conducted using a cross-sectional large-scale survey amongst high-value manufacturing employees. As these studies are extensively discussed in their respective chapters, this section aims to consolidate their findings and provide an integrative résumé. First, the findings associated with the research questions are addressed before outlining the contributions of the results to the extant theories and bodies of knowledge.

8.1 Findings

Each empirical study followed a theoretical framework based on extant literature. Mainly drawing on the theory of planned behaviour, the studies revealed some interesting results. The key finding is that the process of developing DT behaviours is contingent. In addition, CI behaviours play a major role in influencing DT dynamics by simultaneously reducing behavioural DT readiness and enabling the positive effect of a DT mindset on employees' readiness to engage in DT. This paradoxical phenomenon was further supported in our Study C, which emphasises the importance of an organisational culture's strength in influencing change dynamics in the context of DT. Overall, this research addresses three main questions that, until now, remained unanswered in the current literature.

What behavioural digital transformation characteristics might impact organisational digital transformation performance?

Although the field of DT has attracted considerable attention over the last years, studies looking at the role of people and particularly behavioural aspects are still scarce. Yet, transforming the workforce alongside the integration of digital technologies is considered foundational for the success of DT (Eden et al., 2019). The notion of workforce transformation for DT remains vague, challenging how individuals support the success of DT. This position further questions how DT behaviours impact DT performance, how they can be developed and how they are influenced by extant mindsets.

Current theory in this context is only just evolving as nascent research fields, that are mostly isolated and context-specific in their applications. The study draws on the theory of planned behaviour as established framework to guide the research as well as the fields of DT competences (Blanka et al., 2022) and individual DT readiness (Muehlburger et al., 2022). With this foundational work, it was predicted that DT behaviours can be established through DT intentions which in turn are influenced by the cognitive concepts of DT attitude, DT subjective norms and DT self-efficacy. It was also predicted for DT behaviours to have a positive effect on perceived organisational DT performance.

The theory of planned behaviour assumes a chain of behavioural conditions for behaviours to be performed, which the results almost completely substantiated. The significant relationships found in this study support the chain effect. However, intention negatively influenced DT behaviours, while DT behaviours very strongly influenced perceived DT performance. The results also show that self-efficacy was exclusively influencing DT intention. Answering the first research question, it was found that the DT characterisitcs of self-efficacy, intention and behaviours directly or indirectly impact perceived DT performance. Therefore, the results emphasise the role of the individual in enabling successful DT.

With this study, several contributions to the extant knowledge are made. First and foremost, individual characteristics required for successful DT are clarified and the influence of DT behaviours on perceived DT performance was empirically validated. In addition, the notion of DT performance was discussed and narrowed down for the manufacturing context. By addressing a relational research question, the so far isolated fields of mindset, behaviours and competences, and DT performance were linked. Therefore, a more holistic approach was followed by connecting these and empirically

examining both the effects and relationships of DT mindset, intention and behaviours, hereby emphasising how DT behaviours are influenced.

From a theoretical perspective, the concepts of DT mindset and DT readiness were conceptualised and integrated into the theory of planned behaviour, hereby including subjective norms as additional readiness factor. Moreover, the TPB was extended to incorporate the effect of individual behaviours on organisational performance.

Overall, it can be argued that a motivated workforce will not be sufficient for developing DT behaviours, but that structural conditions and support systems such as leadership and trainings are essential in effectively realising the dynamics and benefits of DT characteristics for DT performance.

How might CI behaviours influence the digital transformation readiness of employees?

The interaction of CI and DT are currently not well understood. Some studies suggest a positive interplay between the two concepts. However, their point of origin primarily explores this intersection from a technical perspective while understandings of the impact of organisational culture are missing. Adopting a novel approach, this study addresses this gap by investigating the relationship between CI culture and DT readiness from the perspective of the individual. In this study, CI culture is described as a combination of CI mindset and CI behaviours while individual DT readiness was conceptualised as the intention to engage in DT (i.e. DT intention) which is driven by DT mindset.

Based on extant literature, organisational change factors seem to play a role in navigating DT readiness. As empowerment is considered fundamental for both CI and DT, it was predicted that CI behaviours embody an influential organisational change factor that impacts individual DT readiness through empowerment. The findings partially confirmed this assumption. CI behaviours were found to significantly impact empowerment and individual DT readiness. However, empowerment was predicted to be mediating the effect, but did not have an effect on individual DT readiness. From a holistic model perspective, CI behaviours simultaneously directly reduced and indirectly promoted behavioural DT readiness. Answering the research question, this study found paradoxical effect whereby CI behaviours decreased individual DT readiness directly, but also enabled DT mindset to be effective in increasing individual DT readiness.

As opposed to the primarily positivist perspective that argues for a synergy between CI and DT, this study adopts a critical standpoint pointing at the challenge between CI behaviours and DT readiness. One of the key findings is that CI changed the dynamics of individual DT characteristics. While in Study A, DT mindset did not significantly impact the intention to engage in DT, in the presence of CI, DT mindset did significantly impact the intention to engage in DT. This could mean that overall, a CI environment supports the establishment of DT readiness. In addition, the results evidence structural and psychological empowerment to be influenced by CI behaviours for the first time. This study also adds to the scarce literature on CI impacting DT rather than vice versa.

How might CI maturity influence the effects that behavioural DT characteristics have on DT performance?

In response to the findings in Study B, an in-depth investigation was required to better understand the strength and impact of CI culture on DT. The current literature lacks insights as to how CI cultures influence organisations in their attempt to integrate different initiatives and transformation efforts. Therefore, this follow-up study aimed at assessing the interplay between CI maturity and DT dynamics from a behavioural change perspective.

Based on previous findings, CI literature and organisational culture foundations, CI maturity was predicted to have converse effects on DT. Utilising hierarchical cluster analysis, a preliminary categorisation was carried out to provide insights into the CI maturity level of the sample. The results show that, overall, an advanced CI maturity level was present. This finding was a prerequisite to examine the effect of CI maturity on DT. In a subsequent examination, the study revealed a negative moderation of CI maturity on the relationship between DT behaviours and perceived DT performance, and a positive moderation of CI maturity on the relationship between DT intention and DT behaviours. These contrary effects of CI maturity support paradox theory and confirm the results found in Study B. Moreover, the study shows that in the presence of CI, the effect of DT intention on DT behaviours becomes positive, as opposed to the results in Study A. In summary, answering the research question, it was found that CI maturity strengthens the effect of DT intention on DT behaviours, but dampens the effect of DT behaviours on perceived DT performance.

This study contributes to the extant knowledge on the intersection between CI and DT with a new approach, namely investigating their interplay from a behavioural change perspective. It was evidenced that CI maturity not only influences DT readiness but behavioural DT dynamics as a whole by affecting their relationships. Thus, paradoxical effects were confirmed as discovered in Study B. Consequently, it can be argued that organisational culture can have a major impact on the effectiveness of new initiatives.

8.2 Key scholarly contributions

The highlighted findings from the three studies make valuable contributions to the development of individual DT capabilities and the re-evaluation of CI cultures. In addition, the findings have implications for underlying research arenas including the theory of planned behaviour, ambidexterity and paradox theories.

Individual digital transformation capability

Until now, researchers have predominantly focused on organisational capabilities required for DT, particularly from a dynamic capability perspective. Although previous research agrees that individual abilities are central in understanding organisational outcomes (Felin et al., 2012), there is an evident lack of theoretical discussions and empirical research surrounding individual's capabilities in the context of DT. Specifically, individual characteristcs influencing the effectiveness of DT remained unexplained. By drawing on the scarce competence literature for DT as well as utilising the theory of planned behaviour, the notion of DT behaviours and the process leading towards them were conceptualised. Overall, the constructs of attitude, subjective norms, self-efficacy, intention and behaviours were identified to be relevant individual characteristics for the success of organisational DT. Furthermore, the impact of DT behaviours on perceived DT performance was assessed, hereby emphasising the chain effect of individual characteristics on the effectiveness of DT.

In addition, this research contributes to the nascent research field of DT mindset as a component of individual DT capability by incorporating the concept of perceived social pressure (i.e. subjective norms) and measuring DT mindset as a second-order construct. Social pressure has been shown to strongly influence individual behaviour but has not received any attention in the context of DT. Nevertheless, as this field of investigation is

only in its infancy, this research is the first to empirically validate its effect on employees' intention to engage in DT.

However, by examining these individual DT characteristics in the context of CI, it became apparent that the effects are contingent, whereby CI paradoxically influences the dynamics of DT capability development.

Continuous improvement culture

The field of CI is well explored. However, research rarely goes beyond disciplinary borders and effects of CI on organisational aspects independent of CI are rare. With the rise of digitalisation, organisations following a CI approach are now faced with the integration of DT. Despite few studies investigating the interplay of CI and DT, primarily from a technical perspective, there is no evidence on how CI cultures influence the adoption of DT, and DT performance overall.

Supporting interdisciplinary research and addressing the human factor, these gaps are filled by investigating the effect of CI on DT from a behavioural perspective. The findings clearly demonstrate that CI cultures influence DT dynamics, including a direct impact of DT behaviours on perceived DT performance. Moreover, the paradoxical effect CI cultures can have on the establishment and integration of new practices and initiatives should be highlighted.

Theory of planned behaviour

The theory of planned behaviour is a well-established theory and has been applied in various fields. The TPB assumes a a systematic chain-like logic in explaining behaviours. According to theory, behaviour is driven by the intention to engage in said behaviour while intention is driven by attitudes, subjective norms and self-efficacy. Utilising TPB as research framework, the findings indicate that the TPB is highly context-dependent and does not necessarily hold in the context of DT.

This research advances the TPB in two ways simultaneously. First, it evidences a theoretical reverse effect. Based on the theory's foundations, the intention to engage in a behaviour influences the actual performance of this behaviour. In contrast, this study examines the impact of behaviour on the intention to engage in a behaviour. As this relationship was revealed to be significant, it can be advocated for a reinforcing effect whereby intention influences behaviour and behaviour influences intention. Such a

feedback loop aligns with traditional learning theories that explain the accumulation of knowledge through feedback mechanisms.

Second, the results of the research emphasise that the intention to engage in behaviour can also be influenced by independent behaviours. Stressing contextual circumstances, other practices and mindsets can regulate the dynamics of the behavioural chain. Thus, this finding implies that the process of performing behaviour is grounded in a network rather than in a simplistic chain. Similarly, this mechanism supports organisational learning theories which argue that learning impacts organisational actions and routines, and consequently establish organisational cultures.

In summary, the TPB alone does not fully hold in a DT context, but contingent factors are essential is enabling and balancing the relational effects between the constructs.

Going beyond TPB, the bodies of knowledge are advanced by extending the TPB through the integration of individual's contribution to organisational performance through behaviour. Continuing the theoretical chain, this research confirms the strong impact of DT behaviours on DT performance.

Paradox theory

Paradox theory provides a framework for comprehending the complexities inherent in organisational life. It acknowledges that organisations face inherent contradictions, tensions, and dualities, offering a lens through which to understand and appreciate the multifaceted nature of organisational challenges. It is closely associated with the concept of ambidexterity, which involves the simultaneous pursuit of exploration and exploitation. This balanced approach enables organisations to adapt to changing environments while maintaining efficiency and stability in existing operations.

The paradox perspective acknowledges the importance of context in shaping the nature and resolution of paradoxes. However, it often provides insufficient guidance on how organisational contexts influence the emergence and management of paradoxes, limiting its applicability.

The findings demonstrate paradoxical effects in the interplay of CI and DT, which confirms the findings of previous studies in the lean management literature (Maalouf and Gammelgaard, 2016). Enhancing synergy between these two concepts and enabling the management of paradoxes involves a cautious balancing of stability versus flexibility. Table 12 highlights the key theoretical contributions.

Table 12. Theoretical contributions

Theory or research field	**Gap in knowledge**	**Findings / theoretical implications**	**Study (chapter)**
Individual DT capabilities	Individual charactertics influencing DT success is not explored	In line with TPB, competence, motivation and behaviours are contributing to DT performance	Study A
DT mindset	Focus on attitudes and competences	Subjective norms indicating perceived social pressure enhances the understanding of a DT mindset	Study A / Study B
CI culture	Influence of CI culture not understood	CI offers some explanation for paradoxical effects in developing individual DT capabilities in line with the TPB	Study B / Study C
CI culture	CI behaviours have not been linked with DT	CI behaviours directly influence DT performance	Study C
Theory of planned behaviour	Isolated chain reaction	Theory is contingent and can be influenced by other extant behaviours and mindsets	Study A / Study B
Theory of planned behaviour	One-directional process	Reverse relationship, involving the effect of behaviour on intention	Study B
Paradox theory	Ambidextrous relationship between CI and DT	CI both promotes and hinders DT	Study B / Study C

9 Conclusions

The benefits of digital technologies have given rise to the inception of transformation efforts in business organisations. With their attempts to leverage new digital opportunities, modifications of their extant operating model are resulting out of the necessity to capture tended performance-enhancing potentials. Changing practices, processes and business models in the context of DT also requires re-evaluation organisational cultures for their transformative fit. Many manufacturing companies have been following CI philosophies which have become part of their organisational identity. A culture driven by CI advocates small incremental and systematic improvements on a continuous basis with the aim of enhancing organisational performance. Although such a culture embraces change, it also emphasises the importance of structure, systems and stability. With the increasing need to digitally transform manufacturing organisations, the question arises whether CI cultures support or hinder DT efforts. Previous studies have shown that CI principles can support the implementation of DT, while digital technologies can promote the effectiveness of CI. However, extant literature fails to explain the impact of organisational culture on the readiness of individuals to engage in DT and does not anticipate their joint effect on the success of DT initiatives. Therefore, this dissertation aimed to understand the interplay of CI culture and DT from a behavioural perspective. By conceptualising and assessing their interfaces, this research contradicts with the current predominantly positive associations between CI and DT.

Utilising a large-scale cross-sectional survey design amongst 300 high-value manufacturing employees, the results imply paradoxical effects. By drawing on the theory of planned behaviour, the results show that DT self-efficacy uniquely influenced the intention to engage in DT while intention decreased DT behaviours. On the other hand, DT behaviours had a major impact on perceived DT performance. In the presence of CI, DT mindset improved the intention to engage in DT (i.e. individual DT readiness) while CI behaviours reduced the intention to engage in DT. Although CI behaviours significantly influenced empowerment, the construct empowerment did not mediate the effect of CI behaviours on individual DT readiness. The paradoxical effects found were further confirmed in a follow-up study. Here, the results revealed that CI maturity moderated the relationships between DT intention, DT behaviours and perceived DT performance, implying direct implications for the dynamics of DT capability development.

With these findings, this dissertation advances knowledge in the fields of DT and CI, having both theoretical and practical implications. Overall, this research has discovered how individuals contribute to the success of DT and which role CI culture plays in influencing this dynamic.

The concluding sections (9.1 and 9.2) provide an overview of the key research implications and future research opportunities based on this research's limitations.

9.1 Research implications

The interconnection of CI and DT is not a straightforward concept. This research suggests that while CI inherently promotes and embodies an innovation orientation, involvement, pro-activeness and continuous learning, it simultaneously impedes the motivation to engage in additional, yet somewhat similar behaviours with a strong innovation orientation. In carrying out three interlinked studies, this research has implications for both theory and practice as well as methodological inferences.

Theoretical implications

As elaborated in more detail in Chapter 8, the findings of this research generate a meaningful spectrum of theoretical implications. One major contribution to the current body of knowledge is an enhanced understanding of how individuals contribute to the success of DT. This research emphasises that individuals are an essential factor influencing DT that needs to be considered when exploring the phenomenon of DT, highlighting and justifying emerging future research agendas. Moreover, by integrating the theory-based variables of attitudes, subjective norms and self-efficacy into the concept of DT mindset, this research advances the understanding of cognitive drivers for DT and emphasises the necessity to go beyond the mere technological focus observed in many studies. Similarly, while current literature assumes an outright positive relationship between CI and DT, this research challenges this perspective by empirically confirming paradoxical effects. One potential explanation for this contrastive finding is this research's focus on behavioural aspects as opposed to the technical focus of other studies. Another theoretical implication is the contingency in developing DT behaviours. Utilising the context of CI, it was shown that DT readiness influenced DT behaviours differently depending on contingent factors of CI. Developing DT behaviours should thus not be considered in isolation but in their respective contexts. Taking this point further and

acknowledging CI as a form of organisational culture, it can also be theoretically stated that organisational culture influences DT readiness and behaviours. Therefore, these findings imply a strong need for organisational learning as cultural practices are learned and unlearned over time. The value of learning for integrating CI and DT has only recently been pointed out by another study (Powell et al., 2024) and requires further exploration for its potential synergetic role. Finally, by drawing on the theory of planned behaviour, this research indicates some recursivity in its application which may support the concept of cumulative learning and reinforcement and, thus, capability development. The theory was also extended to link behaviour with perceived organisational outcomes, which, in itself can be seen as recursive relationship indicating that behaviours influence perception and, consequently, beliefs.

Practical implications

While digital technologies are at the core of DT, the impact of extant organisational cultures on DT initiatives cannot be overstated. Mindset, intentions and behaviours are key elements in developing individual DT capability and need to be reinforced for DT initiatives to be effective. Especially, stimulating specific DT behaviours such as experimentation with digital technologies and knowledge sharing will significantly enhance the chance for DT to be effective. This research clearly indicates the importance of DT behaviours for DT success and should, thus, form part of any DT roadmap. Similarly, self-efficacy was found to be the key influential factor for individual DT readiness. While attitudes and norms are equally important in forming a successful DT mindset, the perception of one's own competences significantly affects the intention to engage in DT. Therefore, developing skills and competences through training and freed-up time for learning throughout an organisation should be the first step when commencing DT. This research also indicates that developing DT capabilities should not be regarded as an isolated process, but must be implemented with its environment in mind as the context can both act as an enabler and barrier to DT. Thus, if appropriate support systems and structures are in place, motivation for DT is more likely to prosper. A thorough analysis will help to identify organisational elements that can have an adverse effect on the development of DT capabilities and those that are supporting it. This research also suggests that this is also true for examining the context of CI in depth. Following a different change strategy, CI can act as both an enabler and barrier to DT. Here, it is crucial to carefully balance exploration and exploitation activities, while

making use of learning-supporting behaviours that CI is reinforcing. Since DT blurs the boundaries of organisations, change cannot be regarded in isolation (Hanelt et al., 2021). The integration of DT activities always requires the cautious balancing of extant structures and routines, and new digital opportunities. Implementing DT while neglecting extant organisational cultures will hinder DT to be effectively and sustainably implemented.

Finally, although CI may have some drawbacks in developing individual DT capabilities, it also promotes the effectiveness of a DT mindset in encouraging DT behaviours. Here, it is crucial to focus on the strengths of the CI system, enhancing the core capabilities of the organisation. At the same time, elements of CI should be re-assessed and modified to better fit the requirements of new digital business models. Overall, CI remains worthy to be established as a supporting structure for DT, albeit a modified version is recommended.

Methodological and empirical implications

A quantitative survey approach was selected to enable measuring the effect of CI on DT. By following such a research design, this thesis uniquely contributes to better understanding the relationship between CI and DT from a size and scope perspective, incorporating both well-established and novel measurement scales. Moreover, this research empirically validates the influence of CI on both structural and psychological empowerment. While the relationship between CI and empowerment has been frequently mentioned in the extant literature, it has not been empirically tested as a multi-faceted construct to date. Finally, DT involves a major change in an entire business environment which impacts CI on various levels. In order to investigate the research questions from a system perspective, this research explicitly consults cross-hierarchical participants. The sample allows for enhanced generalisabiltiy, considering the business as a whole rather than isolated stakeholder groups. Future research will look to build upon these research implications.

9.2 Limitations and further research

This research follows a systematic approach to answer the defined research questions. Therefore, the research design was chosen to fit the research purpose. By thoroughly following an objectivism path, the results indicate strong validity to

sufficiently answer the research questions, and confirming the research approach to be effective.

Nevertheless, this research work inhibits some limitations that yield potential for further research. First, a single quantitative study was chosen to measure the relationships between the variables of interest. Based on the lack of quantitative studies in this research field, all three studies contributed to novel knowledge by benefiting from a newly-taken quantitative approach. Although the chosen method effectively answered the research questions, further research could enrich the data and meaning of the findings by following a qualitative or mixed-method approach. For instance, a qualitative study would be valuable to better understand the concept of DT behaviours and to establish a well-grounded measurement scale. By using a mixed-method approach, further studies may further explore the behavioural inter-dynamics of CI and DT by considering contextual factors and their effects.

Second, a sufficient sample size is crucial for establishing valid and reliable findings. Taking into account factors influencing the required sample size such as number of variables and method for data analysis, a minimum sample size of 200 was necessary for the research studies based on power analysis. Despite indicating a final sample size comparable with other similar studies (n = 300) and meeting the sample size requirements for this research, a larger sample size is recommended in further studies to improve statistical variations between the constructs. Particularly, if data non-normality is expected, larger sample sizes may counteract outliers. Moreover, Study C would have greatly benefitted from a multi-group analysis to specify the effect of varying CI maturity levels on individual DT characteristics. However, multi-group analysis using SPSS Amos relies on very large sample sizes, i.e. 200 per group.

Third, using a deductive approach, this research draws on the theory of planned behaviour. In quantitative research, established theoretical concepts are utilised to answer novel research questions. Thus, theory-driven variables determine the framework under study. While these variables effectively target this research's objectives, they simultaneously limit the scope and perspective on this research subject. Using additional theories in future studies, such as microfoundations for dynamic capabilites, will help to broaden the behavioural understanding of CI-DT.

Similarly, the theory of planned behaviour was only partially applied to allow for manageable complexity. Belief variables are not included in this research, but pose

promising opportunities for further investigations. Considering the findings, beliefs may add an interesting layer to the concept of DT mindset.

In addition to the research limitations, the findings emphasise the phenomenon of paradoxical tensions between CI and DT. Future research can build on this finding and explore factors strengthening the synergy between CI and DT to advance the field of knowledge. This will be a crucial step towards improving the harmonisation and effectiveness of CI and DT. Moreover, the studies are undertaken in the context of high-value manufacturing. This environment was chosen due to the established concept of CI in many firms while digitalisation provides new business avenues for production, in particular. To confirm the generalisability of this research, different industries and contexts should considered.

Overall, future research studies can develop the findings of this research to further enhance knowledge on the interplay between CI and DT. As El Sawy and Perreira (2013:2) state, '*[u]nlike other business environments, digital business ecosystems can never be expected to revert to any kind of "equilibrium" after disruptions change things; turbulence implies that cause-and-effect may cascade in unpredictable ways to alter the structure or health of the ecosystem, or end it entirely'*. After all, CI and DT can make profitable companions if their interplay is well understood. By modifying or testing theories under different conditions, science evolves into an enriched understanding of reality, gradually coming closer to the truth.

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Appendices

Appendix A. Questionnaire items

English Version

	Code	Question	Measurement scale items
Consensus	Consent		I consent I do not consent
Instruction	Instruction		-
Section 2 Personal information (control variables)			
Organisational Role	*Org_Role*	*What is your main organisational role?*	Operator Production manager Non-production manager / Manager support function Specialist / Expert Executive / Director Other
Tenure	*Tenure*	*How long have you been working in your current company?*	Less than 1 year 1-3 years 4-6 years 7-10 years over 10 years
Company type	*TypeCompany*	*Which type of company do you currently work for?*	OEM / Vehicle production Tier 1 supplier Tier 2 supplier Tier 3 supplier Other manufacturing company I am not sure which type my company belongs to
Country	*Country*	*Which country do you currently mainly work in?*	
Gender	*Gender*	*What is your gender?*	Male Female Non-binary / third gender Prefer not to say
Age	*Age*	*Which age group do you belong to?*	19 years or below 20-29 years 30-39 years 40-49 years 50-59 years 60 years or above

Section 3 Empowerment			
Structural Empowerment	*EMP1*	*I am inspired by what we are trying to achieve as an organisation.*	1-2-3-4-5-6-7
	EMP2	*Thinking outside the box is appreciated in my organisation.*	1-2-3-4-5-6-7
	EMP3	*I have a say in defining my job responsibilities.*	1-2-3-4-5-6-7
	EMP4	*My organisation does not disseminate information to all levels of employees evenly.*	1-2-3-4-5-6-7
Psychological Empowerment	*EMP5*	*The work I do is important to me.*	1-2-3-4-5-6-7
	EMP6	*I have the abilities to do my job well.*	1-2-3-4-5-6-7
	EMP7	*I can decide on my own how to go about doing my work.*	1-2-3-4-5-6-7
	EMP8	*My impact on what happens in my department is high.*	1-2-3-4-5-6-7
Section 4 CI Perspective			
CI Attitude	*CIA1*	*We strive to continuously improve all aspects of products and processes, rather than taking a static approach.*	1-2-3-4-5-6-7
	CIA2	*If I am not constantly learning, my performance will suffer in the long run.*	1-2-3-4-5-6-7
	CIA3	*Teamwork is central for continuous improvement activities to be successful because different perspectives are taken into account.*	1-2-3-4-5-6-7
	CIA4	*Without commitment from leadership, continuous improvement activities will fail.*	1-2-3-4-5-6-7
CI Norms	*CIN1*	*We need to continuously improve our processes to react to changes imposed by customers or to comply with legislation.*	1-2-3-4-5-6-7
	CIN2	*My co-workers expect me to participate in continuous improvement activities.*	1-2-3-4-5-6-7
	CIN3	*In order to stay competitive, we are forced to continuously review and improve our organisational processes.*	1-2-3-4-5-6-7
CI Self-Efficacy	*CIE1*	*I feel capable of completing continuous improvement activities in an autonomous way.*	1-2-3-4-5-6-7
	CIE2	*I have the competences to implement the necessary improvements to assist with my daily routines.*	1-2-3-4-5-6-7
	CIE3	*I am able to come up with new ideas for improvement at my company.*	1-2-3-4-5-6-7
	CIE4	*I am able to successfully overcome challenges during continuous improvement projects.*	1-2-3-4-5-6-7

Section 5 CI Behaviours

CI Behaviours	*CIB1*	*We are encouraged to participate in continuous improvement activities (in terms of initiation and implementation).*	1-2-3-4-5-6-7
	CIB2	*In my company, we make use of some formal (structured) problem-finding and problem-solving cycle (e.g. PDCA).*	1-2-3-4-5-6-7
	CIB3	*When there are unwanted results, the natural reaction of people at all levels is to identify the causes of the problem, and not to blame individuals.*	1-2-3-4-5-6-7
	CIB4	*We use the company's strategic goals to focus, prioritise and measure improvements (e.g. using a specific set of metrics).*	1-2-3-4-5-6-7
	CIB5	*The objectives for the continuous improvement process are communicated to all employees.*	1-2-3-4-5-6-7
	CIB6	*Continuous improvement activities are integrated into day-to-day operations; they are not just one-off bursts of improvement.*	1-2-3-4-5-6-7
	CIB7	*There are mechanisms for recognizing and rewarding continuous improvement efforts.*	1-2-3-4-5-6-7
	CIB8	*Middle managers provide the necessary resources (e.g. time, money, space, training) for continuous improvement.*	1-2-3-4-5-6-7
	CIB9	*Senior management supports the ongoing development of the continuous improvement system by allocating sufficient resources (e.g. time, money, personnel).*	1-2-3-4-5-6-7
	CIB10	*Key processes of my company are regularly evaluated for implementing improvements.*	1-2-3-4-5-6-7
	CIB11	*My company uses a formal system to manage and control all continuous improvement activities.*	1-2-3-4-5-6-7
	CIB12	*Continuous improvement activities, involving problem solving, are carried out in interdisciplinary teams (different departments and/or hierarchical levels).*	1-2-3-4-5-6-7
	CIB13	*Continuous improvement activities, involving problem solving, with external stakeholders (e.g. customers) are commonplace.*	1-2-3-4-5-6-7
	CIB14	*My organisation deploys the learning that is captured across the organisation related to continuous improvement (e.g. good practices, successes and failures).*	1-2-3-4-5-6-7

Section 6 DT Perspective			
DT Attitude	*DTA1*	*People are too dependent on digital technologies to do things for them at work.*	1-2-3-4-5-6-7
	DTA2	*Digital technologies make me more productive at work.*	1-2-3-4-5-6-7
	DTA3	*I take calculated risks and engage in digital activities that have a chance of not working out.*	1-2-3-4-5-6-7
	DTA4	*In the course of my work, I like to take the initiative to fix or improve things, often through the use of digital technologies.*	1-2-3-4-5-6-7
DT Norms	*DTN1*	*My colleagues expect me to use digital technologies in the course of my work.*	1-2-3-4-5-6-7
	DTN2	*I feel excluded if I do not participate in technological advancements.*	1-2-3-4-5-6-7
	DTN3	*In order to be competitive, my organisation wants me to engage in technological advancements.*	1-2-3-4-5-6-7
DT Self-Efficacy	*DTE1*	*I can usually figure out new high-tech products and services quite quickly.*	1-2-3-4-5-6-7
	DTE2	*I feel confident to use new digital technologies without help from others.*	1-2-3-4-5-6-7
	DTE3	*I feel confident to actively lead on digital transformation initiatives in my company.*	1-2-3-4-5-6-7
DT Intention	*DTI1*	*I intend to actively support the change processes that may lead to a digitally transformed organisation.*	1-2-3-4-5-6-7
	DTI2	*I will try to actively participate in the change processes that may lead to a digitally transformed organisation.*	1-2-3-4-5-6-7
	DTI3	*I plan to provide proactive feedback regarding the change processes that may lead to a digitally transformed organisation.*	1-2-3-4-5-6-7
Section 7 DT Behaviours			
DT Behaviours	*DTB1*	*I work towards my company's digital vision.*	1-2-3-4-5-6-7
	DTB2	*I can access and use digital data to make well-informed decisions.*	1-2-3-4-5-6-7
	DTB3	*I pro-actively tackle challenges arising from my use of digital technologies.*	1-2-3-4-5-6-7
	DTB4	*I experiment with digital technologies and learn as I go.*	1-2-3-4-5-6-7
	DTB5	*I exchange knowledge with my co-workers on any digital transformation learnings.*	1-2-3-4-5-6-7
	DTB6	*I develop creative and purposeful ideas involving digital technologies around e.g. new processes, products or services.*	1-2-3-4-5-6-7

	DTB7	*I identify the value of new digital opportunities and develop plans of how we can take advantage of it.*	1-2-3-4-5-6-7
	DTB8	*Managers and leaders, at all hierarchical levels, support digital transformation activities.*	1-2-3-4-5-6-7
	DTB9	*We work in self-organising teams.*	1-2-3-4-5-6-7
	DTB10	*My organisation adjusts its digital roadmap according to internal or external changes in the business environment.*	1-2-3-4-5-6-7
Section 8 DT Performance			
DT Performance	*DTP1*	*My company has improved processes because of its introduction of digital technologies or digital transformation initiatives.*	1-2-3-4-5-6-7
	DTP2	*My company is perceived as digital frontrunner (i.e. a digital innovator or early adopter).*	1-2-3-4-5-6-7
	DTP3	*The digital vision of my company in what digital transformation will deliver in terms of performance benefits is always clear and transparent to me.*	1-2-3-4-5-6-7
	DTP4	*Digital technologies have improved social interaction at my company (e.g. through digital communication channels).*	1-2-3-4-5-6-7

German Version

	Code	Question	Measurement scale items
Einverständnis	Consent		Ich stimme zu Ich stimme nicht zu
Anleitung	Instruction		-
Section 2 Persönliche Angaben			
Position im Unternehmen	*Org_Role*	*Was ist Ihre Position in Ihrem Unternehmen?*	Produktionsmitarbeiter Produktionsmanager Nicht-Produktionsmanager/Manager Support Funktion Spezialist / Experte Executive / Direktor Andere
Beschäftigungs-dauer	*Tenure*	*Wie lange arbeiten Sie schon bei Ihrem aktuellen Unternehmen?*	Weniger als 1 Jahr 1-3 Jahre 4-6 Jahre 7-10 Jahre Mehr als 10 Jahre
Art von Unternehmen	*TypeCompany*	*In welcher Art von Unternehmen arbeiten Sie aktuell?*	OEM / Fahrzeugproduktion Tier 1 Lieferant Tier 2 Lieferant Tier 3 Lieferant Anderes produzierendes Unternehmen Ich bin mit nicht sicher, welcher Art mein Unternehmen zugehörig ist
Land	*Country*	*In welchem Land arbeiten Sie derzeit hauptsächlich?*	
Geschlecht	*Gender*	*Mit welchem Geschlecht identifizieren Sie sich?*	Männlich Weiblich Divers Möchte ich nicht angeben
Alter	*Age*	*Welcher Altersgruppe sind Sie zugehörig?*	19 Jahre oder jünger 20-29 Jahre 30-39 Jahre 40-49 Jahre 50-59 Jahre 60 oder über 60 Jahre
Section 3 Befähigung			
Strukturelle Befähigung	*EMP1*	*Ich bin inspiriert von dem, was wir als Unternehmen erreichen möchten.*	1-2-3-4-5-6-7
	EMP2	*Über den Tellerrand hinaus (unkonventionell) zu denken wird in meinem Unternehmen wertgeschätzt.*	1-2-3-4-5-6-7
	EMP3	*Ich habe ein Mitspracherecht bei der Definition meiner Aufgaben.*	1-2-3-4-5-6-7

	EMP4	*Mein Unternehmen verteilt Informationen nicht gleichmäßig an alle Mitarbeiterebenen.*	1-2-3-4-5-6-7
Psychologische Befähigung	*EMP5*	*Die Arbeit, die ich mache, ist mir wichtig.*	1-2-3-4-5-6-7
	EMP6	*Ich habe die nötigen Fähigkeiten, um meinen Job gut zu machen.*	1-2-3-4-5-6-7
	EMP7	*Ich kann selbst entscheiden, wie ich meine Arbeit erledigen möchte.*	1-2-3-4-5-6-7
	EMP8	*Ich habe einen großen Einfluss auf das, was in meiner Abteilung passiert.*	1-2-3-4-5-6-7
Section 4 CI Perspective			
Einstellung zur kontinuierlichen Verbesserung	*CIA1*	*Im Gegensatz zu einem statischen Ansatz streben wir eine kontinuierliche Verbesserung unserer Produkte und Prozesse an.*	1-2-3-4-5-6-7
	CIA2	*Wenn ich nicht ständig dazulerne, wird meine Leistung auf Dauer schlechter.*	1-2-3-4-5-6-7
	CIA3	*Für den Erfolg von kontinuierlichen Verbesserungsaktivitäten ist Teamwork sehr wichtig, da unterschiedliche Perspektiven in Betracht gezogen werden.*	1-2-3-4-5-6-7
	CIA4	*Ohne Engagement der Führungskräfte werden kontinuierliche Verbesserungsmaßnahmen scheitern.*	1-2-3-4-5-6-7
Normen in kontinuierlicher Verbesserung	*CIN1*	*Wir müssen unsere Prozesse kontinuierlich verbessern, um auf von Kunden gewünschte Änderungen reagieren oder die Gesetzgebung einhalten zu können.*	1-2-3-4-5-6-7
	CIN2	*Meine Kollegen erwarten von mir, dass ich mich an kontinuierlichen Verbesserungsmaßnahmen beteilige.*	1-2-3-4-5-6-7
	CIN3	*Um wettbewerbsfähig zu bleiben, müssen wir unsere Unternehmensprozesse kontinuierlich überprüfen und verbessern.*	1-2-3-4-5-6-7
Selbstwirksam-keit in kontinuierlicher Verbesserung	*CIE1*	*Ich fühle mich in der Lage, kontinuierliche Verbesserungsaktivitäten selbstständig durchzuführen.*	1-2-3-4-5-6-7
	CIE2	*Ich habe die Kompetenz, die notwendigen Verbesserungen zur Unterstützung meiner*	1-2-3-4-5-6-7

		täglichen Arbeitsroutinen umzusetzen.	
	CIE3	*Mir fallen oft neue Ideen für Verbesserungen in meinem Unternehmen ein.*	1-2-3-4-5-6-7
	CIE4	*Ich kann Herausforderungen in Projekten zur kontinuierlichen Verbesserung meistern.*	1-2-3-4-5-6-7
Section 5 CI Behaviours			
Kontinuierliche Verbesserungs-praktiken	*CIB1*	*Wir werden ermutigt, uns an Aktivitäten zur kontinuierlichen Verbesserung zu beteiligen (in Bezug auf Initiierung und Umsetzung).*	1-2-3-4-5-6-7
	CIB2	*In meinem Unternehmen nutzen wir eine Art von formalen (strukturierten) Problemfindungs- und Lösungszyklen (z.B. PDCA).*	1-2-3-4-5-6-7
	CIB3	*Wenn es zu unerwünschten Ergebnissen kommt, besteht die natürliche Reaktion von Menschen auf allen Ebenen darin, die Ursachen des Problems zu identifizieren und nicht Einzelpersonen dafür verantwortlich zu machen.*	1-2-3-4-5-6-7
	CIB4	*In meinem Unternehmen nutzen wir strategische Unternehmensziele, um Verbesserungen zu fokussieren, zu priorisieren und zu messen (z.B. mithilfe einer bestimmten Art von Kennzahlen).*	1-2-3-4-5-6-7
	CIB5	*Die Ziele für den kontinuierlichen Verbesserungsprozess werden allen Mitarbeitern kommuniziert.*	1-2-3-4-5-6-7
	CIB6	*In meinem Unternehmen sind kontinuierliche Verbesserungsaktivitäten in den täglichen Betrieb integriert; Es handelt sich nicht nur um einmalige Verbesserungsschübe.*	1-2-3-4-5-6-7
	CIB7	*Es gibt Mechanismen zur Anerkennung und Belohnung von Aktivitäten zur kontinuierlichen Verbesserung.*	1-2-3-4-5-6-7
	CIB8	*Führungskräfte des mittleren Managements stellen die notwendigen Ressourcen (z. B. Zeit, Geld, Raum, Training) für kontinuierliche Verbesserungen zur Vefügung.*	1-2-3-4-5-6-7
	CIB9	*Die Geschäftsleitung unterstützt die Weiterentwicklung des*	1-2-3-4-5-6-7

		kontinuierlichen Verbesserungssystems durch die Bereitstellung ausreichender Ressourcen (z. B. Zeit, Geld, Personal).	
	CIB10	*Wesentliche Prozesse meines Unternehmens werden regelmäßig auf die Umsetzung von Verbesserungen hin geprüft.*	1-2-3-4-5-6-7
	CIB11	*Mein Unternehmen nutzt ein formales System zur Verwaltung und Kontrolle aller Aktivitäten von kontinuierlicher Verbesserung.*	1-2-3-4-5-6-7
	CIB12	*Kontinuierliche Verbesserungsaktivitäten, insbesondere Problemlösung, werden in interdisziplinären Teams (verschiedene Abteilungen und/oder Hierarchieebenen) durchgeführt.*	1-2-3-4-5-6-7
	CIB13	*Kontinuierliche Verbesserungsaktivitäten, insbesondere Problemlösung, mit externen Akteuren (z.B. Kunden) sind an der Tagesordnung.*	1-2-3-4-5-6-7
	CIB14	*Mein Unternehmen nutzt die gewonnenen Erkenntnisse im Zusammenhang mit der kontinuierlichen Verbesserung (z.B. bewährte Verfahren, Erfolge und Misserfolge).*	1-2-3-4-5-6-7
Section 6 DT Perspective			
Einstellung zur digitalen Transformation	*DTA1*	*Menschen sind bei ihrer Arbeit viel zu abhängig von digitalen Technologien.*	1-2-3-4-5-6-7
	DTA2	*Digitale Technologien machen mich bei der Arbeit produktiver.*	1-2-3-4-5-6-7
	DTA3	*Ich gehe bedacht Risiken ein und lasse mich auf digitale Aktivitäten ein, bei denen die Gefahr besteht, dass sie nicht funktionieren.*	1-2-3-4-5-6-7
	DTA4	*Im Rahmen meiner Arbeit ergreife ich gerne die Initiative, Dinge zu reparieren oder zu verbessern, oft durch den Einsatz digitaler Technologien.*	1-2-3-4-5-6-7
Normen in der digitalen Transformation	*DTN1*	*Meine Kollegen erwarten von mir, dass ich im Rahmen meiner Arbeit digitale Technologien anwende.*	1-2-3-4-5-6-7
	DTN2	*Ich fühle mich ausgeschlossen, wenn ich nicht am*	1-2-3-4-5-6-7

		technologischen Fortschritt teilnehme.	
	DTN3	*Um wettbewerbsfähig zu sein, möchte mein Unternehmen, dass ich mich mit technologischen Fortschritten beschäftige.*	1-2-3-4-5-6-7
Selbstwirksam-keit in der digitalen Transformation	*DTE1*	*Ich kann neue High-Tech-Produkte und -Dienstleistungen meist recht schnell verstehen.*	1-2-3-4-5-6-7
	DTE2	*Ich bin mir sicher, neue digitale Technologien ohne Hilfe anderer nutzen zu können.*	1-2-3-4-5-6-7
	DTE3	*Ich bin zuversichtlich, Initiativen zur digitalen Transformation in meinem Unternehmen selbst aktiv vorantreiben zu können.*	1-2-3-4-5-6-7
Intention zur digitalen Transformation	*DTI1*	*Ich beabsichtige, die Veränderungsprozesse, die zu einem digital transformierten Unternehmen führen können, aktiv zu unterstützen.*	1-2-3-4-5-6-7
	DTI2	*Ich werde versuchen, mich aktiv an den Veränderungsprozessen zu beteiligen, die zu einem digital transformierten Unternehmen führen können.*	1-2-3-4-5-6-7
	DTI3	*Ich habe vor, proaktiv Feedback zu den Veränderungsprozessen zu geben, die zu einem digital transformierten Unternehmen führen können.*	1-2-3-4-5-6-7
Section 7 DT Behaviours			
Digital Transformations-praktiken	*DTB1*	*Ich arbeite auf die digitale Vision meines Unternehmens hin.*	1-2-3-4-5-6-7
	DTB2	*Ich kann auf digitale Daten zugreifen und diese nutzen, um fundierte Entscheidungen zu treffen.*	1-2-3-4-5-6-7
	DTB3	*Herausforderungen, die sich aus der Nutzung digitaler Technologien ergeben, gehe ich proaktiv an.*	1-2-3-4-5-6-7
	DTB4	*Ich experimentiere mit digitalen Technologien und lerne davon.*	1-2-3-4-5-6-7
	DTB5	*Ich tausche mein Wissen mit meinen Kollegen über jegliche Erkenntnisse zu digitalen Transformationsaktivitäten aus.*	1-2-3-4-5-6-7
	DTB6	*Ich entwickle kreative und zielgerichtete Ideen unter*	1-2-3-4-5-6-7

		Einbeziehung digitaler Technologien, beispielsweise rund um neue Prozesse, Produkte oder Dienstleistungen.	
	DTB7	*Ich erkenne den Wert neuer digitaler Chancen und entwickle Pläne, wie wir diese nutzen können.*	1-2-3-4-5-6-7
	DTB8	*Manager und Führungskräfte aller Hierarchieebenen unterstützen Aktivitäten zur digitalen Transformation.*	1-2-3-4-5-6-7
	DTB9	*Wir arbeiten in selbstorganisierenden (autonomen) Teams.*	1-2-3-4-5-6-7
	DTB10	*Mein Unternehmen passt seine digitale Roadmap an interne oder externe Veränderungen im Geschäftsumfeld an.*	1-2-3-4-5-6-7
Section 8 DT Performance			
Digitale Transformations-leistung	*DTP1*	*Mein Unternehmen hat durch die Einführung digitaler Technologien oder Initiativen zur digitalen Transformation Prozesse verbessert.*	1-2-3-4-5-6-7
	DTP2	*Mein Unternehmen gilt als digitaler Vorreiter (d.h. als Innovator oder frühzeitiger Anwender).*	1-2-3-4-5-6-7
	DTP3	*Die digitale Vision meines Unternehmens hinsichtlich der Leistungsvorteile, die die digitale Transformation bringen wird, ist für mich immer klar und transparent.*	1-2-3-4-5-6-7
	DTP4	*Digitale Technologien haben soziale Interaktionen in meinem Unternehmen verbessert (z.B. durch digitale Kommunikationskanäle).*	1-2-3-4-5-6-7

Hungarian Version

	Code	Question	Measurement scale items
Beleegyezés	Consent		Beleegyezek Nem egyezek bele
Útmutató	Instruction		-
Section 2 Personal information (control variables)			
Pozíció	*Org_Role*	*Milyen pozícióban dolgozik?*	Operátor Középvezető (termelési területen) Középvezető (nem termelési területen) Specialista Ügyvezető Igazgató / Igazgató Egyéb
Vállalatnál eltöltött idő	*Tenure*	*Mióta dolgozik jelenlegi munkahelyén?*	Kevesebb mint 1 éve 1-3 éve 4-6 éve 7-10 év Több mint 10 éve
Vállalat	*TypeCompany*	*Jelenleg milyen besorolású autóipari vállalatnál dolgozik?*	OEM – gépjárműgyártás TIER 1 - autóipari rendszerek és modulok TIER 2 – autóalkatrészek TIER 3 - nyers-, félnyersanyagok és alkatrészek Egyéb gyártó, termelő vállalat Nem tudok válaszolni
Ország	*Country*	*Jelenleg melyik országban dolgozik főként?*	
Nem	*Gender*	*Neme:*	Férfi Nő Egyéb Nem válaszolok
Életkor	*Age*	*Életkora:*	19 alatt 20-29 30-39 40-49 50-59 60 felett
Section 3 Empowerment			
Felhatalmazás	*EMP1*	*Engem inspirál az, amit szervezetként igyekszünk elérni.*	1-2-3-4-5-6-7
	EMP2	*Szervezetemben nagyra értékelik a megszokottól eltérő gondolkodást.*	1-2-3-4-5-6-7

	EMP3	*Van beleszólásom a munkakörömhöz tartozó felelősségi körök meghatározásába.*	1-2-3-4-5-6-7
	EMP4	*Szervezetem nem azonos mértékben informálja a munkavállalóit a különböző szinteken.*	1-2-3-4-5-6-7
	EMP5	*A munka, amit végzek fontos számomra.*	1-2-3-4-5-6-7
	EMP6	*Megvannak a képességeim ahhoz, hogy jól végezzem a munkámat.*	1-2-3-4-5-6-7
	EMP7	*Szabadon dönthetek arról, hogy hogyan végezzem a munkámat.*	1-2-3-4-5-6-7
	EMP8	*Nagymértékben befolyásolom, hogy mi történik az osztályomon.*	1-2-3-4-5-6-7
Section 4 CI Perspective			
CI Attitude	*CIA1*	*A statikus megközelítés helyett arra törekszünk, hogy folyamatosan javítsuk a termékeinket és folyamatainkat.*	1-2-3-4-5-6-7
	CIA2	*Ha nem tanulok folyamatosan, akkor a teljesítményem hosszú távon csökkenni fog.*	1-2-3-4-5-6-7
	CIA3	*A csapatmunka kulcsfontosságú a folyamatos fejlesztési tevékenységek sikerességéhez, mert különböző nézőpontok találkoznak.*	1-2-3-4-5-6-7
	CIA4	*A vezetés elkötelezettsége nélkül a folyamatos fejlesztési tevékenységek kudarcot vallanak.*	1-2-3-4-5-6-7
CI Norms	*CIN1*	*Folyamatosan fejlesztenünk kell folyamatainkat, hogy időben reagálhassunk a vevői igények változásaira vagy megfeleljünk a változó jogszabályi környezetnek.*	1-2-3-4-5-6-7
	CIN2	*Munkatársaim elvárják tőlem, hogy részt vegyek a folyamatos fejlesztési tevékenységekben.*	1-2-3-4-5-6-7
	CIN3	*Ahhoz, hogy versenyképesek maradjunk, rá vagyunk kényszerítve a folyamataink folyamatos felülvizsgálatára és optimalizálására.*	1-2-3-4-5-6-7
CI Self-Efficacy	*CIE1*	*Úgy érzem, hogy képes vagyok a folyamatos fejlesztési tevékenységek önálló végrehajtására.*	1-2-3-4-5-6-7
	CIE2	*Képes vagyok végrehajtani a szükséges fejlesztéseket, hogy megkönnyítsem, meggyorsítsam a rutinfeladataim elvégzését.*	1-2-3-4-5-6-7
	CIE3	*Új fejlesztési ötletekkel tudok előállni.*	1-2-3-4-5-6-7
	CIE4	*Le tudom küzdeni a folyamatos fejlesztéssel kapcsolatos projektek során felmerülő kihívásokat.*	1-2-3-4-5-6-7
Section 5 CI Behaviours			
Folyamatos fejlesztési gyakorlatok	*CIB1*	*Minden alkalmazottat bátorítanak, hogy vegyen részt a folyamatos fejlesztési tevékenységekben (mind a*	1-2-3-4-5-6-7

		kezdeményezés, mind a végrehajtás tekintetében).	
	CIB2	*A vállalatomnál dolgozók valamilyen formális (strukturált) problémakereső és -megoldó ciklust alkalmaznak. (pl.: PDCA)*	1-2-3-4-5-6-7
	CIB3	*Nem várt eredmények esetén, a vállalat dolgozóinak természetes reakciója a vállalat minden szintjén az, hogy azonosítják a probléma okait, és nem másokat hibáztatnak.*	1-2-3-4-5-6-7
	CIB4	*A vállalat stratégiai céljait használjuk a fejlesztések fókuszálására, rangsorolására és mérésére (pl. meghatározott mérőszámok segítségével).*	1-2-3-4-5-6-7
	CIB5	*A folyamatos fejlesztési folyamat céljait és célkitűzéseit a vállalat minden szintjén komminukálják.*	1-2-3-4-5-6-7
	CIB6	*A folyamatos fejlesztési tevékenységek beépülnek a napi működésbe; ezek nem csak alkalomszerű változtatások.*	1-2-3-4-5-6-7
	CIB7	*Léteznek mechanizmusok a folyamatos fejlesztésekkel kapcsolatos erőfeszítések elismerésére és jutalmazására.*	1-2-3-4-5-6-7
	CIB8	*A középvezetők biztosítják a folyamatos fejlesztéshez szükséges erőforrásokat (pl. idő, pénz, képzés).*	1-2-3-4-5-6-7
	CIB9	*A felsővezetők elegendő erőforrás (pl. idő, pénz, személyzet) biztosításával támogatják a folyamatos fejlesztési rendszert.*	1-2-3-4-5-6-7
	CIB10	*A vállalat összes kulcsfontosságú folyamatát rendszeresen kiértékelik a fejlesztések megvalósítása érdekében.*	1-2-3-4-5-6-7
	CIB11	*A vállalat formális rendszert használ az összes folyamatos fejlesztési tevékenység menedzselésére és ellenőrzésére.*	1-2-3-4-5-6-7
	CIB12	*A vállalatnál a problémamegoldást is magába foglaló folyamatos fejlesztési tevékenységeket interdiszciplináris csapatokban (különböző osztályok és/vagy hierarchikus szintek) végzik.*	1-2-3-4-5-6-7
	CIB13	*A problémamegoldást is magába foglaló folyamatos fejlesztési tevékenységek külső érintettekkel (pl. partnerek, vevők) mindennaposak.*	1-2-3-4-5-6-7
	CIB14	*Szervezetem konkrét mechanizmusokat alkalmaz a folyamatos fejlesztéssel kapcsolatos, a szervezeten belül összegyűjtött tanulás (pl. jó gyakorlatok, sikerek és kudarcok) hasznosítására.*	1-2-3-4-5-6-7
Section 6 DT Perspective			
DT Attitude	*DTA1*	*Az emberek a munkájuk soron túlságosan függenek a digitális technológiáktól.*	1-2-3-4-5-6-7

	DTA2	*A digitális technológiák produktívabbá tesznek a munkában.*	1-2-3-4-5-6-7
	DTA3	*Kockázatvállaló vagyok a digitális tevékenységek terén.*	1-2-3-4-5-6-7
	DTA4	*Munkám során szeretek kezdeményezni, hogy javítsak, fejlesszek dolgokat, és ezt gyakran digitális technológiák segítségével teszem.*	1-2-3-4-5-6-7
DT Norms	*DTN1*	*Munkatársaim elvárják, hogy munkám során digitális technológiákat alkalmazzak.*	1-2-3-4-5-6-7
	DTN2	*Kiközösítettnek érzem magam, ha nem veszek részt a technológiai fejlesztésekben.*	1-2-3-4-5-6-7
	DTN3	*A vállalatom a versenyképesség megtartása érdekében elvárja tőlem, hogy elfogadjam és ösztönözzem a technológiai fejlesztéseket.*	1-2-3-4-5-6-7
DT Self-Efficacy	*DTE1*	*Általában elég gyorsan megértem a csúcstechnológiás termékek és szolgáltatások működését.*	1-2-3-4-5-6-7
	DTE2	*Mások segítsége nélkül is magabiztosnak érzem magam az új digitális technológiák használatában.*	1-2-3-4-5-6-7
	DTE3	*Magabiztosnak érzem magam a digitális transzformációval kapcsolatos kezdeményezések vezetésében.*	1-2-3-4-5-6-7
DT Intention	*DTI1*	*Szándékomban áll aktívan támogatni azokat a változtatási folyamatokat, amelyek egy digitális technológiákat használó szervezethez vezethetnek.*	1-2-3-4-5-6-7
	DTI2	*Igyekszem aktívan részt venni azokban a változtatási folyamatokban, amelyek egy digitális technológiákat használó szervezethez vezethetnek.*	1-2-3-4-5-6-7
	DTI3	*Szándékomban áll proaktív visszajelzést adni azokról a változtatási folyamatokról, amelyek egy digitálisan átalakult szervezethez vezethetnek.*	1-2-3-4-5-6-7
Section 7 DT Behaviours			
Digitális átalakítási gyakorlatok	*DTB1*	*Teszek azért, hogy a vállalat digitális jövőképe megvalósuljon.*	1-2-3-4-5-6-7
	DTB2	*Hozzáférek digitális adatokhoz és felhasználom azokat, hogy megalapozott döntéseket hozzak.*	1-2-3-4-5-6-7
	DTB3	*Proaktívan kezelem a digitális technológiák használatából fakadó kihívásokat.*	1-2-3-4-5-6-7
	DTB4	*Arra ösztönöznek, hogy kísérletezzek a digitális technológiákkal és tanuljak közben.*	1-2-3-4-5-6-7
	DTB5	*Digitális technológiával kapcsolatos tudást cserélek munkatársaimmal.*	1-2-3-4-5-6-7
	DTB6	*Kreatív és céltudatos ötleteket dolgozok ki digitális technológiák*	1-2-3-4-5-6-7

		felhasználásával pl. új folyamatok, termékek vagy szolgáltatások.	
	DTB7	*Felismerem az új lehetőségben rejlő értéket, és konkrét tervekkel tudok előállni arra vonatkozóan, hogy hogyan tudjuk kihasználni ezeket.*	1-2-3-4-5-6-7
	DTB8	*A mendedzserek és vezetők a vállalati hierarchia minden szintjén támogatják a digitális átalakítási tevékenységeket.*	1-2-3-4-5-6-7
	DTB9	*Önszerveződő csapatokban dolgozunk.*	1-2-3-4-5-6-7
	DTB10	*Szervezetem az üzleti környezet belső vagy külső változásaihoz igazítja digitális ütemtervét.*	1-2-3-4-5-6-7
Section 8 DT Performance			
Digitális átalakítási teljesítmény	*DTP1*	*Vállalatom a digitális technológiák bevezetése és/vagy a digitális átalakítási kezdeményezések révén továbbfejlesztette a folyamatait.*	1-2-3-4-5-6-7
	DTP2	*Vállalatomat digitális éllovasnak (azaz újítónak vagy korai alkalmazónak) tekintik.*	1-2-3-4-5-6-7
	DTP3	*Vállalatom digitális jövőképe azzal kapcsolatban, hogy a digitális átalakulás milyen teljesítménybeli előnyökkel jár, mindig világos és átlátható számomra.*	1-2-3-4-5-6-7
	DTP4	*A digitális technológiák javították a társadalmi interakciókat a vállalatomnál. (pl. digitális kommunikációs csatornákon keresztül)*	1-2-3-4-5-6-7

Appendix B. Data analysis: Post factum allocation

As part of the questionnaire, respondents were asked to indicate their current organisational role. If none of the pre-defined roles matched their actual role or respondents did not know which answer to select, they had the option to select "other" and were then able to describe their role in a free text.
Based on these free text descriptions, we re-allocated some of the roles to "specialist" while keeping four roles in "other" as shown below.

Re-allocation to "specialist"	Production planning, Production technician, Logistics complaints management, Logistics planning, Logistics engineer, Quality management engineer, Process designer, Change management, Engineer, Operations engineer, Development engineer, Lean consultant, Mechanical system design engineer, Materials planner, Project manager, IT specialist, Sales, Purchasing, Production maintenance engineer, Process engineer
Keep as "other"	Employee, Administration, Intern, Working student

The same logic applied to the question collecting the type of company. Using codes according to the Standard Industrial Classification (SIC), we categorised the type of company by dividing them into different industries. The initial type of company description is also based on the answer provided in a free text.

Table 13. Type of company classifications

Industry	**Description**
Electronics	26110 Manufacture of electronic components
	26120 Manufacture of loaded electronic boards (Microelectronics)
Metals	25110 Manufacture of metal structures and parts of structures (Metallic plating)
	25910 Manufacture of steel drums and similar containers (Rolling mill)
	25990 Manufacture of other fabricated metal products n.e.c. (fabrication)

Industry	Description
	25290 Manufacture of other tanks, reservoirs and containers of metal (metal storage products)
Information systems	26309 Manufacture of communication equipment other than telegraph, and telephone apparatus and equipment (Information technologies, Information systems)
	26411 Manufacture of electronic measuring, testing etc. equipment, not for industrial process control (Test benches, measurement technology, software for optimisation and simulation)
Pharmaceuticals	21100 Manufacture of basic pharmaceutical products (Pharmaceuticals, Medicine / Supplements)
Packaging	28990 Manufacture of other special-purpose machinery n.e.c. (Packaging machinery, Eco-friendly packaging and machinery, Baling machine)
	17219 Manufacture of other paper and paperboard containers (Cardboard boxes)
	17120 Manufacture of paper and paperboard (Paper)
Energy and Water	23610 Manufacture of concrete products for construction purposes (Thermal insulation material)
	25210 Manufacture of central heating radiators and boilers (Boiler, Heating systems)
	28120 Manufacture of fluid power equipment (Water technologies, Hydraulic and pneumatic equipment)
Lighting and sensors	27400 Manufacture of electric lighting equipment (Emergency lighting components)
	29310 Manufacture of electrical and electronic equipment for motor vehicles and their engines (Sensors)
Ship building	30110 Building of ships and floating structures (Boats)
Other manufacturing	20412 Manufacture of cleaning and polishing preparations (Polishing compounds)
	10720 Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes (Frozen bakery products)

Appendix C. Sample demographics

Table 14. Sample demographics

Control variable	Items	No. respondents	Sample (%)
Organisational Role	Operator	15	5%
	Production manager	26	8.7%
	Non-production manager / Manager support function	80	26.7%
	Specialist / Expert	129	43%
	Executive / Director	41	13.7%
	Other	9	3%
Tenure	Less than 1 year	18	6%
	1-3 years	57	19%
	4-6 years	60	20%
	7-10 years	41	13.7%
	over 10 years	124	41.3%
Company type	OEM / Vehicle production	106	35.3%
	Tier 1 supplier	22	7.3%
	Tier 2 supplier	38	12.7%
	Tier 3 supplier	16	5.3%
	Other manufacturing company	118	39.3%
Country (→Continent)	Europe	216	72%
	Asia	77	25.7%
	Americas	7	2.3%
Gender	Male	229	76.3%
	Female	70	23.3%
	Non-binary / third gender	1	0.3%
	Prefer not to say	-	-
Age	19 years or below	-	-
	20-29 years	53	17.7%
	30-39 years	101	33.7%
	40-49 years	94	31.3%
	50-59 years	44	14.7%
	60 years or above	8	2.7%
Research sample (n=300)			

Appendix D. Participant Information Sheet

Research Study: Understanding the relationship of continuous improvement and digital transformation readiness

Carried out by

Mrs Lucia Szűcs-Luipold
PhD Researcher, Norwich Business School,
University of East Anglia

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PARTICIPANT INFORMATION SHEET

(1) What is this study about?
You are invited to take part in a research study about continuous improvement and digital transformation readiness. You are invited to participate because you are working in a manufacturing company that is either pursuing or has established continuous improvement and digital transformation initiatives, and you or your work is affected by it. The study aims to capture your opinions and experiences as a reference for understanding the business dynamics that manufacturing companies currently face. This Participant Information Sheet tells you about the research study. Knowing what is involved will help you decide if you want to take part in the study. Please read this sheet carefully and ask questions about anything that you don't understand or want to know more about.

Participation in this research study is voluntary. By giving consent to take part in this study you are telling us that you:

- ✓ Understand what you have read.
- ✓ Agree to take part in the research study as outlined below.
- ✓ Agree to the use of your personal information as described.
- ✓ You have downloaded a copy of this Participant Information Sheet to keep.

(2) Who is running the study?
The study is being carried out by the following researcher(s): Ms Lucia Olszewski.This will take place under the supervision of Dr Arijit Bhattacharya (A.Bhattacharya@uea.ac.uk, +441603597520). and Dr Tomás Harrington (tomas.harrington@uea.ac.uk).

In this study, no financial benefits are involved. The study is not funded nor does it hand out financial benefits to individual persons.

(3) What will the study involve for me?
The questionnaire is distributed online which requires access to the internet. It can be filled out at any location at any time, but not more than once.
You will be asked to rank statements to the best of your knowledge and ability. Every effort was made to include only relevant questions that are required for this research.
The last section gives you the opportunity to make additional comments.
It is also possible to jump back and forth between questions, but only in between sections.

The questionnaire relies on your full contribution, hence it is only possible to submit the questionnaire when entirely filled out.
You will not have the opportunity to review information generated about you prior to publication as data is anonymised.

(4) How much of my time will the study take?
Completing the questionnaire will take around 15 minutes.

(5) Do I have to be in the study? Can I withdraw from the study once I have started?
Being in this study is completely voluntary and you do not have to take part.
Your decision whether to participate will not affect your current or future relationship with the researchers or anyone else at the University of East Anglia (or anyone else in your company) now or in the future.

If you decide to take part in the study, you can withdraw your consent up to the point that your data is fully anonymised. You can do this by contacting the researcher in the process of submitting the questionnaire stating that you would like to withdraw your consent or by exiting the questionnaire without submission.

(6) What are the consequences if I withdraw from the study?
If you decide to take part in the study and then change your mind, you are free to withdraw at any time before you have submitted the questionnaire. Once you have submitted it, your responses cannot be withdrawn because they are anonymous and therefore we will not be able to tell which one is yours.

(7) Are there any risks or costs associated with being in the study?
Aside from giving up your time, we do not expect that there will be any risks or costs associated with taking part in this study.

(8) Are there any benefits associated with being in the study?
With your participation, you are contributing to the advancement of science.
The results of this study will benefit manufacturing organisations in their attempt to develop digital transformation capabilities. The study highlights the importance of human factors in their digital transformation journey which will allow them to find better approaches to hiring, developing and retaining employees.

(9) What will happen to information provided by me and data collected during the study?
When we use personal information, we are required to take appropriate technical and organisational measures to protect that information from accidental or unlawful destruction, loss, alteration, unauthorised disclosure or access. Our obligations extend from the point we collect the information up to, and including, the time of its destruction.

Your personal data and information will only be used as outlined in this Participant Information Sheet, unless you consent otherwise. Data management will follow the Data Protection Act 2018 (DPA 2018) and UK General Data Protection Regulation (UK GDPR), and the University of East Anglia's Research Data Management Policy.

The information you provide will be stored securely and your identity will be kept strictly confidential, except as required by law. Study findings may be published, but you will not be identified in these publications if you decide to participate in this study.
Study data may also be deposited with a repository to allow it to be made available for scholarly and educational purposes. The data will be kept for at least 10 years beyond the last date the data were accessed. The deposited data will not include your name or any identifiable information about you.

(10) What if I would like further information about the study?
When you have read this information, Ms Lucia Olszewski (l.olszewski@uea.ac.uk, +4366478002188) will be available to discuss it with you further and answer any questions you may have.

(11) Will I be told the results of the study?
You have a right to receive feedback about the overall results of this study. You can receive feedback by emailing the researcher, l.luipold@uea.ac.uk This feedback will be in the form of a file that contains a summary of the study results. This feedback will be given at the end of the study. You will not have the opportunity to review information generated about you prior to publication.

(12) What if I have a complaint or any concerns about the study?
If there is a problem please let the researcher know. You can contact her via the University of East Anglia at the following address:

Mrs Lucia Szűcs-Luipold
Norwich Business School
University of East Anglia
NORWICH NR4 7TJ
l.luipold@uea.ac.uk
+4366478002188

If you are concerned about the way this study is being conducted or you wish to make a complaint to someone independent from the study, please contact the Head of Norwich Business School: Prof Olga Tregaskis (O.Tregaskis@uea.ac.uk,).

(13) How do I know that this study has been approved to take place?
To protect your safety, rights, wellbeing and dignity, all research in the University of East Anglia is reviewed by a Research Ethics Body. This research was approved by the NBS S-REC (Norwich Business School Research Ethics Subcommittee).

(14) What is the general data protection information I need to be informed about?
According to data protection legislation, we are required to inform you that the legal basis for processing your data as listed in Article 6(1) of the UK GDPR is because this allows us to process personal data when it is necessary to perform our public tasks as a University.

In addition to the specific information provided above about why your personal data is required and how it will be used, there is also some general information which needs to be provided for you:

- The data controller is the University of East Anglia.
- For further information, you can contact the University's Data Protection Officer at dataprotection@uea.ac.uk
- You can also find out more about your data protection rights at the Information Commissioner's Office (ICO).

If you are unhappy with how your personal data has been used, please contact the University's Data Protection Officer at dataprotection@uea.ac.ukin the first instance.

(16) Further information
This information was last updated on 3 August 2023.

If there are changes to the information provided, you will be notified by the researcher prior to undertaking the questionnaire.

This information sheet is for you to keep