



**Navigating Digital Transformation:
Examining Chief Digital Officer skills in
German small – and medium sized
enterprises (SMEs)**

MASTER THESIS

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Abstract

This master thesis examines the critical skills of Chief Digital Officers (CDOs) in driving digital transformation within small and medium-sized enterprises (SMEs) in Germany. With digital technologies reshaping industries, SMEs face unique challenges in implementing these transformations, often lagging behind larger corporations. This research identifies and analyzes essential CDO-related skills that SME leaders must adopt to successfully navigate the digital landscape. Through a comprehensive literature review and quantitative survey, this study proposes a framework that highlights the pivotal role of digital strategic vision, leadership orientation, innovative thinking, tech savviness, and networking in enhancing the digital maturity of SMEs. The findings offer valuable insights for SME leaders aiming to steer their organizations toward sustainable digital growth.

Keywords: *Chief Digital Officer (CDO), Digital transformation, German SMEs (Small and Medium-sized Enterprises), Digital maturity, Leadership skills*

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1 Introduction

1.1 Digital Transformation in German SMEs – the current state

In the past ten years, digital technologies have significantly enhanced productivity and enabled new business models in a broad range of Germany industry. Various sectors have made considerable progress by developing new processes, products, entering new markets, and establishing new partnerships (Federal Ministry for Economic Affairs and Energy, 2016). This transformative process, also known as ‘Digital Transformation’, involves using digital technologies to change the core business model of a company. Several factors contribute to the development of the digital transformation concept. Increasing competition forces companies to improve their ability to innovate, become more efficient, and reduce the time it takes to bring products to market. As a result, these companies are investing in modern digital technologies (Horváth & Szabó, 2019). The evolving customer preferences, shorter product lifecycles, and increasingly diverse markets create the need for change, resulting in significant alterations to existing business models and the creation of new ways to generate value (Horváth & Szabó, 2019). The influence of digital transformation extends to all businesses, and its outcomes may not consistently favor well-established organizations. Established companies may encounter difficulties in adjusting to this shift, as demonstrated by BSP Business School Berlin (2017). According to BSP Business School (2017), businesses widely acknowledge the importance of digital transformation. Nevertheless, many companies tend to neglect the implementation of essential measures (BSP Business School Berlin, 2017).

In Germany, small and medium-sized enterprises (SMEs) in particular, struggle to execute digital transformation initiatives, falling behind larger organizations. This concerning trend cannot be overlooked, considering the significant importance of Germany's SME sector to the overall economy of the country. German SMEs make up 99.6% of private sector companies in Germany. They are regionally focused, with medium-sized enterprises generating 35.3% of Germany's total turnover and employing almost 60% of the country's workers. Many German medium-sized companies lead niche markets worldwide and are successful exporters (BDI, 2015). A study by Daheim et al. (2017) highlights that the digital transformation of small and medium-sized businesses is happening, but at a rather slow pace. Although companies have caught up with large corporations since 2015, there is still much work to be done (Daheim et al., 2017). As reported by Daheim et al. (2017) there are still companies that do not place a high priority on digital transformation, with 20% of them considering it unimportant. This is underlined by the fact that expenditure on DT – related projects in the SME sector remains low, with only EUR 15 billion spent in 2017 compared to EUR 169 billion invested in machinery, buildings, equipment, and similar items (KfW Research, 2019). Daheim et al. (2017) suggest that progress in digital transformation encounters challenges due to limited dedication from managers and leaders and a dated industry perspective. This makes catching up increasingly difficult with each passing moment. For digital transformation to succeed, Daheim et al. (2017) state that senior management must take responsibility with a well-designed strategy. It is insufficient to rely on individual initiatives. To achieve a comprehensive transformation, the

company requires digitally competent leaders who can position the entire business towards a digital future using a comprehensive strategy.

Additional research shows that German small and medium-sized enterprises experience digital transformation as more challenging compared to larger firms (Haxhani & Khasarro, 2021). They argue that small and medium-sized enterprises (SMEs) encounter obstacles in achieving digital transformation due to a lack of essential resources and knowledge, including an understanding of necessary competencies and how to structure the transformation process. These results are consistent with the findings presented by Slimane et al. (2022). They point out that small and medium-sized enterprises (SMEs) may struggle to cope with the disruptive effects of digital technologies due to their limited resources. SMEs must tackle these obstacles to keep pace with the fast-changing digital environment and maintain their competitiveness (Slimane et al., 2022).

We've provided a brief introduction to the ongoing situation of digital transformation within German SMEs. The integration and exploitation of new digital technologies will likely disrupt existing business models. However, transitioning successfully to digital methods poses significant challenges, as highlighted by various studies. German small and medium sized enterprises often struggle to effectively navigate this terrain. While it is widely accepted that innovation and constant renewal can drive firm performance and growth, there is still ongoing discussion on the specific competencies that firms and its leaders need to address to innovate effectively in the face of technological change (Soluk & Kammerlander, 2021). German SMEs will require managers and leaders to develop unique skill sets and mindsets, unlike those required for previous transformative technologies in order to overcome these challenges (Becker et al., 2018). In the following section, we delve into the significance of the Chief Digital Officer as a catalyst for the digital transformation journey, illustrating how this role can assist SME leaders and managers in overcoming their digital transformation hurdles.

1.2 CDO's role in modern management – challenges and complexities

Digital technologies have already brought significant changes in various industries, enhancing productivity, and initiating novel business approaches. However, the successful transition to digital methods is not straightforward, as highlighted by several research studies. German companies, although recognizing the significance of digital transformation, frequently encounter difficulties in effectively navigating this landscape. This difficulty originates from a lack of essential expertise, theoretical understanding, and a clear roadmap for guiding them in this transformative journey. It becomes evident that the challenges associated with digital transformation (DT) requires a leader with strategic, innovative, and change management skills that go beyond those of a traditional leader (Berbel-Vera et al., 2022). To remain competitive in the emerging digital economy, leaders must proactively guide their organizations through this ever-changing landscape (Ngayo Fotso, 2021). It requires a shift in leadership competencies. Leadership qualities that sufficed in past industrial phases are no longer adequate to navigate the complexities of today's world (Ngayo Fotso, 2021). Leaders must now be equipped with skills that align with this new reality to ensure the continued resilience of their organizations (Ngayo Fotso, 2021). Nevertheless, there remains a lack of consensus among researchers regarding the identification of competencies that SME leaders and managers should strengthen

to address the disruptive impacts of digital innovation (Slimane et al., 2022). The challenge lies in determining a set of skills that leaders in SME's will need to embrace to overcome DT challenges and to foster the success of DT projects within their organizations.

The role of Chief Digital Officer (CDO) has been established specifically to address the challenges of transforming a company's business model digitally. In Germany, the role of the CDO has become increasingly important as they navigate the challenges of digital transformation (Becker et al., 2018). This is in line with Moker (2020) who states that the Chief Digital Officer (CDO) can have a significant impact on assisting organizations to overcome the obstacles of digital transformation and remain competitive in today's business environment. Basically, the CDO is responsible for developing and communicating a comprehensive digital strategy supporting organizations to remain competitive in a rapidly evolving business landscape (Thomas, 2020). The CDO promotes digital initiatives and leads the required transformation efforts across the entire organizations. Firk et al. (2021) describes the CDO as the person who takes charge of the company's digital transformation by creating and implementing a digital strategy for the entire organization, working with leadership teams across the business, and forming partnerships with external parties. The role of the CDO encompasses a distinct set of skills required for leading digital transformation efforts. Singh et al. (2020) discuss some of these skills, such as IT proficiency for developing digital products and services, business acumen for strategy and change management, effective communication throughout the organization, and visionary thinking to envision the digital future of the organization. Still, there are some unique challenges that are presented by the role of the CDO and its departure from traditional leadership positions, as noted by Berbel-Vera et al. (2022). This is in line with Thomas (2020) who notes that establishing the role of the Chief Digital Officer is one of the primary difficulties for small and medium-sized enterprises.

In the last 5 years, researchers have raised questions about whether adding a management layer, such as the CDO, will help or hinder organizations in achieving their digital objectives. There is still a lack of understanding about how exactly the CDO can assist SMEs in overcoming their digital challenges, and the role itself remains somewhat ambiguous. Despite numerous advantages associated with this role, there are some disadvantages that need consideration too. Small and medium-sized enterprises (SMEs), which have fewer resources compared to large companies, find it particularly challenging to defend the associated costs and to attract the right people for the role of CDO. Consequently, questions can be raised whether or whether not German SMEs should consider the role of CDO. By outlining the challenges and importance of the CDO role, we can now investigate whether this position is essential for German SMEs, as explored in the following subsection.

1.2.1 Relevance of the Chief Digital Officer – are CDOs essential for German SMEs?

As explained in the previous section, the role of a Chief Digital Officer in SMEs has been a subject of debate. While some argue that a dedicated CDO is essential for digital transformation, several researchers propose alternative perspectives. In this chapter, we explain the complexities of digital transformation and present arguments suggesting that SMEs may not necessarily require a dedicated CDO. Instead, alternative approaches that distribute responsibilities among managers and leverage existing leadership structures are explored.

Digital transformation (DT) encompasses a diverse range of complex, cross-functional, and interdependent tasks, and activities. Berbel-Vera et al. (2022) argue that relying solely on one person to manage all these complexities may not be sufficient. To ensure a successful digital transformation, managerial responsibilities need to be appropriately assigned and spread across multiple managers, enabling comprehensive coverage of different aspects of the transformation process. Berbel-Vera et al. (2022) argue that leaders must develop strong dynamic competencies that allow them to rapidly create, implement, and transform business models. These include skills, processes, structures, decision rules, and disciplines. They further emphasize that these requirements are not exclusive to the role of a CDO. Rather, they can be distributed among managers who possess the necessary skills to motivate and promote digital sensing, seizing opportunities, and transforming capabilities (Berbel-Vera et al., 2022), which is in great line with findings presented by Scuotto et al. (2022). They argue that the presence or absence of a CDO is not the main concern for companies; instead, the focus should be on how to exploit the skills of a CDO to gain a competitive advantage (Scuotto et al., 2022). The key role of a CDO lies in offering innovative solutions, seizing business opportunities, and adapting to changes by utilizing appropriate digital technologies. SMEs can leverage the expertise and adaptability of existing managers to fulfill these roles effectively (Scuotto et al., 2022).

Building on this, research by Zoppelletto et al. (2023) and Lorentzen (2021) sheds light on the role of distributed leadership within SMEs' top management teams during digital transformation. In SMEs, digital transformation is often managed collectively by the top management team, allowing for a holistic approach that mobilizes and sustains digital transformation efforts. This approach capitalizes on the diverse experiences and expertise of team members, reducing the need for a dedicated CDO role. This argumentation is used by Deloitte MCS Limited (2018) as well. They suggest that existing business executives, such as CEOs or business unit leaders, can spearhead the digital transition. This approach allows for a seamless integration of digital and traditional aspects within the organization, capitalizing on the leader's digital leadership traits (Deloitte MCS Limited, 2018).

We might question how traditional leaders can effectively transition to these new skills. One approach is to adopt change management practices. As highlighted by Miler (2002) adapting becomes crucial for effective leadership in today's digital landscape. Leaders not only need to embrace change themselves but also actively champion it, treating it as a personal mission. This requires embracing suitable change management practices and gaining a profound understanding of change dynamics.

The concept of change management, as highlighted by Bellantuono et al. (2021) provides leaders with a structured framework to navigate smooth transitions. Kurt Lewin's influential Change Management Model emphasizes the importance of guiding change, unfreezing current behaviors, and then reshaping the organization into a new equilibrium. To overcome inherent resistance and foster acceptance of new behaviors and attitudes, this model underscores the leader's role in providing knowledge, motivation, and stability throughout the change journey. In summary, thriving in today's digital environment requires leaders to embrace adaptability, utilize change management concepts, and embody critical traits. By adopting change management practices, leaders can effectively acquire CDO-related digital skills, empowering them to drive successful digital transformation within the organization.

An alternative perspective suggests that small and medium enterprises (SMEs) may not require a Chief Digital Officer (CDO) due to the limited requirements for coordination. Slimane et al. (2022) argue that SMEs may not require a CDO due to their low coordination needs. The organizational structure of SMEs facilitates communication, information diffusion, and internal coordination, allowing them to respond to change through flexibility and adaptation. Singh et al. (2020) suggest that coordination complexity is greater in larger companies or those with decentralized structures, indicating a reduced need for a CDO in SMEs (see figure 1). Furthermore, it can be questioned whether small and medium-sized enterprises should consider outsourcing their digital transformation process. Haxhani & Khasrro (2021) argue that while involving external parties, such as IT consultants, can address expertise gaps, financial constraints often limit this option. Additionally, relying heavily on external consultants may pose challenges if their guidance is based on generic guidelines rather (Haxhani & Khasrro, 2021).

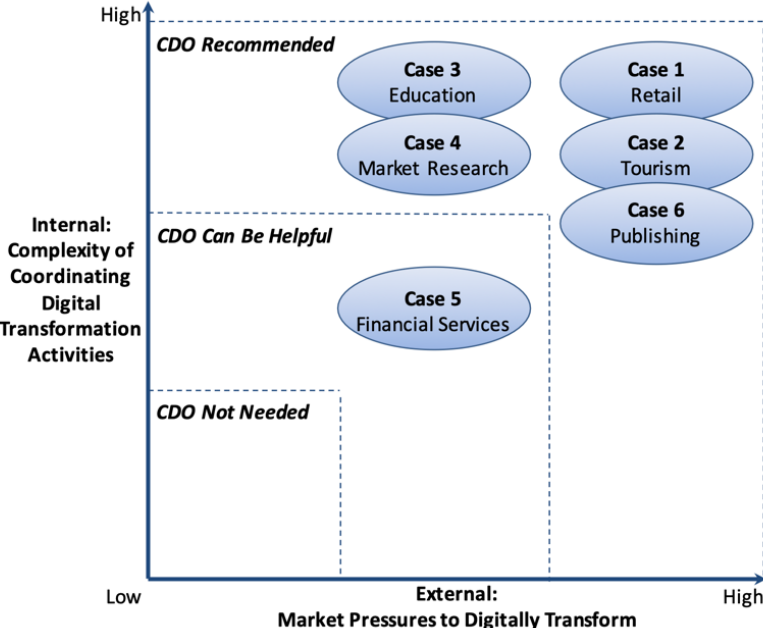


Figure 1 (Slimane et al., 2022)

We conclude that in the context of small and medium enterprises, the need for a Chief Digital Officer is not universally applicable, it is not a one-size-fits-all solution. SMEs should assess their unique circumstances and consider alternative approaches such as distributing responsibilities among different leaders. Nonetheless, examining the skills of a Chief Digital Officer (CDO) remains highly relevant, as the CDO's expertise can guide managers and leaders in identifying digital proficiencies tailored for the digital transformation journey of SMEs. The role and profile of the CDO can serve as a blueprint for SME leaders striving to lead digitally. The CDO embodies digital skills crucial for the success of digital transformation in

organizations. This exploration of the CDO's relevance provides the foundation for framing our research question, which we address in the next subsection.

1.3 Research Question

Given the current challenges faced by German SMEs in navigating digital transformation, as outlined in section 1.1, it becomes evident that leadership plays a critical role in overcoming these hurdles. As explored in section 1.2, the role of the Chief Digital Officer has emerged as a potential solution for guiding organizations through this complex shift. However, despite the growing relevance of the CDO in modern management, there remains uncertainty about the specific skills required for effective digital leadership in SMEs. The existing challenges and complexities surrounding the digital transformation of German SMEs have prompted the formulation of the following research question:

"Which CDO-related skills are essential for leaders in German small and medium-sized enterprises to adopt in order to effectively drive digital transformation initiatives within their organizations?"

In this research study, we identified and analyzed the specific set of CDO-related skills that leaders within German Small and Medium-sized Enterprises (SMEs) can choose to incorporate into their professional skill sets. Essentially, we examined if there's a relation between SME leaders' acquisition of CDO-related digital skills (whether they have relevant CDO-digital skills or not) and the organization's level of digital transformation maturity. By exploring the adoption of these skills, we tried to contribute to a better understanding of the strategies and competencies that empower leaders to navigate and succeed in the ever-evolving landscape of digital transformation, particularly within the unique context of German SMEs. Having introduced the research question, the following subsections address its academic and practical relevance to the broader field of digital leadership.

1.4 Academic Relevance

This research paper holds significant academic relevance as it addressed the management challenges faced by small and medium enterprises (SMEs) in Germany in their digital transformation efforts. The pace of digital transformation in SMEs has been relatively slow compared to larger corporations, despite some progress made since 2015 (Daheim et al., 2017). The study conducted by Daheim et al. (2017) reveals that a significant number of companies still do not prioritize DT, with 20% considering it unimportant. This lack of commitment from management has been identified as a hindrance to successful digital transformation (Daheim et al., 2017). Additionally, Haxhani & Khasrro (2021) highlight the unique challenges that German SMEs face in achieving digital transformation due to limited resources, knowledge gaps, and difficulties in structuring the transformation process.

There is a need to identify the skills that digital leaders in SMEs must embrace to overcome digital transformation challenges and ensure project success within their organizations. This paper acknowledged the need for leaders in SMEs to develop unfamiliar skills to adapt to digital transformation and emphasizes the lack of theoretical and empirical knowledge in this area

(Soluk & Kammerlander, 2021). Therefore, we reflected on the role of the CDO as it precisely embodies the optimal characteristics of a digital leader. While digital leadership competencies can be broad and generic, the skills linked to the CDO profile align seamlessly with the dynamics of digital transformation. Given the focus of our research on the digital transformation process, the CDO's profile emerges as significantly more relevant than generic digital leadership competencies.

The literature review conducted for this research has identified five skills of the CDO in SMEs, which were used to develop a framework for managers and leaders in German SMEs to drive digital transformation. This framework provides valuable guidance on leveraging CDO-related skills within the management team of SMEs. Analyzing a set of key Chief Digital Officer (CDO)-related skills is important for a comprehensive understanding of their impact on digital transformation efforts. Relying on a single competency is not sufficient, as digital transformation requires a holistic approach. Small and medium-sized enterprises (SMEs) cannot expect one person to possess all necessary skills. By studying a range of core competencies, we identified the collective skills and knowledge required for effective digital transformation leadership in German SMEs. Breaking down these allows the management team to allocate responsibilities based on individual strengths, fostering collaboration, and enhancing digital transformation initiatives. Focusing on a single competency would overlook the practical contributions of a diverse management team. Therefore, it is vital to provide practical insights for successful digital transformation in German SMEs.

In summary, this research deepens the theoretical understanding by addressing the gap in literature regarding the role of the Chief Digital Officer (CDO) in SMEs during digital transformation. By identifying key CDO-related skills and emphasizing the importance of a holistic approach to digital leadership, this study enriches the academic discussion on digital transformation in SMEs. It provides a theoretical framework that enhances our understanding of how digital leadership, through a range of specific skills, can support the digital transformation process within these organizations.

1.5 Practical Relevance

This master thesis holds significant practical relevance for German small and medium enterprises (SMEs) undergoing digital transformation. The increasing market demand for digital products and services has created time pressures and intensified competition (Firk et al., 2021). Many companies face the challenge of accelerating their digital transformation efforts (Firk et al., 2021). One approach to expedite this process is by appointing a Chief Digital Officer (CDO) to establish and enforce digital rules within the organization. However, concerns persist regarding the role of the CDO in SMEs (Firk et al., 2021). The findings of this study provide valuable insights and practical guidance to CEOs, leaders, and top management teams (TMTs) of SMEs in Germany. By understanding the digital skills, they need to develop, they can effectively foster digital transformation within their organizations. This research paper bridges the gap between theory and practice by offering tangible recommendations for SMEs seeking to enhance their digital transformation efforts.

By embracing the key CDO-related digital skills identified in this study, SME leaders can adapt to the evolving digital landscape, seize opportunities, and remain competitive in the market. The practical insights provided by this research paper enable SMEs to align their digital strategies with their overall business goals, ensuring a successful and impactful digital transformation journey. The practical insights presented here lead into the next chapter, where we review existing literature on CDO skills and digital transformation theories.

2 Literature Review – Theories

Chapter 2 presents the findings of our literature review, conducted to provide a theoretical foundation for answering the research question. The review critically assesses existing studies on digital transformation and leadership. Next, we focus on the skills of Chief Digital Officers. By examining these skills through established frameworks, we highlighted how CDOs drive digital transformation and aligned these insights with our research question.

2.1 Competencies & Skills

In this section, we define key terms such as competencies and skills, setting the stage for a deeper exploration of CDO-related skills in the context of digital leadership. Competencies, in a general sense, include a diverse range of attributes, skills, knowledge, and personal characteristics that are essential for both individual task performance and the overall success of organizations (Oberländer et al., 2020). These competencies can be further broken down into specific components, with "skills" being an important subpart of competencies. This section provides definitions, characteristics, and classifications of skills, focusing on both hard and soft skills, within the broader context of competencies in management.

Competencies - In the broader context, competencies include a diverse range of attributes, skills, knowledge, and personal characteristics that are essential for both individual task performance and the overall success of organizations. These competencies are complex and multifaceted, including knowledge, skills, abilities, and individual attributes. These elements are critical for effectively executing job responsibilities, particularly in the dynamic digital landscape (Oberländer et al., 2020). The term 'digital competencies' has been formulated to underscore their significance in the context of workplace information and communication technologies (ICT) and digital media. This term encompasses a broad range of attributes, including knowledge, skills, abilities, and personal characteristics, necessary for thriving in the digital era (Oberländer et al., 2020). This research paper will specifically emphasize the complex dynamics of skills, as a subpart of competencies, within the context of management and the evolving digital landscape.

Skills - Skills, as components of competencies, play a crucial role in various domains, particularly in the workplace. They empower individuals to excel in their roles and make substantial contributions to their organization's success (Hendarman & Cantner, 2018). We define skills as specific abilities, knowledge, or expertise that individuals possess, enabling them to effectively execute tasks, activities, or functions. These competencies are refined through training, education, practice, and experience, making them a fundamental element of

an individual's practical and applied knowledge (Hendarman & Cantner, 2018). Skills can be broadly categorized into two main types: technical or hard skills, and soft skills. These are not only instrumental in the workplace but also serve as markers of an individual's competence and adaptability in their chosen field (Hendarman & Cantner, 2018). Hard skills, as the term suggests, include those competencies that are linked to the technical aspects of specific job requirements. These skills are often rooted in the acquisition of knowledge and are primarily cognitive in nature. For instance, they might involve proficiency in using equipment, tools, or software related to a particular job. Hard skills are most pertinent for first-level managers (Lamri & Lubart, 2023). Hard skills are multifaceted and can include both technical skills specific to a certain field or technology and more broadly applicable thinking and creativity skills, such as critical thinking, imagination, and curiosity. These are essential for problem-solving and innovation, where technical expertise must be complemented by creative thinking (Lamri & Lubart, 2023). Soft skills, conversely, encompass the interpersonal, behavioral, and human skills that facilitate effective interaction and collaboration. These skills revolve around attributes such as communication, teamwork, leadership, and emotional intelligence (Hendarman & Cantner, 2018). In the context of project management, for instance, interpersonal skills are integral and include traits such as leadership, communication, negotiation, and problem-solving. In addition, within the realm of innovation, leadership skills play a crucial role. Innovation leadership involves guiding and developing trust and relationships among team members to influence or provide direction regarding innovative activities in the workplace (Lamri & Lubart, 2023). As this research considers the broader impact of skills in both individual and organizational performance, Robert Katz's framework provides a useful model for understanding the specific competencies required for managers.

Katz and Kahn's Skills Framework - Robert Katz's skills framework is a prominent model for categorizing competencies in management (see figure 2). It identifies three primary types of skills that are fundamental to successful management processes:

1. **Technical Skills:** Technical skills provide managers with the knowledge and ability to use various techniques to achieve specific objectives. These skills are significant for first-level managers and encompass both machinery-related skills and proficiency in tasks like sales, product design, or marketing (PFH Private Hochschule Göttingen, n.d.)
2. **Human or Interpersonal Management Skills:** These skills enable managers to work effectively with people, which is a fundamental aspect of management. Human or interpersonal skills are essential for all hierarchical levels within an organization, as they empower managers to lead, motivate, and harness the potential of their workforce (PFH Private Hochschule Göttingen, n.d.)

3. **Conceptual Skills:** Conceptual skills allow managers to think abstractly, analyze different states, and predict the future of a business or department as a whole. These skills are of utmost importance for top-level managers and decision-makers as they require a broader, more strategic perspective (PFH Private Hochschule Göttingen, n.d.)

In this research, this framework has been applied to classify diverse CDO-related skills. We were striving to explore a comprehensive range of digital skills that cover all aspects of this framework.

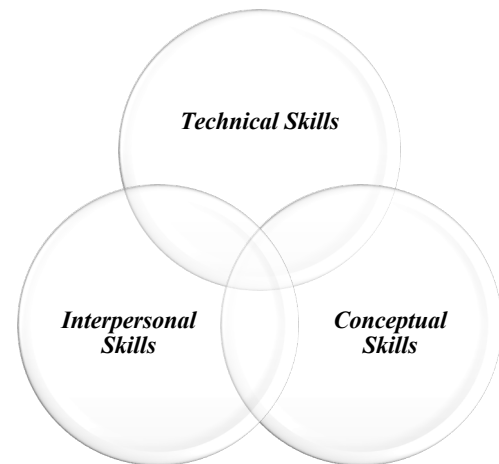


Figure 2 Katz & Kahn Leadership Skills

In summary, competencies are complex constructs comprising a broad range of attributes, skills, knowledge, and personal characteristics. They are crucial for both individual job performance and the success of organizations. Skills are integral components of competencies and play a fundamental role in management and various professional domains. They can be categorized as hard or soft, each offering a distinct set of attributes and abilities. The study of competencies, particularly in the context of Chief Digital Officers (CDOs), provides valuable insights into the diverse skills and knowledge required to lead in the ever-evolving digital landscape. This understanding is instrumental in guiding organizations through digital transformation successfully (Hendarman & Cantner, 2018; Oberländer et al., 2020; Singh Chouhan & Srivastava, 2014). With a clear understanding of competencies and skills, we now move on to the broader concept of digital transformation and its implications for SMEs. In the next section, we explain the concept of digital transformation, focusing on how it applies to small and medium-sized enterprises (SMEs).

2.2 Digital Transformation

In today's rapidly changing business landscape, companies are facing increasing competition and the need to enhance their innovation capabilities, efficiency, and time-to-market while meeting evolving customer preferences and diverse markets (Horváth & Szabó, 2019). This has given rise to the concepts of digitization, digitalization, and digital transformation. While these terms are often used interchangeably, they represent distinct aspects of leveraging digital technologies within an organization. In this chapter, we provide definitions for each concept and explore their unique characteristics and implications. It is important to acknowledge that there is no single, universally accepted definition for these concepts. The literature surrounding digital transformation is diverse, with researchers offering different viewpoints. Some scholars focus on the technological aspects, while others emphasize organizational change or business model innovation. As a result, the interpretations of digital transformation can vary depending on the context, industry, or specific focus of the research.

We recognize this ongoing debate and acknowledge that the definitions and perspectives we present reflect a specific viewpoint.

Digitization refers to the process of converting analog information or resources into digital format, making them accessible and manipulable by computers and digital systems (Horváth & Szabó, 2019). It involves the conversion of physical or analog data, such as documents, images, or sound recordings, into digital representations, typically represented by binary code. Digitization enables the storage, processing, and transmission of data using digital devices and networks. For businesses, digitization entails transforming physical assets, processes, and records into digital counterparts. This enables organizations to streamline operations, improve efficiency, and enhance accessibility to information (Wrobel et al., 2019). Digitization allows for easy searchability, sharing, and analysis of digital data, eliminating the constraints associated with physical or paper-based documents.

Digitalization goes beyond the technical process of digitization and encompasses a broader transformational journey that integrates digital technologies across various aspects of an organization (Horváth & Szabó, 2019). It involves leveraging digital infrastructure and technologies to drive changes in business models, processes, and the overall value chain (Scuotto et al., 2022). Digitalization is driven by the rapid pace of technological advancements and their disruptive impact on industries. From an internal perspective, digitalization requires organizations to integrate digital systems, processes, and culture throughout the entire organization (Haxhani & Khasarro, 2021). It involves strategic and operational activities aimed at leveraging digital technologies for innovation, efficiency, and improved customer experiences. Externally, digitalization focuses on customer-centricity, business model innovation, and leveraging digital channels and technologies to interact with customers, partners, and the broader ecosystem (Haxhani & Khasarro, 2021).

Digital Transformation represents a more comprehensive and profound organizational change compared to digitization and digitalization. It involves leveraging digital technologies to fundamentally transform business strategies, processes, capabilities, products, and relationships (Soluk & Kammerlander, 2021). According to Verhoef et al. (2021) digital transformation refers to using digital technology to change the core business model of a company, leading to significant changes in processes, routines, and skills across the organization. It shifts the nature of value creation from traditional physical products to smart products and data, impacting the global supply chain and necessitating structural and organizational adjustments (Becker et al., 2018). Digital transformation can take various forms depending on the specific needs and goals of a business. It may involve adopting cutting-edge technologies, leveraging social media for customer engagement, or other strategies aligned with organizational objectives (Scuotto et al., 2022). The dimensions of digital transformation can vary based on factors such as organizational size, type, and stage of the transformation journey (Scuotto et al., 2022).

Digital transformation is not merely about adopting specific technologies but about reimagining the entire organization and its approach to doing business. Digital transformation requires organizations to rethink their core business models, customer engagement strategies, and organizational structures to capitalize on the opportunities offered by digital technologies

(Hönigsberg & Dinter, 2019). It involves embracing a digital mindset, fostering a culture of innovation, and aligning the organization's strategy with the possibilities offered by the digital era. Further, DT calls for building skills that strengthen strategic agility and the ability to respond rapidly to unexpected opportunities and disruptions associated with digital technologies (Berbel-Vera et al., 2022). Companies that successfully navigate the digital transformation journey can gain a critical competitive edge by improving efficiency, cutting costs, accessing new markets, and enhancing customer experiences (Microsoft, 2022).

We conclude that digitization, digitalization, and digital transformation are closely related concepts that involve leveraging digital technologies to drive organizational change and create value. Digitization focuses on the conversion of analog information into digital format, while digitalization encompasses a broader transformational process that impacts business models and organizational elements. Digital transformation represents a more comprehensive and profound change that involves the fundamental transformation of the entire organization, including its strategies, processes, capabilities, and relationships. Having defined digital transformation, we will now examine the specific technologies driving this process in German SMEs.

2.2.1 Technologies Facilitating Digital Transformation in German SMEs

Digital transformation technologies have significantly impacted organizations, enhancing various operational aspects such as procurement, supply chain management, marketing, manufacturing processes, and other operational aspects (Kraus et al., 2022). Technologies like robotic process automation, artificial intelligence, big data analytics, IoT, and blockchains have played a transformative role in supply chain management, enabling automation, data analysis, and secure transactions (Kraus et al., 2022). In marketing, the integration of digital technologies has provided valuable insights into customer behavior and preferences through big data analytics and social media (Kraus et al., 2022). Manufacturers have embraced digital technologies like IoT and artificial intelligence to optimize production, improve product quality, and offer personalized offerings, leading to enhanced customer experiences (Kraus et al., 2022). In the appendix 1, a table is presented summarizing the different technologies that enable digital transformation along with a short explanation for each technology. The table presents information from Carlotta (2021) and Pascucci et al. (2023). These technologies can give an initial assessment of whether organizations are already undergoing digital transformation or not.

In the preceding section, we have explored the profound implications of digital transformation technologies. These technologies have made a significant impact, reshaping everything from supply chain management to the way businesses understand and engage with their customers. Furthermore, manufacturers have leveraged IoT and artificial intelligence, producing more streamlined and personalized customer interactions. As we move on to the next section, we turn our attention to the definition of German small and medium sized enterprises (SMEs). We'll explore how this dynamic sector deals with the digital changes. Our findings provide important insights to comprehend the SMEs position in the constantly changing digital world.

2.3 German small and medium sized enterprises (SMEs)

Germany's thriving economy owes much of its success to their SMEs, which comprises medium-sized and family-run enterprises known for their innovation, reliability, and entrepreneurial spirit (BDI, 2015). Over 60% of Germany's workforce is employed in SMEs, highlighting their importance (Wrobel et al., 2019). The middle class, often referred to as the "backbone of the German economy," is globally recognized for its exceptional quality and trustworthiness (Wrobel et al., 2019).

In the context of defining small and medium-sized enterprises (SMEs) in Germany, it is worth noting that the country's definition differs from the international standard, particularly in relation to the maximum number of employees. In Germany, SMEs are classified as companies with fewer than 500 employees (see figure 2), which contrasts with the European Union's definition of SMEs as having a maximum of 250 employees (Bundesamt, 2014). This distinction highlights the variation in the criteria used to determine the size of SMEs, with Germany emphasizing quantitative measures such as turnover and employee count in line with the European Commission's recommendation (Bundesamt, 2014). In this research paper, we complied to the definition given by the European Union.

SMEs form a significant portion of Germany's private sector, accounting for 99.6% of total companies (BDI, 2015). These enterprises have a regional focus, with medium-sized companies generating 35.3% of Germany's total turnover and employing nearly 60% of the workforce. Many German medium-sized companies excel in niche markets globally and have achieved success as exporters (BDI, 2015). While quantitative measures such as turnover and employee count are central to the classification of SMEs, qualitative factors like business relations and ownership structure also play a role in defining SMEs (Bundesamt, 2014). This comprehensive approach ensures a well-rounded understanding of what constitutes an SME in Germany, with both numerical and non-numerical criteria being important considerations. It is essential to account for these factors when analyzing related statistics (Bundesamt, 2014).

2.3.1 Digital Transformation in German SMEs

The current state of digital transformation in German small and medium enterprises (SMEs) reveals a mixed picture, characterized by disparities between different segments of the SME sector (KfW Research, 2022). According to a study by KfW Research, SMEs with more than 50 employees are more active in undertaking DT initiatives compared to smaller businesses with less than five employees (KfW Research, 2022). Not only do larger SMEs engage in digital transformation projects more frequently, but they also allocate significantly more resources to these projects, with an average spending of EUR 160,000, in contrast to just below EUR 8,000 for smaller SMEs (KfW Research, 2022). The difference in digital transformation efforts is also noticeable in the area of research and development (R&D). Larger SMEs have significantly increased their spending on DT – related activities during the pandemic, widening the gap between them and smaller businesses (KfW Research, 2022). Consequently, there is a risk of SMEs dividing into two distinct groups: highly digitized and mostly large SMEs with R&D activities, and a significant proportion of smaller businesses struggling to keep pace with digital transformation (KfW Research, 2022).

Digital transformation challenges: The digital transformation process in German SMEs is faced with various challenges that hinder its progress and effectiveness. One major challenge is the slow pace of digital transformation in small and medium-sized enterprises, despite their efforts to catch up with larger corporations in recent years (Daheim et al., 2017). This slow progress can be attributed to a lack of determination, belief, and trust in the workforce, as well as management's reluctance and adherence to traditional industry thinking (Daheim et al., 2017).

Another challenge lies in the need for leaders of SMEs to develop new skills that are unfamiliar to their business (Soluk & Kammerlander, 2021). The lack of theoretical and empirical knowledge on how leaders approach digital transformation and develop these new skills poses a critical issue (Soluk & Kammerlander, 2021). While innovation and constant renewal are recognized as drivers of firm performance and growth, there is ongoing discussion regarding the specific abilities required by SMEs to effectively innovate in the face of technological change and how to develop these abilities.

Finances present another challenge for SMEs in their digital transformation efforts (Wrobel et al., 2019). Limited budgets and financial constraints can hinder their ability to invest in DT, leading to potential financial bottlenecks if unforeseen hurdles arise (Wrobel et al., 2019). Additionally, time delays are a common challenge in digital transformation projects (Wrobel et al., 2019). These projects often take longer than planned, causing delays, and making it challenging to implement digital changes within the desired timeframe.

Furthermore, change management poses a significant challenge in the digital transformation process. Preparing employees for change and ensuring their acceptance and adaptation to new technologies and processes can be a complex and challenging task (Wrobel et al., 2019). Employees may resist change. Overcoming their resistance and fostering a culture of change and innovation require careful planning and effective change management strategies. Overcoming these challenges is crucial for SMEs to successfully embrace digital transformation efforts and leverage its benefits for their growth and competitiveness in the digital age. Having explored the challenges of digital transformation in SMEs, we now move on to initiatives that are helping these enterprises navigate the digital shift.

2.3.2 Initiatives driving digital transformation in German SMEs

In German SMEs, various digital transformation efforts have been implemented to enhance customer experience, improve efficiency, and adapt to the changing business landscape (Bundesamt, 2014). One example of digital transformation is the implementation of contactless check-in at hotels. This allows guests to check-in without physical contact, reducing the time spent at the reception desk and enhancing convenience and safety. Another example is the development of online shops by businesses in the trade sector. By establishing their online presence, companies can reach a wider customer base and offer their products or services through digital platforms. Additionally, smartphone-supported ordering and payment systems have been introduced in restaurants, enabling customers to place orders and make payments

using their mobile devices, reducing waiting times and enhancing the overall dining experience (Bundesamt, 2014).

Furthermore, the use of digital technologies in the trade sector includes the adoption of service robots like Charly, developed by the Mittelstand 4.0 Competence Center Usability. Charly assists customers by engaging in conversations and providing product information, reducing wait times and improving customer service. This remote-enabled robot also enables sales staff to work from home, increasing flexibility and productivity (Bundesamt, 2014). In the hospitality sector, projects include online table reservations, digital menus, and self-ordering systems via smartphones. Guests can easily reserve tables online, providing them with more control and flexibility. Digital menus enable interactive and dynamic presentation of food and beverage options, enhancing the dining experience. Self-ordering via smartphones reduces the workload of service staff and allows customers to place orders conveniently (Bundesamt, 2014). These examples illustrate the potential of digital transformation for SMEs highlighting the use of technologies to improve customer experiences, streamline operations, and adapt to the digital age. It is important for German SMEs to embrace the concept of digital transformation and explore innovative solutions to stay competitive in the evolving market. Understanding these initiatives allows us to appreciate the broader role of leadership in digital transformation, a topic we explore next.

2.4 Digital Leadership: The CDO's impact and influence

In this subsection, we explore the concept of digital leadership, focusing on how the CDO can shape and drive the digital transformation process within SMEs. Leadership, a multifaceted and evolving concept, involves complex processes of influence aimed at achieving organizational objectives through dynamic change (Com et al., 2018). Traditional theories, encompassing traits, behaviors, and contingencies, provide a foundational understanding of leadership across individual, group, and organizational levels (Com et al., 2018). However, the 21st century introduces a novel landscape marked by constant change, uncertainty, and complexity, largely driven by technological advancements (Ngayo Fotso, 2021).

Digital leadership is a response to this changing environment. It involves a shift from traditional leadership to leadership styles that are more adaptable, collaborative, and innovative. Digital leaders must adapt their behavior and leadership styles to suit different situations and the needs of their teams. To excel in a digitized economy, digital leaders need to develop a digital vision and strategy, which, in turn, demands new business models and a reassessment of the role of information technology in daily operations (Ngayo Fotso, 2021). Industry 4.0 underscores the need for leaders to excel in real-time interactions with customers, stakeholders, and employees. Proficiency in digital tools for data analytics, communication, virtual collaboration, task automation, and operational enhancement is essential for leaders (Ngayo Fotso, 2021). Digital leaders are distinguished by their ability to inspire innovation, a profound understanding of organizational objectives, and a dynamic approach to task distribution based on situational and team competencies (Com et al., 2018). Their leadership style is characterized by high agility and adaptability, particularly in the face of industry challenges (Com et al., 2018).

Given the urgent need to identify these crucial skills, a new management position has emerged, known as the **Chief Digital Officer (CDO)**. This role represents a significant advancement in digital leadership research, as it encompasses a comprehensive set of essential digital skills. A thorough analysis of this profile will provide valuable insights into the specific digital skills that are most relevant for German SME digital leaders to embrace and incorporate effectively. The literature highlights that digital leadership is a multifaceted construct that focuses on creating a customer-centric, digitally enabled, and forward-thinking business model (Ahlemann et al., 2021). It requires transforming the role, skills, and leadership style of the digital leader, realizing a digital organization, and adjusting people management, virtual teams, knowledge, and communication and collaboration at the individual level (Ahlemann et al., 2021).

In essence, digital leadership goes beyond technological expertise; it is a transformative leadership style imperative for organizations navigating the complexities of Industry 4.0. The rise of the CDO underscores the strategic importance of digital skills in leadership. As we progress deeper into the digital era, leadership must continually evolve, embracing change, and cultivating a culture that thrives in the age of Industry 4.0. It is not merely about the integration of technology; it is about fostering a mindset that embraces innovation, collaboration, and adaptability in the face of a rapidly changing digital landscape. This understanding of digital leadership sets the stage for a deeper exploration of the specific skills required by a CDO to lead digital change

2.4.1 The role of the Chief Digital Officer (CDO)

The successful implementation of digital transformation (DT) requires a leader with strategic, innovative, and change management skills (Berbel-Vera et al., 2022). Chief Digital Officers (CDOs) have been established specifically to address the challenges of transforming a company's business model digitally. In Germany, the role of the CDO has gained increasing importance for Small and Medium-sized Enterprises (SMEs) as they navigate the complexities of digital transformation (Becker et al., 2018). In this subsection we delve into the specific role of the Chief Digital Officer (CDO), examining how CDOs contribute to digital transformation in SMEs

The role of the CDO encompasses a unique set of skills necessary to lead digital transformation efforts. Leaders can adopt the CDO profile to delve into the distinctive skills that are crucial for navigating the organization's digital transformation process. CDOs are responsible for developing and communicating a comprehensive digital strategy that supports organizations in remaining competitive in a rapidly evolving business landscape (Thomas, 2020). They promote digital initiatives and lead the required transformation efforts across the entire organization by working with leadership teams and forming partnerships with external parties (Firk et al., 2021). While the role of the CDO remains significant in larger organizations, it is arguable that the same level of relevance is to be observed in SMEs (Hönigsberg & Dinter, 2019). As a result, it's more effective for SMEs to distribute and adapt CDO-related skills to the management team, rather than appointing a specific CDO (Becker et al., 2018).

This section presents a literature review that explores the key skills of the CDO in the context of SMEs in Germany. The aim is to define skills that leaders of German SMEs can embrace to foster their digital transformation process. The findings from the literature review will form the basis for developing a framework that has been used in the subsequent part of the research, which involves conducting quantitative questionnaires to validate and further explore these skills.

2.4.2 CDO Skills in Driving Digital Transformation in SMEs

The role of the CDO in SMEs encompasses a wide range of skills that are essential for successful digital transformation. The literature review conducted for this research highlights several key skills identified by different authors. Berbel-Vera et al. (2022) emphasize the importance of building robust digital competencies to enable rapid development, implementation, and transformation of business models. These capabilities involve activities such as digital sensing, digital seizing, and digital transforming. Becker et al. (2018) note that CDOs in SMEs require a broader skill set compared to their counterparts in larger enterprises. In addition to technical expertise, CDOs in SMEs must possess skills in transforming and digitizing business models. They also enjoy greater autonomy in defining digital goals and initiatives, while ensuring alignment with the overall strategy set by top management.

The literature review conducted for this research has identified five key skills of the CDO in SMEs. These will be used to build a theoretical framework that can be adopted and adapted by managers and leaders in German SMEs to drive digital transformation. This section explores the various perspectives provided by scholars on identifying key CDO-related skills in the context of digital transformation. First, a cross-sectional literature review has been conducted to explore the most discussed and hence relevant CDO-related skills for leaders in German SMEs. By comparing the frequency and context in which these skills are mentioned across different sources, the skills *Digital Strategic Vision*, *Digital Leadership Orientation*, *Innovative Thinking*, *Tech Savviness*, and *Networking & Scanning*, are derived. The table below (table 1) highlights the specific articles where each of these skills have been emphasized, offering a clear overview of how different sources contribute to the understanding of CDO competencies

	<i>CDO skill</i>	<i>Digital Strategic Vision</i>	<i>Digital Leadership Orientation</i>	<i>Innovative Thinking</i>	<i>Tech Savviness</i>	<i>Networking & Scanning</i>
<i>References</i>						
Warner & Wäger (2019)		✓				
Slimane, Coeurderoy & Mhenni (2022)		✓	✓	✓	✓	✓
Artemenko (2020)		✓			✓	
Becker, Schmid & Botzkowski (2018)		✓				
Berbel-Vera, Palanca & Gonzalez-Sanchez (2022)		✓	✓	✓		✓
BSP Business School Berlin (2017)		✓	✓		✓	✓
Culasso et al. (2023)		✓	✓		✓	
Deloitte MCS Limited (2018)		✓	✓		✓	✓
Singh et al. (2020)		✓				
Singh & Hess (2017)			✓		✓	
Zoppelletto et al. (2023)			✓			
Scuotto, Magni, Theofilos & Giudice (2022)				✓	✓	
Microsoft (2022)					✓	✓

Table 1 Overview of CDO-Related skills and their references in key literature

In the following sections, we explore each of the identified CDO-related skills and explain in greater detail. This detailed analysis provides insights into how these skills contribute to effective digital leadership, particularly within the context of German SMEs. By examining each skill individually, the significance of these skills in driving digital transformation becomes clearer. Each skill leads to a hypothesis, forming the foundation for the conceptual framework that has been explained later. In the appendix 2, you can find a table presenting a summary of the main points of the identified CDO skills, including a categorization according to Katz & Kahn's framework, an operational definition and key insights.

(1) Digital Strategic Vision refers to the capacity of leaders to envision and articulate a clear direction for the organization within the digital landscape. It encompasses grasping the integration of digital technologies into the existing business model and formulating a comprehensive digital business strategy, which extends beyond just the incorporation of IT applications and infrastructure (Warner & Wäger, 2019). This strategic vision encompasses identifying novel opportunities, anticipating potential disruptions, and aligning the overall corporate strategy with DT objectives (Slimane et al., 2022). Such a vision plays a pivotal role in the broader context of corporate transformation and strategy, necessitating the reconfiguration of the organization to harness digital technologies. This includes establishing a

roadmap for transitioning business processes, products, and services into a digital format (Artemenko, 2020).

Moreover, this strategic vision empowers leaders to discern shifts in customer demands stemming from digital transformation and explore innovative business models. It requires the transition from traditional physical products to intelligent products and value creation driven by data (Becker et al., 2018). Leaders with strategic vision are pivotal in identifying opportunities for value creation through the incorporation of digital technologies (Berbel-Vera et al., 2022). They function as digital transformation consultants within the organization, steering the development of digital business domains, integrating digital competencies throughout the company, and fostering the creation of novel digital business models (Becker et al., 2018). Furthermore, leaders with strategic vision, in the realm of digital strategic planning, establish a consolidated, long-term perspective on all ongoing digital initiatives. They manage these initiatives with an emphasis on long-term strategic alignment between the digital transformation process and the overall digital strategy (Warner & Wäger, 2019).

Additionally, strategic vision empowers leaders to seamlessly integrate digital aspects into existing corporate strategies or develop explicit digitization strategies. This alignment ensures that digital initiatives function as cross-functional elements within the organization, fostering a holistic approach to digital integration (BSP Business School Berlin, 2017). Essentially, strategic digital integration necessitates agility, strategic planning, and the seamless integration of digital elements into the organizational framework. In this context, digital leaders need to address the transformation of the organizational landscape to align with the demands of the digital era.

Having the competency of digital strategic vision also requires the reconfiguration of the organization to harness digital technologies. In this context, Horváth & Szabó (2019) emphasize the importance of making organizational structures more flexible in terms of time and space, promoting transparency, decentralization, and reduced hierarchy in workflows. This perspective underscores the need for Chief Digital Officers (CDOs) to institute structures that facilitate flexibility, enabling remote work, cross-departmental collaboration, and rapid responses to digital opportunities and challenges. Redesigning internal structures through digital technologies is deemed critical for generating value, enhancing digital maturity, and mastering data analytics techniques. In a similar vein, BSP Business School Berlin (2017) underscores the need for managers and leaders to introduce a new organizational structure as part of their digital strategic vision competency. This entails adapting digital strategies and crafting appropriate organizational and management structures that accommodate the diverse mindsets and skill sets required by new technologies (Becker et al., 2018). Leaders should establish operational routines dedicated to technologies and concentrate on building effective teams to manage the digital transformation process (Scuotto et al., 2022).

We conclude that strategic vision emerges as a key CDO skill to navigate the complexities of digital transformation. By formulating a robust digital business strategy, leaders can reshape the business model, explore novel opportunities, and ensure alignment. Strategic vision empowers German SMEs to excel in the digital era, harnessing digital technologies to create value and

adapt to the changing digital landscape. Leaders need to be adept at restructuring the organization as part of their digital strategic vision competency.

***Hypothesis:** There is a relationship between a leader's digital strategic vision and the digital transformation maturity level of the organization.*

(2) Digital leadership orientation, which is yet another crucial CDO-related skill. It involves the adept guidance and inspiration of individuals and teams toward the achievement of digital transformation objectives (Slimane et al., 2022). Particularly in German SMEs, where the absence of a dedicated Chief Digital Officer (CDO) is common, leaders can adopt robust leadership practices to facilitate the organization's shift toward a digital-first mindset. Empirical evidence underscores that a strong leadership orientation is a pivotal distinguishing factor between a CDO and other leaders when it comes to propelling digital transformation (Berbel-Vera et al., 2022).

Within the realm of digital leadership, embracing agility as a central leadership and organizational principle is essential for driving digital transformation (BSP Business School Berlin, 2017). Leaders with a strong leadership orientation endorse an agile approach, expertly guiding their teams through continuous improvement and adaptation to the ever-evolving digital landscape. This also extends to the domain of team engagement and empowerment. In the sphere of team engagement and empowerment, the nurturing of connections and trust emerges as a fundamental pursuit for digital leaders. Proficiency in relationship-building and the ability to influence others, fostering buy-in and building trust, are critical skills (Deloitte MCS Limited, 2018). In this context, digital leadership orientation encompasses the promotion of open communication, integrity, and stakeholder engagement. Digital leaders must excel in communication and collaborative leadership, inspiring and motivating their teams to attain high performance and foster innovation. Moreover, motivating individuals stands as a vital facet of leadership in driving digital transformation (Singh et al., 2020). Leaders with a strong leadership orientation excel at conveying mission-critical information throughout the organization, transcending hierarchical structures. They inspire and motivate individuals to embrace change, cultivating a culture that values digital transformation.

Digital leadership orientation not only underscores the theme of 'agility' but also underscores the need for leaders to nurture a culture of change and innovation within the organization (Slimane et al., 2022). This involves shaping the behavior, mindset, and values of the workforce to align with the objectives and requisites of digital transformation initiatives. Leaders initiating a digital culture shift promote a supportive and growth-oriented approach, rather than a critical or judgmental one. They focus on advancing digital transformation projects and overcoming resistance and silo mentalities (Zoppelletto et al., 2023). In doing so, they create an environment that fosters open-mindedness, encourages collaboration, and breaks down barriers between departments or teams, thus facilitating the smoother implementation of digital initiatives.

As a part of their digital leadership orientation, leaders must effectively communicate the significance of digital transformation, educate employees about its advantages, and generate awareness of the necessity for change. This promotion of a digital mindset encourages employees to welcome new technologies, innovative practices, and digital methods of

operation. Within the realm of German SMEs, leaders spearheading the digital culture shift adopt a supportive approach (Zoppelletto et al., 2023). Instead of being critical or judgmental, they focus on empowering employees and facilitating their personal and professional growth. This approach builds trust, motivates employees to explore new digital skills and knowledge, and instills a culture of continuous learning within the organization.

We conclude that digital leadership orientation plays a critical role in driving digital transformation within German SMEs. Leaders who embrace a strong leadership orientation foster a culture of change, expertly guide their teams through agility, cultivate relationships and trust, motivate individuals, and effectively convey the mission-critical information necessary for successful digital transformation. By adopting and adapting these leadership skills, German SMEs can navigate the complexities of the digital era and drive their organizations toward digital success.

***Hypothesis:** There is a relationship between a leader's digital leadership orientation and the digital transformation maturity level of the organization.*

(3) Innovative thinking is the next CDO- related skill we explore. It describes the dynamic process of conceiving groundbreaking concepts and advancing them to the stage of early prototypes to explore their feasibility and potential impact on the organization. This entails fostering entrepreneurial behaviors, nurturing the generation of new ideas, and cultivating a culture of creativity and innovation (Slimane et al., 2022). Effective innovative thinking also encompasses idea generation and prototyping, demanding that leaders strike a delicate balance between risk and reward in formulating innovative ideas for products or services (Berbel-Vera et al., 2022). Leaders in German SMEs, even in the absence of a designated Chief Digital Officer (CDO), must embrace rapid prototyping and the logic of real options to evaluate the viability of novel developments before committing to their integration. Additionally, innovative thinking facilitates the expansion of innovative business models in German SMEs (Berbel-Vera et al., 2022). Leaders who embody this competency focus on leveraging digital technologies to enhance products, customer relationships, and competitive positions. They also spearhead strategic modifications to organizational processes, products, services, and business models, ensuring a high degree of alignment and consensus among stakeholders.

Activities associated with innovative thinking in German SMEs are designed to prevent inertia and stagnation while fostering a climate of creativity and innovation (Scuotto et al., 2022). Leaders foster a culture of experimentation and stay aligned with emerging digital trends. They stay updated on industry advancements and proactively monitor emerging startup ventures to assess their potential for integration within the organization. Furthermore, the processes of idea generation and prototyping promote continuous enhancement and iterative development within German SMEs (Slimane et al., 2022). Leaders encourage the generation of fresh ideas, provide support for experimentation, and allocate resources for testing and refining prototypes. This iterative approach empowers the organization to adapt and refine its digital transformation initiatives in response to feedback and emerging opportunities.

We conclude that innovative thinking is instrumental in driving digital transformation within German SMEs. Leaders who embrace this skill adeptly navigate the balance between risk and reward, facilitate the scaling of innovative business models, foster creativity and innovation, and champion continuous improvement. By cultivating a culture of experimentation and embracing emerging trends, leaders in German SMEs can generate and prototype novel ideas that drive the organization toward successful digital transformation.

Hypothesis: *There is a relationship between a leaders innovative thinking and the digital transformation maturity level of the organization.*

(4) Tech savviness refers to the digital skills and knowledge that leaders need to navigate the digital landscape effectively (Microsoft, 2022). It encompasses a profound understanding of existing technologies, their applications, practical value, and the ability to work with data. Tech-savvy leaders possess technical expertise, market analysis skills, and an understanding of digital tools and technologies (Artemenko, 2020; Deloitte, 2018; Culasso et al., 2023). Tech-savvy leaders in German SMEs are enthusiastic about technology and readily incorporate it into their personal and professional lives (Microsoft, 2022). They act as change agents, leading companies to become early adopters of new technologies. Their tech savviness helps SMEs overcome hesitancy and embrace digital advancements.

Tech-savvy leaders possess the necessary digital skills to enhance the organization's digital capabilities (Slimane et al., 2022). They actively develop and build tools, software, and technological architectures that support digital transformation, leveraging their technical expertise. Through this, they drive the effective utilization of digital technologies to improve internal processes and achieve organizational goals (Culasso et al., 2023). Additionally, their tech savviness extends to IT competency, enabling them to understand IT applications, infrastructures, and upgrades (Singh et al., 2020). This knowledge allows them to formulate IT requirements and iteratively develop new digital products and services, making informed decisions regarding digital infrastructure investments (Deloitte MCS Limited, 2018; Weigel et al., 2020). Moreover, tech-savvy leaders in German SMEs stay updated with emerging digital trends and technologies (BSP Business School Berlin, 2017; Scuotto et al., 2022). Their ability to anticipate new trends and leverage digital tools empowers them to drive innovation within the organization, fostering a culture of continuous improvement and forward-thinking.

We conclude that although German SMEs may not have a dedicated CDO, leaders within these organizations can embrace tech savviness to drive digital transformation. Tech-savvy leaders act as catalysts for change, enhance the organization's digital capabilities, promote IT competency, and anticipate emerging trends and innovation. By fostering a culture of tech savviness, German SMEs can navigate the digital landscape loo effectively and achieve successful digital transformation.

Hypothesis: *There is a relationship between a leader's tech savviness and the digital transformation maturity level of the organization.*

(5) Networking (& scanning), as a CDO - skill, relates to the capacity to foster collaborations and create open networks, both internally and externally, utilizing digital technologies to drive digital transformation initiatives. This involves establishing connections with a wide array of stakeholders, including value chain partners, in-house departments, technology collaborators, and external entities (Slimane et al., 2022). Leaders in German SMEs who embrace networking skills are attuned to the external landscape and actively seek opportunities to collaborate with value chain partners (Slimane et al., 2022). They proactively engage with external stakeholders, encompassing suppliers, customers, and technology collaborators, to explore innovative solutions, share expertise, and harness external knowledge. Furthermore, network skills play a pivotal role in bridging the gap between various departments within an organization (Berbel-Vera et al., 2022). Leaders function as boundary spanners, facilitating communication and cooperation between business and IT functions. They translate the digital business strategy into actionable initiatives, promoting shared comprehension and coordinated endeavors toward digital transformation.

Another facet of this skill involves anticipating political and legal changes. As mentioned by BSP Business School Berlin (2017), leaders with network skills vigilantly monitor and respond to potential shifts in the political and legal landscape. By staying well-informed and anticipating regulatory modifications, they ensure the organization's compliance and its adaptability in adjusting digital strategies, thus optimizing entrepreneurial opportunities amid evolving circumstances. Moreover, exemplary digital leaders must collaborate with fellow business leaders to discern prospects for harnessing digital technology (Deloitte MCS Limited, 2018). They serve as trusted advisors, capitalizing on their networks and relationships to drive initiatives that harness the potential of digital technologies. This collaboration assures alignment between digital transformation endeavors and overarching business goals. Additionally, leaders must engage in collaboration not only with fellow business leaders but also with a diverse array of technology partners. In the pursuit of digital transformation, leaders in German SMEs acknowledge the strategic significance of technology partners (Microsoft, 2022). They actively seek technological solutions and prioritize partnerships with technology providers who can deliver innovative products, services, and guidance. Collaborating with technology partners empowers SMEs to access expertise and stay at the forefront of digital advancements.

We conclude that the networking (and scanning) is an important CDO - skill to steer digital transformation. By developing external openness and fostering collaborations, bridging departmental divides, collaborating with business leaders, anticipating regulatory shifts, and leveraging technology partners, leaders create an ecosystem of connections that facilitate knowledge exchange, innovation, and the successful implementation of digital initiatives.

Hypothesis: *There is a relationship between a leaders networking & scanning and the digital transformation maturity level of the organization.*

Having identified these essential CDO-related skills, we now translate these insights into a conceptual framework that serves as the basis for exploring if there is a relation between these

skills and the digital transformation maturity level of SMEs. The following section presents this framework.

2.4.3 Conceptual Framework

Building on the insights presented in the previous chapters, a conceptual framework was developed to examine the essential skills of Chief Digital Officers in driving digital transformation in German small and medium-sized enterprises (SMEs). Chapter 1 outlined the growing importance of digital transformation for SMEs, highlighting the significant challenges they face in adapting to rapidly evolving digital landscapes. This chapter also introduced the role of the CDO as a key player in navigating these transformations but noted that there is limited clarity regarding the specific skills that are crucial for this role in the SME context. In Chapter 2, through a comprehensive review of the literature, we identified and analyzed core skills required for effective digital leadership, with a specific focus on the CDO’s role. The literature pointed to five essential CDO-related skills: Tech Savviness, Digital Strategic Vision, Innovative Thinking, Digital Leadership Orientation, and Networking & Scanning. Each of these skills has been shown to play a pivotal role in fostering digital transformation. The conceptual framework, therefore, serves as the foundation for investigating how these leadership skills influence the maturity of digital transformation initiatives within SMEs, as outlined in the research question.

The conceptual framework (see figure 3) illustrates the relationship between five independent variables, Digital Leadership Orientation, Tech Savviness, Networking & Scanning, Digital Strategic Vision, and Innovative Thinking, and one dependent variable, Digital Transformation Maturity. The framework explores the relationship of these CDO-related skills on the maturity of digital transformation in SMEs. Each independent variable represents a specific skill believed to be crucial for driving digital transformation. Our study investigated how these CDO skills contribute to the organization's ability to achieve a high level of digital maturity. To validate the framework, quantitative survey questionnaires were conducted.

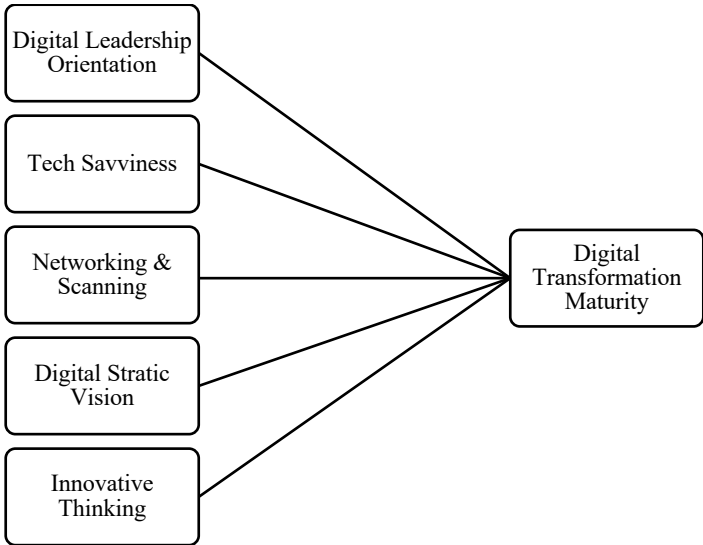


Figure 3 Conceptual framework CDO- skills

3 Research Design

This section presents the research design, outlining the methodologies employed to investigate the CDO-related skills that influence digital transformation in German SMEs. The research design of this paper included two main approaches: first, a literature review, and second, quantitative surveys with business practitioners.

3.1 Literature Review

First, a literature review has been conducted to explore the topic in general, to explore its relevance and to understand existing knowledge and viewpoints on the Chief Digital Officer's (CDO) skills in German small and medium-sized businesses. This contributed to overcome gaps in the existing literature and obtain a complete understanding of the CDO position. The literature review for this study has already been conducted, and the findings can be found in Chapter 2. This section lays the theoretical foundation for the research by exploring key concepts and identifying relevant CDO-related skills essential for digital transformation in SMEs.

A literature review plays a crucial role in the development of a comprehensive and well-grounded master's thesis. It involves the examination and analysis of existing academic literature relevant to the research topic. It can help with: **(1) Establishing the research context:** A literature review helps establish the research context by providing a comprehensive understanding of the research field. It offers an overview of the existing knowledge, theories, and concepts related to the research topic, enabling the researcher to position their work within the broader academic context (Webster & Watson, 2002). **(2) Identifying research gaps:** A literature review allows researchers to identify gaps or areas that have not been adequately explored in the existing literature. By reviewing relevant studies, researchers can determine where knowledge is lacking or where inconsistencies exist (Randolph, 2009). **(3) Developing a theoretical framework:** The literature review assists in developing the theoretical framework for the master's thesis. By combining existing theories, models, and concepts, researchers can establish the conceptual foundation for their study (Plano Clark & Creswell, 2015).

In this master's thesis, we undertook a literature review to address the research question: "Which CDO-related skills are essential for leaders in German small and medium-sized enterprises to adopt in order to effectively drive digital transformation initiatives within their organizations?". This methodical review process involved several key steps. To gather a comprehensive set of relevant sources, we conducted searches across various databases and search engines. The primary sources we used included LISA UTwente, Google Scholar, and the academic database Web of Science (see figure 4). These sources were carefully selected to ensure a well-rounded approach to data collection. In designing my search queries, a strategic process is used similar to a literature review funnel. We first used broad search terms to throw a wide net, which we then gradually narrowed down to focus on particular details. Utilizing Boolean operators such as AND, OR, and NOT, we constructed search queries tailored to capture the essence of my research question (a complete overview of all search queries can be found in table 2).

Search Query

"digital transformation" AND "CDO-related skills"
"Leaders in German SMEs"
"Chief Digital Officer skills" OR "CDO competencies"
"Leadership in SMEs" AND "digital transformation"
"Role of CDO" AND "German small businesses"
"Effective leadership" AND "digital change" AND "CDO-related skills"
"CDO competencies" OR "Chief Digital Officer skills"
"Small and medium-sized enterprises" AND "digital transformation" AND "CDO-related skills"
"Digital transformation" OR "Digital change" AND "Leadership skills"
"CDO responsibilities" OR "Chief Digital Officer duties"
"Innovation leadership" AND "SMEs" AND "Technology adoption"
"Digitalization strategies" AND "Leadership challenges" OR "Opportunities"
"Adaptability" OR "Flexibility" AND "Digital disruption" AND "CDO roles"
"Organizational change" AND "CDO impact" OR "Effectiveness" OR "Success factors"

Table 2 search queries used in literature review

Throughout the search process, we were able to identify and explore a significant number of publications that seemed relevant to the research objective. After review, we found that a total of 15 papers were directly relevant to the research question. These papers provided valuable insights into the CDO-related skills that are of significance to leaders in German SMEs and their role in driving effective digital transformation initiatives. To ensure the quality and relevance of the selected papers, strict exclusion criteria were applied. One of these criteria was that the publication date of the papers should not be older than 10 years (only applied to references directly related the concept of digital transformation / CDO skills). This criterion helped ensure that the literature we considered for this research was up-to-date and aligned with current trends and developments in the field of digital transformation. In addition, only peer-reviewed sources were included to ensure credibility, and publications in English or German were prioritized for accessibility. Papers were selected based on their direct relevance to digital transformation, CDO skills, and leadership in SMEs, with a preference for studies focused on German or European contexts. Only full-text sources were considered for thorough analysis. Finally, papers that featured key concepts like innovation, technology adoption, and leadership in digital contexts were specifically targeted.

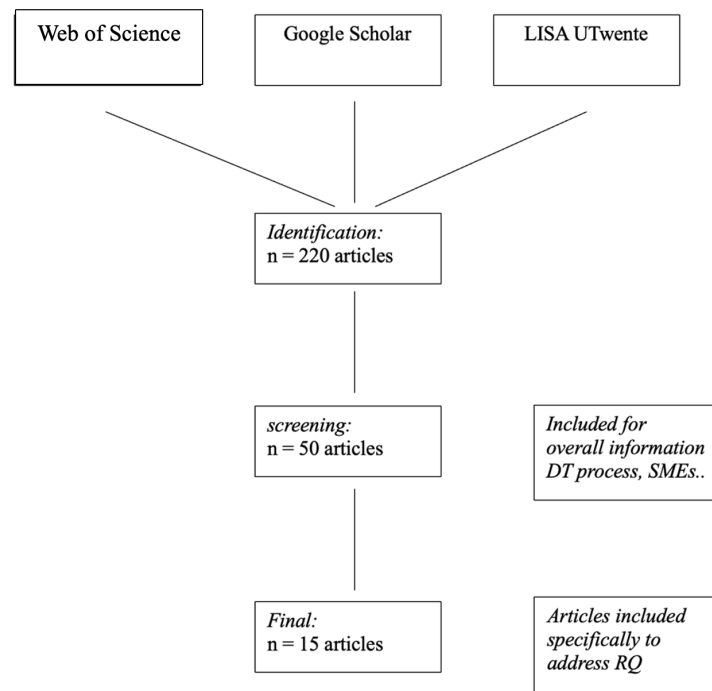


Figure 4 Literature Review Process

In summary, the literature review process followed a structured approach, starting with a broad search and ended in the identification of 15 relevant papers. These papers played a key role in identifying the specific CDO-related skills that leaders in German SMEs can adopt to effectively lead digital transformation initiatives within their organizations.

3.2 Conducting Surveys

In addition, surveys (quantitative, questionnaire) with business practitioners were conducted to collect further knowledge on the practical implications of the CDOs skills in German small and medium-sized enterprises. The objective of the survey was to examine how the CDO-related skills possessed by leaders of German SMEs influence the digital transformation maturity of their organizations. Essentially, the survey was designed to validate and support the insights gained from the literature review. The results of the quantitative survey are presented in Chapter 4. This chapter provides a detailed statistical analysis, and insights derived from the empirical data.

Conducting surveys is an important data collection method to validate information explored in the literature review. Firstly, it allows researchers to confirm or refute information gathered from secondary sources such as books, articles, and online databases. This helps to identify any inconsistencies in the literature, thereby ensuring the robustness and reliability of the research (Hart, 2018). Another advantage of using survey research to validate literature review findings is the potential to gather additional information beyond what is already available in the literature. This approach allows researchers to investigate aspects of a phenomenon that may not have been covered in existing literature, thereby expanding the study's reach (Bryman, 2016). Lastly, surveys can improve the generalizability of research outcomes. Through collecting data from a representative sample of participants, surveys can provide a better

understanding of the perspectives and behaviors of a wider population. This helps to reinforce the external validity of the research and make it more applicable to real-world situations (Dillman et al., 2014).

The use of surveys allowed for differentiation among various sizes of German small and medium-sized enterprises (SMEs), enabling a comprehensive analysis of their digital transformation efforts. To gain insights into potential differences or similarities, respondents were asked to indicate the size of the SME they work for, such as small, small to medium, or medium-sized. The survey questionnaire will be designed based on the conceptual framework that encompasses relevant digital skills for SMEs. Next, the survey questionnaire was designed to include Likert-scale questions, allowing participants to rate their level of agreement or disagreement with statements related to the identified CDO-related competencies. The Likert scale provides a structured format that enables respondents to express their opinions and perceptions quantitatively. The survey has been first tested on a small sample group to confirm its clarity, completeness, and ease of use before being widely distributed.

Research sample: The survey has been conducted among leaders and managers working in German small and medium enterprises (SMEs). The aim was to gain insights into the key CDO-related skills that can drive digital transformation in these organizations. The survey has been conducted collaboratively with my colleague Schipmann, who undertook her master's thesis research on "digital leadership in the context of digital transformation." Our thorough evaluation of survey items and assessment of independent and dependent variables were closely aligned to ensure methodological consistency. The collaborative approach helped to secure a larger pool of respondents, thereby enhancing the robustness and generalizability of our combined research findings.

Data collection & analysis: The survey has been crafted using Qualtrics, a widely recognized online survey platform appreciated for its adaptable features and user-friendly interface. Qualtrics offers the flexibility to create diverse question types, including Likert scales and open-ended responses, tailored to meet the specific requirements of the study. To ensure a diverse participant pool, the survey has been distributed through multiple channels, with a primary focus on the professional network LinkedIn. Leveraging LinkedIn's extensive network of over 1000 connections, we targeted individuals holding significant roles in digital leadership. Additionally, the survey link has been shared via email to enhance accessibility to potential respondents and via the survey platform 'survey circle'. Once the survey period concluded, the collected data from Qualtrics has been exported to statistical analysis software for thorough examination. For data analysis, structural equation modeling (SEM) has been applied. SEM is widely used across various disciplines, including psychology, sociology, economics, and management, to test theoretical models, validate hypotheses, and gain a deeper understanding of complex phenomena (Sarstedt et al., 2021). Its flexibility and ability to account for measurement error and complex causal relationships make it a valuable tool for researchers seeking to analyze intricate datasets and uncover underlying patterns in their data (Sarstedt et al., 2021). At its core, SEM combines elements of factor analysis and path analysis to examine both observed and latent (unobservable) variables. SEM enables researchers to assess the direct and indirect effects of variables on one another, providing insights into the underlying

mechanisms driving relationships in a given model. It also allows for the evaluation of measurement models, assessing the reliability and validity of the measurement instruments (Sarstedt et al., 2021). In addition, we used other inferential statistical methods like regression analysis or correlation to identify potential relationships among different variables. We took into consideration that in the course of the master thesis research alternative statistical methods like SPSS were employed for data analysis. An overview of the various steps can be found below (figure 5).

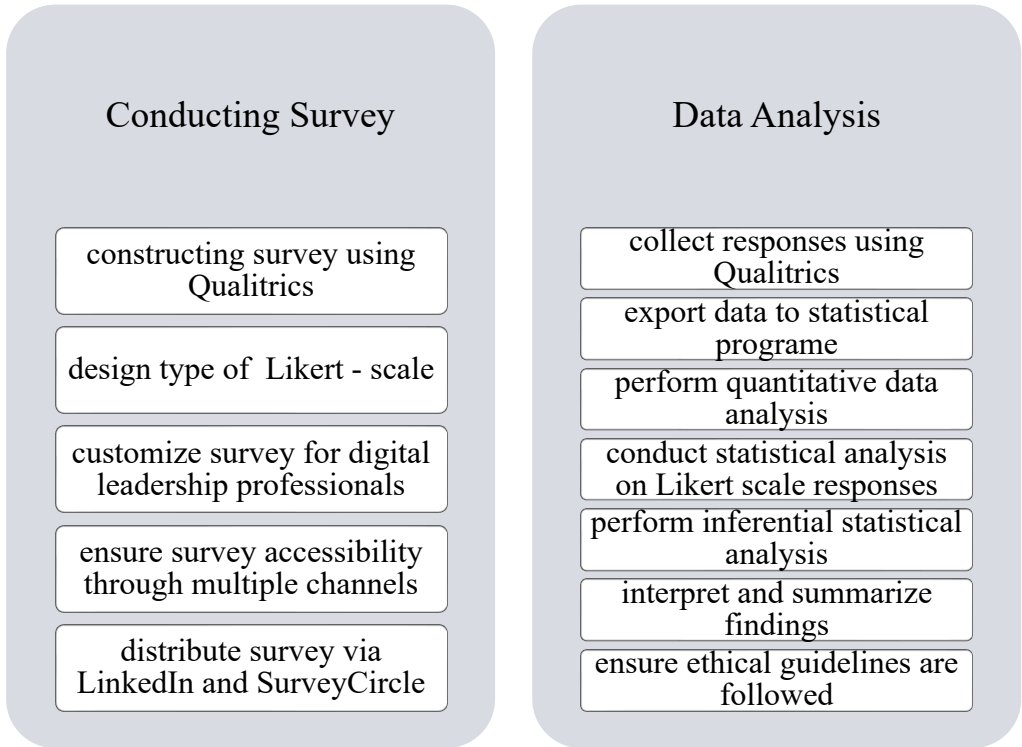


Figure 5 process design data collection and analysis

Ethical Considerations: Before starting the survey, we ensured adherence to ethical guidelines to protect participants' privacy and confidentiality. Participants received clear information about the survey's purpose and voluntary participation. Additionally, ethical approval has been given by the university's ethics committee.

Overall, the combination of a scientific literature review and surveys allowed to provide a more comprehensive and practical understanding of the relevant CDO skills. This research design ensured that this study is highly relevant to the skills and knowledge challenges faced by SMEs in their digital transformation journey.

3.2.1 Measurement (scales)

This subsection explains the measurement scales used to assess the independent variables (CDO skills) and the dependent variable (digital transformation maturity). The constructs used in this study were developed based on an extensive review of existing literature. To measure the independent variables (skills), established measurement scales were analyzed and adapted to best suit the context of this research paper. To measure the dependent variable, an established

digital maturity model has been used. Additionally, control variables were considered to ensure the robustness and validity of the research findings.

Dependent variable: Digital Transformation Maturity Level

Maturity models serve as valuable tools for assessing and guiding the development and progress of systems and organizations (Mohd Lokman Toshimasa Yamanaka et al., 2018). They represent a structured approach to enhancing an organization's processes, including business process management. The concept of maturity in this context denotes a state of perfection, readiness, or completeness, highlighting the journey from an initial state to maturity. These models consist of a sequence of levels or stages, forming an anticipated and logical path of development. An organization's current maturity level reflects its capabilities within a specific object or application domain (Mohd Lokman Toshimasa Yamanaka et al., 2018). The application of maturity models extends across a wide range of areas and is expected to gain increasing adoption within various industries (Mohd Lokman Toshimasa Yamanaka et al., 2018). The academic interest in these models is also on the rise. They are particularly useful for assessing the current situation and guiding improvement initiatives while monitoring progress (Mohd Lokman Toshimasa Yamanaka et al., 2018).

Digital maturity models, a specific subset, focus on evaluating digital capabilities within domains like information technology (IT) and business intelligence (BI) (Williams et al., 2019). These models are essential for assessing the gap between a company's existing capabilities and future objectives. They provide a structured framework for understanding the transformation path from the present state to the desired maturity level (Williams et al., 2019). In the field of digital transformation, it's essential to highlight the functionality of maturity models (Berghaus & Back, 2016). On the one hand, they describe dimensions requiring attention and on the other side, they outline the evolutionary path to the desired state, making them a crucial resource in Information System research. However, it's worth noting that in the context of digital transformation, the prescriptive functionality of maturity models may not always apply due to the non-linear, iterative nature of digital evolution (Berghaus & Back, 2016).

In this study, the dependent variable, 'digital transformation maturity level' has been assessed by utilizing a model outlined by Weritz et al. (2024). This model provides a thorough framework for conceptualizing and evaluating DT maturity level as a multifaceted construct, establishing a solid groundwork for empirical investigation in the field of information systems (IS). The principal objective of this model is to offer a robust structure for assessing the effectiveness of digital transformation efforts within organizations. Weritz et al. (2024) proposed model categorizes DT maturity level into four key domains: empowered talent, digitized practices and operations, digital-first mentality, and data access and collaborative tools. It emphasizes the essential nature of organizational shifts toward a digital-first mindset, the integration of digital technology into operational workflows, the cultivation of empowered talent equipped with digital competencies, and the effective utilization of data and collaborative tools. By employing this model, we aim to measure the degree to which organizations have developed in implementing digital transformation initiatives. In essence, the model put forth by Weritz et al. (2024) as a valuable instrument for examining DT maturity level within the scope of our research. Its multidimensional framework offers a comprehensive perspective for evaluating

the efficacy of digital transformation undertakings, thereby fostering a deeper comprehension of DT's role in shaping organizational strategy and performance.

The calculation of maturity stages for the "digital transformation maturity level" employed a weighted average approach. This involved assigning weights to each response category on a 5-point Likert scale, allowing for a nuanced and comprehensive assessment (1 = not distinct to 5 very distinct). By integrating these weighted values, the maturity stages were determined, providing a nuanced understanding of the digital transformation landscape within the specified framework. Each item goes through five levels of growth. Level 1 signifies a complete absence of attributes supporting the concepts of digital transformation, while level 5 represents the cutting-edge state of the art with all requisite attributes. Finally, the minimum result obtained through our assessment on the 5-point Likert scale accurately reflects the current state of digital transformation maturity within the organization. This lowest possible score serves as a tangible indicator of the baseline, offering insight into the starting point for evaluating the progression and effectiveness of digital transformation initiatives.

Independent variables: the skills

The independent variables were each measured as follows: (1) *Digital Strategic Vision* will be assessed using six items; (2) *Digital Leadership orientation* is measured through nine items; (3) *Innovative Thinking* is assessed using seven items; (4) *Tech Savviness* is measured through seven items; (5) *Networking & Scanning* has been measured using six items (a detailed list of all measurement items can be found in appendix 3 and 4). In this research, well-established measurement tools were employed to test the independent variables. These instruments, carefully selected from prior studies, have consistently demonstrated strong reliability in previous research papers. *The reliability aspects* of each measurement set is discussed in subsequent sections, detailing the steps taken to verify their validity and consistency, as outlined by the original researchers. Utilizing these validated items with demonstrated reliability aims to improve the robustness and credibility of our study's measures, thereby enhancing the trustworthiness of the findings.

For instance, Berbel-Vera et al. (2022) provided a set of items for the variables "digital strategic vision," "innovative thinking," and "tech savviness." Their rigorous procedure involved comprehensive reviews by senior researchers, IT specialists, and junior researchers, leading to adjustments in the statements based on pre-test feedback. Subsequently, the internal consistency of the statements was validated using Cronbach's alpha coefficient, with an overall coefficient of 0.92 confirming the validity of the measures. Similarly, Munsamy et al. (2023) adhered to Cohen's (1988) guidelines, setting a reliability threshold of $\alpha \geq 0.70$, particularly for assessing "tech savviness." Moreover, Weber et al. (2022) employed items to evaluate "Innovative Thinking" and "Tech Savviness," ensuring credibility through data triangulation and confirming satisfaction of all reliability thresholds. Their comprehensive empirical assessment, including scale evaluation and tests of predictive validity. Additionally, Amundsen & Martinsen (2014) validated the two-dimensional, 18-item instrument, measuring "digital leadership orientation." Mharapara et al. (2019) provided descriptive statistics and internal consistency estimates, demonstrating excellent reliability of the measurement items for assessing the variable "networking (scanning)." Furthermore, items from Arnold et al. (2000) displayed high factor

loadings and acceptable internal consistency reliability, particularly in measuring "digital leadership orientation." Lastly, Hassan et al. reported Cronbach's α values exceeding the suggested cutoff, except for "external monitoring," which might be attributed to the diverse examples included in the scale. These items were utilized to test the variable "networking (scanning)."

Control variables:

Further, eight control variables were considered to ensure the robustness and validity of the research findings. First, the "digital transformation decision involvement" variable assessed the person's previous involvement in digital transformation projects. This measure was essential for identifying the participants' levels of exposure and familiarity, which provided a more nuanced understanding of their viewpoints and interpretations. In addition, there were three control variables to test whether the participants organization is part of the German SME sector. These are: 'annual turnover', 'geographical location' and 'company size'. 'Annual turnover' assessed the organizations revenue generated over a year. 'Company size', focused on small and medium-sized entities (SMEs). Next, 'geographical location' has been used to control that companies are operating in German. By delimiting the study's focus to a specific national context, we sought to contextualize findings within the cultural norms, and market dynamics unique to Germany, thus enriching the understanding of digital transformation trajectories. Additionally, 'management position' was included to ascertain the participants' positions within their respective organizations. Next, 'industry sector' identified the categorization of organizations into different sectors based on the type of goods or services they produce. It allowed to study how certain variables vary across different industries. Finally, two more generic control variables were included which are 'age' and 'gender'.

The control variables in this study were designed to ensure the participant pool was relevant and aligned with the research goals. By focusing on job position, location (Germany), and organization size (SMEs), the study ensured that only those in management roles responsible for strategic decisions in German SMEs participated. These variables not only enhanced the data's robustness but also provided readers with valuable contextual information about the participants and their organizations. This context enriched the study by offering readers deeper insights into the organizational and strategic environment influencing digital transformation efforts. Collectively, these control variables act as essential instruments for enhancing the precision and depth of the research findings. They mitigated irrelevant factors and enabled a more nuanced examination of the relationship between digital transformation maturity and the CDO's skills.

In the appendix 4, a plan of the process is presented that will guide the execution of my master thesis research, detailing the steps essential to achieve the research objective. With the measurement framework in place, we will now move on to the results of the empirical analysis, where these variables are studied.

4 Results

This chapter presents the results that correspond to the data collected from the quantitative survey questionnaire, which was specifically designed to validate the CDO-related digital skills previously identified in the literature review. This survey provided empirical data that was analyzed using various statistical methods, including descriptive statistics, confirmatory factor analysis (CFA), and structural modeling, to ensure the reliability and validity of the identified skills. The analysis begins with descriptive statistics to give an overview of the survey data. CFA was then used to confirm the factor structure of the skills identified, ensuring that they accurately represent the key CDO- skills in the context of German SMEs. Lastly, the structural model further tested the relationships between the identified skills and their relevance to digital transformation maturity. Each section not only presents the statistical insights but also integrates these findings into the broader context of identifying CDO – related digital skills that are essential for leaders driving digital transformation in German SMEs.

4.1 Descriptive Statistics

First, we begin with the descriptive statistics, which offer insights into the characteristics of the respondents and their organizations. This is an important first step as it helps to ensure that the sample is appropriate and representative for exploring the key research question. The dataset consisted of 92 valid responses from managers and leaders. The descriptive statistics provide a clear view of the participant pool, highlighting its relevance to the research question. A significant portion of respondents are in senior leadership roles, with top-level management being the most represented category, comprising 44.6% of the sample, highlighting their influence in shaping digital transformation strategies. Additionally, participants reported a high level of involvement in decision-making, with most respondents either being primary decision – makers (52.2%) or part of the decision-making team (45.7%). This reinforces the relevance of the sample to the study's focus (see table 3 & 4). Further, we notice that respondents were primarily from retail (40%), manufacturing (18.5%), and technology (17.4%) sectors, which provides a diverse cross-section of industries struggling with digital transformation challenges. This implies that the study is comprehensive and not limited to a single sector. Further, medium-sized organizations (50-249 employees) constitute 52.2% of the sample, indicating a focus on mid-sized businesses in the data collection, while small enterprises (10-49 employees) account for 38%. This distribution highlights that a significant portion of respondents were embedded in organizations with sufficient resources to engage in digital initiatives but still faced the typical constraints of SMEs, such as limited budgets and human capital.

<i>Job Position</i>	<i>Frequency</i>	<i>Percent</i>	<i>Cumulative Percent</i>
Top-level Management	41	44.6%	44.6%
Mid-level Management	29	31.5%	76.1%
First-line Management	18	19.6%	95.7%
Team Leader	4	4.3%	100.0%
Total	92	100.0%	100.0%

Table 3 descriptive statistics job position

<i>Involvement in Decision-Making</i>	<i>Frequency</i>	<i>Percent</i>	<i>Cumulative Percent</i>
Yes, I am the primary decision-maker	48	52.2%	52.2%
Yes, I am part of the decision-making team	42	45.7%	97.8%
No, I am not directly involved in the decision-making process	2	2.2%	100.0%
Total	92	100.0%	100.0%

Table 4 descriptive statistics decision-making involvement

Further, we have noticed a high mean score of 3.8 (on a scale from 1 to 5) on the dependent variable digital transformation maturity level. This suggests that organizational structures are in place to support digital initiatives, setting a solid foundation for further analysis of how specific skills contribute to digital transformation maturity. For a detailed overview of the relevant descriptive statistics, refer to Appendix 6. Here you can also find the categorizations of variable items, which provides you with additional information about how to interpret e.g. this studies mean scores (e.g. a mean score of 4.2 for age refers to about the category labeled 4 corresponding to age 35-44). These descriptive statistics provided a comprehensive overview of the sample's characteristics and confirm that the participants are well-suited for this study's focus on leadership skills in digital transformation. With respondents primarily occupying senior leadership roles and representing key industries, the descriptive analysis demonstrated that the sample is relevant and appropriate for addressing the research questions.

4.2 Confirmatory Factor Analysis (CFA) and Measurement Model Fit

In this section, we conducted a Confirmatory Factor Analysis (CFA) to validate the constructs used in our model. This step ensured that the theoretical constructs are both reliable and valid (Benitez et al., 2020). The validation is crucial for ensuring that our structural model and hypothesis testing are based on solid foundations, preventing incorrect assumptions that could undermine the credibility of the findings. We began by *assessing the factor loadings* to confirm the strength of the relationship between each variable and its respective construct. Items with factor loadings below 0.50 or significant cross-loadings were removed to enhance the model's robustness. For example, several items from the "Networking" construct were excluded because they did not sufficiently contribute to the measurement. This refinement process improved the internal consistency of the model, ensuring that only the most reliable indicators were retained (see appendix 7 for an overview of removed items).

Next, we *evaluated the overall fit of the model*. The primary reason for evaluating the overall fit of the model is to ensure that the proposed model accurately reflects the relationships among the variables being studied. For this process, we used several key metrics, including the chi-square statistic, SRMR, and NNFI. For the chi-square value, which tests the difference between observed and expected covariance matrices, we prefer lower values. We conclude that the chi-square was within an acceptable range, indicating a reasonable fit between the model and the data. However, it's important to note that Chi-square is sensitive to sample size and model complexity (Bentler & Bonett, 1980). Although the SRMR value of 0.097 slightly exceeded the preferred threshold of 0.080 (Hu & Bentler, 1999), it remains within an acceptable range. The NNFI, with values of 0.644 for the saturated model and 0.619 for the estimated model, was

below the ideal threshold of 0.90 (Schermelleh-Engel, 2003), but given the study's constraints and theoretical requirements, the overall fit is still considered acceptable. We also considered further simplifying the model by excluding highly correlated items, but this was not feasible. The independent variables had already been refined in earlier stages, and removing any dependent variable items would have weakened the validity of the construct, as we relied on an established model to assess it. Moreover, the sample size, though limited by time constraints, was sufficient for the analysis. While a larger sample could have produced more robust estimates and improved model fit indices, the current results remain interpretable within the study context. Additionally, including several control variables added complexity to the model, which may have slightly affected the fit. However, this complexity was necessary to account for potential conflicting factors and ensure a detailed analysis. Despite these limitations, the model fit remains acceptable, and the results are meaningful and reliable. For a detailed overview of the goodness-of-fit results, refer to appendix 7.

Finally, we **assessed the reliability and validity** which were essential to ensure that the constructs being measured (e.g., CDO-related digital skills) are consistent, accurate, and well-represented in the study. Reliability of the constructs was assessed using Cronbach's alpha and composite reliability (CR). The threshold for Cronbach's alpha is greater than 0.70. This metric evaluates the internal consistency, or how closely related a set of items are within a group. Values above 0.70 indicate good internal consistency and reliability, suggesting that the items effectively measure the same underlying construct (Tavakol & Dennick, 2011). For composite reliability, the threshold is also set above 0.70. This measure assesses the reliability of a latent variable's indicator variables, providing an evaluation similar to Cronbach's alpha but tailored for Partial Least Squares Structural Equation Modeling (PLS-SEM) (Henseler et al., 2009). Both metrics are exceeding the 0.70 threshold, confirming that the constructs are consistent. Convergent validity was confirmed through Average Variance Extracted (AVE), which measures the level of variance that a construct captures relative to the level of variance due to measurement error. The threshold for AVE is greater than 0.50 which is met in our data set (Fornell & Larcker, 1981). Lastly, discriminant validity was demonstrated using the HTMT ratio, which is a contemporary measure that compares the average correlations between indicators of different constructs to the average correlations within the same construct. For our study, we can conclude that all values are below the critical threshold of 0.85 (Henseler et al., 2015). Table 5 presents the reliability and validity assessment results for each construct in the measurement model:

<i>Construct</i>	<i>Cronbach's Alpha</i>	<i>Composite Reliability</i>	<i>AVE</i>	<i>HTMT</i>	<i>Reliability met?</i>	<i>Validity met?</i>
Digital Transformation Maturity	0.969	0.972	0.697	-	Yes	Yes
Digital Strategy	0.941	0.953	0.772	0.801	Yes	Yes
Empowerment	0.719	0.825	0.542	0.646	Yes	Yes
Innovation	0.847	0.907	0.766	0.809	Yes	Yes
Networking	0.777	0.865	0.684	0.664	Yes	Yes
Tech Savviness	0.914	0.940	0.796	0.832	Yes	Yes

Table 5 reliability and validity assessment results

In this section, we conducted a Confirmatory Factor Analysis (CFA) to validate the constructs used in our model, ensuring that they are both reliable and valid for further analysis (all relevant outputs from the SmartPLS analysis can be found in appendix 7). This step was essential as it confirmed that the theoretical constructs, such as the independent variables, accurately reflect the data. We refined the model by removing items with low factor loadings, thereby improving its internal consistency and overall fit. Despite some minor deviations from optimal thresholds in fit indices, the model was deemed acceptable for further analysis. The reliability and validity assessments, including Cronbach's alpha, composite reliability (CR), and Average Variance Extracted (AVE), showed that the constructs are consistent and well-differentiated. These results give us confidence that the measurement model is sound, laying a strong foundation for the next critical phase: testing the hypotheses. In the next section, we will analyze the relationships between the key constructs and evaluate the impact of CDO-related skills on digital transformation, addressing the core research questions.

4.3 Structural Model Analysis and Hypotheses Testing

With the measurement model validated, the next step of the data analysis was to test the structural relationships between the key constructs. This step allows us to validate the hypotheses outlined in Chapter 2 of the thesis and assess how well the conceptual framework aligns with the empirical data. By examining the relationships between essential skills and Digital Transformation Maturity, we gain deeper insights into which skills are most critical for advancing digital transformation in organizations, which directly supports the overall research objective (the model that has been tested can be found in appendix 7). To test these hypotheses, the data were analyzed using SmartPLS software, a tool specifically designed for Partial Least Squares Structural Equation Modeling (PLS-SEM). SmartPLS was chosen due to its robustness in handling small to medium sample sizes and its ability to model complex relationships among variables.

The path analysis revealed several key insights into the relationships between CDO-related skills and digital maturity. We conclude that *Tech Savviness* has the strongest relationship with Digital Transformation Maturity, with a path coefficient (β) of 0.440 and a highly significant p-value of 0.000. This result underscores the critical role of technological expertise in enabling leaders to drive digital initiatives effectively. Leaders who possess strong technical skills are better equipped to implement digital tools and processes, enhancing the organization's overall digital maturity. *Digital Strategy* also showed a significant positive effect on Digital Transformation Maturity, with a path coefficient (β) of 0.362 and a p-value of 0.000. This finding emphasizes the importance of having a clear strategic vision for digital transformation. Leaders who can align digital initiatives with the organization's broader goals are more successful in advancing digital transformation efforts. *Innovative thinking* demonstrated a significant, though somewhat smaller, positive effect on Digital Transformation Maturity, with a path coefficient (β) of 0.190 and a p-value of 0.019. This suggests that fostering innovative thinking among leaders contributes to an organization's ability to embrace new ideas and technologies, facilitating digital growth.

On the other hand, ***Digital Leadership Orientation (Empowerment)*** did not show a significant effect, with a path coefficient (β) of 0.034 and a p-value of 0.495. This indicates that empowerment-focused leadership may not have a direct influence on digital transformation, suggesting that other skills or factors might be more critical in this context. Lastly, ***Networking*** had a negative but not statistically significant impact on Digital Transformation Maturity, with a path coefficient (β) of -0.148 and a p-value of 0.069. While networking is often considered important for gathering external insights, the data suggest that it may not directly influence an organization's internal digital transformation efforts.

In addition to testing the key constructs, we also analyzed several ***control variables*** to gain further insights into the factors that might influence digital transformation maturity. This step helped to identify whether factors such as job position, industry type, or organization size play a significant role alongside the primary leadership skills assessed in the structural model. The analysis of control variables provided additional insights into the factors influencing digital transformation maturity. Job position had a significant positive effect (path coefficient = 0.231, $p < 0.01$), indicating that individuals in higher management positions are more likely to drive digital transformation initiatives successfully. This aligns with the understanding that senior leaders have the authority, resources, and strategic oversight to implement large-scale changes within their organizations. However, as this is not the primary focus of this research, this finding is acknowledged but not explored in detail. The industry type, organization size, and age of the leader did not have significant effects on digital transformation maturity, suggesting that the impact of CDO-related skills transcends these demographic or organizational characteristics. This reinforces the conclusion that it is the specific skills of the leaders, rather than external factors, that are crucial to the success of digital transformation initiatives.

The results of this analysis provide clear evidence that digital strategy, tech savviness, and innovative thinking are the key CDO skills that leaders must possess to successfully drive digital transformation in German SMEs. These skills enable leaders to align their organization's strategy with digital initiatives, leverage technology effectively, and foster a culture of innovation that is essential in the current digital age. While digital leadership orientation qualities (e.g. empowerment) and networking may still play supportive roles, they do not appear to be the primary drivers of transformation (you can find all relevant outputs in the appendix 7). The next chapter will examine the findings in more detail and explore the practical and theoretical implications of these findings.

5 Discussion and Implications

This chapter analyzes the key findings from the research and discusses their implications for theory and practice. The section begins by connecting the study's core findings with its limitations, providing a balanced perspective. Practical contributions and theoretical advancements are also discussed in detail.

5.1 Key Findings and Limitations of Research

In this section, we explore the main findings of the research, critically evaluating how CDO-related skills influence digital transformation maturity. The results from the empirical analysis provide strong support for the theoretical framework proposed in this study. They validate that leadership skills tailored to the digital domain are essential for SMEs navigating the rapidly evolving business environment which is in line with findings from Berghaus & Back (2016). We also address the study's limitations, offering a detailed analysis of the constraints and challenges encountered during the research.

Tech Savviness ($\beta = 0.440, p = 0.000$) emerged as the strongest predictor of digital transformation maturity, highlighting the critical role of technical expertise in the digital age. This aligns with the concept of 'digital fluency' proposed by Weill & Woerner (2018), which suggests that leaders who are proficient in digital technologies are better able to guide their organizations through complex digital landscapes. In today's business environment, where digital technologies are rapidly evolving, leaders with a strong grasp of these technologies are better positioned to make informed decisions about which tools and platforms to adopt. They can effectively integrate these technologies into existing processes and lead their teams in acquiring the necessary skills. For German SMEs, which may not have the extensive IT resources of larger firms, tech-savvy leadership can be a critical factor in achieving successful digital transformation. The theoretical background of this study emphasized that SME leaders must possess a deep understanding of the digital landscape, including emerging trends and data-driven decision-making, to effectively guide their organizations through the transformation process (Munsamy et al., 2023; Weber et al., 2022).

Digital Strategic Vision has a strong positive effect ($\beta = 0.362, p = 0.000$) on digital transformation maturity, highlighting the need for a long-term strategic focus on digital initiatives. This highlights the importance for leaders having a forward-thinking approach that integrates digital activities with broader company objectives. This finding builds on the work of Warner & Wäger (2019), who argue that leaders who possess the ability to integrate digital initiatives into their core business strategy are better positioned to achieve sustainable transformation. According to the theoretical framework, a well-crafted digital strategy not only guides the deployment of digital technologies, but also supports the organization stay aligned and work together effectively when responding to changing market conditions and technological disruptions. This vision is especially important for SMEs, where balancing limited resources with long-term objectives is critical. SME leaders need to develop and communicate this vision, ensuring that digital transformation is not just an operational change, but a fundamental rethinking of the company's DNA (Horváth & Szabó, 2019).

Innovative Thinking ($\beta = 0.190, p = 0.019$) also showed a positive and significant relationship with digital transformation maturity, reinforcing the idea that innovation is central to navigating the complexities of the digital age. This supports the work of Scuotto et al. (2022), who found that SMEs must adopt creative approaches to overcome the limitations they face in terms of budget and human capital. By encouraging experimentation and embracing new ideas, leaders can drive continuous improvement and adaptability, both of which are critical for thriving in a

dynamic digital environment. Innovation, as explored in the theoretical framework, goes beyond the introduction of new products or services. It involves reengineering processes, exploring new business models, and fostering a culture that supports continuous improvement and adaptation (Slimane et al., 2022). For SMEs, where agility and responsiveness are often key competitive advantages, leaders who cultivate an environment of innovation can better equip their organizations to thrive in the fast-evolving digital landscape.

On the other hand, *Digital Leadership Orientation* ($\beta = 0.034, p = 0.495$) did not show a significant impact on digital transformation maturity. The theoretical framework suggested that while leadership is critical in any organizational change, the specific demands of digital transformation—such as aligning technology with strategy and fostering innovation—require a different set of competencies. This could explain why digital leadership orientation, which focuses more on traditional leadership qualities like empowerment and team motivation, showed a less direct impact on the digital transformation maturity of SMEs (Amundsen & Martinsen, 2014).

Networking & Scanning ($\beta = -0.148, p = 0.069$) revealed a negative relationship with digital transformation maturity that, while near significance, was not statistically conclusive. This contrasts with findings in larger firms where external partnerships and networks play a more prominent role in digital transformation (Deloitte MCS Limited, 2018). The observed negative association is somewhat surprising, as networking is typically regarded as a valuable asset for organizational growth and innovation. However, in the context of SMEs, this study suggests that excessive focus on external networking could potentially hinder the internal focus required for the effective implementation of digital strategies. Theoretical insights suggest that while networking can provide leaders with important insights and foster beneficial relationships that support digital transformation, it may also lead to information overload or distract from the strategic execution of digital initiatives (Hassan et al., 2018; Mharapara et al., 2019). Given the p-value of 0.069, this result is considered "marginally" significant, indicating that while there is some evidence of an effect, it does not meet the conventional threshold for statistical significance. This implies that the negative relationship observed between Networking & Scanning and digital transformation maturity might be true, but it doesn't have the strength or reliability to be considered statistically significant by conventional measures.

While the key findings highlight significant insights into the role of Tech Savviness, Digital Strategic Vision, and Innovative Thinking in driving digital transformation maturity, it is essential to acknowledge *the limitations* that might impact the broader application of these findings. First, the research was specifically focused on SMEs in Germany. This means the findings may not apply to other regions or industries. Another limitation comes from the use of self-reported data to assess the CDO-related skills. Since participants provided their own evaluations, there's always a chance for bias—whether they unknowingly overestimated or underestimated their abilities. To strengthen future research, it would be valuable to include more objective data sources, such as performance metrics or evaluations from third parties. Additionally, this study was cross-sectional, capturing a single moment in time. This limits the ability to understand how the relationship between these skills and digital transformation develops over time. Another limitation is the limited number of survey responses. With a

sample size of 92 participants, the study's statistical power is somewhat restricted. A larger sample size could provide more robust results and may allow for more detailed subgroup analysis, offering a clearer picture of the impact of CDO-related skills across various types of organizations. Next, there has been an issue with high correlations among certain variables, which led to the exclusion of some items from the final model. This decision was made to ensure the reliability of the results, but it also means that some aspects of the CDO-related skills may not have been fully captured. Future studies could refine these measures to avoid multicollinearity issues and offer a more comprehensive view of the relationships between the skills and digital transformation maturity. Further, the Non-Normed Fit Index (NNFI) values for both the saturated and estimated models fell below the ideal threshold of 0.90, with values of 0.644 and 0.619, respectively. While this indicates a less-than-optimal fit, these values are still considered acceptable. Future research could address this limitation by refining the model and incorporating more comprehensive fit measures. Moreover, the study focuses on five specific CDO-related skills, leaving open the possibility that other relevant competencies were not included. For instance, change management skills, may play a crucial role in successful digital transformation but were not explicitly covered in this research. Another limitation concerns the lack of consideration of external factors that may influence the effectiveness of CDO-related skills. The study does not account for external factors such as market volatility, technological disruptions, or economic downturns, which could significantly impact how leaders manage digital transformation. For example, leadership in digital transformation might be influenced by external technological innovations (such as AI, blockchain) or by competitive pressures in the market. A more comprehensive model would include these external factors to assess how leadership skills interact with the broader business environment. role of external partnerships and collaborations in SME digital transformation. In line with this, we suggest that future studies could also investigate whether external networks become more important as organizations progress further along the digital maturity scale or whether industry-specific factors play a role in determining the importance of networking skills. Finally, while the study provides valuable insights into leadership skills and digital transformation, it does not delve deeply into organizational culture and its role in digital transformation efforts. A supportive organizational culture is often critical for the success of digital initiatives, as it fosters innovation and reduces resistance to change. Future research should explore the interaction between leadership skills and organizational culture.

This chapter has provided a critical evaluation of the key findings, highlighting the significant role of Tech Savviness, Digital Strategic Vision, and Innovative Thinking in driving digital transformation maturity in German SMEs. At the same time, the research underscores that other leadership skills, such as Digital Leadership Orientation and Networking & Scanning, may not have the direct influence on digital transformation that is often assumed. However, the study's limitations, emphasize the need for caution when applying these findings in broader contexts. As we move to the next section, the practical and theoretical contributions of the research will be discussed in more detail. These contributions provide actionable insights for leaders of SMEs looking to enhance their digital capabilities while also advancing academic discussions about the specific competencies required for digital transformation leadership.

5.2 Practical Contributions

This section highlights the practical implications of the research findings for SME leaders and organizations. The goal is to provide actionable insights on how the identified CDO-related skills can be leveraged to drive digital transformation in practice. It is important to note that our study found that only three of the identified key skills, innovative thinking, tech savviness, and digital business strategy, have a statistically significant impact on digital transformation maturity. Therefore, we recommend that SME leaders prioritize the development of these three skills as a first step in strengthening their organization's digital transformation efforts. While the other skills, such as networking and digital leadership orientation, were not found to be significant in our study, they remain valuable based on insights from the broader literature. Leaders should consider these areas as part of a holistic approach to leadership development.

First, it's important for SME leaders to focus on developing a clear and practical digital strategy that aligns with their overall business goals. To make this happen, leaders should organize regular strategy workshops with key team members and create a dedicated team to oversee the implementation of the digital strategy (Grant, 2003; Wirtz & Daiser, 2017). This ensures that the strategy isn't just a plan on paper but something that can be effectively put into action. Further, leaders can establish a specialized team responsible for overseeing the development, implementation, and continuous adjustment of the digital strategy. This team acts as the driving force behind the transformation, ensuring the organization stays on course to meet its digital goals (Wirtz & Daiser, 2017). Another recommendation for SME leaders is to avoid treating the organization's digital strategy in isolation. Instead, it should be closely aligned with the company's overall business objectives. This integration ensures that digital initiatives directly support the company's broader goals for growth and competitiveness (Grant, 2003; Wirtz & Daiser, 2017).

Next, fostering a culture of innovation (*innovative thinking*) within the company is crucial. Digital leaders should aim to create an environment where trying new things is encouraged, and mistakes are seen as opportunities to learn. Leaders can support this by organizing activities like internal hackathons or setting up innovation labs to inspire creative problem-solving and new ideas Chesbrough (2004) and using collaboration platforms Sawyer (2000). Making innovation a part of performance reviews can motivate teams to contribute actively to the digital transformation, keeping innovation at the forefront of the company's priorities.

The CDO skill *tech savviness* was found to be the strongest predictor of digital transformation maturity. This underscores the need for SMEs to ensure that both their leadership and workforce are equipped with the necessary digital skills to navigate and implement new technologies. SME leaders need to ensure that, both themselves and their workforce, are committed. This does not mean that all leaders must be IT experts, but they should have sufficient digital literacy to make informed decisions and guide their organizations effectively through the complexities of digital transformation. Practical steps to enhance tech savviness include to continuous learning and upskilling to keep pace with technological advancements. This can be achieved through partnerships with educational institutions to offer customized training programs or certifications in key areas like data analytics, cloud computing, and AI (Davenport, 2005). Further, to ensure

that leaders stay at the forefront of digital trends, they should actively participate in digital leadership conferences and workshops. This not only enhances their knowledge but also equips them to make informed decisions about which technologies to adopt and how to implement them (Davenport, 2005). Lastly, we recommend SME leaders to promote a culture where employees are encouraged to experiment with and adopt new technologies. This helps integrate tech savviness across all levels of the organization, from leadership down to individual contributors (Swap et al., 2001).

While the skills *networking & scanning* and *digital leadership orientation* did not show a significant positive direct effect on digital transformation, both skills still play an important role. It's advised that SME leaders should focus their efforts on building relationships that provide real value for the organization's digital strategy. This could involve participating in industry-specific digital forums (Gulati et al., 2000), joining digital transformation groups, or working with technology vendors who can offer practical help in implementing digital solutions (Das & Teng, 2000). Additionally, bringing in external experts can be very beneficial, especially in areas where the company might not have in-house expertise. This could mean hiring consultants for specific digital projects or partnering with tech companies to gain access to the latest tools and best practices without having to make large investments (Etzkowitz & Leydesdorff, 2000). Next, we recommend that SME leaders adopt leadership programs that emphasize digital literacy, managing change in a digital environment. By encouraging leaders to think with a digital-first mindset, companies can ensure that digital transformation becomes a core part of their strategic direction and culture (Kotter, 1995).

5.3 Theoretical contribution

This study contributes to the evolving body of literature on digital transformation, leadership competencies, and the specific role of Chief Digital Officers (CDOs) in small and medium-sized enterprises (SMEs). While much of the existing research has concentrated on large corporations and their digital leadership strategies, SMEs—despite being key to the economy—have been less studied in this context. This thesis addresses this gap by investigating the intersection of digital transformation and leadership in SMEs, focusing specifically on the CDO's role and skill set, which have not been extensively explored in academic literature.

One of the core theoretical contributions is the *conceptual framework developed for understanding which CDO-related skills are most critical* for driving digital transformation in SMEs. Previous studies have often focused on broad, generic leadership competencies without delving deeply into the specific skills required to manage digital initiatives in smaller firms. By isolating key CDO skills—such as innovative thinking, tech savviness, and digital business strategy—and empirically testing their relevance to digital transformation maturity, this research fills an important gap in leadership studies. Additionally, this thesis *contributes to the ongoing theoretical debate on the necessity of the CDO role itself in SMEs*. While prior studies (e.g. Zoppelletto et al., 2023) have debated the effectiveness of having a dedicated digital officer versus distributing digital leadership across existing management, this thesis adds empirical evidence to the discussion by demonstrating that certain CDO skills can be critical for transformation, regardless of whether a formal CDO role is present. This insight supports an emerging view in the literature that distributed leadership or cross-functional leadership

teams can successfully lead digital initiatives, especially in SMEs where resources may not justify a dedicated CDO role.

In the previous section, we emphasized the practical and theoretical significance of the key CDO-related skills, Tech Savviness, Innovative Thinking, and Digital Strategic Vision, in driving digital transformation in SMEs. As we move to the final chapter, the conclusion, the focus shifts to summarizing the overall findings of the research. We will revisit the research question and demonstrate how the findings contribute to addressing it. This chapter will connect the study's main outcomes with its goals of understanding CDO leadership in digital transformation within SMEs. It will also reflect on how the research contributes to the academic discussion and suggest ideas for future research.

6 Conclusion

This chapter presents the conclusions drawn from the research, critically analyzing the key findings to address the research question: "Which CDO-related skills are essential for leaders in German small and medium-sized enterprises to adopt in order to effectively drive digital transformation initiatives within their organizations?". The findings of this study directly contribute to addressing the research question by identifying and validating the essential CDO-related skills required for leaders in German SMEs to effectively drive digital transformation. Specifically, the skills of Tech Savviness, Digital Strategic Vision, and Innovative Thinking were confirmed as having a significant impact on digital transformation maturity, supporting the need for leaders to be both technologically adept and strategically innovative. While the study provides valuable insights, a critical evaluation of its implications is necessary to understand its broader relevance and the complexities.

6.1 Answering the Research Question

Initially, we started the research with a comprehensive literature review that identified five essential CDO-related skills: Tech Savviness, Digital Strategic Vision, Innovative Thinking, Digital Leadership Orientation, and Networking. These skills were proposed as crucial for driving digital transformation maturity in small and medium-sized enterprises (SMEs). To validate these theoretical insights, a quantitative survey questionnaire was conducted among SME leaders. The results of the survey showed that only three of the five identified skills, Tech Savviness, Digital Strategic Vision, and Innovative Thinking, had a significant positive relationship with digital transformation maturity. These findings suggest that leaders who possess advanced technical skills, a clear strategic approach, and an innovative mindset are better equipped to guide their organizations through digital transformation. While these skills are valuable, the study's focus on a narrow set of skills risks oversimplifying the complexity of leadership in digital contexts. Digital transformation is an ongoing process that involves not only leadership competencies but also cultural, structural, and financial factors. By focusing on a limited set of CDO-related skills, the research might underplay the importance of such factors.

Moreover, while the skills Digital Leadership Orientation and Networking were not found to have a direct impact on digital transformation maturity, their influence should not be

overlooked. Leadership orientation shapes an organization's culture, and the ability to build networks can help secure external resources and insights that are critical in responding to industry changes. By overlooking these skills, the study may miss how these contribute to transformation over time. Therefore, the interpretation of these findings needs consideration of the broader organizational and environmental factors that could enhance or limit the effectiveness of these skills.

6.2 Final Reflection

In conclusion, this research highlights the critical role of specific CDO-related skills, Tech Savviness, Digital Strategic Vision, and Innovative Thinking, in driving digital transformation in German SMEs. From a practical standpoint, the emphasis on Tech Savviness offers valuable guidance for SMEs that need to stay competitive with technological advancements. However, not all SMEs may have the resources to build these technical expertise in-house. Smaller organizations, especially those with limited financial or technical resources, may struggle to develop the level of tech expertise suggested by this study. In such cases, relying on external consultants or forming strategic partnerships may be more feasible solutions. This reliance, however, can introduce new challenges, such as dependency on external expertise. Moreover, while Digital Strategic Vision and Innovative Thinking are crucial for guiding long-term transformation, these skills alone may not be sufficient for organizations that are not prepared for change. SME leaders might face resistance from employees, misalignment across departments, or difficulties integrating new technologies into existing systems. Assuming that fostering innovation and technical know-how alone will guarantee successful digital transformation oversimplifies the complex nature of organizational change. SMEs must also invest in change management processes, workforce training, and infrastructure development, elements that were not as heavily emphasized in this research but are just as crucial for successful transformation.

Despite these challenges, the research offers valuable takeaways for SME leaders and practitioners. The identification of Tech Savviness, Digital Strategic Vision, and Innovative Thinking as key drivers of digital transformation provides a clear roadmap for developing leadership skills that have a proven impact on digital maturity. By prioritizing these skills, SMEs can position themselves more effectively in the digital landscape and create a foundation for sustained growth and competitiveness. Moreover, the findings reaffirm the importance of leadership in digital transformation, demonstrating that even in resource-constrained environments like SMEs, focused leadership development can have a significant positive effect on digital progress. The study also offers motivation to SMEs by showing that successful digital transformation doesn't always require extensive resources, rather, it requires leadership with the right skills to drive innovation and align digital efforts with strategic business objectives. This insight gives hope that, with the right investment in leadership development, SMEs can effectively navigate digital challenges and thrive in an evolving digital landscape.

Ultimately, while the findings provide valuable guidance for SME leaders, they should be applied with caution, particularly in diverse organizational contexts. In the next subsection, we will conclude this research by exploring potential directions for future research, focusing on

how further studies can expand our understanding of digital transformation in different contexts and address some of the gaps identified in this research.

6.3 Future Direction

Several important directions for future research emerge from the findings of this study. Firstly, future research could focus on expanding the study to include SMEs from different geographic regions and industries, allowing for a better understanding of whether the identified CDO-related skills are universally applicable or context-dependent. Additionally, research into how organizational structure and employee resistance affect the implementation of these digital skills would provide more holistic insights into the digital transformation process. Longitudinal studies tracking the evolution of digital transformation over time would offer a more dynamic view of how leadership competencies evolve alongside technological advancements. Another potential research area lies in exploring the role of soft skills, such as emotional intelligence and adaptability, which were not emphasized in this study but are likely critical for overcoming human-related challenges during digital change. Finally, investigating the interplay between leadership skills and external factors, such as market trends, economic conditions, and regulatory changes, would add depth to the current understanding of digital transformation. A more comprehensive analysis that incorporates both internal leadership skills and external environmental factors could yield more actionable insights for SME leaders globally.

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8 Appendix

Appendix 1: Digital Technologies enabling Digital Transformation

Technology	Explanation
5G Connectivity	5G networks offer faster connectivity, enabling machine-to-machine communication, fostering innovation, and accommodating the IoT (OECD, 2021).
Internet of Things (IoT)	IoT encompasses interconnected devices and sensors that exchange data, facilitating insights and information exchange between devices and humans (OECD, 2021).
Big Data Analytics	Analyzing large volumes of data enables businesses to uncover insights, dependencies, and predictions, enhancing decision-making and personalization (OECD, 2021).
Cloud Computing (CC)	CC provides on-demand access to ICT services, offering flexibility, cost reduction, and eliminating upfront investments in hardware and software (OECD, 2021).
Artificial Intelligence (AI)	AI automates processes, analyzes data, and enhances decision-making, contributing to improved customer service, personalization, and automation (OECD, 2021).

Blockchain

Blockchain technology ensures secure and transparent transactions, reduces costs, and enhances trust in value transfers and agreements (OECD, 2021).

Mobile Technology and Smart Apps

Mobile apps enable personalized experiences and seamless transactions, while smart devices enhance productivity and customer service (Pascucci, Savelli & Gistri, 2023).

Social Media Platforms

Social media platforms connect businesses with customers, build brand awareness, conduct marketing campaigns, and gather valuable consumer insights (Pascucci, Savelli & Gistri, 2023).

Enterprise Resource Planning (ERP) Systems

ERP systems streamline operations by integrating information flows, automating functions, and improving efficiency in back-office tasks and planning (Pascucci, Savelli & Gistri, 2023).

Appendix 2: overview CDO-related skills including key insights, definition, categorization

CDO-Related Skill	Category (Katz & Kahn)	Operational Definition	Key Insights
<i>Digital Strategic Vision</i>	Conceptual	The proficiency to conceptualize, convey, and execute a digital strategic vision aligned with organizational goals.	Conceptualizing and executing a digital strategy aligned with goals; integrating digital technologies into business models; fostering innovation and flexibility.
<i>Digital Leadership Orientation</i>	Interpersonal	The ability to demonstrate leadership skills, including decision-making, communication, and team management.	Demonstrating leadership in decision-making, communication, and team management; guiding digital transformation; fostering a culture of innovation.
<i>Innovative Thinking</i>	Conceptual	Skills to generate creative ideas and transform them into prototypes or tangible solutions.	Fostering creativity and balancing risk in idea generation; leveraging digital technologies for innovation and staying updated on trends.
<i>Tech Savviness</i>	Technical	Competence in using, adapting, and utilizing technology, digital tools, and platforms effectively.	Effective use of technology; deep understanding of digital tools; early adoption of emerging trends; developing digital architectures.
<i>Networking & Scanning</i>	Interpersonal	Proficiency in establishing, managing, and leveraging networks and relationships for strategic objectives.	Establishing and managing networks for collaboration; responding to political and legal changes; facilitating knowledge exchange and innovation.

Appendix 3: Measurement items independent variables (CDO related skills)

Zero – order concepts (items)	First – order concepts	Second – order concepts (skills)	Cronbachs alpha / item reference
The CDO / digital leader...			
1. evaluates customer-centeredness using a variety of data to gain insights	Digital Business Strategy' formulation	Digital Strategic Vision	<u>Berbel- Vera et al.:</u> $\alpha = 0.92$
2. develops digital technologies that can enhance products, customer relationship and competitive position	Identification and Exploitation of Digital Opportunities		Niemand et al., 2021: $\alpha = 0.86$
3. manages digital initiatives within the organization with a long term and strategic focus			
4. is questioning existing business models	'Digital Business Strategy' integration		AlNuaimi et al., 2022: $\alpha = 0.925$
5. integrates digital technologies and business strategy to attain strategy alignment			
6. ensures the implementation of digital strategy across all business units			
7. articulates a clearly defined digital strategy for the organization			
8. regularly evaluates and adapts the digital strategy as needed			
The CDO / digital leader...			
1. encourages team members to express ideas/suggestions.	Empowerment	Digital Leadership Orientation	<u>Amundsen & Martinsen:</u> delegation ($\alpha = 0.78$), information sharing (α
2. encourages team members to exchange information with one another	Motivating		

<ol style="list-style-type: none"> 3. uses his/her teams' suggestions to make decisions that affect the organization. 4. gives all team members a chance to voice their opinions. 5. distributes responsibility to team members. 6. gives team members authority over issues. 7. inspires all members with the digital transformation plans for our organization. 8. motivates team members to work together for the same digital transformation goals. 9. delegates power to team members as appropriate 	<p>Inspiring</p>	<p>= 0.82), encourage initiative ($\alpha = 0.84$) inspiring ($\alpha = 0.82$),</p>	
<p><u>Arnold et al.:</u> coaching ($\alpha = 0.9$); participative decision making ($\alpha = 0.86$); showing concerns ($\alpha = 0.89$)</p>			
<p>The CDO / digital leader...</p> <ol style="list-style-type: none"> 1. implements innovative ideas in the organization. 2. gets organizational members enthusiastic about innovations in the organization. 3. uses creative problem-solving methods to encourage innovation in the organization. 4. creates an open error culture in the team. 5. gives the freedom and flexibility to experiment intensely with a variety of digital technologies. 6. is less focused on operational reliability and more focused on experimenting with new capabilities in novel areas. 7. facilitates continual experimentation with minimal viable products of digital innovations. 	<p>Idea generation & prototyping</p>	<p>Innovative Thinking</p>	<p><u>Weber et al.:</u> Items from category: 'Innovator' ($\alpha = 0.94$) 'Enabler' ($\alpha = 0.88$) <u>Berbel Vera et al.:</u> Overall $\alpha = 0.92$</p>
<p>The CDO / digital leader...</p> <ol style="list-style-type: none"> 1. understands the drivers of digital transformation. 2. recognizes digital trends at an early stage. 3. has extensive knowledge of digital technologies. ---- 	<p>Knowledge of existing technologies Use of digital tools and platforms</p>	<p>Tech Savviness</p>	<p><u>Weber et al.:</u> Items from category: 'Digital Pioneer' ($\alpha = 0.94$)</p>

<ol style="list-style-type: none"> 4. has the skills for data analysis so he/she can gain insights from both internal and external data sources. 5. understands data analytics techniques. 6. focuses on data quality issues. 7. adapt data policies to the digital evolution in the organization. 	<p>Incorporation of technology into decision making</p>	<p><u>Munsamy et al.:</u> Digital adoption ($\alpha = 0.853$); data understanding ($\alpha = 0.826$); digital technical skills & know how ($\alpha = 0.864$);</p>	
<p><u>Berbel Vera et al.:</u> Overall $\alpha = 0.92$</p>			
<p>The CDO / digital leader ...</p> <ol style="list-style-type: none"> 1. builds and maintains a wide network of contacts among peers and outsiders 2. attends social and professional events to meet people with useful information 3. joins social networks that include outsiders with useful information 4. develops cooperative relations with people who can provide resources and assistance 5. keeps informed about changes in the political environment, and behaviors of competitors and collaborators 6. enables working in interdisciplinary teams 	<p>Stakeholder engagement</p> <p>Relationship Building</p> <p>Internal & External Environment Awareness</p>	<p>Networking (& scanning)</p>	<p><u>Mharapara et al.:</u> Networking items ($\alpha = 0.9$)</p> <p><u>Hssan et al.:</u> Networking items ($\alpha = 0.91$) External monitoring items ($\alpha = 0.64$)</p>

Appendix 4: Digital transformation maturity model items (dependent variable) by Weritz et al. (2024)

<i>Capability</i>	<i>Items</i>
Data access & collaboration tools	<p>Within our firm we have an increase use of real-time customer and operations data.</p> <p>Within our firm we have an increase use of integrated end-user data.</p> <p>Within our firm we have communication, feedback, and collaboration tools that make it easy to be productive.</p> <p>Within our firm we can access flexible computing power and storage (e.g., through cloud services and external assets).</p>
Digital-first mindset	<p>Within our firm we take advantage of digital solutions wherever possible.</p> <p>Within our firm people naturally think of digital technologies when we consider ways to improve.</p> <p>Within our firm we prioritize digital solutions.</p> <p>Within our firm we openly explore digital opportunities.</p>
Digitized practices and operations	<p>Within our firm our core operational processes are automated and digitized.</p> <p>Within our firm we monitor our operations in real time.</p> <p>Within our firm we employ data-driven decision-making.</p> <p>Within our firm we standardize processes that require human input.</p>
Empowered talent	<p>Within our firm we have experience with new technologies like mobile devices and applications, social media tools and data, big data and advanced analytics, artificial intelligence, machine learning, and internet of things.</p> <p>Within our firm digital skills are widely distributed across.</p> <p>Within our firm we have the skills necessary to conduct digital initiatives.</p>

Appendix 5: Plan of action

Week	Task	Duration
1	Evaluating survey questions	1 week
2	Constructing survey with Qualtrics	1 week
3-6	Distributing survey and collecting responses	5 weeks
7-8	Data analysis	2 weeks
9	Data interpretation	1 week
10-11	Discussion of results	2 weeks
12-14	Writing research paper conclusion	2 weeks

Appendix 6: outputs descriptive statistics IBM SPSS

	<i>Mean</i>	<i>Std. Deviation</i>
<i>Control Variables</i>		
Location	1.00	.000
Industry	3.62	1.525
Number Employees	2.42	.667
Turnover	1.09	.410
Gender	1.47	.502
Age	4.20	.975
Job Position	1.84	.893
Involvement	1.50	.545
<i>Independent variables</i>		
Digital Strategy	3.9674	.88545
Digital Leadership Orientation	4.3777	.40174
Innovative Thinking	3.2428	.98475
Networking	4.3007	.65756
Tech Savviness	3.5625	.97399
<i>Dependent variable</i>		
Digital Transformation Level	3.8175	.88401

Table descriptive statistics all variables

<u>Variable Name</u>	<u>Description</u>	<u>Survey Question</u>	<u>Scale Description</u>
Location	Control variable	Is your organization currently operating in Germany?	1: Yes 2: No
Industry	Control variable	Please classify your organization according to the industry it operates in	1: Manufacturing 2: Healthcare 3: Service 4: Retail 5: Technology 6: Hospitality 7: Other
NumberEmployees	Control variable	Please classify your organization based on the number of employees	1: Micro 1-9 Employees 2: Small 10 – 49 Employees 3: Medium 50 – 249 Employees 5: large more than 249 Employees
Turnover	Control variable	Is your annual turnover or revenue below €50 million?	1: Yes 2: No 3: prefer not to answer
Gender	Control variable	What is your gender?	1: male 2: female
Age	Control variable	What is your age?	1: under 18 2: 18-24 3: 25-34 4: 35-44 5: 45-54 6: 55-64 7: 65-74 8: 75-8 9: 85 or older
JobPosition	Control variable	What is your current management job position within your organization?	1: Top-level Management (e.g., Owner, Senior, CEO, COO, CFO, CMO)

			<p>2: Mid-level Management (e.g., Director, Manager)</p> <p>3: First-line Management (e.g., Assistant Manager, Supervisor)</p> <p>4: Team Leader</p> <p>5: Other (please specify)</p>
Involvement	Control variable	Are you directly involved in the decision-making process related to digital transformation initiatives within your organization?	<p>1: Yes, I am the primary decision-maker</p> <p>2: Yes, I am part of the decision-making team</p> <p>3: No, I am not directly involved in the decision-making process</p>
Digital Strategy Digital Leadership - Orientation Innovative Thinking Networking Tech Savviness	Independent variables	Please rate your agreement with the following statements...	<p>1: strongly disagree</p> <p>2: somewhat disagree</p> <p>3: neither agree nor disagree</p> <p>4: somewhat agree</p> <p>5: strongly agree</p>
Digital Transformation Maturity	Dependent variable	Please rate your agreement with the following statements...	<p>1: strongly disagree</p> <p>2: somewhat disagree</p> <p>3: neither agree nor disagree</p> <p>4: somewhat agree</p> <p>5: strongly agree</p>

Table 'information categorization of variable items'

		NumberEmployees			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Micro 1-9 Employees	9	9.8	9.8	9.8
	Small 10-49 Employees	35	38.0	38.0	47.8
	Medium 50-249 Employees	48	52.2	52.2	100.0
	Total	92	100.0	100.0	

Table descriptive statistics control variable number of employees

		Involvement			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, I am the primary decision-maker	48	52.2	52.2	52.2
	Yes, I am part of the decision-making team	42	45.7	45.7	97.8
	No, I am not directly involved in the decision-making process	2	2.2	2.2	100.0
	Total	92	100.0	100.0	

Table descriptive statistics control variable decision making involvement

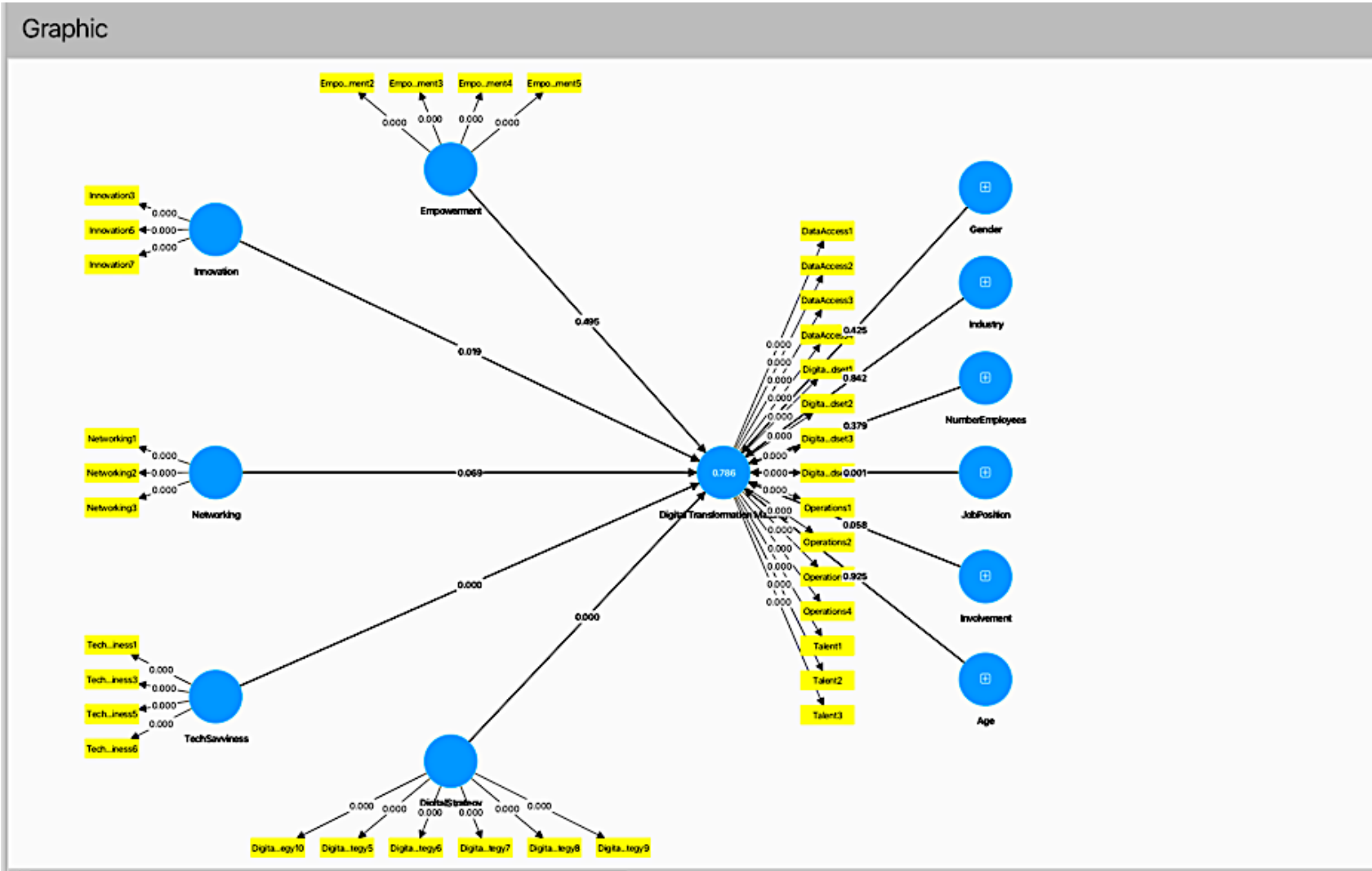
		Industry			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Manufacturing	17	18.5	18.5	18.5
	Healthcare	1	1.1	1.1	19.6
	Service	14	15.2	15.2	34.8
	Retail	37	40.2	40.2	75.0
	Technology	16	17.4	17.4	92.4
	Hospitality	5	5.4	5.4	97.8
	Other	2	2.2	2.2	100.0
	Total	92	100.0	100.0	

Table descriptive statistics control variable industry sector

		JobPosition1			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Top-level Management	41	44.6	44.6	44.6
	Mid-level Management	29	31.5	31.5	76.1
	First-line Management	18	19.6	19.6	95.7
	Team Leader	4	4.3	4.3	100.0
	Total	92	100.0	100.0	

Table descriptive statistics control variable job position

Appendix 7: outputs SEM data analysis (Smart PLS)



<i>Variable</i>	<i>Removed Items</i>	<i>Reason</i>
Digital Strategy	Items 1, 2, 3, 4	Cross-loadings; HTMT not acceptable
Digital Leadership Orientation	Items 1, 6, 7, 8	Lowest factor loadings, leading to low AVE
Innovative Thinking	Items 1, 2, 4, 6	Cross-loadings; HTMT not acceptable; high residual values
Networking	Items 4, 5, 6	Lowest factor loadings, leading to low AVE
Tech Savviness	Item 2, 4	Cross-loadings; HTMT not acceptable; high VIF; lowest factor loadings

Table removed measurement items

<i>Assumption</i>	<i>Method</i>	<i>Criteria</i>
<u>Multicollinearity Check</u>	Variance Inflation Factor (VIF)	VIF values should be below 5 (preferably below 3) to indicate no significant multicollinearity.
<u>Reliability</u>	Cronbach's Alpha & Composite Reliability (CR)	Cronbach's Alpha and CR values should be greater than 0.70 to ensure internal consistency.
<u>Convergent Validity</u>	Average Variance Extracted (AVE)	AVE should be above 0.50, indicating that constructs explain more than half the variance in their indicators.
<u>Discriminant Validity</u>	Heterotrait-Monotrait (HTMT) Ratio	HTMT values should be below 0.85 or 0.90 (depending on threshold) to confirm discriminant validity.

Table overview assumptions criteria

<u>Metric</u>	<u>Threshold</u>	<u>Saturated Model</u>	<u>Estimated Model</u>
Chi-square (χ^2)	Low values preferred	1656.198	1772.542
Standardized Root Mean Square Residual (SRMR)	< 0.080	0.085	0.097
Non-Normed Fit Index (NNFI)	> 0.90	0.644	0.619
<u>d_ ULS</u>	-	6.215	8.119
<u>d_ G</u>	-	4.033	3.864

Table goodness-of-fit measure results

R-square - Overview		
	R-square	R-square adjusted
Digital Transformation Maturity	0.786	0.756

Table SmartPLS output R-square

Model fit		
	Saturated model	Estimated model
SRMR	0.085	0.097
d_ ULS	6.215	8.119
d_ G	4.033	3.864
Chi-square	1656.198	1772.542
NFI	0.644	0.619

Table SmartPLS output Model Fit

Path coefficients - Mean, STDEV, T values, p values						Copy to Excel/Word	Copy to R
	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O /STDEV)	P values		
Age -> Digital Transformation Maturity	0.012	0.024	0.129	0.094	0.925		
DigitalStrategy -> Digital Transformation Maturity	0.362	0.361	0.101	3.571	0.000		
Empowerment -> Digital Transformation Maturity	0.034	0.039	0.050	0.682	0.495		
Gender -> Digital Transformation Maturity	0.106	0.096	0.133	0.798	0.425		
Industry -> Digital Transformation Maturity	-0.018	-0.020	0.092	0.200	0.842		
Innovation -> Digital Transformation Maturity	0.190	0.189	0.081	2.359	0.019		
Involvement -> Digital Transformation Maturity	0.384	0.361	0.202	1.901	0.058		
JobPosition -> Digital Transformation Maturity	0.248	0.250	0.073	3.404	0.001		
Networking -> Digital Transformation Maturity	-0.148	-0.138	0.082	1.821	0.069		
NumberEmployees -> Digital Transformation Maturity	-0.111	-0.110	0.126	0.880	0.379		
TechSavviness -> Digital Transformation Maturity	0.440	0.438	0.112	3.917	0.000		

Table SmartPls output Path coefficients

Construct reliability and validity - Overview						Copy to Excel/Word	Copy to R
	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)			
Digital Transformation Maturity	0.969	0.971	0.972	0.697			
DigitalStrategy	0.941	0.943	0.953	0.772			
Empowerment	0.719	0.730	0.825	0.542			
Innovation	0.847	0.871	0.907	0.766			
Networking	0.777	0.867	0.865	0.684			
TechSavviness	0.914	0.917	0.940	0.796			

Table SmartPls output construct reliability & validity

Discriminant validity - Heterotrait-monotrait ratio (HTMT) - Matrix												Copy to Excel/W
	Age	Digital Transformation Maturity	DigitalStrategy	Empowerment	Gender	Industry	Innovation	Involvement	JobPosition	Networking	NumberEmployees	TechSaviness
Age	1.000											
Digital Transformation Maturity	0.194	1.000										
DigitalStrategy	0.199	0.801	1.000									
Empowerment	0.161	0.413	0.646	1.000								
Gender	0.170	0.220	0.171	0.146	1.000							
Industry	0.413	0.208	0.176	0.188	0.077	1.000						
Innovation	0.066	0.777	0.809	0.509	0.376	0.093	1.000					
Involvement	0.772	0.179	0.165	0.113	0.150	0.039	0.089	1.000				
JobPosition	0.089	0.235	0.159	0.256	0.147	0.035	0.072	0.069	1.000			
Networking	0.339	0.446	0.664	0.532	0.202	0.119	0.561	0.357	0.160	1.000		
NumberEmployees	0.784	0.123	0.124	0.135	0.255	0.067	0.143	0.832	0.025	0.432	1.000	
TechSaviness	0.244	0.848	0.832	0.400	0.383	0.285	0.842	0.157	0.102	0.514	0.094	1.000

Table SmartPLS output HTMT matrix

Outer loadings - Matrix													Copy to Excel/Word	Copy to R
	Age	Digital Transformation Maturity	DigitalStrategy	Empowerment	Gender	Industry	Innovation	Involvement	JobPosition	Networking	NumberEmployees	TechSaviness		
Age	1.000													
DataAccess1		0.795												
DataAccess2		0.842												
DataAccess3		0.827												
DataAccess4		0.936												
DigitalMindset1		0.826												
DigitalMindset2		0.825												
DigitalMindset3		0.813												
DigitalMindset4		0.837												
DigitalStrategy10			0.897											
DigitalStrategy6			0.877											
DigitalStrategy9			0.857											
DigitalStrategy7			0.874											
DigitalStrategy8			0.835											
DigitalStrategy9			0.930											
Empowerment2				0.742										
Empowerment3				0.684										
Empowerment4				0.811										
Empowerment5				0.703										
Gender					1.000									
Industry						1.000								
Innovation3							0.798							
Innovation5							0.904							
Innovation7							0.919							
Involvement								1.000						
JobPosition									1.000					
Networking1										0.919				
Networking2										0.985				
Networking3										0.677				
NumberEmployees											1.000			
Operations1		0.686												
Operations2		0.850												
Operations3		0.913												
Operations4		0.762												
Talent1		0.863												
Talent2		0.828												
Talent3		0.894												
TechSaviness1												0.833		
TechSaviness3												0.934		
TechSaviness5												0.932		
TechSaviness6												0.877		

Table SmartPLS output outer loadings