UNIVERSITY OF TWENTE.

SKILLS AND LEADERSHIP IN THE IMPLEMENTATION OF SMART TECHNOLOGY: ADAPTING TO CHANGE OVER TIME

Master Thesis in Business Administration

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Abstract

This study investigates the key skills and leadership styles necessary for the effective implementation of smart technologies in the workplace, with a particular focus on the Connected Worker program. This program exemplifies smart technology that supports industrial and manufacturing employees by enhancing communication and facilitating access to information, thereby improving daily operations in the workplace.

An extensive literature review delineates four key skill categories critical for effective working with smart technologies : technical skills, adaptability skills, communication skills and professional & leadership skills. Relevant leadership styles, particularly transformational and instrumental, are also examined for their roles in guiding technology adoption. To underpin the theoretical framework, the study employs the Unified Theory of Acceptance and Use of Technology (UTAUT) model to elucidate factors influencing technology acceptance, and Leader-Member Exchange (LMX) theory to investigate the relationship between leadership style and employee skill development.

A retrospective, multi-perspective case study approach was applied, focusing on operators and their direct supervisors at Company X in Poland. Interviews were conducted in the participants' native language, with questionnaires tailored specifically to their roles. Following transcription, the interviews were inductively coded and organized into Gioia tables, which categorized the data into first-order concepts, second-order themes, and aggregate dimensions. The analysis was conducted across three stages of smart technology implementation, each stage employing the same Gioia methodology for consistency.

Based on this analysis, the researcher identifies an opportunity to extend the original UTAUT model by incorporating leadership style as an additional factor influencing behavioral intention. At the same time, leadership style affects the development of key employee skills required for working with smart technologies, which in turn have a direct impact on use behavior within the UTAUT framework. Additionally, a conceptual framework has been developed, that suggests the most effective leadership style for fostering the skills most needed at each stage of smart technology implementation, aligning the most suitable leadership approach to each stage. It proposes that transformational leadership is most effective in the pre-implementation stage, supporting the development of technical, professional, communication, and adaptability skills required at this stage. During implementation, instrumental leadership is suggested to enhance professional, leadership, adaptability, and technical skills. In the post-implementation stage, empowering leadership is seen as most beneficial, promoting adaptability, professional and leadership skills, and communication skills that are crucial at this phase.

This research addresses a critical gap in understanding the evolving relationship between leadership styles and employee skills within a changing technological landscape, differentiating the implementation process across three distinct stages and aligning specific leadership styles with each phase. The findings contribute to both theory and practice by proposing a dynamic framework that supports organizations in selecting the most effective leadership approaches to foster essential skills throughout each stage of smart technology adoption.

Keywords: Industry 4.0, smart technologies, leadership styles, employees skills, transformational leadership, instrumental leadership, technology adoption

Table of Contents

1. Introduction

1.1 Background and context

The Fourth Industrial Revolution, commonly referred to as Industry 4.0, marks a transformative era in manufacturing and beyond, characterized by the integration of digital technologies across the entire product lifecycle and production systems (Pamuk & Soysal, 2018). Unlike previous industrial revolutions, Industry 4.0 represents a paradigm shift marked by the increased intelligence and interconnectedness of machines. This revolution has profound implications for employee dynamics, as it reduces human involvement in the production process through the automation and autonomy of smart technologies (Popkova et al., 2018).

As organizations invest heavily in these emerging technologies, the nature of jobs is changing rapidly, requiring employees to upskill and reskill to meet new demands. Consequently, managers must also adapt to these successive changes, recognizing the importance of supporting workers amidst evolving technological landscapes. In the digital era, digital technology not only reshapes leadership but also impacts both organizations and employees (Hensellek, 2020).

While the impact of Industry 4.0 on organizational practices and job roles has received considerable attention, there remains a notable gap in understanding the evolving relationship between leadership styles and employee skills within this rapidly changing technological landscape. Historically, previous industrial revolutions often led to a disconnect between management and employees. However, the increasing demand for advanced skill sets in the smart industry necessitates a more integrated approach to leadership and workforce development (Edmond, 2024). In this context, leaders are becoming increasingly engaged in fostering an environment for the creative growth of team members through collaboration and ongoing learning, rather than solely assigning and overseeing tasks (Bass and Riggio, 2006). A greater emphasis on the new skills of leaders arises from their values, shapes workplace behaviors and the values of employees (followers) (Brown & Treviño, 2009). Bandura's (1977) social learning theory highlights the significant influence of modeled and observed behavior on learning. Despite these changes, we still have limited insight into how leadership styles need to adapt to foster the continuous growth and effectiveness of high-skill employees.

This study aims to address this gap by identifying the critical skills that employees need for the effective implementation of smart technologies and analyzing the leadership styles that best support this process. Furthermore, the research will explore how these skills and leadership styles co-evolve through mutual interaction, providing insights into how organizations can foster both employee

development and adaptive leadership in the context of Industry 4.0. Ultimately, this research seeks to assist organizations in better navigating the challenges of digital transformation.

1.2 Problem statement

As the era of Industry 4.0 progresses, organizations encounter the dual task of embracing technological innovations and addressing the evolving needs of their workforce. Industry 4.0 relies highly on the Internet of Things (IoT) considered as one of the most important areas of future technology (Cerf & Strous, 2020). It is important to highlight that IoT should be considered an instrument of Industry 4.0, not a synonym (Atzori et al., 2017). IoT connects the physical and digital worlds, enabling continuous connectivity through a global network of interconnected objects (Georgios et al., 2019). It allows various devices, like sensors and mobile phones, to interact and cooperate for common goals (Cerf & Strous, 2020). Integrating IT infrastructures, such as RFID tags and wireless internet, is essential to fully leverage IoT benefits (Shin, 2009). IoT revolutionizes data gathering, analysis, and response through wired and wireless communication technologies (Cerf & Strous, 2020), supporting initiatives like the Connected Worker Program, which enhances employee capabilities by providing real-time data and communication tools. As a transformative technology, IoT creates new opportunities for individuals, governments, and businesses to develop innovative business models and interactions. This technology encompasses a wide range of applications, direct influence on operations, and serves as a catalyst for other technologies. Consequently, it shapes employee skill development and influences leadership styles to enhance organizational performance in a digitally-driven environment. This master's thesis focuses on IoT's role, particularly through the lens of the Connected Worker Program, to ensure a comprehensive understanding of how IoT drives the changes inherent in Industry 4.0, offering insights that are crucial for both academic and practical applications.

This study focuses on both transformational leadership and instrumental leaderhip style. These styles have a well-documented connection with innovative performance, which is crucial in the smart industry. Transformational leaders inspire their followers by creating and articulating a motivating and purpose-driven vision. On the other hand, instrumental leaders put more emphasis on strategy formulation and planning by monitoring and setting goals. (Rowold et al., 2017). There is an extensive research on the required skills or leadership style in Industry 4.0, and a few empirical studies that examine the relationship between innovative leadership style and employee innovative behavior (Basu & Green, 1997; Boerner et al., 2007; Wilson-Evered et al., 2004) concentrating mostly on the individual role of leader and explaining how innovative leaders boost followers' morale and motivation (Bass, 1985). This scarcity of literature leaves unanswered questions about how various leadership styles, such as transformational and instrumental leadership, and the emerging skills of employees and

leaders influence each other and how they evolve over time. This study seeks to address questions such as: Do employees tend to imitate the behaviors and qualities of their leaders? How do employees' skills typical for the smart industry affect the role of the leader? What new skills are emerging among both employees and leaders? How do those skills and leadership styles evolve? Additionally, this study may also shed light on questions concerning the impact of leadership styles on employee motivation, job satisfaction, and organizational culture within the context of Industry 4.0. To refine the research question, this study will particularly focus on the effective implementation of smart technologies. For a clearer identification of both direct and indirect behaviors or traits of employees and leaders, this research will be conducted at the individual level, between individual employees and his/her direct supervisor. The significance of this study lies in the key role played by this collaboration in ensuring organizational success amidst the technological advancements and characteristic changes of this era.

1.3 Research question

Therefore, this study aims to address this gap by investigating not only the evolving roles but also the collaborative dynamics between leaders and employees, recognizing their interrelated nature and significance in the context of digital transformation. The primary research question guiding this study is:

"What essential skills and leadership styles best support employees across the different stages of smart technology adoption?"

1.4 Relevance of the research

Understanding the evolving roles and collaborative dynamics between leaders and employees in the context of smart technologies is crucial for organizational success amidst technological advancements. Filling the gap in research and providing insights into how interactions between an employee and their direct supervisor mutually influence each other can help organizations to understand what skills of both parties need to be prioritized and trained in order to enhance interaction and communication between them, further fostering a cohesive and productive relationship. As a result it can refine development processes, enhance team effectiveness, and better utilize human potential in the age of digital transformation. Ultimately, this study aims to contribute to the effective integration of smart technologies and the enhancement of organizational resilience in an increasingly digitized world.

2. Theoretical background

This study's theoretical framework includes the notion of Industry 4.0, marking a new phase in technological advancement. As stated by Fraunhofer IAO, the largest research institute in Europe, Industry 4.0 requires the integration of "things," individuals, and services (Stergiou et al., 2023). This means that these three elements must collaborate seamlessly within an automated system. Both employees and leadership need to continually evolve and acquire new skills to effectively operate in this integrated environment. It is equally important to understand how these skills and technologies are implemented in practice, as adapting to new technologies requires consideration of several key factors. As will be argued below, the UTAUT model provides a useful framework for understanding these technological transitions. However, it has some limitations which involve trust in technology, the role of user experience and social influence in adoption, how employee attitudes and perceptions impact adoption, and the need to consider individual factors (Akbar et al., 2023). While UTAUT identifies key determinants of technology acceptance, these factors are not sufficiently addressed.

The UTAUT model also overlooks the impact of leadership, despite evidence demonstrating its significant role in technology acceptance (Aziz et al., 2020; Van Dun and Kumar, 2023) by affecting the factors encompassed within this framework. It is important to remember that technological change is a complex phenomenon, requiring deeper study, especially at a personal level. Various studies have examined the impact of leadership styles on technology acceptance within the UTAUT model. In this study, I will focus on two styles: transformational and instrumental leadership, which many studies suggest are among the most effective in fostering technology adoption (Seyal, 2015; Antonakis & House, 2014).

Recognizing the critical role of leadership in technology acceptance highlights the need to consider how managers can facilitate the development of new human skills driven by technology adoption. As organizations navigate the complexities of Industry 4.0, it becomes increasingly relevant for managers to optimize socio-technical interactions. Given the limited research available on this subject (Pedota et al., 2023), this study will also focus on identifying the skills and behaviours that promote effective technology adoption, while exploring how these new skills emerge in the workplace.

Furthermore, many existing studies have methodological limitations, primarily relying on cross-sectional research conducted in pre- and post-acceptance stages (Venkatesh et al., 2003; Taylor & Todd, 1995). These studies tend to focus on technology acceptance in voluntary contexts rather than mandatory settings. This highlights the need for research that includes the influence of leadership and

examines changes over time. An additional advantage of such a study is that it would be conducted in mandatory settings, allowing for more robust insights into technology acceptance dynamics.

2.1 The concept of Industry 4.0

The Industrial Revolution stands as an important point in modern history, representing a transition from an agrarian and handicraft economy to one dominated by industry and machine manufacturing. These technological advancements brought about new lifestyles and working methods, fundamentally altering societal norms (The Editors of Encyclopaedia Britannica, 2024).

The first Industrial Revolution occurred in late eighteenth-century Britain, transitioning societies from agrarian to manufacturing economies. It replaced manual labor with machinery, marking a shift to a technological mode of production. This change was driven by the establishment of industrial infrastructure, restructuring the industry. A significant aspect was the introduction of steam-powered transportation, facilitating faster and cheaper goods transport (Popkova et al., 2018). During the late 19th to the early 20th centuries, the second Industrial Revolution brought about profound changes. Notably, it revolutionized management practices through the introduction of modern organizational methods for large-scale businesses operating across vast areas (Popkova et al., 2018). This period witnessed expanded railroads, extensive iron and steel production, increased use of steam power, widespread telegraph usage, petroleum utilization, and the beginning of electrification which caused the transition from mechanical to mass production (Drath & Horch, 2014). The onset of the third industrial revolution in the late 20th century marked the emergence of digital technology, automation, and the internet. This era witnessed the creation of various innovative tools such as personal computers, mobile devices, and the internet, leading to the establishment of networked business processes. These technologies revolutionized numerous sectors, including manufacturing, communications, transportation, and healthcare, necessitating digital equipment and a global infrastructure (Popkova et al., 2018). This revolution presented the first programmable logic controller that enabled digital programming of automation systems (Drath & Horch, 2014), which developed thousands of businesses and million of jobs globally.

The Fourth Industrial Revolution used interchangeably with the term "Industry 4.0" refers to the the transformative process within global value creation chains and it involves the merging of cyber-physical systems, blending computation, networking, and physical processes. This fusion encompasses various technologies such as mobile devices, the Internet of Things (IoT), artificial intelligence (AI), robotics, cyber security, and 3D printing (Piccarozzi et al., 2018). According to K. Schwab's it includes transformation of business processes in industry that envisage organization of global production

networks on the basis of new information and communication technologies and Internet technologies, with the help of which interaction of the production objects is conducted. These new technologies and their interactions impacts all disciplines, economies and industries (Schwab, 2016).

2.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

Many studies on acceptance of technology concluded that mass adoption requires public acceptance which is more dependent on psychological issues than on the technology itself (Shariff et al., 2017). The fourth industrial revolution profoundly affects how work is organized (Cagliano et al., 2019). Exploring individual acceptance and use information technology stands as one of the most well-developed branches of information systems research, offering valuable insights into human-computer interaction dynamics (Venkatesh et al., 2007). Research suggests that employees' attitudes toward organizational change heavily influence technology adoption (Choi, 2011), with managerial roles playing a significant role in fostering adoption (Vidyarthy et al., 2014).

Smart technologies present in Industry 4.0 are used in the daily work of both employees and leaders. Therefore, assessing the readiness and acceptance of new technologies can help identify key predictors. For over two decades, individual technology acceptance and adoption has been extensively studied (Venkatesh et al., 2007). The Unified Theory of Acceptance and Use of Technology (UTAUT), an extension of the Technology Acceptance Model (TAM), is among the theoretical frameworks utilized for understanding and predicting acceptance and adoption of technology on individual level. Various studies have consistently emphasized UTAUT's superiority over other individual models proposed by researchers (Venkatesh et al., 2003). This likely stems from the fact that it is a comprehensive model combined from various acceptance models (Rejali et al., 2023).These studies confirms that UTAUT serves as a valuable tool for managers assessing the potential success of new technology implementations. It aids in comprehending the factors driving acceptance, allowing for targeted interventions to be designed for user populations less inclined to adopt new systems. This underscores the utility of UTAUT in facilitating the introduction of new technologies and enabling proactive intervention design tailored to specific user groups within organizations (Venkatesh et al., 2003). The UTAUT model, primarily applicable in organizational settings, highlights four key factors (performance expectancy, effort expectancy, social influence, and facilitating conditions) and four moderators (age, gender, experience, and voluntariness) associated with predicting individuals' behavioral intentions towards technology use. It suggests that behavioral intention to use a technology is influenced by performance expectancy, effort expectancy, and social influence, whereas actual technology usage is determined by both behavioral intention and facilitating conditions (Venkatesh et al., 2016). Moreover, it has been found that leadership style is also an important factor (Van Dun &

Kumar, 2023; Neufeld et al., 2007). Hence, it's imperative for leaders to familiarize themselves with relevant knowledge to effectively implement new technologies vital for Industry 4.0.

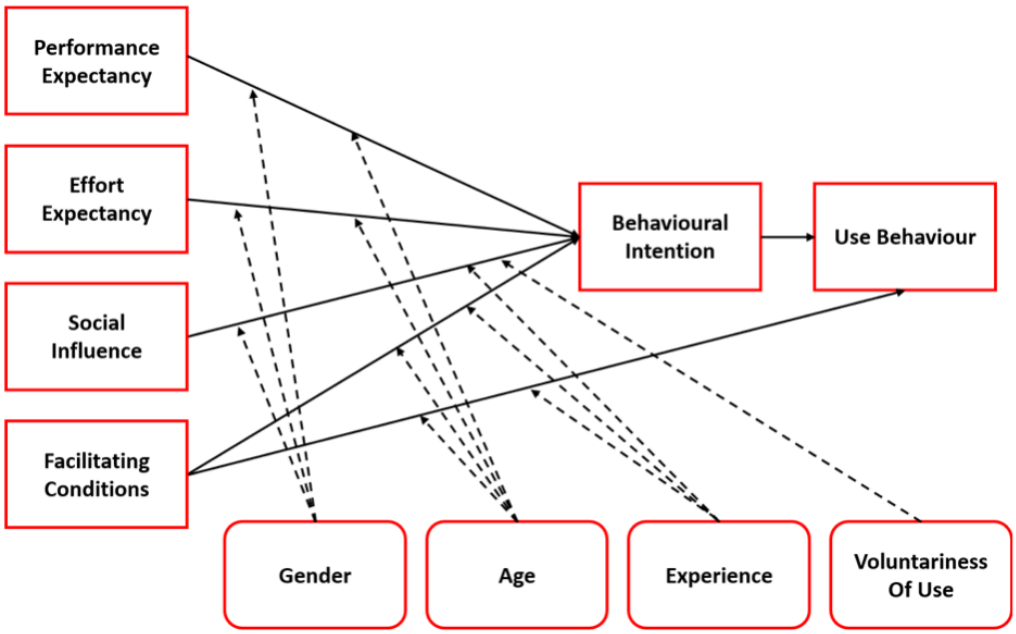

Figure 1: UTAUT model (Venkatesh et al., 2003)

Table 1. *Variables of the UTAUT model (Haron et al., 2021)*

Performance expectancy	The degree to which an individual believes that utilizing a specific system will improve their job performance.
Effort expectancy	Concerns how easy or convenient an individual perceives using the system to be.
Social influence	Relates to how much an individual considers the opinions of others when deciding whether to adopt the new system.
Facilitating conditions	Refers to the extent of individuals' perception regarding the organizational and technical infrastructure available to support the utilization of the system.

Over time, this model has evolved to incorporate new mechanisms, with four main types of UTAUT extensions: exogenous mechanisms, endogenous mechanisms, moderating mechanisms, and outcome mechanisms (Venkatesh et al., 2016). This extended model however studied acceptance and use of technology within consumer contexts, rather than organizational environments.

Although the UTAUT model identifies significant factors in technology acceptance, it does not account for the influence of leadership styles, which limits its usefulness in fully understanding adoption processes. Research by Van Dun and Kumar (2023) indicates that the factors included in the UTAUT model are not the only predictors of employee intentions. Additional dimensions have been identified, such as managers' leadership behaviors and the ability to handle emotions during digital transformation. Similarly, Aziz et al. (2020) found a strong correlation between leadership styles and technology acceptance, further emphasizing the need to consider these factors in future research.

Consequently, further research is necessary to explore which leadership styles and employee skills influence the successful adoption of smart technologies. The changing demands in this area underscore the need to adapt managerial roles and develop employee skills in response to the continuous changes in the technological landscape.

2.3 Transformational leadership style

Of significance is the distinction between the roles of 'manager' and 'leader', which may not always coincide. While a manager is characterized by formal authority, a leader, irrespective of managerial title, possesses the ability to wield influence (Oberer & Erkollar, 2018). As defined by Lussier & Achua (2016), leadership is the ‘influencing process of leaders and folllowers to achieve organizational objectives through change.' In the age of Industry 4.0, leadership revolves around shifting mindsets rather than wielding power or status (Puhovichová & Jankelová, 2021). Traditional leadership styles have proven to be dysfunctional in the realm of smart technologies (Vlasov & Chromjaková, 2018). Integration of leadership principles with the pillars of Industry 4.0 is inevitable, leading many companies to develop and implement new leadership styles (smart leadership) that are better suited to the demands of Industry 4.0 (Deloitte, 2014). Effective leadership is considered crucial during digital transformations as it provides guidance, support, and direction to the organization towards the desired future (Asbari, Hidayat, & Purwanto, 2021; Al-Haddad & Kotnour, 2015).

The most commonly used theory is the full-range leadership theory, incorporating both transformational and transactional leadership styles (Anderson & Sun, 1990). Baas (1985), who introduced both transactional and transformational leadership which are most often used, suggests that transformational leadership complements transactional approaches to management by proving more effective in fostering significant improvements and changes among employees. While a transactional leader concentrates on the control of the activities of subordinates and may encourage a reasonable level of involvement, loyalty, commitment, and performance from them, a transformational leader can achieve much more (Baas, 1985). James Burns (1978) was the first to distinguish between transactional

and transformational leadership, noting that transformational leaders encourage us exceed our initial expectations and aspirations. Moreover, several studies have indicated that within organizational contexts, transformational leadership exhibits a positive correlation with technology acceptance, contrasting with transactional leadership, which lacks such an association (Schepers et al., 2005; Van Dun & Kumar, 2022).

In comparing various leadership styles, it was found that transformational leadership (adaptive leadership) has a greater impact on innovative performance (Bossink, 2004). This is because it stimulates new ideas and enriches creative channels within the business (Bass & Avolio, 1994), fostering an environment conducive to innovation, especially crucial in the context of Industry 4.0 where adaptability and creativity are paramount. This leadership style is characterized by being more trustworthy, realistic, and practical (Bass, 1999) which influences how effectively employees implement innovative ideas, thus making employee innovation crucial for organizational innovation (Michaelis et al., 2010). The four features of transformational leadership are: idealised influence, inspirational motivation, individualised consideration and intellectual stimulation (Bass & Avolio, 1994). The literature on digital transformation and leadership in digital contexts emphasizes the significance of transformational leadership. According to Ly (2023), this leadership style is noted for its influence on fostering innovative work behavior among employees within organizations (Pradhan & Jena, 2019). Recent research has also shown that transformational leadership contributes to the adoption of e-businesses (Alos-Simo et al., 2017) and enhances organizational agility (Akkaya & Tabak, 2020).

Table 2. *The factors related to transformational leadership style influencing technology acceptance (Bass & Avolio, 1994)*

Characteristics	**Description**
Intellectual stimulation	Represents a supportive leader who fosters acceptance of change and encourages creativity within the organization.
Individualized consideration	Entails empowering employees through timely skills training which aligns with both organizational goals and their personal development targets.
Inspirational motivation	Represents a leader's positive and enthusiastic commitment to build a dynamic team to achieve organizational goals.
Idealized influence	Represents leaders with charismatic personalities who have high moral, ethical values and clear vision for the organisation.

During the implementation of smart technologies, both the development of employees' skills and leadership styles play a crucial role. Transformational leadership, which motivates employees to take calculated risks and supports their growth, contributes to building organizational agility. This agility is essential in the dynamic environment of the smart industry, as it allows organizations to quickly adapt to new technologies and challenges (Wageeh, 2016). As a result, organizational agility becomes a product of the continuous development and adaptability of leaders and employees, enabling effective management in the face of digital transformation (Ly, 2023; Akkaya, 2019).

Based on the findings of the study by Van Dun & Kumar (2023), the UTAUT model factors were not the sole predictors of employees' intentions. Alongside, transformational leadership style and emotional intelligence of both managers and employees emerged as crucial factors to enable employees adoption of smart technologies. Interestingly, several studies have shown that transformational leadership significantly predicts UTAUT and technology adoption (Kalasindhu & Kuntonbutr, 2022), indicating its positive influence on employees' acceptance and use of new technologies. Research has shown that transformational leadership enhances employees' skills and knowledge, performance expectancy, effort expectancy, social influence, facilitating conditions, self-efficacy, anxiety, and their attitude towards using technology. This suggests that the UTAUT model and transformational leadership are interconnected rather than separate models for assessing technology acceptance in the workplace, as they may influence each other in direct or indirect way.

2.4 Instrumental leadership style

Despite the existence of numerous studies confirming that transformational leadership is positively related to indicators of leadership effectiveness such as subordinate satisfaction, motivation, and performance (Bass, 1998), there are certain shortcomings that have been highlighted in other research (Yukl, 1999). These include ambiguous constructs, a lack of detailed explanation of processes, an overly narrow focus on leader-follower interactions, neglect of some important behaviors, and heroic leadership bias. To address these gaps, the instrumental leadership style was developed (Antonakis & House, 2014). Interestingly, a study examining the impact of leadership style on employee adoption of smart technologies across different implementation stages found that transformational leadership is particularly effective during the pre-implementation phase. However, as the implementation progresses, there is a noticeable shift towards an instrumental leadership style (Van Dun et al., 2024).

Accordingly, this study will also focus on the instrumental leadership style which is defined as “the application of leader expert knowledge on monitoring of the environment and of performance, and the implementation of strategic and tactical solutions” (Antonakis & House, 2014) and it is

comprised of two main components: strategic leadership and job facilitation leadership. Strategic leadership entails guiding organizational processes and structures through two main dimensions: environmental monitoring and strategic formulation and implementation. Some studies suggests that to achieve full employee engagement, it is important to consider all dimensions of work involvement, ranging from everyday operational responsibilities to the alignment with the organization and one's role within it (Sarti, 2014). Instrumental leadership facilitates this by fostering an environment where employees receive consistent support and feedback, allowing them to navigate the complexities of new technologies effectively. By establishing achievable targets, instrumental leaders bolster skill development and enhance employees' work involvement and job performance. Environmental monitoring involves assessing both internal and external organizational contexts to anticipate future opportunities. Meanwhile, strategic formulation and implementation revolve around crafting policies, goals, and supportive actions to realize the organizational vision. Job facilitation leadership includes two essential dimensions: facilitating the route towards objective and monitoring the performance. In the first dimension, based on path-goal theory (House, 1971), leaders engage in behaviors focused on setting targets, offering support and resources, and removing obstacles. Performance monitoring involves leaders providing feedback to enhance job effectiveness (Antonakis & House, 2014). Thus, instrumental leadership entails a structured action plan maintained throughout the work process.

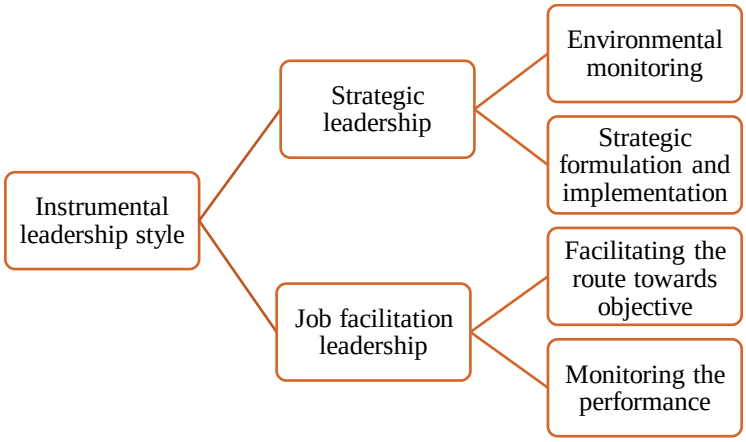

Figure 2: Instrumental leadership style

Transformational leadership emphasizes socio-emotional interactions, whereas instrumental leadership prioritizes strategic planning. While transformational leaders may incorporate rewards or punishments, instrumental leaders concentrate on fostering goal achievement without recourse to such measures. Instrumental leaders play a crucial role in connecting the vision with successful adoption. The instrumental leadership style can positively impact the components found in the UTAUT model. By prioritizing task completion and goal attainment, this style can increase performance expectancy.

Many studies, including House (1996), show that goal-oriented leadership improves employee performance by clarifying tasks and objectives, indirectly suggesting how this leadership style could enhance performance expectancy in the context of technology use. Providing necessary support by monitoring the environment and performance, and taking actions to facilitate the route toward the objective, can positively impact effort expectancy and strengthen facilitating conditions. Leaders who set clear goals and offer support can cultivate a culture of innovation (Scott & Bruce, 1994), which implies that instrumental leaders may also influence social norms and expectations related to technology adoption.

According to research examining leader-leader interactions (Bedell-Avers et al., 2009), leaders with different leadership styles can effectively collaborate. Their responses to specific situations, such as crises, may differ, but when they share a common vision, their combined efforts can result in more positive outcomes. In such collaborations, one leader may build upon another leader's approach to enhance their own strategy. This indicates that a single leadership style is does not always serve as the best solution, and a mix of different leadership styles can be even more advantageous.

2.5 Key skills and competencies

As previously noted, the adoption of automation and robotics in various industries, as highlighted by Ali (2023), has led to a demand for new skills among employees. This transformation has also increased the need for employees to have enhanced capabilities across various stages of the value chain, such as procurement, production, distribution, and retail (Benešová & Tupa, 2017). Consequently, the demand for these competencies is expected to continue rising as organizations adapt to an evolving landscape (Szabó et al., 2023).

In adapting to the evolving landscape of procurement, individuals need to develop both technical and non-technical skills, to effectively navigate these processes (Neeley, 2022). The literature highlights essential technical and non-technical competencies for effectively working with smart technologies. Employees are categorized as low-skilled, semi-skilled, and high-skilled based on their job profiles, occupational competencies, and academic qualifications, with the skill formation process being a key determinant in the technical context (Janis & Alias, 2018). Technical skills are crucial for proficient interaction with modern digital tools. These include include digital literacy, data analysis skills, technical problem-solving, and technological proficiency (Rasskazova et al., 2020). These competencies are vital for employees to perform effectively in high-skilled roles, where installation, maintenance, and modification tasks require strong problem-solving and decision-making abilities (Dworschak & Zaiser, 2014).

As organizations increasingly demand technical skills, these competencies also shape employees' non-technical abilities. This study will primarily focus on non-technical skills identified as vital for success in Industry 4.0, as noted by Prifti et al. (2017), while also recognizing the importance of technical competencies

So far, 31 non-technical competencies have been identified, with the most frequently mentioned in literature being problem-solving, creativity, decision-making, and adaptive skills (Janis & Alias, 2018). Due to the continuously changing and evolving technologies, skills such as the ability to learn and adapt are also crucial. Adaptability skills encompass a range of competencies that empower employees to thrive in dynamic environments. These include learning agility (Szabó, MÍkva, Marková, Samáková, et al., 2023), which focuses on continuous improvement and is regarded as a core competency, competitive advantage, and key differentiator. It enables individuals to quickly acquire and apply new knowledge. Furthermore, adaptability skills require strategic thinking, creative problem-solving, and an entrepreneurial mindset, along with a willingness to embrace change and a constant readiness to adapt and take proactive measures (Harraf et al., 2015). Resilience to change is another vital competency, as it helps employees maintain their effectiveness amid uncertainty. Additionally, skills such as cognitive flexibility and self-discipline (Büth et al., 2017; Prifti et al., 2017) foster the capacity to shift perspectives and maintain focus, respectively.

As mentioned earlier, experts in a team may have different experience backgrounds, but to collaborate effectively in a team, they must have well-developed communication skills to work in interdisciplinary areas. Many studies emphasize the importance of communication skills in the context of evolving leadership, and this research considers both the employee and leader perspectives. Therefore, communication skills constitute a distinct category, with cross-functional communication (Pissardini & Filho, 2024) being a key component, as it enables effective collaboration between different departments. Another skill in this category is stakeholder management, which focuses on the effective exchange of information while considering the interests and concerns of all parties involved, recognizing diverse perspectives (Alsulaimi & Abdullah, 2020), including both team members and leaders.

The last identified category is professional and leadership skills, which are often grouped together due to their complementary nature in driving organizational success. These skills are essential for high-skilled workers and encompass competencies such as leadership, project management, and relationship management (Davis et al., 2018). A good leader should possess visionary thinking (Galli et al., 2017), which is critical for guiding their team toward future goals. This visionary thinking translates into the ability to train and teach, as it enables leaders to understand the distinction between training and coaching. Training focuses on imparting specific skills or knowledge, while coaching

emphasizes personal development and growth, fostering a deeper understanding of individual strengths and weaknesses. Despite the historical emphasis on technical and economic competencies during previous industrial revolutions, continuous professional development has significantly increased the importance of social competencies which encompass of a range of interpersonal abilities that foster positive relationships and enhance collaboration, ultimately improving work efficiency. This includes skills like effective communication, leadership capabilities, and conflict resolution proficiency (Łupicka & Grzybowska, 2018).

Furthermore, behavioral competencies consist of characteristics, skills, and motivations that contribute to improving talent decisions and are essential for the application of technical skills and knowledge in the workplace. Key aspects include adherence to compliance standards, understanding power dynamics, and fostering a culture of diversity and inclusivity (Szabó et al., 2023). A recent study on digital workplace skills identified critical competencies required for the future, emphasizing the importance of an entrepreneurial mindset (Weritz, 2022)—defined as the ability to rapidly sense, act, and mobilize creativity and innovation while identifying opportunities (Kooskora, 2020).

A review of the literature identified essential skills for working with smart technologies, summarized in Table 3 below.

Table 3. *Essential Skills and Competencies for Working with Smart Technologies*

Category	***Skills and competencies***
Technical skills	Digital literacy Data analysis skills Technical problem solving Technological proficiency
Adaptability skills	Learning agility Resilience to change Continuous learning Cognitive flexibility Self-discipline Creative problem-solving Personal development Entrepreneurial mindset (Innovation thinking)
Communication skills	Cross-functional communication Collaboration and teamwork Stakeholder management
Professional and leadership skills	Visionary thinking Change management skills Influence and persuasion Relationship management Ability to train and teach Conflict resolution proficiency Fostering a culture of diversity and inclusivity

2.6 The Role of LMX in Social Exchange

Leadership styles characterized by trustworthiness, groundedness, and pragmatism are often associated with fostering innovative work behavior (Hui et al., 2019; Li et al., 2019). Numerous studies suggest that such leadership can motivate followers to engage in more critical thinking (Bass, 1985) and the positive association between inspirational leadership and effectiveness in organizations including organizational commitment, engagement at work (Wang et al., 2022), creativity (Tse et al., 2023; Jun & Lee, 2023) and organizational citizenship behavior (Majeed et al., 2017). Furthermore, studies on leadership styles emphasizing support for employees have shown that such leadership boosts employee motivation (Kalasindhu & Kuntonbutr, 2022). Consequently, employees tend to be more willing to assist management in recognition of the support they receive from the organization.

This relationships can be explained by the Social Exchange Theory (SET) (Blau, 1964; Emerson, 1976), a psychological and economic model of human behavior commonly applied to interpret workplace dynamics and the interactions among members within organizations (Osman et al., 2016). SET posits reciprocity as its fundamental value (Gouldner, 1960), suggesting that every

individual involved in a social exchange relationship will feel a sense of responsibility to give back for any benefits they've received (Lioukas, C. S., & Reuer, J. J., 2015). This theory suggests that social relationships seek to maximize benefits and minimize the individual's costs in achieving life purposes, including within organizational settings where it explains the concept of social exchange, often perceived as administrative support.

An important part of the social exchange theory is the Leader-Member Exchange (LMX) theory, which has contributed to identifying the positive impact on employees' innovative behavior. It emphasizes the quality of interactions between supervisors and employees in a one-on-one relationship (Graen & Uhl-Bien, 1995). According to the LMX theory, the supervisor and the employee engage in an ongoing social exchange process. In line with social exchange theory, a high-quality leader-member exchange relationship is characterized by employees perceiving their immediate supervising manager as acting in their best interest, being caring, supportive, loyal, and reliable (Schermuly et al., 2013). There are five conditions for high quality LMX relationship (Gómez & Rosen, 2001):

Trust
Contribution (amount of activity toward the mutual goals)
Affect (mutual liking)
Loyalty (consistent faithfulness)
Professional respect (perception of reputation)

Some studies indicates that a strong LMX relationship involves supervisors providing employees with increased time, work-related information, emotional support, and respect (Sparrowe & Liden, 1997). In return, employees tend to show higher commitment and a positive work attitude. This fosters greater innovative behavior and enhances employee creativity. Notably, individuals with lower-quality relationships tend to allocate more time to routine tasks, while those with higher-quality relationships spend more time on non-routine tasks (Graen, 1995), stimulating them to generate new ideas and influencing creativity.

These theories are significant in this research because they will help us to understand the importance of these factors in forming a strong LMX relationship and how this relationship impacts the interaction between employees and their leaders (see Figure 3)

Figure 3: LMX framework

3. Method

3.1 Research design

For this research, a qualitative data collection was used as this method provides deeper insights into real-world problems and it gathers participants' experiences, perceptions, and behavior (Busetto et al., 2020). This approach will assist in exploring the factors that affect interactions between highly skilled employees and their direct supervisors. It aims to understand the reciprocal influence of new skills between employees and leaders while also contributing to the effective implementation of smart technologies. Furthermore, it will delve into the direct and indirect impacts of these interactions on both parties, offering insights into the potential evolution of their roles over time.

The central focus of this study lies in the exploration and development of new concepts and theories, thus justifying the application of the Gioia Method (Gioia, Corley, & Hamilton, 2013). Renowned for its qualitative approach to grounded theory development, this methodology is characterized by its holistic approach, which ensures a comprehensive examination of the research area within the broader system context. The Gioia Method employs an inductive approach primarily through its structured data analysis process, which comprises three key stages. Firstly, developing analytic codes and categories; secondly, constructing a grounded theoretical model through constant comparison of data; and finally, organizing findings into informant-centered codes and theory-centered themes. This systematic approach meets the standards of quantitative research while offering a comprehensive understanding of phenomena and participants' experiences. By avoiding preconceived hypotheses, it allows insights and patterns to emerge directly from the data, facilitating the development of broader theories (Gioia, 2012).

Given that this study involves describing a social change, phenomenological analysis is applied (Bortz & Doering, 1995). This approach is particularly suitable for research projects seeking

correlations and structures, placing emphasis on grasping the subjective significance of social actions. It enables a thorough and systematic examination of diverse situations (Hofmann, 2016).

3.2 Data sampling

The primary focus of the study is to conduct interviews with key stakeholders within a major multinational manufacturing company, renowned in both industrial and consumer sectors. The company actively engages with smart technologies and continuously develops new business and collaboration models to ensure the best technological solutions and efficient implementation of these technologies. The company has its roots in the late 19th century and it largely expanded its offerings in the early 20th century. Currently, it operates in 79 countries across the Americas, Asia-Pacific, Europe, and the Middle East & Africa. The study involved individuals from functional domains such as Digital Business (DX), where digital integration, business process management, and IT expertise converge, and Production & Engineering, responsible for streamlining processes and machinery through cutting-edge technology and innovations in plant operations. This spectrum of roles includes technical specialists, production engineers, quality control inspectors, and data analysts. Purposive sampling was utilized to select participants for this study based on specific criteria, such as their roles, responsibilities, and engagement in the adoption or utilization of smart technologies within the organization, as well as their tenure with the company. This method ensured participants were properly identified and selected, providing valuable insights (Stewart, 2024). The main goal was to select employees and their direct supervisors who worked with smart technologies at the operational level, meaning they were involved in practical or executive tasks and handled daily operations and responsibilities. The study placed particular emphasis on the Connected Worker Program, which had been implemented in this factory some time ago. Interviews were conducted with individuals of varying tenures, including those who had been with the company for a long time and witnessed the entire implementation process, as well as those with shorter tenures. It is worth noting that a study on the Connected Worker Program was conducted in 2023 (Bartelink, 2023), which led to the discovery of interesting insights and inspired continued research on this topic.

The sample consisted of 12 participants, ranging in age from 25 to 45 years, consisting of 6 operators and their 6 direct supervisors from factory in Poland. This sample size was influenced by the limited number of employees at the facility and the decision to evenly divide the participants between these two groups While the group comprised both male and female employees, males were slightly more represented. Participants had varying levels of experience within company X, from 2 to 32 years. The diversity in age, gender, and tenure, combined with the shared cultural background,

provides valuable insights into differing attitudes towards the implementation of new technologies from a uniquely Polish workforce perspective. Although the participant count was small, qualitative research emphasized a "humanistic focus" (Azungah, 2018), prioritizing the exploration of perspectives from a smaller group over testing hypotheses with larger samples. This method enriched the understanding of participants' experiences and viewpoints.

The summary of the participants demographics can be found in Table 4.

Table 4. *Sample demographics*

Participant	Age	Gender	Role	Years of experience at company X	Nationality	Supervisor
1	25	M	Operator	2	Polish	Participant 6
2	31	F	HPS Supervisor	5	Polish	-
3	46	M	Supervisor	23	Polish	-
4	40	F	Operator	11	Polish	Participant 4
5	39	M	HPS	1.5	Polish	Participant 2
6	37	M	Supervisor	7	Polish	-
7	34	F	Operator	3	Polish	Participant 8
8	30	M	Supervisor	4	Polish	-
9	49	F	Operator	16	Polish	Participant X
10	57	M	HPS	32	Polish	Participant 2
11	51	F	Operator	25	Polish	Participant 12
12	49	M	Supervisor	26	Polish	-

One standout aspect of the interviews was the case of Participant 9, where the interview was conducted with the participant but not with their direct supervisor due to illness. Additionally, in the HPS department (focused on managing applications), Participant 2 serves as the leader, with Participants 5 and 10 as part of her team. Although they do not operate machinery directly, they are responsible for the development of applications and work closely with machine operators, gaining first-hand insights into how operators engage with the technology. This unique setup offers a dual perspective: both a leadership view of machine operations and an application development viewpoint, providing a more comprehensive understanding of the technological implementation.

3.4 Data Collection

Data collection involved conducting 12 semi-structured interviews with selected participants from company X, each lasting approximately one hour. Semi-structured interviews enable the interviewer to ask spontaneous follow-up questions in response to the participant's answers, allowing for personal insights and unique responses (Kallio et al., 2016). In my questions to participants, I frequently referred to the Connected Worker Programme (CWP) as an example of smart technologies. CWP is a type of manufacturing software that serves as the foundation for the concept known as the connected worker. It integrates all the tools, paper-based procedures, and communication methods necessary for daily operations on the shop floor into a single platform, accessible on various smart devices (Cherkezov, 2023). This reference helped participants gain a clearer understanding of the concept of smart technologies and their practical applications in real-world scenarios. The aim of this study was to identify the impact of implementing smart technologies on the development of employees' skills and leadership styles, as well as those of their direct supervisors, at three key stages: pre-implementation, during implementation, and the current situation. To achieve this objective, a retrospective, multi-perspective case study was conducted. Data was collected at a single point in time, but the questions addressed the three different stages of the implementation process. This research design allows for an understanding of changes over time based on the participants' reflections on their past experiences (E. Buchan, 1987). By incorporating perspectives from both employees and their direct supervisors within the same organization, the study provides a comprehensive view of how smart technologies impact skill development and leadership dynamics.

The interviews were conducted in person, allowing for synchronous communication in both time and place. This face-to-face format enabled the researcher to capture valuable social cues, such as tone of voice, intonation, and body language, which added depth to the data collected. Additionally, respondents' answers tended to be more spontaneous, increasing the likelihood of honest responses (Opdenakker, 2006). To further enhance the depth of understanding, the interviews were held in Polish, the native language of both the researcher and the participants, ensuring a more nuanced and comprehensive analysis of their responses. This approach enables a more complete and natural expression of emotions, linguistic nuances, and subtle shades of meaning. Participants are likely to feel more comfortable and relaxed, which fosters openness and honesty in the conversation. Consequently, the information gathered during the interview are more authentic and accurate, enhancing the credibility and value of the collected data. All participants provided informed consent before the interviews, with a guarantee of confidentiality throughout the process. The interviews were audio-recorded and subsequently transcribed for analysis using Microsoft Teams and Amberscript

software. The researcher later reviewed and manually edited the transcripts The interview guide was carefully tailored to the research question and included open-ended questions to encourage detailed responses. It was developed using Helfferich's (2010) method, which involves four steps: collecting, checking, sorting, and prioritizing information. This approach ensures that the interview guide is thorough, well-organized, and aligned with the research objectives. Key topics explored included the collaboration between employees and their direct supervisors, with a focus on their experiences with smart technologies, challenges encountered and overcome, communication dynamics, leadership styles, learning processes, and the role of organizational culture in adapting to smart technologies, particularly in the context of the Connected Worker Program.

Some exemplary questions posed to participants included:

- Can you describe your experience with the smart technologies / Connected Worker Program?
- Have there been any challenges or obstacles in the implementation process?
- How has the interaction between leaders and employees changed with the introduction of CWP and other smart technologies?
- What specific skills do you believe are essential for employees working with the CWP/ smart technologies? What can positively influence the development of these skills in employees?
- How would you describe your leadership style and how do you think your leadership style has evolved with the advent of smart technologies?

For a full list of questions for operators and their direct supervisors, please refer to the interview guides provided in the appendix 1.

3.5 Data Analysis

The research divided the gathered data into two segments: one from employees and another from their direct supervisors. The choice of an inductive approach for this study is deliberate. It allows the researcher to spot emerging patterns, themes, and concepts within the data. This method aims to derive meanings from the collected dataset to uncover patterns and relationships, ultimately contributing to theory-building. Nonetheless, the inductive approach doesn't preclude the use of existing theories to shape the research question and participant inquiries. Inductive reasoning typically starts with detailed observations and moves towards more abstract generalizations and ideas (Albrecht & Stone, 2018). The study follows the Gioia method, which involves inductive coding to identify patterns and themes in the data. The process begins with open coding, where key concepts are derived from interview transcripts. These initial concepts are then grouped into broader second-order themes, leading to the

construction of aggregate dimensions that synthesize the key insights across all participants. Atlas.ti software was used to facilitate efficient coding, organization, and retrieval of data during the analysis.

A major benefit of interviewing both operators and their direct supervisors is the ability to examine not only their experiences with the implementation of smart technologies, but also the specific skills required by employees and the leadership styles employed by supervisors to support this transition. By comparing perspectives from both groups, the study uncovers how operators develop the necessary skills to adapt to new technologies, and how supervisors facilitate this process through effective leadership and communication. In addition, this comparative analysis offers deeper insight into how both the necessary skills and leadership approaches may evolve as employees and supervisors continue to adapt to technological advancements. Age differences are also being considered, as they can significantly influence adaptability, learning styles, and the pace at which individuals adjust to new technologies. The analysis progresses from identifying individual responses (first-order concepts) to broader themes (second-order themes) and eventually to aggregate dimensions, allowing for a detailed comparison of how different age groups, roles, and leadership strategies affect the success of the implementation process.

For this study, Gioia's method was applied across three stages of the Connected Worker Program implementation:

1. Pre-implementation stage
2. During implementation stage
3. Current situation:

While the different stages of implementation will be recognized, the coding process will adhere to the inductive principles of Gioia's methodology. This means that the stages will not be used as predetermined coding categories. Instead, themes will be allowed to emerge organically from the data. Once these themes are established, an analysis will be conducted to explore how they relate to the different stages of the implementation process. This approach aligns with the perspective highlighted by Magnani and Gioia (2023), which facilitates the emergence of grounded theory while acknowledging the context of the study. This analysis will provide detailed insights into how employees' skills and their direct supervisors' leadership styles evolve over time and how these factors interact with the implementation of smart technologies.

4. Findings

The findings chapter in this paper delves into the insights gained from 12 interviews with both employees and their direct supervisors. This research provided us with a detailed understanding of how both groups perceive and experience the development of skills and leadership styles when working with smart technologies like the Connected Worker Program. By examining these interviews, we reveal how these individuals approach and handle technological advancements, how their skills evolve, and the changes in leadership strategies necessary for effective implementation. The most challenges were encountered during the pre-implementation stage, when the organization faced resistance to change and a lack of necessary technical skills. During the implementation stage, there was a balance between the challenges and the development of key competencies, as employees gradually adapted to new tools and processes while also struggling with the difficulties of implementation. In the post-implementation stage, the most significant development of skills and capabilities can be observed, although challenges did not entirely disappear. This smooth transition from challenges to the development of skills and capabilities demonstrates a gradual evolution, where the initial problems became a catalyst for building the competencies required to effectively operate in the new work environment. The figure 3 illustrates the aggregated dimensions identified through the Gioia Method, highlighting the 1st order concepts, 2nd order themes, and aggregate dimensions across the pre-implementation, during implementation, and current situation stages

For a full list of quotes for operators and their direct supervisors which indicated 1st order concepts, please refer to the appendix 2.

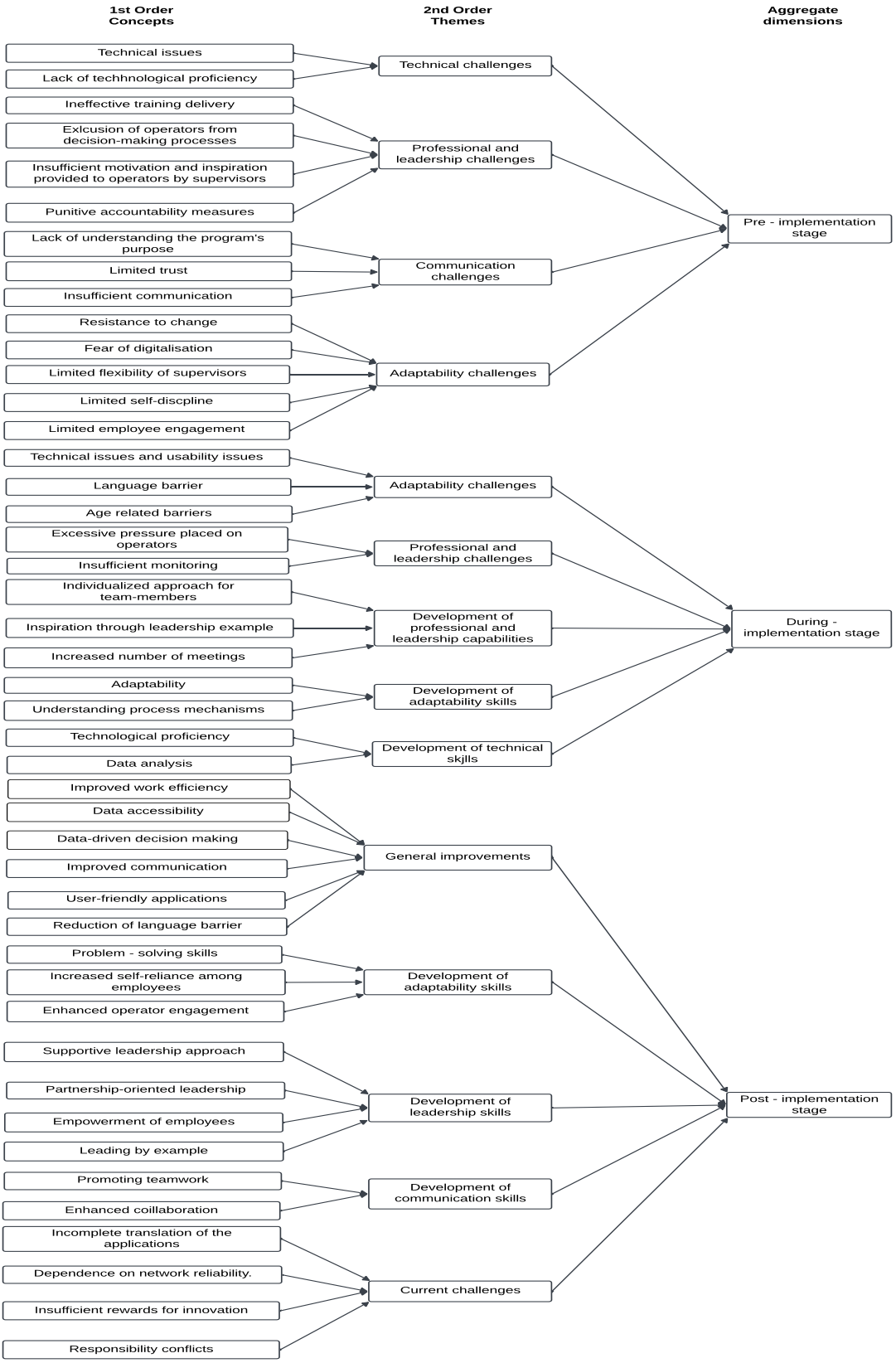

Figure 4: Gioia Method Analysis

4.1 Pre-implementation stage

The analysis identified four key areas on which respondents focused at this stage, without yet referring to developed skills, but concentrating primarily on the challenges they faced. These areas reflect the various difficulties encountered by both operators and their direct supervisors. The identified challenges include: technical challenges, challenges related to professional and leadership skills, communication issues, and difficulties in adapting to change.

The core challenges faced by employees were rooted in operational and technical barriers, starting with **technical issues.** Firstly, the interface of the new program was unintuitive, making it difficult for users to navigate effectively. Additionally, early versions of the program contained bugs and glitches, which strongly demotivated employees. This issue, combined with the employees' **limited technological proficiency**, made it even more difficult and contributed to operator demotivation. For many, the Connected Worker Program was their first encounter with modern technological systems, as most tasks in the factory had previously been documented on paper. Both operators and supervisors were unfamiliar with such tools, and the introduction of multiple applications at once left many feeling overwhelmed. As one participant noted, "*Managing multiple applications simultaneously proved challenging. It often seemed that trying to master several applications at once was less effective than focusing on and mastering just one."* Compounding this issue was the unfamiliarity with the iOS-based system used by the Connected Worker Program, as Android was more commonly used in Poland at the time. Participant 2 highlighted this problem, stating, "*Another issue was that we primarily used iPads, which run on an operating system less common in Poland, where Android is more prevalent. As a result, technical difficulties arose, and simply resetting the application often failed to resolve these issues."*

While most operators felt supported by their supervisors and appreciated the frequency of the training sessions*"I can't complain, the size and frequency of the trainings were okay,"* one operator stated—leaders identified key areas for improvement. Although the primary training sessions were conducted by external trainers, leaders also needed to convey significant portions of knowledge to their teams. Hence, many leaders expressed concerns about the overall **effectiveness of the training**. One key issue was that the training was often reactive rather than proactive. As Participant 3 observed, "*There could have been more emphasis on raising awareness during the implementation phase, specifically regarding the purpose and benefits of the training. Although training sessions were conducted, they were often introduced only when it became evident that the team was not using the tools effectively."*

This reactive approach meant that employees were not adequately prepared from the outset, and the training was used as a corrective measure rather than a preventative one. This reactive approach meant that operators weren't prepared from the outset, and training was used as a corrective measure rather than preventative. Additionally, th**e expertise of trainers was often lacking in practical, hands-on experience,** leading to a disconnect between theory and real-world application. As Participant 10 noted, *"I believe that, first and foremost, training should be conducted by competent individuals who are well-versed not only in the software but also in the practical aspects of what happens on the machines and production lines. This way, employees can learn from someone who is a credible authority, someone who can show them how things should work in practice. It's important that operators don't feel like the person conducting the training is disconnected from the reality of the shop floor and only talking about the software without understanding the day-to-day operation*." This resulted in a strong emphasis on theory, without sufficient practical application. Participant 5 shared a similar perspective, explaining, "*A more practical approach was missing. It felt like the subject was just being presented without enough hands-on application. Understanding things from a training session is one thing—it gives you an ideal concept of how things should work. But in reality, many factors, like the material we work with, can affect the process, and conditions can change*." In addition to ineffective training, operators also expressed concerns about their **exclusion from decision-making processes.** disconnect contributed to a broader divide between employees and supervisors. Production workers often felt overlooked and excluded from important decisions, which left them feeling undervalued. As one participant stated, *"As production workers, we are often not asked for our opinions, and we feel overlooked. However, this seems to be gradually changing for the better. The boundary between us and supervisors is becoming less rigid, but it hasn't always been this way, unfortunately."* This lack of communication and inclusion fostered frustration and diminished the potential for genuine employee engagement or innovation, as employees were often expected to comply with directives without fully understanding the reasoning behind them. Participants 12 has advised that operators should be involved in implementation process in the very early stages: "*The operators—those directly affected by the changes—should be involved much earlier, ideally at the stage of designing the change. Their opinions should be considered from the outset, rather than introducing changes without any consultation and only seeking their input after the fact, once the equipment has already been designed and implemented".* Further compounding these challenges was **the lack of motivation and inspiration provided by leadership** during the implementation phase. As Participant 7 pointedly noted, *"The key factor of effective leadership is probably motivating us all the time."* Finally, these issues were exacerbated by the punitive accountability measures in place, which discouraged proactive behavior. Instead of fostering a culture of learning and continuous improvement,

the system imposed financial penalties for mistakes, creating a workplace environment where employees felt they had to “keep their heads down.” Instead of promoting proactive behavior and initiative, such a system discouraged risk-taking or reporting issues, leading to an atmosphere of fear regarding potential consequences.

The lack of understanding the program's purpose, which stemmed from insufficient communication, emerged as one of the main reasons for initial skepticism, as it was frequently mentioned during interviews. This confusion about the system's objectives led to hesitation and resistance among employees, who questioned the necessity of documenting and reporting issues through the new platform. For instance, one application intended to enhance operator safety by allowing anonymous reporting of potentially hazardous behaviors was often misinterpreted as simply a means to "complain about a colleague." As one participant noted, *“I initially thought it was more about reporting on a colleague than focusing on safety.”* Additionally, one of he participants proposed the theory saying that "*Many companies treat their employees like children, fearing that if they explain the benefits of new technologies, management might become unnecessary. Right now, management is overly expansive and burdensome. If people are properly trained in continuous improvement, my role could become redundant.”* This viewpoint emphasizes that organizations can enable staff members to take more responsibility for their roles by giving them the necessary training and support. In the end, this strategy may result in a more productive and engaged staff, which will reduce the demand for extensive management. This highlights the urgent need for clearer communication about the program's goals. Attention was also drawn to **the limited trust**, particularly between operators and administrative workers involved in planning the implementation process. Because operators often lack trust in administrative workers—who, in turn, issue directives to team leaders—this mistrust leads to a further erosion of confidence between operators and their direct supervisors. The earlier mentioned disconnect serves as a primary cause of this situation, creating a cycle where lack of trust undermines effective communication and collaboration. While the operational and technical barriers presented significant challenges, they also highlighted issues related to communication and exclusion of operators. Firstly, **communication was initially limited** due to physical restrictions imposed by the pandemic during part of the implementation process.

Initial resistance and skepticism regarding the CWP were likely the result of numerous challenges faced by employees. Overall, the workers exhibited **a resistant attitude toward transformation**. Notably, half of those interviewed had been with the company for over 10 years, indicating a long tenure that often fosters deep-rooted habits and a strong attachment to established practices. This long

experience can lead to a sense of comfort with the current situation, making employees more reluctant to accept change. Many supervisors observed that people generally dislike change, and there is always a prevailing skepticism at the onset of new initiatives, largely due to the necessity of learning new skills. As Operator 11 remarked, "*Well, I guess a person of a certain age gets tired of learning more new things***."** The change being introduced to the company was already a challenge on its own, but the added shift towards **digitalisation** created an additional layer of difficulty, as many people held reservations about it at the time. Several employees expressed concerns about their capacity to keep pace with the fast-evolving technology, particularly those who were less experienced with digital tools. However, resistance was not limited to the operators; supervisors, too, faced difficulties in adapting, as many struggled with **the limited flexibility** required in dynamic environments. When new technology or processes are introduced, especially in environments involving machinery and complex systems, adaptability is key. As Participant 5 explained, "*Some supervisors didn't fully understand that the initial guidelines were just a starting reference and could be adjusted over time, depending on factors like material differences, environmental conditions, or temperature.*" Supervisors adhered too strictly to established rules, which limited their ability to respond to the nuances of real-world production challenges. Since supervisors serve as role models, their ability to convey knowledge in a practical and adaptable way is crucial. Just as employees may resist new processes out of habit or fear of change, supervisors must learn to navigate these uncertainties with greater flexibility. Guidelines provide a framework, but production environments often require adjustments that go beyond rigid adherence to instructions. Limited accountability was clearly linked to **limited self-discipline.** When defects occurred in the machines, operators rarely considered the causes of these errors or the potential consequences of the situation. This reluctance to engage not only hindered effective problem-solving but also contributed to a cycle of unresolved issues. Moreover, the weakened communication contributed to a sense of exclusion among operators. The Connected Worker Program applications are designed to facilitate reporting issues, yet operators frequently found themselves uninformed about efforts to address these problems. This lack of feedback not only hindered their engagement but also led them to question the value of the applications more often. In this context, the absence of encouragement and clear communication from supervisors ultimately detracted from the overall effectiveness of the program and left operators feeling demotivated. As a result, employees avoided taking responsibility and engaged only minimally, sticking strictly to their immediate tasks. Consequently, their **engagement was substantially low**; operators primarily fulfilled their duties but lacked a sense of responsibility. In the past, employees had limited responsibility for their work areas and machines, which led to a harmful neglect of safety and quality standards. Operators tended to focus only on their individual tasks, often without understanding the overall processes in the factory. This

narrow focus reduced their ability to spot potential hazards or inefficiencies and discouraged collaboration and improvement. Without a sense of ownership over their work, operators were less motivated to take initiative or suggest enhancements, creating a cycle of disengagement where they merely complied with instructions instead of actively participating in the workplace.

The number of identified challenges highlights a strong need to develop specific skills and capabilities to effectively address them. However, it is important to clarify that many of these skills were not directly identified in the data but rather inferred through the challenges posed by their absence. Figure 4 outlines these key skills, which are essential to overcoming the challenges identified during the pre-implementation stage.

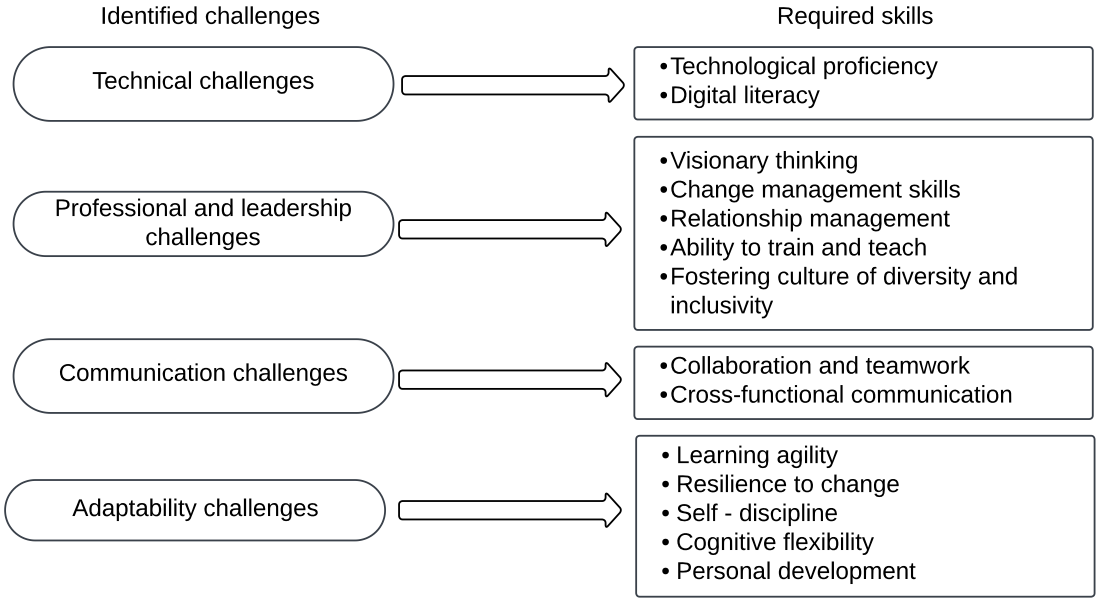

Figure 5: Skillss for Addressing Challenges identified in pre-implementation stage

4.2 During implementation stage

During the implementation stage, we will start by discussing the challenges that participants specifically pointed out. Much like during the pre-implementation phase, the primary issues were **technical and usability-related.** Applications frequently malfunctioned or would crash which resulted in the loss of valuable data. The optimism that the program would run smoothly diminished among both operators and some leaders. As one leader expressed, *"Together with the operators, I*

honestly doubted that it would work out because the amount of errors that were put in there and delays in updating all that data were so high." We can therefore conclude that one of the main reasons for the lack of motivation and enthusiasm in using the applications was the technical issues As another leader, Participant 12, observed: "*Such technical problems strongly demotivate people to use the technology later, and we need to keep reminding them."* **The language barrier** also proved to be a significant issue. Many applications during the implementation phase were not translated, with English being the only available language. While this wasn't a major problem for younger employees, older individuals who did not speak English found it particularly challenging. This sentiment smoothly transitions us to the next first-order concept: **age-related barriers.** The majority of participants acknowledged that age influences technology adaptation. For example, Participant 10 observed, "*Generations are evolving, and younger people entering the workforce typically approach technology differently. For older generations, who have been accustomed to a particular working style for many years, new technologies can present significant challenges. In contrast, the newest generation entering the job market generally adapts to these technologies more effortlessly and experiences fewer difficulties."* However, it is essential to recognize that some participants felt age is not a significant factor in adapting to technology. They argued that individual willingness and openness to change are more critical. As Participant 6 noted*, "I believe that adaptability to technology is more about individual characteristics than age. From my observations, there are older individuals who are very eager to learn and engage with new technologies, sometimes even more so than younger people. Therefore, it's more accurate to focus on personal interest and willingness to learn rather than categorizing based on age alone. Personal traits and a desire to embrace technology play a crucial role in this adaptability."*

An initial issue was the lack of appropriate professional and leadership skills among supervisors, who placed **excessive pressure** on operators during the implementation process. Many operators noted that this period brought increased pressure, as they were frequently reminded to use the applications associated with the Connected Worker Program. The sudden announcement of the program significantly impacted their workflow, initially making tasks take much longer. Rather than feeling encouraged to use the applications, operators felt pressured. As Participant 4 observed: *"In the beginning, there was so much pressure that we felt overwhelmed. I think that's why people were resistant—they simply didn't want to engage because of the way it was handled."* Similarly, Participant 7 mentioned: *"There's more pressure than motivation to use the applications."* This pressure became a source of frustration, but it wasn't accompanied by **sufficient monitoring** to ensure that operators were actually fulfilling their new responsibilities. Some participants pointed out that when employees

are assigned new tasks without regular oversight, they may feel that their extra efforts are unimportant. This perception led to decreased engagement, causing operators to use the applications less frequently than expected. As a result, the excessive pressure, instead of motivating operators, combined with insufficient monitoring to create disengagement and lower overall involvement.

Many responses indicated that leadership was gradually evolving. Given that the introduction of the CWP represented a significant change for the entire organization, supervisors needed to adopt various methods to effectively engage their team members. The quotes included in the figure underscore the importance of an **individualized approach** to employees. Understanding that each person absorbs knowledge differently—some easily grasp concepts in a group setting, while others require a more personalized approach or additional time to assimilate new information—is a key aspect of emotional intelligence Participants also noted that witnessing a leader who genuinely cares about their work can be very inspiring, motivating others to invest more effort and contribute to the organization's success. This concept of **inspiration through leadership by example** was highlighted by Participant 9, who remarked, "A leader should first demonstrate how to perform tasks before expecting others to do the same." They elaborated, saying, "It's important for leaders to show that they can do the work as well, providing their team with a clear example to follow. A good leader should lead in a way that encourages everyone to recognize this as the right approach, and I truly appreciate that mindset." This underscores the significance of leaders actively engaging in their responsibilities to set a positive example for their teams. To address challenges that appeared, **the number of meetings was increased** to provide more opportunities for discussing progress, clarifying any misunderstandings, and fostering a sense of accountability among team members.

Initially, there was a significant level of resistance among employees, but over time, they began to embrace the changes and demonstrate a gradual **adaptability.** One participant reflected*, "I was at first skeptical about the changes, but I gradually learned and adapted."* Their direct supervisors shared similar experiences. For instance, Participant 2 emphasized her commitment to developing new skills, specifically in mastering Tableau and Power BI, to *"get more out of it"* and facilitate a smoother transition to the new tools. The development of these skills has allowed employees to deepen their **understanding of the processes and mechanisms** that operate within the factory. As Participant 5 noted, "I*t helped me understand the processes and improve them."* This newfound insight not only motivates employees to perform their tasks more thoughtfully but also promotes logical thinking and encourages them to actively look for solutions to any problems they encounter.

Despite the difficulties in using the applications, employees had to adapt to the new requirements and begin learning how to operate the tools, which led to the development of both operators' and leaders' skills. It was the operators who were most involved with the daily use of the applications, making them the first to notice improvements in their technical skills. Employees, especially those who had previously depended on manual processes, had to develop the **technological proficiency** needed to manage the applications that were central to the CWP system. As one manager observed, *"There's definitely a need for at least a basic understanding of digital technologies...So, there has to be some familiarity with it."* As employees became more proficient in using the new applications, another important skill began to emerge: **data analysis.** The CWP system necessitates data analysis, as the information collected by these applications is invaluable in the factory environment where operators work daily with machinery. For instance, when a machine malfunctions, having access to a wealth of data allows teams to anticipate the underlying causes. Operators, who are responsible for managing these machines, needed to learn how to analyze this data to work more efficiently. As Participant 3 stated, *"Now we have it all in one place, so you can analyze it for yourself. It's a lot quicker*."

As observed, the number of challenges during the implementation stage has significantly decreased compared to the pre-implementation stage. This reduction can be largely attributed to the development of key skills and capabilities that emerged throughout the process, which played a crucial role in mitigating obstacles and ensuring smoother progress. During this stage, we noted significant growth in professional, leadership, adaptability, and technical skills that addressed the challenges from the pre-implementation phase. In particular, leaders demonstrated notable progress in areas such as change management, influence and persuasion, relationship management, and training capabilities. The Connected Worker Program also helped both leaders and operators gain a deeper understanding of plant processes, fostering adaptability skills like learning agility and resilience to change. Moreover, there was a marked improvement in technical skills, including technological proficiency and data analysis.

Despite these advancements, it's important to highlight the specific skills still required to overcome the remaining challenges, as illustrated in Figure 5.

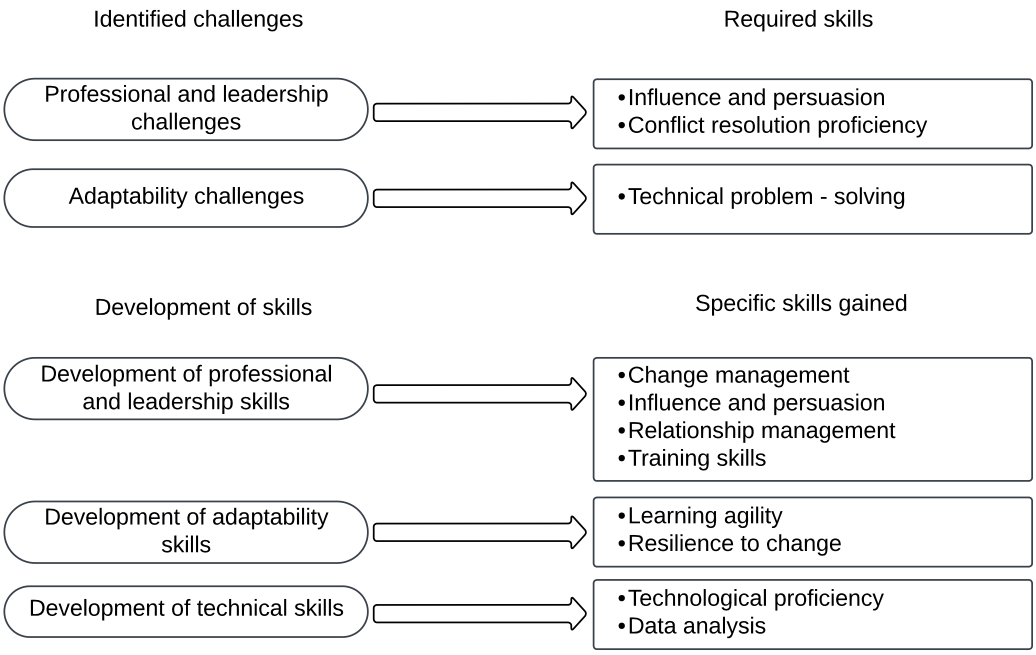

Figure 6: Identified Challenges and Development of Skills during the During - Implementation Stage

4.3 Current situation

The analysis of the current situation provides valuable insight into the progress made in areas such as overall operations, skill development, and leadership styles. This is largely because interview participants tended to focus more on the present state of affairs, offering detailed reflections on the improvements and changes they have experienced in these areas.

When asked about the key benefits of implementing the CWP, most participants focused on **improvements in work efficiency,** emphasizing how processes have become significantly faster. Participant 12 provided a clear example, referring to the reconfiguration of a machine used for packing different sizes of boxes: *"Initially, it took eight hours to re-equip the machine, we got it down to four hours, and now we're rearming the machine in just one hour."* This demonstrates how processes within the company have become much faster, leading to increased productivity and operational efficiency. Additionally, employees are now better equipped to handle various challenges. As Participant 11 remarked, *"It makes a lot of things easier... I know I can respond quicker and react to unforeseen situations."* This is a notable improvement from the past, when the entire production plan had to be printed out. Today, everyone has access to the plan at any time, allowing for better

preparation and adaptability in the face of unexpected circumstances, such as a lack of necessary resources for a given day's production. The improvement is undoubtedly largely attributed to **the access to a large amount of data**. As one participant noted, *"We have all the information in one place."* This shift has transformed how employees interact with data; previously, they had to retrieve physical documents, manually input the information into the computer, and this was often the only way to access critical data. Now, the same information is readily available with just a few clicks, significantly enhancing their ability to manage processes more effectively. Moreover, this easy access to data fosters a culture of **informed decision-making,** allowing employees to quickly analyze information and respond to issues in real time. As another participant highlighted, *"In the past, we had to go get the paper, enter it into the computer, and that was the only way to have any data… now we have exactly the same thing, the same data, but they are available in a few clicks, which helps us manage processes better."* This shift not only streamlines workflows but also empowers employees to take proactive measures rather than reactive ones. Ultimately, the availability of data at their fingertips has revolutionized how teams operate, leading to a more agile and responsive work environment. Consequently, issue management has improved significantly. For instance, in the event of a machine failure, identifying the root cause has become much easier due to the ability to analyze historical data. This capability allows employees to effectively anticipate potential problems. As one participant noted, responsibilities for detecting issues based on data have now been assigned to specific individuals, further enhancing the overall process. All these factors serve as a foundation for **improved communication** within the organization. A significant number of participants noted a marked enhancement in communication. The primary tool facilitating communication was undoubtedly the tablets, which allowed problems to be reported and communicated in real time. As Participant 2 noted, *"There is this conviction that if the problem is typed somewhere, someone will actually take care of it."* This sentiment highlights a stark contrast to the past, when issues reported on paper were often neglected and overlooked. However, it is worth noting that some participants indicated that while communication has improved, this enhancement primarily pertains to the relationship between operators and their immediate supervisors, rather than extending to higher management: *"...most management team doesn't use these programs, so the communication there hasn't improved."* Since the pre-implementation stage, the applications have been updated multiple times to make them easier for employees to use, and this has been positively acknowledged. Firstly, the emphasis on designing **user-friendly applications** has significantly improved their usability for employees. The more intuitive interface has simplified navigation, enabling employees to focus on their tasks instead of dealing with technical difficulties. Moreover, the addition of multilingual support in the recent updates has effectively **addressed the language barrier**, especially among older employees.

In the post-implementation stage, the emphasis on employee development has become increasingly evident, particularly regarding the competencies that have been cultivated over time. Similar to the during-implementation stage, employees began to notice the growth of certain skills within themselves. Reflecting on the current situation, they confidently highlighted improvements in areas such as better **problem-solving techniques** and greater proficiency in new technologies overall as mentioned earlier. Operators also no longer required assistance with data analysis, as they had gained easy access to the data and learned how to analyze it effectively. This enhanced capability not only empowers employees to monitor their work more efficiently but also enables them to make informed decisions based on real-time data. The development of some skills, particularly among operators, has positively influenced their leaders as well. One leader noted, "*I feel comfortable working with people who have advanced technical skills because I know I can rely on them, and I know I can get support from my team."* This observation reflects an important shift in the traditional dynamic of support within teams. Instead of assistance flowing solely from leaders to operators, it now moves in both directions. This leads us to the next observation: **the increased self-reliance** among employees. One of the applications integrated into the CWP focused on ensuring workplace safety. This tool allowed employees to report potentially hazardous situations on-site, which in turn heightened their awareness of safety concerns. As a result, many operators became more vigilant and thorough in their daily tasks. This increased focus on safety and quality not only improved workplace conditions but also contributed to a growing sense of self-reliance among employees. Operators began to take greater ownership of their responsibilities, and this rising independence was also noticed by their supervisors. By monitoring their own work processes and even identifying machine defects, operators demonstrated a stronger ability to manage tasks autonomously. As one operator explained, "*I'm now more in control of my work and can manage tasks directly. If I need to, I can contact the manager to discuss our progress and make faster decisions."* This newfound independence and self-reliance empowered operators to take initiative and make autonomous decisions, which, in turn, led to **greater engagement** in their tasks. Rather than merely focusing on fulfilling their assigned duties, they began to take an active role in improving processes, including enhancing the quality of data and content within the program. They also became more proactive in identifying and addressing process-related issues. This shift largely resulted from operators gaining a better understanding of the processes within the plant.

In terms of skills, the most noticeable improvements were observed among the operators. However, the leadership style also began to evolve in response to these transformations. It is worth noting that in this facility, most individuals in leadership roles have long tenures and began their careers at the entry level. This experience has given them a unique perspective, as they have a deep understanding of both the day-to-day operational challenges and the broader strategic objectives of the

company. Their background enables them to effectively bridge the gap between management and employees. This background likely played a significant role in shaping **the supportive leadership approach** taken toward operators. As one leader mentioned, *"I try to be there so that if someone has questions, they can always ask me."* Operators echoed this sentiment, with Participant 7 stating, *"There is no such thing as a manager not helping out"* and Participant 9 adding, *"I can always count on my supervisor."* Participant 9 also reflected on his initial reluctance toward new technologies, emphasizing how his direct supervisor was supportive throughout the process: *"He never pressured me; he wanted to offer support...you could say he's a caretaker of operators."* This collaborative and supportive leadership style was instrumental in easing the transition for many workers. One leader described their approach as follows: "*It's more of a partnership. Perhaps this stems from the way I was promoted here, as I already knew many of the people. They were my colleagues, with whom I worked in an equivalent position."* This statement highlights a **leadership style that is partnership-oriented**, built on mutual respect and familiarity. By maintaining this sense of equality and collaboration, leaders who have risen through the ranks are able to foster stronger connections and trust with their teams, ultimately creating a more cohesive and supportive work environment. By fostering stronger connections and trust, leaders have significantly contributed to the **empowerment of employees.** They have begun to emphasize encouraging operators to take ownership of their work rather than relying solely on constant monitoring and control. One leader advocated for a coaching approach that involves assisting and guiding employees in problem-solving rather than completely separating operators from the issues they face. Previously, operators would approach their supervisors with problems, expecting them to resolve the entire issue. However, now when operators present challenges, the leader's role is more focused on coaching and support, encouraging operators to engage in analytical and logical thinking to identify potential solutions themselves. This approach not only enhances problem-solving skills but also fosters a sense of ownership and accountability among the team. One aspect particularly noted among the operators is **leading by example**. They express deep respect for leaders who first demonstrate their ability to perform a task and understand the process before expecting the same from others. This approach fosters admiration among operators. As one operator pointed out, the dedication displayed by their leaders serves as a source of inspiration, motivating team members to actively engage in the work process and strive to emulate the same level of commitment.

Leaders have also begun to prioritize **teamwork,** emphasizing mutual support among team members and ensuring that tasks are distributed evenly. They have highlighted the contrast between past problem-solving approaches, where supervisors primarily issued commands and were often absent from the day-to-day operations, and the current emphasis on collaboration. Now, the idea of teamwork is actively nurtured within the organization. As one leader noted, "*We work as a team here, let's say*

as a family." This sentiment reinforces the notion that if one person faces a challenge, the entire team comes together to address it: "*If one person can't do it, then somehow we sit down all together and try to solve the problem."* This collective effort is seen as crucial for overcoming obstacles. In this environment of **growing collaboration,** both leaders and operators have emphasized the importance of sharing knowledge and supporting one another. For instance, one of the leaders (Participant 12) stated, "*I am really proud of them and how they are able to communicate with each other and share their knowledge."* Similarly, an operator (Participant 11) remarked, "*We help each other a lot. For example, if I know something and my colleague knows something else, we can exchange our knowledge. It's always better together; by trying things out and combining our knowledge, we achieve more."* This enhanced collaboration is further supported by the real-time reporting mechanisms, which have made operators feel 'heard' and more engaged in the process.

While many aspects that positively influence the work environment have been identified, it is also important to recognize the concerns that persist in the current stage. Although it was previously noted that the language barrier issue has been addressed, it is important to emphasize that this has not been fully resolved. While the majority of applications have undergone translation, there are still some that remain available only in English, which continues to pose a challenge for users. **This incomplete translation of the applications** signifies that not all employees are able to fully utilize the tools at their disposal, thereby limiting their effectiveness and contributing to ongoing difficulties in communication and workflow. Another notable concern is **the dependence on network reliability**. The functionality of the entire system hinges on a stable network connection; when the system experiences failures, it can halt operations entirely. Currently, there are no established protocols or guidelines to follow in such situations, leaving employees uncertain about how to respond. One participant poignantly noted, "*When the system fails, it paralyzes our production completely. Today the system is not running, so tomorrow there will be no data on what was produced, what the stops and rates were, etc."* Interestingly, this remark came during a global system outage when the interview was conducted, further highlighting the urgency of addressing network reliability. An important concern which has been raised is the **insufficient rewards** for innovative ideas. As mentioned by one of the leaders, also stated, *"It's crucial that if someone has an idea about anything, they should be listened to, the concept understood, and the situation explored... If the idea brings either direct or indirect profits, such as increased productivity or cost savings, it should be implemented swiftly, with clear deadlines, and those who proposed the idea should be appropriately rewarded."* He observed that rewards for innovative ideas are modest, and there appears to be limited encouragement for employee-driven suggestions. The speaker emphasized how such an approach would further motivate operators to take initiative and step beyond their usual responsibilities, ultimately contributing to the

company's growth and development. However, this discussion of motivation and initiative also ties into a broader issue: **conflicts over responsibility.** Both operators and their direct supervisors have raised concerns about the uneven distribution of responsibilities. Team leaders noted that operators often defer to the idea that, as leaders, they inherently carry greater responsibility, relying on them too heavily. On the other hand, operators pointed out that their supervisors sometimes take advantage of their enhanced technical skills, expecting them to manage more complex issues on their own. If these observations are not addressed, they could potentially foster increased tension within the workplace in the future.

During the final stage, we can particularly observe significant improvements in the workplace brought about by the Connected Worker Program, alongside the development of key skills. Both operators and leaders demonstrated growth in adaptability skills, such **as creative problem-solving, self-discipline**, and **personal development**. Leaders, in turn, provided greater support to operators and became more involved in processes and changes, showcasing **proficiency in conflict resolution, fostering a culture of diversity and inclusivity, and adopting visionary thinking**. Additionally, communication improvements were notable, both between operators and their supervisors, and among operators themselves. This indicates enhanced **collaboration and teamwork, cross-functional communication,** and **effective stakeholder management.** These developments contributed to a more cohesive and efficient work environment, as employees began to engage more actively in problem-solving and process improvements. The developments outlined above are summarized in Figure 6.

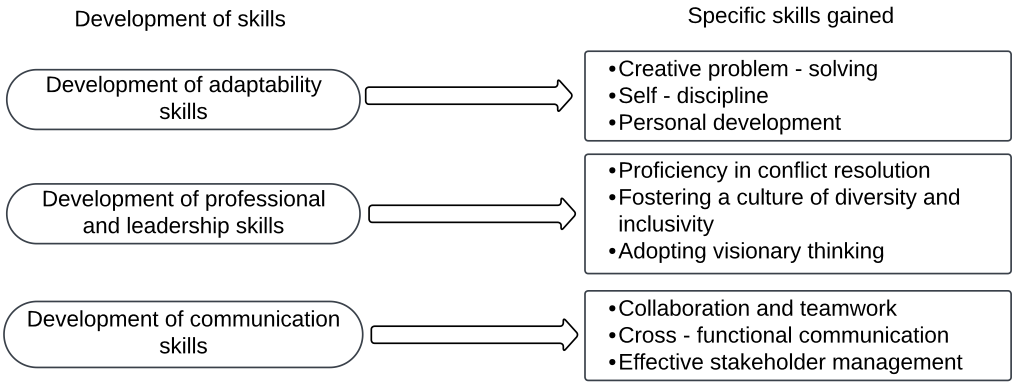

Figure 7: Development of Skills in the Post – implementation stage

5. Discussion

Drawing from a review of relevant literature, interviews were carried out with both operators and their direct supervisors at company X, which adopted the Connected Worker Program as a model of integrating smart technologies into the workplace. The research focused on addressing question: "What specific skills do employees need for the effective implementation of smart technologies, and how do these skills, along with the leadership styles of their supervisors, evolve at different stages of technology adoption?" This study examines both the perspectives of employees and their leaders, proposing an extension of the UTAUT model to include leadership elements. Specifically, it incorporates three leadership styles—transformational, instrumental, and empowering—each applied at different stages of technology adoption. These leadership styles are critical factors influencing employees' behavioural intention to use technology. Additionally, in accordance with **leader-member exchange theory**, these context-specific leadership styles contribute to the development of essential employee skills, which in turn directly affect their actual technology use (use behaviour).

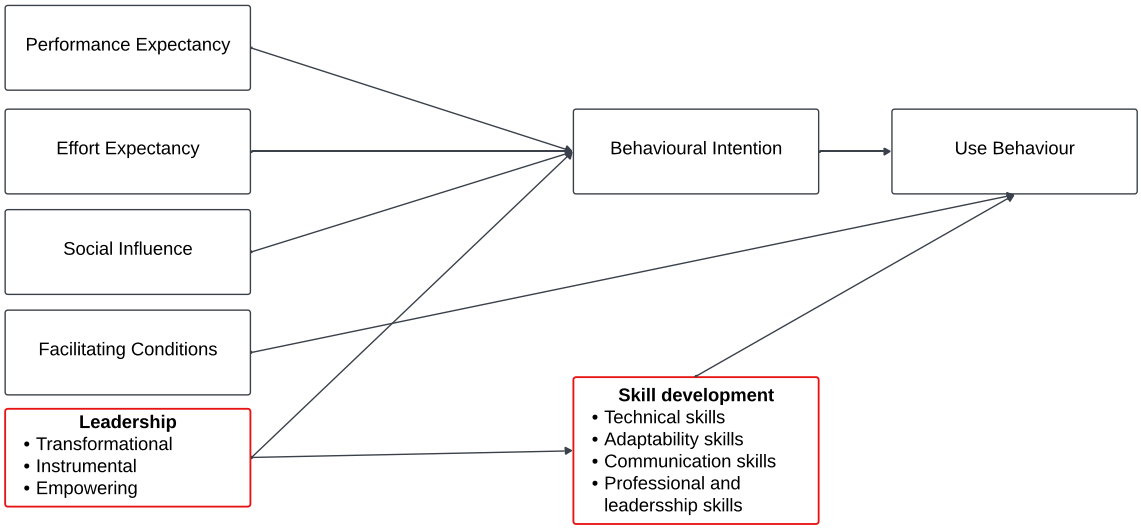

Figure 8: Extended UTAUT Model: Leadership Styles and Skill Development

The study further explores which skills are required at each stage of implementing smart technologies in the workplace and expands this understanding by categorizing these skills based on their relevance in the pre-implementation, implementation, and post-implementation phases. It also examines which leadership style best supports the development of these skills across these stages.

In the pre-implementation stage (see Figure 4), the emphasis is primarily on the development of technical, leadership, communication, and adaptability skills, which are crucial in preparing the organization for upcoming changes. During the implementation phase (see Figure 5), adaptability skills become even more significant, given the continuous technological changes. At the same time, leadership skills—especially in terms of maintaining employee engagement and team management—remain critical, along with technical competencies. In the post-implementation stage (see Figure 6), there is noticeable growth in adaptability skills, reflecting employees' capacity to flexibly respond to new challenges, as well as in leadership skills, which support the continued transformation of the organization. Additionally, the development of communication skills becomes key at this stage, fostering more effective collaboration and enhancing overall team efficiency.

The study found that transformational leadership is most effective in the pre-implementation stage, promoting openness to change and innovation. In the implementation stage, instrumental leadership excels in guiding employees through technological complexities and ensuring task completion. In the post-implementation stage, empowering leadership plays a key role in fostering a culture of continuous improvement and encouraging employee ownership of the new systems.

Based on these findings, this study proposes a framework (see Figure 8) that links specific leadership styles with the development of particular skills at each stage of technology implementation. The order of required skills in each phase is determined by their relevance.

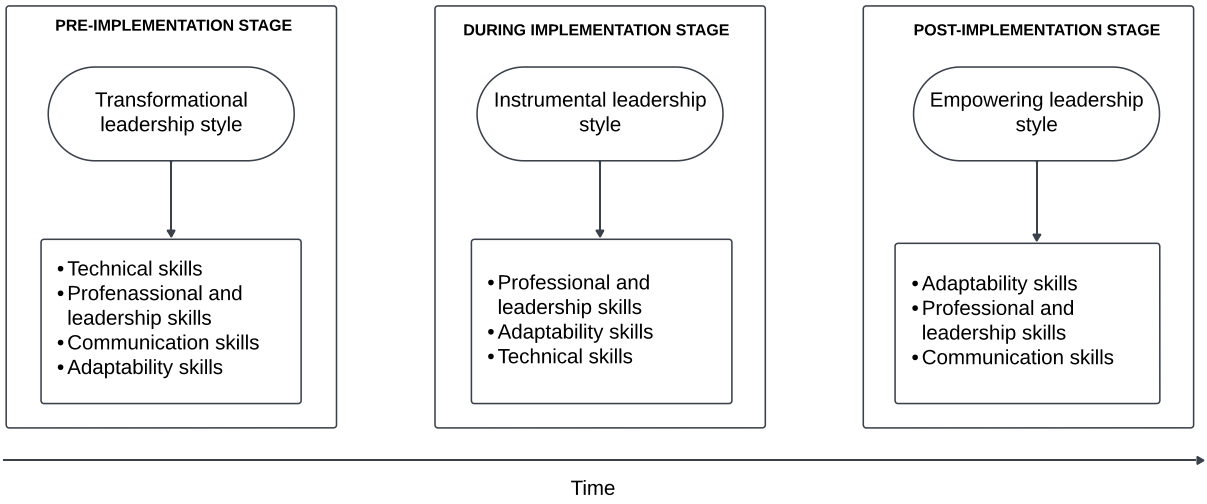

Figure 9: Framework Illustrating Skill Development and Leadership Styles Across Implementation Stages

5.1 Theoretical implications

While the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2007) serves as a foundational model for understanding technology acceptance predictors, this study enhances theoretical insights by integrating leadership styles as one of the factors influencing successful technology adoption. By aligning specific leadership styles with the various stages of implementation, the study demonstrates how these styles positively impact the development of the required skills at each stage.

Both transformational leadership (Bass, 2006) and instrumental leadership styles (Antonakis & House, 2014) are recognized in the literature for their positive impact on employees' adoption of smart technologies (van Dun & Kumar, 2023; Neufeld et al., 2007). However, the analysis revealed that the effectiveness of these leadership styles varies across different implementation stages. This finding enhances existing theories by demonstrating how leadership styles dynamically shift throughout the technology adoption process, moving away from a one-size-fits-all approach. This research provides a broader perspective on the role of leadership in technology acceptance, illustrating that the required leadership styles evolve in response to the changing needs of the organization and its employees at each stage of implementation. The concept regarding the evolution of leadership styles during implementation can be further supported by recent studies examining the impact of leadership styles on employee adoption of smart technologies at various stages of implementation (Van Dun et al., 2024) which highlighted a significant shift from transformational leadership to instrumental leadership as the implementation progresses, providing a strong foundation for this argument.

Initially, a set of essential skills required for effective workplace integration of smart technologies was identified based on the existing literature, as detailed in Table 3 (see page 18) which then were categorized into four categories: technical, adaptability, communication and leadership skills. The research further expands this knowledge by categorizing these skills according to their relevance in the pre-implementation, during implementation, and post-implementation stages.

In the pre-implementation stage, we identified key challenges related to the introduction of the CWP, which helped us define the essential skills for this phase, including technical, leadership, communication, and adaptability skills (see Figure 4). Notably, these skills align with recent studies that also highlight their critical role in ensuring success (Ribeiro et al., 2021). The challenges encountered, such as resistance, lack of trust, and skepticism, were most effectively addressed through transformational leadership, which emerged as the most suitable approach for overcoming these obstacles. The ability of transformational leaders to inspire and motivate employees fosters

collaboration, which in turn reduces fear and uncertainty. This leadership style helps overcome psychological barriers but also actively supports the development of essential skills needed at this stage, including technical, professional and leadership skills, communication, and adaptability (see figure 4). By fostering openness to change and innovation, transformational leaders create conditions that encourage skill development. Supporting this, Busari et al. (2019) and Lei et al. (2019) found that transformational leaders play an important role in initiating change by building trust and enhancing employee engagement. This collaborative and trusting environment directly contributes to the growth of skills, as employees are more willing to embrace new learning opportunities. Similarly, Islam et al. (2021) highlighted that transformational leaders establish emotional connections with employees, which reduces uncertainty and promotes adaptability—a critical skill in the pre-implementation stage.

During the implementation stage, we observed a significant decline in employee enthusiasm and motivation to use the Connected Worker Program (CWP), which aligns with existing research on the implementation phase of new technologies. Studies such as those by Tarafdar et al. (2007) demonstrate that motivation can drop when employees perceive technology as too complex or not immediately beneficial. Similarly, Ayyagari, Grover, & Purvis (2011) identified technostress as a factor contributing to emotional exhaustion and reduced job satisfaction, particularly when employees feel overwhelmed by new tools and processes. Moreover, unmet expectations—such as those described in the UTAUT model (Venkatesh et al., 2007)—also played a role. Many employees experienced frustration due to the rushed introduction of applications, which impacted effort expectancy and required more intensive monitoring and supervision. This is where the **instrumental leadership** style becomes essential. Instrumental leadership, characterized by strategic planning, goal-setting, and close monitoring (Antonakis & House, 2014), is well-suited to the challenges of the implementation stage. It addresses employees' decreasing motivation by providing clear, actionable steps and short-term objectives, which help to maintain focus and performance expectancy. By setting achievable targets, instrumental leaders offer consistent support and feedback, which is critical for guiding employees through the learning process of new technologies. In addition to the identified challenges, we observed significant development of technical and adaptability skills during the implementation phase, which are essential for handling ongoing system updates. Recent studies confirm that adaptability is critical for helping employees adjust to new technologies at this stage (Metz, 2019), while technical skills play a key role in resolving system-related issues. These findings are supported by research showing that the development of these skills enhances the success of technology adoption during implementation (Rasskazova et al., 2020; Johnson et al., 2021).

In the post-implementation stage, we observed notable advancements in leadership, adaptability, and communication skills (see Figure 6). Leaders increasingly focused on empowering employees through a partnership-oriented leadership style that fosters teamwork. This aligns with empowering leadership principles, which aim to encourage employee responsibility and active contribution to organizational goals (Cheong et al., 2018). Horváth & Szabó (2019) highlighted that leadership skills play a key role in maintaining employee engagement and motivation, which are critical factors for long-term success. This leadership style incorporates elements from previous styles, promoting collaboration while emphasizing employee empowerment and autonomy elements that focus on employee development. Leaders strive to create an environment where employees feel capable and confiden. This leadership style has a higher social exchange relationship with employees, as it focuses on employees' independence (Lee & Ding, 2020). As a result, we observed improvements in adaptability skills, particularly regarding personal development, as well as enhanced communication between employees and supervisors and among team members which fosters the generation of new ideas and encourages creative problem-solving (Türkmendağ & Tuna, 2021). The operators have developed a greater sense of agency and confidence through previous stages, and are now equipped to leverage their knowledge to enhance and improve existing technologies. During interviews, many participants expressed enthusiasm for contributing innovative ideas related to the Connected Worker Program (CWP) and actively communicated these suggestions to their supervisors. This proactive approach demonstrates a commitment to continuous improvement and reflects a culture of collaboration and innovation. By giving employees more responsibility, leaders cultivated a sense of ownership, driving accountability and problem-solving within teams (Zhang et al., 2019).

This analysis has allowed us to identify the skills most desired in each phase of implementation and to ascertain which leadership styles most effectively foster the development of these skills. Consequently, the interplay between the identified leadership styles and skills significantly contributes to the successful implementation of smart technologies. By understanding these relationships, organizations can better position themselves for effective technology integration, ultimately enhancing overall performance and adaptability in an increasingly digital landscape.

5.2 Practical implications

This study offers valuable practical insights for organizations seeking to implement smart technologies successfully. The findings emphasize the critical role of leadership in driving technology adoption and

skill development, providing actionable guidance for managers and leaders at different stages of the implementation process.

At the beginning of the implementation process, it is essential to actively involve operators from the very beginning. Early engagement increases the likelihood that employees will understand the purpose behind the transformation, reducing initial resistance. This approach can also help identify and address potential challenges early on, through brainstorming and feedback sessions. Managers should consider offering training in smaller groups to provide more personalized support and facilitate open communication. Ongoing constructive feedback is key during this stage, ensuring employees feel supported and heard. It's equally important to maintain continuous support, especially through face-to-face meetings, which allow for individualized attention and tailored guidance. Moreover, Regular updates on progress toward these long-term goals can further enhance motivation and engagement.

During the implementation phase, managers should introduce changes gradually rather than all at once, to prevent overwhelming employees. Training sessions should be practical and focused, enabling operators to immediately apply new skills in their daily work. An example could be hands-on workshops and simulations that replicate real production issues, which can prepare employees for daily tasks. To ensure progress stays on track, managers should prioritize regular monitoring. This can be achieved through frequent check-ins with employees, tracking key performance indicators (KPIs) related to the skills being developed, and gathering feedback via short, targeted surveys or informal conversations. Setting clear, achievable short-term goals, such as mastering a specific task or process within a set timeframe, can help employees stay focused and motivated. By maintaining oversight, managers can quickly identify areas for improvement and adjust strategies accordingly.

In the post-implementation phase, it's essential to focus on continuous employee development. Providing ongoing learning opportunities will keep operators up-to-date with evolving technologies. Encouraging them to take initiative by proposing innovative ideas and rewarding their contributions such as bonuses or other incentives, will further foster engagement. Additionally, conducting role clarification workshops can ensure that everyone understands their responsibilities within the new system.

Based on the findings, a table of practical recommendations for the transformation process has been developed (see Table 5).

Table 5. *Recommendations for transformation*

Stage	*Recommendations*
Pre-implementation stage	- Arrange early – stage meetings with operators where they can learn about the new technology, ask questions and suggest their ideas. - Provide ample support by establishing dedicated support channels, such as a live chat or messaging platform. - Adopt an individualized approach to training by developing personalized learning tracks. - Conduct training in smaller groups for personalized engagement. - Solicit feedback from operators to improve the process by implementing quick and easy tool for submitting feedback e.g. Google Forms. - Emphasize clear and consistent communication by sending weekly updates. - Implement regular motivational strategies by celebrating small milestones with rewards such as shout-outs or group lunches. - Clarify the purpose of the transformation by creating visual charts - Focus on long – term goals by highlighting career benefits and skill development
During implementation stage	- Implement changes gradually to minimize overwhelm. - Prioritize practical training sessions conducted directly on the shop floor, rather than theoretical instruction. - Collect ongoing feedback from operators e.g. Google Forms - Monitor progress frequently to identify areas for improvement by having weekly meetings with teams to discuss the improvements - Focus on achievable short-term goals by breaking down larger project milestones into weekly or biweekly targets

Post-implementation stage	- Provide ongoing training opportunities e.g. video tutorials or interactive quizzes - Encourage operators to propose innovative ideas. - Implement a reward system for innovation by integrating recognition system where operators might earn points for innovative ideas - Conduct role clarification workshops to ensure understanding of responsibilities.

6. Limitations and Suggestions for Future Research

This study has several limitations that must be considered. The relatively small sample size of 12 participants, while providing valuable insights, limits the generalizability of the findings. A larger and more diverse sample would likely yield a broader range of perspectives and more comprehensive results.

Moreover, the participants' initial resistance to technology adoption, particularly with the Connected Worker Program (CWP), may have influenced the feedback provided. Several participants admitted to having a pre-existing reluctance towards technology, which should be acknowledged as a potential bias in their responses. One reason for this attitude towards the CWP could be that all participants in the study were from Poland. This means they share similar cultural values, such as collectivism. This cultural backdrop may have contributed to initial concerns and skepticism regarding technology adoption.

Another important factor was the role of age. Older employees, who had less exposure to digital technologies, reported more difficulties in adapting to new systems. This generational difference highlighted the need for more targeted support for older employees who may require additional time or resources to effectively engage with technology.

The study's retrospective approach—where participants reflected on their experiences across three distinct phases of implementation in a single interview—posed challenges. The reliance on memory may have affected the depth and accuracy of the insights collected regarding each phase.

Future research should focus on addressing these limitations by expanding the sample size to include a more diverse group of participants, encompassing various industries, and countries which might offer richer and more varied insights. Conducting longitudinal studies would provide a clearer understanding of how skills and leadership styles evolve over time and how employee engagement fluctuates across different implementation stages.

Research could also explore technology adoption in different industries to identify unique challenges and best practices. Moreover, age emerged as a critical factor in this study, with older employees facing more challenges in adapting to new technologies compared to their younger counterparts. Future research should consider recruiting participants from similar age groups to delve deeper into how age-specific barriers impact technology adoption. Such studies could inform the development of targeted training and support strategies to ease the transition for older employees and ensure a more inclusive approach to technology integration. Finally, further research could examine the impact of these challenges on employee well-being and job satisfaction, offering organizations more holistic strategies for creating supportive environments that facilitate smoother technological transitions.

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8. Appendix

Appendix 1

Interview guide (English)

- Welcome
- Sharing information
- Information about anonymity

Before we begin, do you give permission to record this interview? The recording will be transcribed and used solely for the purposes of this research. If you would like a digital copy of the transcription or the results of this research, please let me know. Once the project is completed, the recording will be deleted from all devices. The interview will then be stored only in the University of Twente's secure storage. At the end of this interview, I will provide you with my contact details in case you have any questions.

- Description of research (Industry 4.0, leadership, skills)

1. Introduction

- Could you please introduce yourself?
- What is your role and what are your responsibilities at the case company?
- How long have you been working in your current position?
- What is your age?

2. Smart technologies and CWP

- How have smart technologies and initiatives like the Connected Worker Program impacted your role and the overall functioning of your organization?

For example, have they streamlined communication, improved operational efficiency, or enhanced data analysis?

3. Impact of Smart Technologies

- What are the most significant benefits you've observed since implementing the CWP?
- Have there been any challenges or obstacles in the implementation process?

Questions for leaders

4. Can you place the Connected Worker Program (CWP) within a timeline? When did it start, and what have been the major milestones or phases of its implementation? *Pre-implementation / during / current situation*

5.Could you take us step-by-step through the start of the implementation to the current situation of the connected worker program? To clarify: *What key events happened pre-implementation / during / current situation? When did you first hear about this CWP? What is your story?*

6. Skills and leadership

- How have your skills changed over time since the implementation of the Connected Worker Program (CWP)? Can you recall any specific skills you didn't have before the program that you have developed as a result? *such as data analysis, problem-solving techniques, or proficiency with new technologies or soft skills like communication or teamwork*

- What specific skills do you believe are essential for employees working with the CWP/ smart technologies? *What can positively influence the development of these skills in employees?*
- *How have these skills changed the way employees approach their work and responsibilities?*

7. Leadership style

- How has the adoption of smart technologies influenced your leadership style, and what changes have you noticed in how you lead and manage teams as a result?
- *Can you provide examples of specific adjustments or strategies you've implemented in your leadership approach to effectively integrate smart technologies into your team's workflow?*
- *In what ways do you think your leadership style may continue to evolve as technology advancements like smart technologies progress?*

8. Interaction and Communication

- How has the interaction between leaders and employees changed with

the introduction of CWP and other smart technologies? *For instance, have you noticed changes in how feedback is exchanged, decision-making processes are conducted, or in the frequency of team communication?*

- Can you provide examples of how employees have taken on more responsibility or adapted leadership behaviors *(e.g., task monitoring, project coordination, quality control)?*

-*Can you provide an example of a successful and unsuccessful collaboration?*

9. Evolution of the roles and responsibilities

- How has your role changed since the introduction of the CWP? *For example, have you taken on new responsibilities such as data analysis or quality control monitoring? Have there been changes in how you collaborate with team members?*
- How have the roles and responsibilities of your team changed since the introduction of the CWP?
- How do you see the roles of leaders and employees evolving in the next 5-10 years?
- What new skills do you think will be essential for leaders and employees in the future?

10. Generational differences

Could you please share how CWP has influenced your tasks, responsibilities, or interactions with technology, and whether you see any generational differences in how it's perceived and used?

-*How do you think your age and experience have influenced your leadership approach in implementing the CWP?*

-*Have you observed any challenges or advantages in leading a team with mixed generational perspectives on technology and CWP?*

11. Challenges and opportunities

- *What are some of the biggest challenges you face in managing a team with advanced technical skills?*
- *What opportunities do you see arising from interactions and shared responsibilities between leaders and employees, whether through initiatives like the Connected Worker Program or other collaborative efforts?*

12. Closing questions

- Considering the introduction of the Connected Worker Program (CWP) and its impact on team performance, productivity, and leadership dynamics, what insights or recommendations would you share with leaders aiming to foster effective collaboration and optimize outcomes?
- *How do you feel about the barrier between employee and leader 'disappearing'?*
- *What do you believe are the key factors for successful leadership and employee interaction within the framework of the Connected Worker Program (CWP)?*

Questions for team members

4. Can you place the Connected Worker Program (CWP) within a timeline? When did it start, and what have been the major milestones or phases of its implementation?

5.Could you take us step-by-step through the start of the implementation to the current situation of the connected worker program? To clarify: *What key events happened pre-implementation / during / current situation? When did you first hear about this CWP? What is your story?*

6. Skills

- How have your skills changed over time since the implementation of the Connected Worker Program (CWP)? Can you recall any specific skills you didn't have before the program that you have developed as a result? *such as data analysis, problem-solving techniques, or proficiency with new technologies or soft skills like communication or teamwork*
- *What specific skills do you believe are most important for effectively utilizing CWP and smart technologies in your role? How have you worked to develop these skills?*
- Have you noticed the development of new traits or skills acquired by team members or leaders?

7. Leadership style

- How did your direct supervisor influence the implementation process of the connected worker program? *To clarify: How did your supervisor communicate about the connected worker programme?*
- In what ways, if any, does your supervisor support you in using the Connected Worker Program (CWP)?
- *How would you describe the leadership style of your supervisor?*
- *What leadership qualities do you think have the most positive impact on overall effectiveness?*

8. Interaction and Communication

-How have you experienced changes in interaction with leaders since the introduction of the Connected Worker Program (CWP) and other smart technologies? Have you noticed differences in how feedback is exchanged, decision-making processes are conducted, or in the frequency of team communication?
-Can you provide examples of how you have taken on more responsibility or adapted leadership behaviors since the implementation of CWP? *This could include tasks like monitoring, coordinating projects, or ensuring quality control*
- Can you provide an example of how you've worked together to solve a problem or improve a process? *such as streamlining a workflow, enhancing communication, or troubleshooting a technical issue?*

9. Evolution of roles and skills
-How has your role changed since the introduction of the CWP? *For example, have you taken on new responsibilities such as data analysis or quality control monitoring? Have there been changes in how you collaborate with your direct supervisor?*
- How do you see the roles of leaders and employees evolving in the next 5-
10 years?
- What new skills do you think will be essential for leaders and employees
in the future?

10. Generational differences
-How has the Connected Worker Program (CWP) influenced your tasks, responsibilities, or interactions with technology? From your perspective, do you notice any differences in how different generations perceive and use CWP?
- *How has your age influenced your comfort level with adopting new technologies introduced through the CWP?*
- *Can you provide an example of how different generational perspectives have influenced the use or acceptance of CWP tools among your team?*

11. Challenges and opportunities
- *What are some of the biggest challenges you face in working within a team that utilizes advanced technical skills, such as those involved in the Connected Worker Program (CWP)?*

- What opportunities do you see arising from interactions and shared responsibilities between leaders and employees, whether through initiatives like the Connected Worker Program or other collaborative efforts?

12. Closing questions

- Overall, how do you feel about the impact of the CWP on your work and productivity?

- How do you feel about the barrier between employee and leader 'disappearing'?

- What do you believe are the key factors for successful leadership and employee interaction within the framework of the Connected Worker Program (CWP)?

Additional questions

13. Organizational culture

- How has the organizational culture shifted with the integration of smart technologies and the evolution of leadership roles?

14. Additional

- Is the anything else you would like to add?

- Are there any areas that you think should be covered, but they weren't?

Appendix 2

Participant Quotes and Corresponding First-Order Concepts

PRE-IMPLEMENTATION STAGE

Quotes	1st Order Concepts
'" At the begginning, there was some errors and bugs quite often" *"...Such technical problems strongly demotivate people"*	Technical issues
"I didn't even know how to use computer" *"People did not have this technological proficiency "* *"Everything was done on-paper"* *"At first, some operators said they would never complete a training app"*	Lack of techhnological proficiency
"...It often felt like someone in a position of authority was dictating how things should look and work, without considering the operator's perspective. As a result, it seemed that those making decisions were disconnected from the reality on the shop floor.."	Ineffective training delivery

"Rather than just explaining through charts and presentations, it would be more effective to demonstrate the process in real production. Showing it in practice will yield better responses and understanding."	
"The contact was limited as part of implementation was during pandemic"	Insufficient communication
"I don't think t was quite understood" *"The worst hurdle is to explain to the people who are supposed to use it what it is for and to make them understand it is for their good"* *"I think, at least thought that it was more about not security, it was more about reporting on a colleague. And that might have been a cause of resistance"*	Lack of understanding the program's purpose
"...here is a divide between the physical worker and administrative worker, so people don't always trust their superiors,or people above them"	Limited trust
"In the past, there was a system in which employees were penalized by losing part of their bonus for quality mistakes, such as putting the wrong date on packaging. This system led to limited accountability and engagement, as employees avoided taking responsibility for their actions. "	Punitive accountability measures
"In the past, employees had limited responsibility for their work areas and machines, which resulted in a lack of focus on safety and quality" *"Operators focused solely on their individual tasks, lacking a full understanding of the overall processes occurring in the factory.*	Limited employee engagement
"We used to note defects on machines without much follow-up"	Inadequate Quality Control
"...There are always these individuals who ask why? We didn't have that in past and we used to produce it too..." *"People usually don't like changes"* *"...Always at the begginning, when something new is being introduced, there is always this skepticism among people"* *"Everyone is afraid of new things, because they invented something new again, so this means there is more work"*	Resistance to change
"...there is often this fear of digitalisation." *"Not all employees simply keep up with technology"*	Fear of digitalisation
"At the begginning, there was definitely some pressure, which was quite exhausting" *"There was more a chase than encouargement"* *The implementation process was overly pushy"* *"People weren't prepared for this change, because ti was very sudden"*	Excessive pressure placed on operators
"Supervisors didn't fully understand that the initial guidelines were just a starting reference and could be adjusted over time, depending on factors like material differences, environmental conditions, or temperature.	Limited flexibility of supervisors

Many variables impact production, but he adhered too strictly to the rules without allowing for the flexibility that might have been beneficial"	
"It seems to me that at the very beginning we may have lacked such communication, motivation, showing such real benefits" *"Support was always there, but there were definitely some shortcomings"*	Insufficient motivation and inspiration provided to operators by supervisors

DURING – IMPLEMENTATION STAGE

Quotes	1st Order Concepts
"Often applications would crash. Not everything was going in as it should and that data was just lost" *"The tablets used in the tablets had small or unclear fonts, which made it hard to read."* *"...The problem was that the applications did not work sometimes"*	Technical issues and usability issues
"We all comunicate here in polish and not everyone is speaking english. There was a lot of english material which they did not understand"	Language barrier
"Younger employees seem to have fewer problems with technology, while older employees face more challenges." *"There are some older people who are not very comfortable using the apps."* *.."I also think age matters a lot"* *"You could definitely see the difference among younger generation"*	Age related barriers
"We were all learning to use iPads, computers, and various programs, so our skills were definitely changing to some degree." *"For CWP technical skills were needed to handle the applications"*	Technical skills
"We are definitely analyzing the data more and trying to identify what is working and what isn't. If something isn't working, we investigate the reasons why."	Data analysis
"Employees need better skills and adaptability to understand the changes related to technology." *"I was trying to develop my skills to learn more about how to use the tools effectively and adapt them to work well for me."* *"I was at first skeptical about the changes, but I gradually learned and adapted"* *"...over time, we got used to the changes, which, while seemingly more complicated, actually make many aspects of our work easier."* *"You constantly need to learn something"*	Adaptability

"...it requires not only the ability to use it but also an understanding of the processes and mechanisms behind it."	Understanding process mechanisms
"This change influenced me to approach employees more individually rather than as a group. I realized that they absorb knowledge differently" *""I prefer to talk to people directly, as everyone is different with unique problems and approaches. You need to get to know them personally to adjust accordingly."*	Individualized approach for team-members
"If you can see that someone cares about something, that you then also try harder to make it work"	Inspiration through leadership example
"For one of the applications, no one checked if the entries were being made, so if the process stopped and went unnoticed, it seemed unimportant."	Insufficient monitoring
"We had to remind operators to use the applications very often" *"Our supervisors had to chase us to use the applications"*	Need for frequent reminders
"The number of meetings certainly increased because we had to explain what is this all about"	Increased number of meetings

POST-IMPLEMENTATION STAGE

Quotes	1st Order Concepts
"...They apps certainly made it easier to work..." *"The raction is much quicker now"* *The flow of information is much faster"*	Improved work efficiency
"You can find the data at any moment" *"All data are collected and analysed in real time"*	Data accessibility
"The technology which is getting better and providing more data, is beneficial for me. I can make better decisions based on that information"	Data-driven decision making
"...For example, in defect management, where we log our machine defects into the system, and those problems are then resolved." *"...The number of errors which has now been eliminated"* *"Now, there are people responsible for specific processes who should regularly review their data to identify any issues and take necessary actions to address non-compliance."*	Improved issue management
"...one of the opportunities is certainly better communication. Nothing gets lost or forgotten; everything is clearly documented in the system." *"...they're now able to work together, share their knowledge, and communicate effectively—something they weren't doing before"* *"We help each other a lot during shifts by exchanging knowledge—if I know something, I share it, and my colleague does the same."* *"We have trainings every time when something new is introduced"*	Improved communication

"There are simpler apps now, like Centerlink, which are very user-friendly."	User-friendly applications
"Now the apps are automatically translated . Most of them are already bilingual"	Reduction of language barier
*"I see that I've developed problem solving techniqus and better proficiency in new technologies"'' *	Problem-solving skills
"Data analysis skills have improved...We can easily access information about our performance and check various parameters on each machine."	Data analysis skills
"They are paying more attention to various things, including safety and quality." *I"'m really proud of how our operators have become more independent."* *"we also try to watch out for defects, to make sure that the machine runs well"* *""I'm now more in control of my work and can manage tasks directly. If I need to, I can contact the manager to discuss our progress and make faster decisions."*	Increased self-reliance among employees
"Since we started using the program, I've noticed that people are becoming more involved in these initiatives. They are actively working to improve the data and content within the programs and are eager to enhance what is already included." *"In the past, the operators would just watch and not engage. Now, they are open to discussing tasks and happy to help."* *"If they notice something is wrong or outdated, they come to me right away and suggest changes. They're much more engaged now and eager to influence improvements"* *"The operators have been actively identifying and addressing process issues. They now understand processes better and can quickly suggest and implement changes."*	Enhanced operator engagement
"Control is about supporting and helping them grow, not checking the results" *"Now we have to be there for the operators, help them and support them"* *"It's no longer just telling someone to do something. Now, you need to work alongside them and explain the purpose behind it."*	Supportive leadership approach
"I focus more on dialogue and conversation. It's more of a partnership approach." *"We're all in it together, helping each other, not just leaving people to struggle alone."*	Partnership-oriented leadership
"I prefer to encourage people to take responsibility for their own work and come up with their own initiatives." *"Sometimes we talk to the employees who are in these positions regularly. They often have great ideas and suggestions. We make an effort to listen to their tips and feedback."*	Empowerment of employees
"Teamwork is key for me. I always try to ensure that no one is overwhelmed while others have nothing to do...I	Promoting teamwork

encourage operators to support each other and balance the workload" *"If one person can't do it, then somehow we sit down all together and try to solve the problem"* *"Now, we have a lot more team-related work to do"*	
"What I value most about my supervisor is that she demands a lot from herself before expecting it from others. She doesn't just sit back and tell everyone else what to do; she leads by example." *"You see someone putting their whole self into their work, giving their all, and not doing it for show, not bragging about it. It's mobilizing for us."*	Leading by example
"...There are still things that aren't translated and that causes the biggest problem"	Incomplete translation of the applications
"There have been repeated technical issues; as part of a large network, surprises can always arise" *"Sometimes, it's the technical issues that gets in the way, like the internet...now, technology requires everything to be operational all the time"*	Dependence on network reliability.
"If people here have innovative ideas, they receive a very small amount for saving big amount of money. This feels discouraging... it reflects a lack of motivation due to insufficient rewards."	Insufficient rewards for innovation
"Some individuals naturally take responsibility for themselves, while others adopt a 'push' attitude, expecting others to handle problems and make decisions for them." *"I notice that some people tend to push responsibility away. For example, I often hear statements like, 'you decide; you're the manager."*	Responsibility conflicts