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Article

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Digital transformation in Malaysian manufacturing: a study of change sensing and seizing capabilities

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ABSTRACT

Purpose: This study aims to explore the interplay between organizational culture, available resources, change management competency, and employee attitudes towards digital transformation readiness in Malaysia's manufacturing sector. It seeks to address a research gap by providing empirical evidence and theoretical insights into the specific readiness for digital transformation within this context.

Design/methodology/approach: A mixed-methods design was employed to collect and analyze data, offering a comprehensive view of digital transformation readiness. The quantitative phase involved a structured survey distributed to 357 participants from the manufacturing sector, while the qualitative phase consisted of semi-structured interviews with 20 key informants from selected manufacturing companies. This approach facilitated the exploration of dynamic capabilities, resource availability, change management competencies, and the influence of organizational culture and employee attitudes on digital transformation readiness.

Findings: The findings indicate that organizational culture, resource availability, change management capabilities, and employee attitudes towards innovation and change significantly impact an organization's readiness for digital transformation. The study underscores the critical role of effective change management and the positive influence of a supportive organizational culture and employee attitudes in enhancing digital transformation efforts which will aid sustainable growth in organizations.

Originality/value: This research contributes significantly to the digital transformation literature by analyzing factors affecting digital readiness within the Malaysian manufacturing sector, an area previously underexplored. Integrating Dynamic Capabilities Theory, the Resource-Based View, and Change Management Theories, and using a mixed-methods approach, the study offers valuable insights for industry leaders, managers, and policymakers on effectively driving digital transformation. It highlights the importance of resource allocation, supportive organizational culture, and effective change management practices, addressing a critical gap in existing research.

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Industry and Industrial Studies; Business, Management, and Accounting; Manufacturing Industries; Information Technology Industries

Introduction

Digital transformation has significantly impacted Malaysian manufacturing firms by enhancing their efficiency, productivity, and competitiveness (Digital Nasional Berhad, 2021). The adoption of Industry 4.0 technologies, such as artificial intelligence (AI) and the Internet of Things (IoT), has enabled these firms to streamline operations, automate manual tasks, and predict machinery maintenance, thereby reducing errors and optimizing production processes (Kraus et al., 2021; Volberda et al., 2021). Despite these benefits, the adoption of digital technologies remains relatively low, with only 11% of Malaysian manufacturing companies having transformed most of their business processes by 2022 (Rodríguez-Espindola et al., 2022). Furthermore, 55% of Malaysian organizations lack an integrated enterprise-wide digital

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transformation strategy, and 91% are still in the early stages of digital maturity (Lawrence, 2022). This slow digital adoption is compounded by challenges, such as high costs, lack of infrastructure, and insufficient integrated digital strategies across enterprises (Hussain & Papastathopoulos, 2022). Despite increased awareness of the significance of digital transformation, numerous Malaysian manufacturing companies struggle to successfully adopt and harness digital technologies to their fullest potential (Rodríguez-Espíndola et al., 2022). This persistent disparity between digital aspirations and actualization prevents these organizations from deriving the comprehensive benefits of such transformative processes (Parviainen et al., 2022). Hence, a probe into the factors contributing to, or deterring, organizational readiness for digital transformation within Malaysian manufacturing companies becomes vital.

While existing research has scrutinized factors influencing digital transformation readiness across various contexts, a specific research void exists in understanding the preparedness for digital transformation within Malaysia's manufacturing sector (Brekke et al., 2023; Chatterjee et al., 2021). The unique attributes of this sector, such as its reliance on traditional processes and the particular challenges faced by Malaysian organizations, necessitate a detailed examination of the factors impacting their readiness for digital transformation (Ahmed et al., 2022; Khalil et al., 2022a). Addressing this research lacuna will aid in devising tailored strategies supporting Malaysian manufacturing companies in their digital transformation quests, thereby enhancing their overall competitiveness (Kitsios et al., 2021).

Human resources play a crucial role in an organization's ability to adapt to digital changes and acquire new digital skills (Van Laar et al., 2017). However, a significant gap exists in the availability of skilled personnel within Malaysian manufacturing firms, which hampers the pace of digital transformation. Financial resources are essential for investing in digital technologies and infrastructure (Rosin et al., 2020), yet many SMEs face financial constraints that limit their capacity to procure necessary digital tools and infrastructure, thereby widening the digital divide.

Access to advanced technological resources is also problematic due to the high costs associated with cutting-edge tools and systems (Crittenden et al., 2019). Effective change management capabilities, including proficient management of change processes and overcoming resistance, are critical for successful digital transformation (Li et al., 2018). Nonetheless, many organizations struggle with inadequate change management practices, impeding smooth transitions to digital operations.

Employee attitudes towards digital transformation significantly influence their readiness to accept and engage with digital initiatives (Varshney, 2020). Negative attitudes and resistance to change among employees can derail digital transformation efforts, underscoring the need for enhanced change management and training programs. Finally, organizational culture shapes the values, norms, and beliefs of an organization, affecting its receptivity to digital shifts (Elsbach & Stigliani, 2018; Singh et al., 2020). There is a discernible gap in understanding how to cultivate a culture that supports continuous learning and innovation within the Malaysian manufacturing sector.

Therefore, this study aims to explore the organizational readiness for digital transformation among Malaysian manufacturing companies by investigating the interplay between these pivotal factors. From a theoretical perspective integration of Dynamic Capabilities Theory, Resource-Based View (RBV), and Change Management Theories addresses the struggle to successfully adopt and harness digital technologies to their fullest potential by providing a multi-faceted approach to understanding digital transformation readiness in Malaysian manufacturing firms. Dynamic Capabilities Theory helps firms identify and act on digital opportunities through sensing, seizing, and transforming capabilities (Teece et al., 1997). RBV focuses on leveraging valuable resources, such as skilled personnel, financial capital, and advanced technologies essential for digital transformation (Barney, 1991). Change Management Theories offer insights into managing the human and organizational aspects of change, emphasizing the importance of effective communication, employee engagement, and a supportive culture (Kotter, 1996; Varshney, 2020). By combining these theories, the study can comprehensively examine how organizational culture, resource availability, change management competency, and employee attitudes collectively influence digital transformation readiness, providing a holistic solution to enhance operational efficiency, innovation, and competitiveness in the sector.

By unveiling the key determinants impacting readiness for digital transformation in this specific context, the research will provide valuable insights into the current state of digital readiness among Malaysian manufacturing firms (Khin & Hung Kee, 2022). Additionally, the findings will bear practical implications

for managers, policymakers, and industry stakeholders, directing them in formulating effective strategies to prepare organizations for successful digital transformation (Barends & Rousseau, 2018). By bridging the research gap and illuminating the obstacles and facilitators of digital transformation readiness, this study strives to foster the digital ecosystem in Malaysia, promoting innovation, growth, and sustainable competitiveness within the manufacturing sector.

Review of the literature and development of hypotheses

Organizational digital transformation in manufacturing organizations

Organizational digital transformation refers to the transformation of traditional business processes through the adoption and utilization of digital technologies, such as artificial intelligence, Internet of Things (IoT), cloud computing, and data analytics (Akter et al., 2022; Casalino et al., 2020; Khin & Hung Kee, 2022). This shift toward digital transformation offers numerous benefits to manufacturing organizations, including improved operational efficiency, improved product quality, increased innovation and agility, enhanced customer experience, and the creation of new business models.

Several driving factors contribute to the adoption of digital transformation in manufacturing organizations. Technological advancements, such as the increasing availability and affordability of digital tools, act as enablers for organizations to embark on digital transformation initiatives (Agostino et al., 2020). Market pressures, driven by changing customer expectations and competitive dynamics, also push organizations to embrace digital technologies to stay relevant and competitive (Dixit et al., 2021; Volberda et al., 2021). Furthermore, regulatory requirements, industry standards, and the need for sustainability considerations play a role in driving digital transformation efforts (Sarkis et al., 2021).

Despite the recognized benefits, several challenges hinder the successful implementation of digital transformation initiatives in manufacturing organizations. These challenges include resistance to change, a lack of digital skills and capabilities within the workforce, reliance on legacy systems and infrastructure, data privacy and security concerns, and the need for substantial financial investments (Barends & Rousseau, 2018; Brunetti et al., 2020; Khin & Hung Kee, 2022). Overcoming these challenges requires organizations to develop strategies that address both the technological and organizational aspects of digital transformation.

In the specific context of Malaysian manufacturing organizations, the digital transformation journey is shaped by unique contextual factors. The Malaysian government has actively promoted digital transformation through initiatives, such as the National Policy on Industry 4.0 and the Digital Transformation Acceleration Program (MyDIGITAL). These initiatives aim to enhance the competitiveness of Malaysian manufacturing organizations by encouraging the adoption of digital technologies and fostering the development of digital skills (Shaharudin et al., 2023; Tay et al., 2021). However, the digital transformation landscape in Malaysia exhibits varying levels of adoption and readiness among organizations.

Research specifically focusing on digital transformation in Malaysian manufacturing organizations is still emerging but growing in importance. Studies highlight the challenges faced by these organizations, including limited digital literacy, scarcity of resources for technology adoption, concerns about data security, and the need for organizational culture and leadership support (Beaunoyer et al., 2020; Costan et al., 2021; Falloon, 2020; Khan et al., 2021). Additionally, research emphasizes the potential benefits of digital transformation, such as improved operational efficiency, enhanced competitiveness, and increased innovation (Azeem et al., 2021; Mostaghel et al., 2022; Shen et al., 2022).

Organizational digital transformation has become a critical area of research and practice, as manufacturing organizations actively pursue digital transformation initiatives. The recognized benefits of digital transformation, including improved efficiency, innovation, and competitiveness, further underscore the importance of this topic. However, challenges related to resistance to change, skills gaps, and financial constraints persist. In the context of Malaysian manufacturing organizations, the digital transformation landscape is shaped by government initiatives and specific challenges associated with digital adoption and readiness.

As research on digital transformation in Malaysian manufacturing organizations continues to develop, it sheds light on the unique challenges and opportunities they face on their digital transformation

journeys. Further research is needed to explore effective strategies for overcoming barriers to digital transformation and to assess the impact of digital transformation on the performance and competitiveness of Malaysian manufacturing organizations. By deepening our understanding of these dynamics, this study can provide valuable insights to guide organizations in their digital transformation efforts and contribute to the advancement of knowledge in this field.

Theories in the context of organizational digital transformation

The Dynamic Capabilities Theory (Teece et al., 1997) offers a robust theoretical base for understanding how organizations develop and apply their capabilities to adjust to evolving environments and propel successful digital transformation. Under this framework, Sensing Capabilities describe an organization's aptitude to identify and acknowledge opportunities and threats stemming from the digital environment (Magistretti et al., 2021). They involve monitoring external circumstances, tracking market trends, and collating pertinent data to forecast changes and pinpoint opportunities for digital transformation (Rahman et al., 2020). Seizing Capabilities, contrastingly, allude to the organization's capacity to mobilize and utilize resources to seize identified opportunities, such as resource allocation, forming strategic alliances, and making timely and effective decisions to capture the benefits offered by digital technologies (Åberg & Torchia, 2020). Transforming Capabilities comprise an organization's ability to restructure its resources, processes, and organizational structures to facilitate a successful digital transformation (Åberg & Torchia, 2020). By integrating Sensing, Seizing, and Transforming Capabilities, this research aims to investigate how these dynamic capabilities impact readiness for digital transformation in Malaysian manufacturing companies.

The Resource-Based View (RBV) serves as another significant theoretical lens that aids the understanding of organizational readiness for digital transformation (Barney, 2001). In the realm of organizational digital transformation, Human Resources, Financial Resources, and Technological Resources are central elements within the RBV framework (De Massis et al., 2018). Human Resources incorporate the competencies, knowledge, and skills of the organization's workforce, which are vital for promoting digital transformation (Bansal et al., 2023). Financial Resources involve the organization's financial wherewithal to invest in digital technologies, infrastructure, and talent acquisition (Barney, 2001). Technological Resources refer to the availability and accessibility of sophisticated tools, systems, and infrastructure that facilitate digital innovation and transformation (Åberg & Torchia, 2020). By integrating RBV principles, this research proposes to investigate the influence of these resources on organizational readiness for digital transformation in the Malaysian manufacturing context.

Change management theories offer valuable insights into managing organizational change and fostering readiness for digital transformation (Kotter, 1996). Change management capabilities encapsulate an organization's ability to efficiently plan, introduce, and administer change initiatives associated with digital transformation (Warner & Wäger, 2019). Employee Attitudes play a pivotal role in shaping their acceptance and involvement with digital initiatives (Varshney, 2020). Positive attitudes towards digital transformation can significantly contribute to the successful execution of digital transformation efforts (Ramaprasad et al., 2021). Organizational Culture influences the organization's openness to change and digital transformation efforts. A culture that values innovation, encourages collaboration, and embraces continuous learning facilitates the adoption and integration of digital technologies within the organization (Warner & Wäger, 2019). Drawing on Change Management Theories, this study intends to explore the relationships between Change Management Capabilities, Employee Attitudes, Organizational Culture, and the readiness for digital transformation among Malaysian manufacturing companies.

The ultimate outcomes of digital transformation are Improved Efficiency and Increased Innovation. Improved efficiency refers to the organization's ability to streamline operations, enhance productivity, and optimize resource utilization through digital transformation efforts (Chang et al., 2017). Increased innovation encompasses the organization's capacity to generate and implement new ideas, products, and processes enabled by digital technologies (Seeck & Diehl, 2017). Examining the relationship between these results of digital transformation and organizational performance, this study aims to contribute to a comprehensive understanding of the impact of digital transformation on Malaysian manufacturing companies.

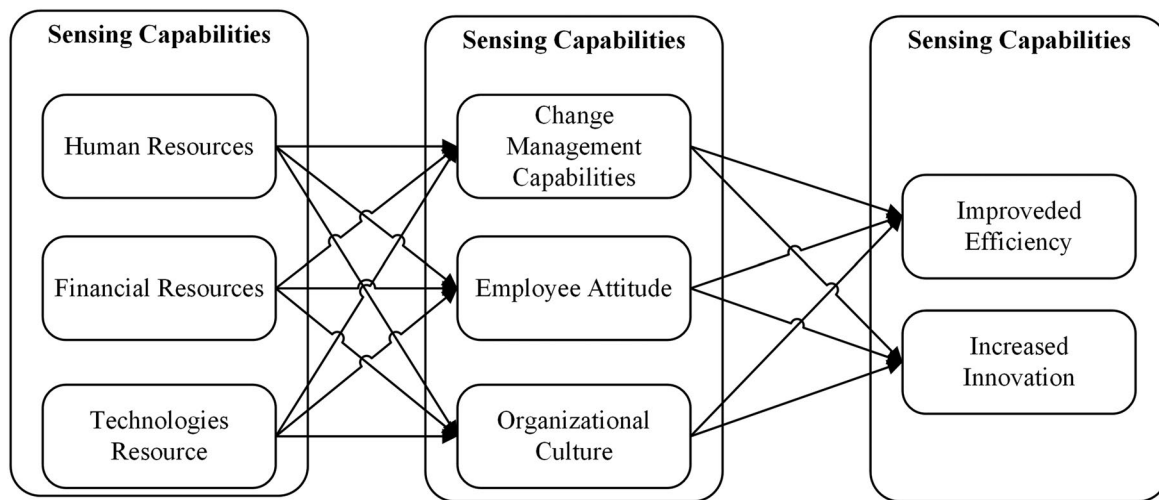


Figure 1. Research framework.

Altogether, the amalgamation of Dynamic Capabilities Theory, RBV, Change Management Theories, and the examination of digital transformation outcomes offer a comprehensive theoretical framework for exploring organizational readiness for digital transformation in Malaysian manufacturing companies. This theoretical foundation provides valuable insights into the factors that drive or hinder digital transformation readiness, guiding organizations in their digital transformation efforts and contributing to the existing body of knowledge (Figure 1).

Hypothesis development

Change sensing capabilities and change management capabilities

Based on the findings of Fosso Wamba et al. (2020), organizations with strong sensing capabilities, characterized by effective scanning and monitoring of the external environment, are more likely to have successful change management practices in place. This supports the notion that higher levels of Change Sensing Capabilities, encompassing Human Resources, Financial Resources, and Technological Resources, contribute to the development of stronger Change Management Capabilities.

The study by Singh et al. (2019) further supports the notion by highlighting the role of sensing capabilities in identifying and recognizing opportunities for change. Organizations with robust Change Sensing Capabilities are better equipped to develop and implement effective change management strategies.

Moreover, Xie et al. (2020) argues that organizations with strong sensing capabilities are more adept at anticipating and responding to environmental changes, enabling them to effectively manage and seize opportunities for change. This suggests a positive relationship between Change Sensing Capabilities and Change Management Capabilities.

Linde et al. (2021) emphasize the importance of sensing capabilities in organizational change processes. Their study suggests that organizations with higher levels of sensing capabilities are more likely to initiate and manage successful change initiatives.

The Resource-Based View literature, as proposed by Barney (2001), Van Rijnsoever et al. (2008), and Wernerfelt (1984) supports the idea that organizations with strong resource sensing capabilities, including Human Resources, Financial Resources, and Technological Resources, are more likely to possess the necessary capabilities and resources for effective change management.

Therefore, drawing from the theoretical foundations of Dynamic Capabilities Theory, Resource-Based View, and findings from various studies.

H1: There is a significant relationship between change-detecting capabilities (Human Resources, Financial Resources, and Technological Resources) and change-management capabilities, where higher levels of Change Sensing Capabilities are associated with stronger change-seizing capabilities.

Change sensing capabilities and organizational culture

Studies by Metwally et al. (2019) and Nakayama et al. (2019) demonstrate that organizations with strong change sensing capabilities are more likely to foster positive employee attitudes toward change. These organizations effectively communicate the rationale behind change initiatives, involve employees in the change process, and provide support and resources to facilitate a smooth transition. As a result, employees perceive change as more favorable and are more likely to embrace and support change efforts.

Research by Bojesson and Fundin (2021) and Kim and Leach (2020) also supports this hypothesis, showing that organizations with higher levels of change-sensing capabilities have employees who exhibit higher levels of commitment and enthusiasm toward change. These positive employee attitudes contribute to the successful implementation of change initiatives and organizational transformation.

Furthermore, the Resource-Based View literature, as discussed by Barney (2001), Van Rijnsoever et al. (2008), and Wernerfelt (1984), provides theoretical support for the relationship between Change Sensing Capabilities and Employee Attitudes. Human Resources, Financial Resources, and Technological Resources play a crucial role in fostering positive employee attitudes toward change. Adequate investment in employee training and development, financial resources to support change initiatives, and access to advanced technological tools and systems can create a conducive environment for positive employee attitudes towards change.

Higher levels of Change Sensing Capabilities are associated with more positive employee attitudes toward change (Edosomwan & Nwanzu, 2021). This theoretical underpinning suggests that organizations with stronger change sensing capabilities are more likely to cultivate a supportive and favorable environment for change among their employees. There is a significant relationship between change detection capabilities (Human Resources, Financial, and Technological Resources) and employee attitudes, by which higher levels of Change Sensing Capabilities are associated with more positive employee attitudes.

H2: There is a significant relationship between Change Sensing Capabilities (Human Resources, Financial Resources, and Technological Resources) and Organizational Culture, whereby higher levels of Change Sensing Capabilities are associated with a more favorable Organizational Culture.

Change seizing capabilities and improved efficiency

Empirical evidence substantiates the hypothesis that a significant relationship exists between Change Seizing Capabilities and Improved Efficiency, implying that stronger Change Seizing Capabilities are positively associated with enhanced efficiency in digital transformation endeavors (Soluk et al., 2021).

Numerous studies, including Hughes et al. (2019) and Mikalef and Pateli (2017) underscore the pivotal role of Change Management Capabilities in driving heightened efficiency during digital transformation. Organizations equipped with skillful change management capabilities can proficiently plan, execute, and oversee change initiatives, resulting in smoother transitions and successful integration of digital technologies (Soluk et al., 2021). Consequently, this engenders streamlined processes, heightened productivity, and optimized resource utilization, ultimately fostering improved operational efficiency.

The works of Edosomwan and Nwanzu (2021) and Teece (2014) also lend support by revealing the significance of positive employee attitudes toward change in achieving heightened efficiency. Employees who exhibit favorable attitudes toward change are more inclined to embrace digital transformation efforts, adapt to novel technologies, and actively participate in the change process. Such engagement and commitment of employees improve efficiency and effectiveness in digital transformation endeavors.

Moreover, organizational culture, as expounded by Bojesson and Fundin (2021) and Kim and Leach (2020) exerts influence on the nexus between Change Seizing Capabilities and improved efficiency. A culture that values innovation, collaboration, and continuous learning provides a nurturing environment for digital transformation, facilitating the assimilation and integration of digital technologies. Such a culture encourages employees to explore novel work methodologies, experiment with digital tools, and contribute to process enhancements, ultimately fostering heightened efficiency.

Theoretical perspectives, including the Resource-Based View (RBV) advanced by Barney (2001) and Change Management Theories, further buttress the relationship between Change Seizing Capabilities and Improved Efficiency. Within the RBV framework, Human Resources, Financial Resources contribute, and Technological Resources significantly to heightened efficiency by empowering organizations to invest in

digital technologies, acquire the necessary skills, and capitalize on technological advancements. Change Management Theories underscore the paramount importance of effective change management practices, encompassing employee attitudes and organizational culture, in driving improved efficiency during digital transformation. So this study proposes:

H3: There is a significant relationship between Change Seizing Capabilities (Change Management Capabilities, Employee Attitudes, and Organizational Culture) and Improved Efficiency, whereby Strong Change Seizing Capabilities are associated with improved efficiency in digital transformation efforts.

Change seizing capabilities and increased innovation

Extensive scholarly research supports the hypothesis that a significant relationship exists between change-seizing capabilities and Increased Innovation, suggesting that organizations with stronger Change Seizing Capabilities are more likely to experience increased innovation in their digital transformation endeavors (Åberg & Torchia, 2020).

Numerous studies, including Do et al. (2021), Grossi et al. (2019), and Sultana and Thompson (2017) emphasize the crucial role of change management capabilities in fostering increased innovation during digital transformation. Organizations equipped with effective change management capabilities possess the ability to plan, implement, and manage change initiatives seamlessly. By providing a structured framework for innovation, these capabilities facilitate the integration of digital technologies and stimulate creative thinking, leading to enhanced innovative outcomes.

The significance of employee attitudes in driving increased innovation is evident in the works of (Bojesson & Fundin, 2021; Chiu, 2021; Edosomwan & Nwanzu, 2021). Positive attitudes toward change engender a culture of openness, receptiveness, and willingness to explore new ideas and embrace digital transformation efforts. Employees with favorable attitudes are more likely to engage in innovative practices, share knowledge, and contribute to the development of innovative solutions, thereby fostering increased innovation in digital transformation initiatives.

Organizational Culture also plays a pivotal role in the relationship between Change Seizing Capabilities and increased innovation. Studies by Barberá-Tomás et al. (2019) and Karim and Thiel (2017) highlight that an organizational culture that values innovation, encourages risk-taking, and supports experimentation provides a conducive environment for fostering increased innovation. Such a culture nurtures creativity, collaboration, and learning, which are critical for generating and implementing innovative ideas enabled by digital technologies.

Theoretical perspectives, such as the Resource-Based View (RBV) proposed by Barney (2001) and Change Management Theories, further support the relationship between Change Seizing Capabilities and increased innovation. Within the RBV framework, Change Management Capabilities, Employee Attitudes, and Organizational Culture are considered valuable resources that contribute to increased innovation. These resources enable organizations to adapt to technological advances, leverage employee knowledge and creativity, and create a supportive environment for innovation.

H4: There is a significant relationship between change-seizing capabilities (change-management capabilities, employee attitudes, and Organizational Culture) and increased innovation, whereby stronger Change Seizing Capabilities are associated with increased innovation in digital transformation efforts.

Mediation effect of change seizing capabilities

Change Sensing Capabilities, as highlighted by Nakayama et al. (2019), enable organizations to identify and recognize opportunities for change by effectively scanning and monitoring the external environment. These capabilities, which include Human Resources, Financial Resources, and Technological Resources, provide organizations with the necessary insights and resources to identify opportunities for digital transformation.

Change Seizing Capabilities play a critical role in translating the identified opportunities into Improved Efficiency (Teece, 2012). Change management capabilities, as explored by Soluk et al. (2021), facilitate effective planning, implementation, and management of change initiatives. They enable organizations to streamline processes, optimize resource utilization, and improve operational efficiency through digital transformation efforts.

Employee attitudes also contribute to the mediation process. As emphasized by Varshney (2020), positive employee attitudes toward change encourage employee engagement, willingness to learn, and adaptability, thereby driving the implementation of digital transformation initiatives. Engaged employees are more likely to embrace change, contribute innovative ideas, and actively participate in improving efficiency through digital transformation.

Moreover, Organizational Culture plays a vital mediating role. An organizational culture that values innovation, collaboration, and continuous improvement, as highlighted in the Resource-Based View (RBV) literature, fosters the integration of change sensing capabilities and Change Management Capabilities. Provides the supportive context and norms necessary for the successful implementation of digital transformation initiatives, ultimately leading to improved efficiency.

By incorporating Change Seizing Capabilities as a mediating factor, this study acknowledges the significance of the interaction between Change Sensing Capabilities and Improved Efficiency in the context of digital transformation. The mediation hypothesis posits that the impact of change detection capabilities on improved efficiency is contingent upon the presence of strong change detection capabilities, emphasizing the importance of comprehensive change management practices, positive employee attitudes, and an organizational culture that supports innovation and continuous improvement.

H5: Change Seizing Capabilities (Change Management Capabilities, Employee Attitudes, and Organizational Culture) mediate the relationship between Change Sensing Capabilities (Human Resources, Financial Resources, and Technological Resources) and Improved Efficiency, meaning that the effect of Change Sensing Capabilities on Improved Efficiency is partially explained by the presence of strong Change Seizing Capabilities.

Drawing upon the foundational work of Baldacchino (2018), and Snowden and Snowden (2021), the study advances a hypothesis that situates Change Seizing Capabilities as a critical mediator in the relationship between Change Sensing Capabilities and Increased Innovation within digital transformation initiatives.

Change-Sensing Capabilities, comprised of Human Resources, Financial Resources, and Technological Resources, provide the underpinning for recognizing and exploiting avenues for innovative change (Snowden & Snowden, 2021; Van Westrhenen et al., 2019). When harmonized with effective change management capabilities, an environment is fostered that nurtures and advances innovation.

Organizational Culture assumes a pivotal role in this mediating process. A culture steeped in innovation, collaboration, and experimentation cultivates a climate conducive to creative ideation and risk-taking, thus driving increased innovation.

Moreover, employee attitudes significantly contribute to this mediation. Positive attitudes catalyze engagement and creativity, significantly strengthening innovative activities within the scope of digital transformation. Accordingly, the hypothesis proposes that-

H6: Change Seizing Capabilities (Change Management Capabilities, Employee Attitudes, and Organizational Culture) mediate the relationship between Change Sensing Capabilities (Human Resources, Financial Resources, and Technological Resources) and Increased Innovation, meaning that the effect of Change Sensing Capabilities on Increased Innovation is partially explained by the presence of strong Change Seizing Capabilities.

Research methodology

Research design

This study employs a mixed-methods approach, combining quantitative and qualitative methodologies to effectively explore the variables influencing readiness for digital transformation within the Malaysian manufacturing sector. The Malaysian manufacturing sector is the focus due to its significant contribution to the nation's economy, accounting for ~23% of Malaysia's GDP and employing around 17% of the workforce (Economic Planning Unit Malaysia, 2022). Despite its economic importance, the sector faces challenges in adopting Industry 4.0 technologies, with only 11% of firms having transformed most of their business processes by 2022 (Rodríguez-Espíndola et al., 2022). Given these challenges and the government's emphasis on digital transformation to enhance global competitiveness, this sector presents a critical area for research to understand and facilitate the necessary transformation. This mixed-methods design facilitates a comprehensive understanding of the research problem, capturing both numerical trends and in-depth experiences.

Quantitative phase

In the study's first phase, a cross-sectional survey will be employed to collect data. For the quantitative phase, a comprehensive survey was administered to a sample of 357 participants, representing a diverse spectrum within the manufacturing industry in Malaysia. These participants were selected by stratified random sampling from 51 organizations from 24 Free Commercial Zones (FCZ) of Malaysia (7 respondents from each organization), ensuring the representation of varying organizational levels and functional domains refer to [Table 1](#) (Palinkas et al., 2015) with informed oral consent from the respondents.

The survey instrument encapsulated several dimensions, gleaned from a thorough literature review, namely Human Resources (Gerhart & Feng, 2021), Financial Resources (Khan et al., 2020), Technological Resources (Yang et al., 2014), Change Management Capabilities (Åberg & Torchia, 2020), Employee Attitudes (Varshney, 2020), and Organizational Culture (Azeem et al., 2021). Responses were collected on a five-point Likert scale.

To mitigate common-method bias, procedural and statistical remedies were employed (MacKenzie & Podsakoff, 2012). Procedurally, the questionnaire was designed to ensure respondent anonymity and reduce evaluation apprehension, while emphasizing that there were no right or wrong answers. Statistically, Harman's single factor test was conducted post-data collection to examine the presence of common method variance (Aguirre-Urreta & Hu, 2019).

Upon completion of the data collection process, the data was analyzed rigorously. Quantitative data derived from the survey were processed using SmartPLS 4.0, a leading software application for partial least squares structural equation modeling (PLS-SEM). SmartPLS 4.0 was chosen for several reasons: it is well-suited for complex models with multiple constructs, it can handle both reflective and formative measurement models, and it is particularly effective for exploratory research where the theoretical framework is still being developed (Hair & Sarstedt, 2019). This approach enabled the investigation of complex relationships among the multiple observed and latent variables in the study (Senathirajah et al., 2023).

The PLS-SEM analysis involved a two-step approach. First, the reliability and validity of the measurement model (outer model) were assessed, encompassing evaluations of indicator reliability, internal consistency reliability, convergent validity, and discriminant validity (Dijkstra & Henseler, 2015). Second, the structural model (inner model) was examined to determine the relationships between the constructs and the predictive accuracy of the model (Hair & Sarstedt, 2019; Senathirajah et al., 2024).

Table 1. Demographic profile of respondent.

	Variables	Frequency	Percent
Gender	Female	147	39.2
	Male	222	59.2
	Prefer not to say	6	1.6
	Total	375	100.0
Please state your age	18–25	2	0.5
	26–35	29	7.7
	36–45	161	42.9
	46–55	164	43.7
	56 and above	19	5.1
	Total	375	100.0
Education	Diploma	165	44.0
	Degree	159	42.4
	Master's	49	13.1
	Doctorate	2	0.5
	Total	375	100.0
Designation of the respondent	Assistant Manager	31	8.3
	Executive Assistant	122	32.5
	Executive	148	39.5
	Manager	49	13.1
	Deputy Head of Department	10	2.7
	Head of Department	15	4.0
	Total	375	100.0
Experience in the farm	<3 years	39	10.4
	From 3 to 5 years	246	65.6
	From 6 to 10 years	81	21.6
	From 11 to 20 years	9	2.4
	Total	375	100.0

Qualitative phase

Following the quantitative phase, a qualitative approach using semi-structured interviews will be employed to gain in-depth insights. Complementing the quantitative study, 20 semi-structured, in-depth interviews were held with key informants drawn from the organizations sampled. The interviewees constituted a diverse mix of senior executives, digital transformation project leaders, and staff involved in digital initiatives (Varshney, 2020). Informed oral consent was obtained from the interviews.

The qualitative data gathered from the semi-structured interviews with key decision-makers in the selected manufacturing companies were thoroughly analyzed using a thematic analysis approach.

The first step in this process was transcription, where the recorded interviews were converted into written text to facilitate a comprehensive examination. Every transcription was then read and reread multiple times by the research team to gain an in-depth understanding and identify initial codes (Braun & Clarke, 2006).

Subsequently, an inductive approach was used to code the raw data, which allowed themes to emerge organically from the data. Through line-by-line coding, pertinent phrases or sections in the transcriptions were marked that appeared to capture key thoughts or concepts relevant to digital transformation readiness. This initial coding was done manually to maintain a close connection with the data (Skjott Linneberg & Korsgaard, 2019).

After initial coding, the codes were grouped based on their relationships and similarities into potential themes. These themes were reviewed and refined in an iterative process, ensuring they accurately represented the coded extracts and the data set as a whole (Braun & Clarke, 2006).

Themes, such as 'Innovation Emphasis', 'Resistance to Change', 'Organizational Culture', 'Resource Availability', 'Change Management Competency', and 'Employee Attitudes towards Digital Transformation' emerged through this process. Each theme was further analyzed and elaborated upon, resulting in a rich, detailed account of the factors affecting readiness for digital transformation among Malaysian manufacturing companies.

Throughout the analysis, reflexivity was maintained by being aware of and noting down the research team's thoughts, assumptions, and biases. This helped mitigate the potential influence of personal biases on the interpretation of data, ensuring the validity of the findings (Berger & Lyengar, 2013).

The use of NVivo, a qualitative data analysis software, facilitated the organization and management of the data. By using this software, the research team could easily categorize and retrieve coded data extracts, improving the reliability and replicability of the analysis (O'Kane et al., 2021).

Triangulation was achieved by comparing and contrasting the qualitative findings with the quantitative survey data. This provided a more holistic understanding of the readiness for digital transformation in the sector and further corroborated the findings, increasing the robustness and validity of the research (Schmitt et al., 2023).

Data analysis

Table 1 presents the demographic profile of the respondents in the study. Of the total sample size of 375 participants, 39.2% identified as female, while 59.2% identified as male. A small proportion (1.6%) preferred not to disclose their gender.

In terms of age distribution, the majority of respondents (43.7%) were between the ages of 46 and 55, followed by those in the 36–45 age group (42.9%). Age groups of 26–35 and 56 and above accounted for 7.7 and 5.1% of the respondents, respectively.

Regarding education, the highest proportion of respondents (44.0%) held a diploma, followed closely by those with a degree (42.4%). A smaller percentage (13.1%) had a master's degree, and only 0.5% held a doctorate.

When considering the designation of the respondents, the majority held positions, such as executive assistant (32.5%) and executive (39.5%). Assistant managers accounted for 8.3% of the respondents, while managers, deputy heads of departments, and heads of departments made up smaller proportions (13.1, 2.7, and 4.0%, respectively).

In terms of field experience, the largest group of respondents (65.6%) had 3–5 years of experience, followed by those with 6–10 years of experience (21.6%). A smaller percentage had <3 years of experience (10.4%), and a very small proportion (2.4%) had 11–20 years of experience.

In general, the table provides an overview of the demographic characteristics of the respondents in terms of gender, age, education, designation, and experience. These demographic factors are important to consider when analyzing the findings of the study and understanding the perspectives of the participants.

Common method bias

To address the potential common method bias (CMB), this study implemented both procedural and statistical remedies, following the guidelines proposed by Podsakoff et al. (2012). Procedurally, all measurement scales used in the study were adopted from validated instruments employed in previous research. This ensured the clarity of terms and minimized the ambiguity in the questionnaire.

Additionally, a clear and explicit criterion for the sample frame was established during the online survey data collection process to ensure that participants met the specified criteria and were suitable for inclusion in the study. To protect respondents' privacy and confidentiality, online snowball sampling was utilized, assuring participants that their responses would remain anonymous. The survey also included filtering questions to ensure sample representativeness (Tehseen et al., 2017). Furthermore, participants were asked to provide personal information, such as email addresses and telephone numbers for data validation purposes (Fabiola Baltar, 2013).

Statistically, Harman's single-factor test was conducted to assess the presence of common-method variance (CMV) in the data. The results indicated that a single factor explained <50% of the total variance, suggesting that CMV was not a significant concern (Podsakoff et al., 2012). Additionally, a correlation matrix was examined to assess the impact of CMV on the correlations among latent variables. The observed correlations were all below 0.9, further confirming that common method bias did not significantly affect the results (Dimoka et al., 2012).

This study implemented rigorous procedural measures, such as utilizing established measurement scales and ensuring participant privacy, to mitigate common method bias. Furthermore, the statistical analyses, including Harman's single factor test and examination of correlation patterns, provided evidence that common-method bias did not undermine the validity of the findings (Osman et al., 2024).

Measurement model evaluation

The findings in Table 2 and Figure 2 demonstrate the results of the evaluation of the measurement model. According to Hair and Sarstedt (2019), the outer load for a measurement scale should ideally be at least 0.708. However, indicators with values more than 0.40 can be retained, considering the content validity of the variables. In this study, the outer loadings of all indicators range from 0.501 to 0.914, all exceeding the minimum acceptable threshold of 0.5. Therefore, all indicators were retained for further analysis.

The internal consistency of the variables is tested through Cronbach's alpha and composite reliability values, both of which exceed the threshold value of 0.7 suggested by Hair and Sarstedt (2019) for all constructs. Cronbach's alpha ranges from 0.713 to 0.892 and composite reliability from 0.738 to 0.893, suggesting high internal consistency.

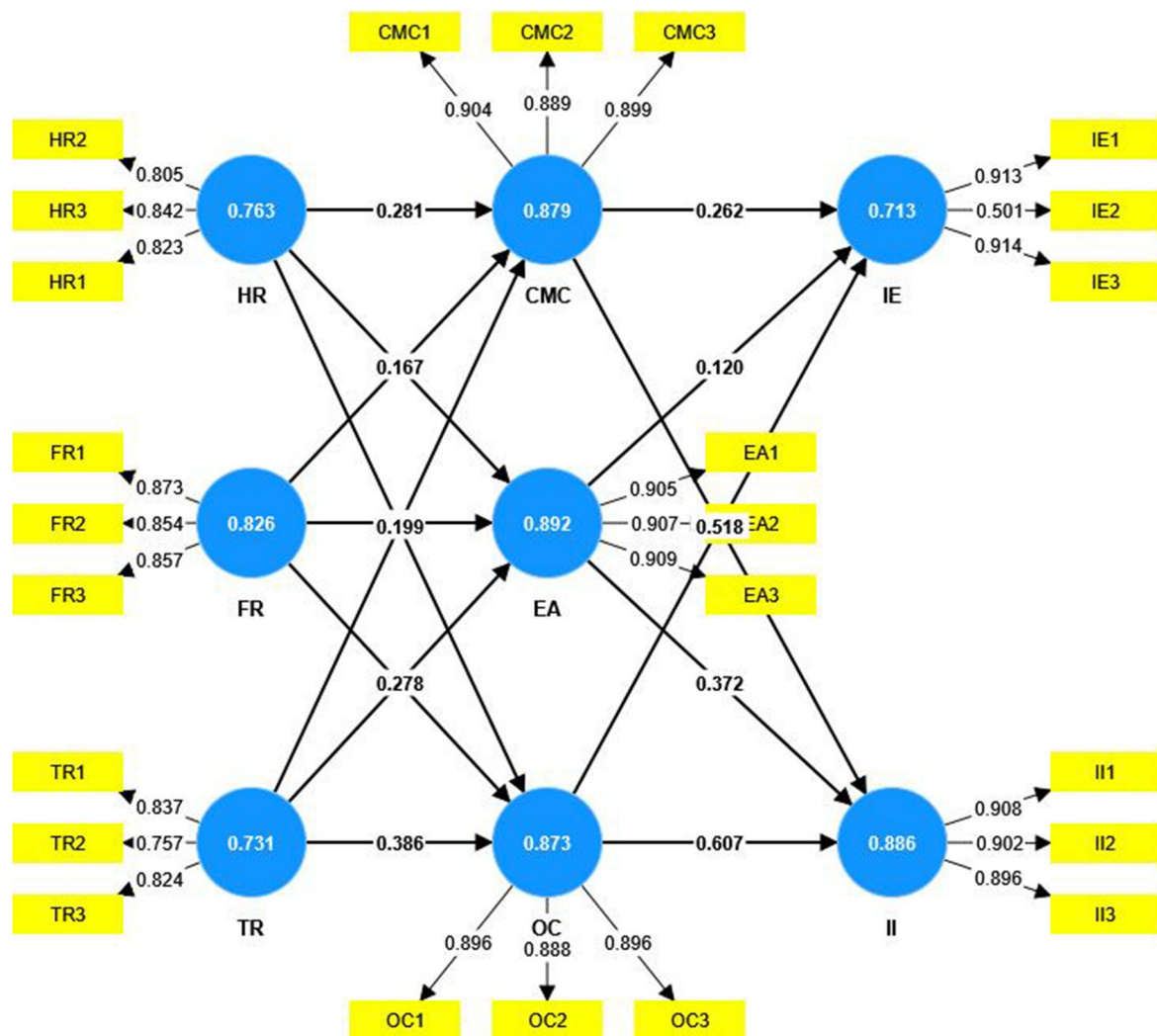
The average variance extracted (AVE) for all constructs ranged from 0.640 to 0.822, exceeding the cut-off level of 0.5, which indicates good convergent validity of the constructs.

Table 3 showing the heterotrait-monotrait (HTMT) ratios, is used to evaluate the discriminant validity of the scale. The HTMT approach is preferred when the outer loadings of the measurement model vary significantly (Hair & Sarstedt, 2019). All HTMT values were less than the threshold value of 0.85, as recommended by Hair and Sarstedt (2019), ranging from 0.438 to 0.890. This suggests that each construct is distinct and does not overly correlate with any other, thus demonstrating good discriminant validity of the scale.

Table 2. Result of measurement model.

Construct	Items	OL	VIF	CA	CR	AVE
CMC	CMC1	0.904	2.498	0.879	0.880	0.805
	CMC2	0.889	2.287			
	CMC3	0.899	2.509			
EA	EA1	0.905	2.596	0.892	0.893	0.822
	EA2	0.907	2.708			
	EA3	0.909	2.615			
FR	FR1	0.873	1.988	0.826	0.826	0.742
	FR2	0.854	1.804			
	FR3	0.857	1.859			
HR	HR1	0.823	1.536	0.763	0.767	0.678
	HR2	0.805	1.528			
	HR3	0.842	1.581			
IE	IE1	0.913	2.105	0.713	0.846	0.640
	IE2	0.501	1.135			
	IE3	0.914	2.152			
II	II1	0.908	2.679	0.886	0.886	0.814
	II2	0.902	2.503			
	II3	0.896	2.424			
OC	OC1	0.896	2.446	0.873	0.874	0.798
	OC2	0.888	2.190			
	OC3	0.896	2.430			
TR	TR1	0.837	1.541	0.731	0.738	0.651
	TR2	0.757	1.351			
	TR3	0.824	1.495			

CMC: change management capabilities; EA: employee attitudes; FR: financial resources; HR: human resources; IE: improved efficiency; II: increased innovation; OC: organizational culture; TR: technological resources.

**Figure 2.** Measurement model illustration.

These findings confirm the consistency, reliability, convergent validity, and discriminant validity of the study's constructs, making them suitable for further research.

Hypothesis testing results and discussion

Table 4 provides further statistical metrics of the model performance, including the R^2 (coefficient of determination), adjusted R^2 , Q^2 predict (predictive relevance), Root Mean Square Error (RMSE), and mean absolute error (MAE) for each construct.

The R^2 value indicates the proportion of variance in the dependent variable that can be explained by the independent variables. Higher values indicate a higher level of explained variance. Here, the R^2 values for all constructs are robust, ranging from 0.740 (for Improved Efficiency) to 0.801 (for Increased Innovation), indicating a strong explanatory power of the model.

The R^2 adjusted accounts for the number of predictors in the model and provides a more accurate picture of the model's performance when applying it to the population. In this study, R^2 adjusted values are very close to the R^2 values, showing that the model maintains its performance even when generalized to a larger population.

The Q^2 predict values, ranging from 0.697 to 0.767, suggest good predictive relevance, meaning that the model is capable of accurately predicting future data points. A Q^2 predict value above zero is indicative of a model with predictive relevance.

Root Mean Square Error (RMSE) is a measure of how well the model can predict the outcome: the lower the RMSE, the better the model's predictive capabilities. In this study, RMSE values range from 0.487 (for Employee Attitudes) to 0.556 (for Increased Innovation), showing reasonable predictive power.

The Mean Absolute Error (MAE) is another measure of prediction error, with lower values indicating better predictive accuracy. In this case, the MAE values range from 0.346 (for Employee Attitudes) to 0.421 (for Improved Efficiency), showing a relatively low prediction error for all constructs.

Table 5 presents the results of the structural model analysis. The results (refer to Figure 3) provide valuable insights into the relationships among different constructs and the impact of different factors on these constructs. For each path in the hypotheses, this study interprets the original sample, sample mean, standard deviation, t statistics, p -values, and f -square (effect size).

Let's look at Hypothesis 1 (H1) which includes three paths: HR → CMC, FR → CMC, and TR → CMC. The original sample values are the estimated coefficients for each path. Positive values indicate a positive relationship between variables. The t statistics show the significance of each relationship. In H1, all t statistics are >1.96, which means all relationships are statistically significant at a 95% confidence level. This is also confirmed by the p -values, which are all <0.05, the commonly accepted threshold for

Table 3. Heterotrait-monotrait ratio (HTMT) matrix.

	CMC	EA	FR	HR	IE	II	OC
EA	0.821						
FR	0.598	0.890					
HR	0.501	0.707	0.685				
IE	0.524	0.721	0.733	0.739			
II	0.888	0.438	0.810	0.713	0.778		
OC	0.614	0.443	0.616	0.718	0.791	0.793	
TR	0.797	0.783	0.815	0.845	0.793	0.793	0.806

CMC: change management capabilities; EA: employee attitudes; FR: financial resources; HR: human resources; IE: improved efficiency; II: increased innovation; OC: organizational culture; TR: technological resources.

Table 4. R^2 , R^2 adjusted, Q^2 predict.

	R^2	R^2 adjusted	Q^2 predict	RMSE	MAE
CMC	0.763	0.761	0.757	0.496	0.378
EA	0.772	0.770	0.767	0.487	0.346
IE	0.740	0.738	0.704	0.548	0.421
II	0.801	0.799	0.697	0.556	0.413
OC	0.757	0.755	0.748	0.506	0.379

CMC: change management capabilities; EA: employee attitudes; IE: improved efficiency; II: increased innovation; OC: organizational culture.

Table 5. Results of the structural model analysis.

	Hypothesis path	Original sample	Sample mean	Standard deviation	t Statistics	p-Values	f-Square
H1	HR -> CMC	0.281	0.282	0.052	5.441	0.000	0.125
	FR -> CMC	0.342	0.339	0.066	5.198	0.000	0.143
	TR -> CMC	0.331	0.331	0.056	5.955	0.000	0.162
H2	HR -> OC	0.199	0.199	0.054	3.696	0.000	0.062
	FR -> OC	0.359	0.355	0.066	5.402	0.000	0.154
	TR -> OC	0.386	0.390	0.072	5.348	0.000	0.215
H3	CMC -> IE	0.262	0.262	0.073	3.592	0.000	0.052
	EA -> IE	0.120	0.127	0.076	1.593	0.111	0.012
	OC -> IE	0.518	0.513	0.070	7.360	0.000	0.256
H4	CMC -> II	-0.051	-0.048	0.056	0.907	0.365	0.003
	EA -> II	0.372	0.374	0.061	6.108	0.000	0.144
	OC -> II	0.607	0.602	0.057	10.588	0.000	0.457
Mediation effect							
H5	FR -> CMC -> IE	0.090	0.088	0.029	3.108	0.002	
	HR -> CMC -> IE	0.074	0.074	0.026	2.847	0.004	
	TR -> CMC -> IE	0.087	0.087	0.030	2.939	0.003	
	HR -> EA -> IE	0.020	0.023	0.017	1.206	0.228	
	FR -> EA -> IE	0.060	0.062	0.036	1.664	0.096	
	TR -> EA -> IE	0.033	0.036	0.024	1.393	0.164	
	HR -> OC -> IE	0.103	0.102	0.031	3.346	0.001	
	FR -> OC -> IE	0.186	0.181	0.038	4.922	0.000	
	TR -> OC -> IE	0.200	0.201	0.050	3.991	0.000	
	HR -> CMC -> II	-0.014	-0.013	0.016	0.892	0.372	
H6	FR -> CMC -> II	-0.017	-0.017	0.020	0.860	0.390	
	TR -> CMC -> II	-0.017	-0.016	0.019	0.898	0.369	
	HR -> EA -> II	0.062	0.062	0.020	3.050	0.002	
	FR -> EA -> II	0.187	0.187	0.035	5.266	0.000	
	TR -> EA -> II	0.103	0.105	0.033	3.170	0.002	
	HR -> OC -> II	0.121	0.119	0.035	3.498	0.000	
	FR -> OC -> II	0.218	0.213	0.041	5.347	0.000	
	TR -> OC -> II	0.234	0.235	0.052	4.498	0.000	

CMC: change management capabilities; EA: employee attitudes; FR: financial resources; HR: human resources; IE: improved efficiency; II: increased innovation; OC: organizational culture; TR: technological resources.

statistical significance. The *f*-square values, which measure the effect size, show that these relationships are of medium to large effect.

Hypothesis 2 (H2), Hypothesis 3 (H3), and Hypothesis 4 (H4) can be interpreted in a similar manner. It's worth noting in H3 that the path EA -> IE is not significant ($p=0.111$), and in H4, the path CMC -> II is not significant ($p=0.365$), which indicates these relationships might not exist in the population.

The mediation effects are shown in Hypothesis 5 (H5) and Hypothesis 6 (H6). These effects describe the influence of an indirect path on the relationship between the predictor and the outcome. For instance, the path FR -> CMC -> IE in H5 indicates the mediation effect of CMC on the relationship between FR and IE. The results show the mediation effect is significant ($p=0.002$), meaning the relationship between FR and IE is at least partly explained by the influence of FR on CMC, and in turn, the influence of CMC on IE. Lastly, the paths HR -> CMC -> II, FR -> CMC -> II, and TR -> CMC -> II in H6 have non-significant *p*-values, suggesting these indirect relationships might not exist in the population.

Thematic analysis

Following an extensive process of transcribing, coding, and analyzing the data from the 20 interviews, several salient themes emerged using NVivo.

Theme 1: Organizational culture and digital readiness

Multiple interviewees pointed to organizational culture as a critical determinant of digital readiness. They shared that companies with a culture of innovation and continuous learning were better positioned to embrace digital transformation. For instance, one CEO explained, 'Our culture of curiosity and continuous improvement has been vital in our journey toward digital transformation.'

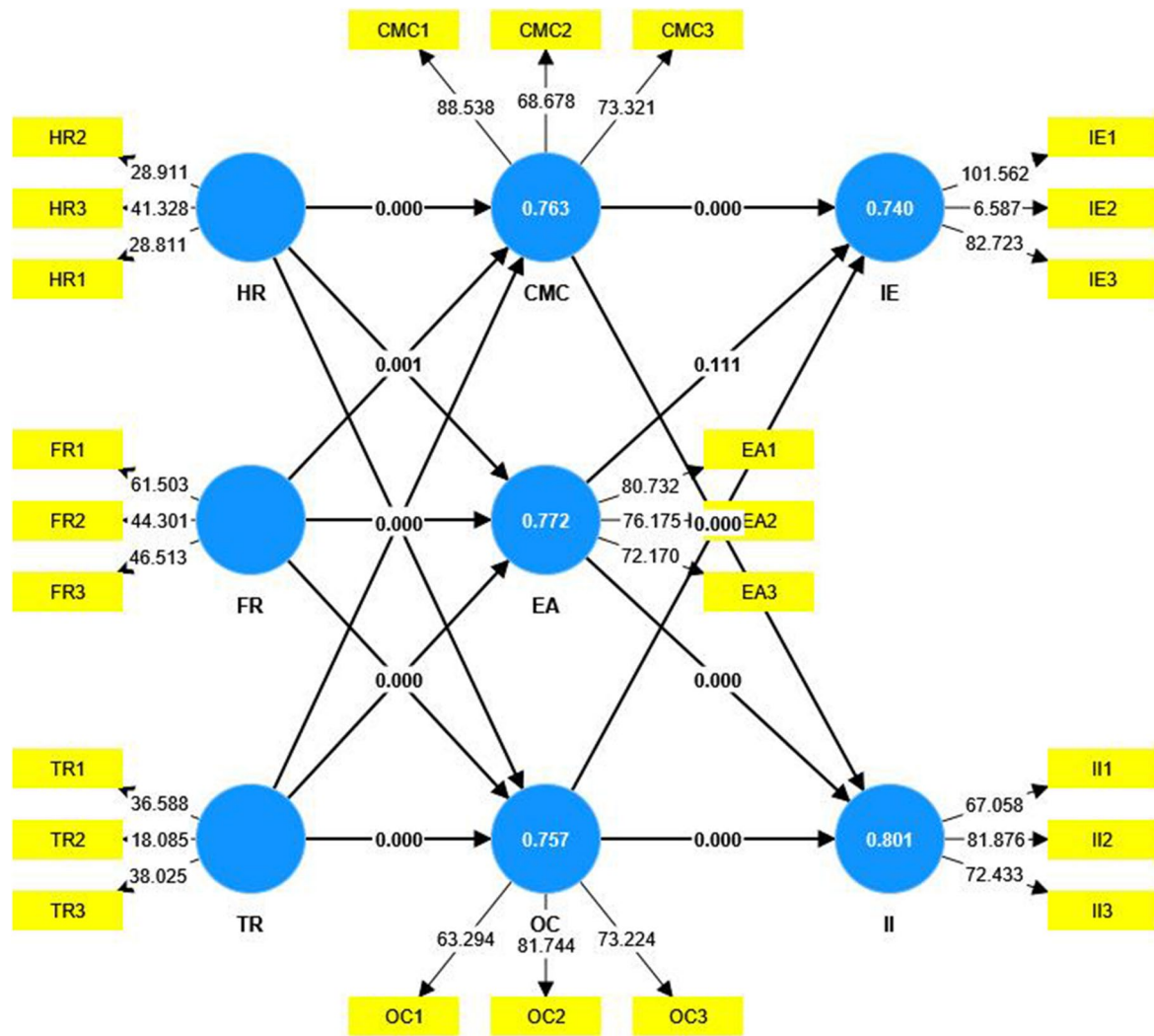


Figure 3. Structural model illustration.

Theme 2: Resource availability

Several participants highlighted the importance of resources for implementing digital transformation. Financial resources, human resources, and technological resources were emphasized. As one interviewee shared, 'Without adequate funding and the right people equipped with necessary digital skills, our digital transformation initiatives would have been impossible' (Pathmanathan et al., 2022).

Theme 3: Change management competency

Participants consistently underlined the role of effective change management in navigating digital transformation. They shared experiences about how structured management of change processes and open communication helped to mitigate resistance. For instance, a participant noted, 'Transparent communication about the benefits and implications of the digital transformation was vital in gaining employee buy-in' (Wangyanwen et al., 2023).

Theme 4: Employee attitudes towards digital transformation

The attitude of employees towards digital transformation was another recurring theme. Participants suggested that positive attitudes were closely linked to successful digital transformation. 'Our employees' enthusiasm for and openness to digital technologies greatly facilitated our transformation', one interviewee remarked (Wickneswary et al., 2024).

Theme 5: Innovation emphasis

Most participants mentioned the importance of an emphasis on innovation. They felt that an organization that values innovation is more likely to adopt and successfully implement digital technologies. One participant shared, 'A focus on innovation allowed us to experiment, take calculated risks, and eventually find digital solutions that work for us.'

Theme 6: Resistance to change

Despite the reported benefits and successes, resistance to change was a common theme that emerged from the interviews. Participants spoke of the challenges posed by employees resistant to digital transformation, reflecting the human aspect of any change process. For instance, one participant shared, 'Overcoming initial resistance was a major hurdle (Ahmed et al., 2024). However, through consistent training and communication, we managed to alleviate many of their concerns.'

In sum, these findings reveal the complex interplay of various factors influencing organizational readiness for digital transformation within the Malaysian manufacturing sector (Ahmed et al., 2022). The themes that emerged contribute to a deeper understanding of the specific nuances and intricacies of preparing for and implementing digital transformation in this context. The results underscore the significance of an organization's culture, resources, change management capabilities, employee attitudes, emphasis on innovation, and overcoming resistance to change in the digital transformation journey.

Discussion of the findings

The study conducted aimed to explore the complex dynamics of digital transformation readiness within organizations, particularly in the Malaysian manufacturing sector. A mixed-methods approach was utilized, and it revealed several compelling insights, supported by both quantitative and qualitative data.

The strong relationship between Organizational Culture (OC) and digital readiness metrics, such as Improved Efficiency (IE) and Increased Innovation (II) reflects the crucial role of organizational culture in promoting digital readiness. Quantitative data reveal that OC significantly impacts both IE ($\beta=0.518$, $p<0.001$) and II ($\beta=0.607$, $p<0.001$), underscoring its importance. This observation echoes previous literature; for instance, Azeem et al. (2021) emphasized that a culture of innovation and continuous learning positively impacts digital transformation efforts. Interview data also underscored this finding, with one CEO explaining that their 'culture of curiosity and continuous improvement' was instrumental in their journey toward digital transformation. These quantitative results and qualitative insights highlight the pivotal role of fostering a supportive and innovative organizational culture to enhance digital readiness.

Regarding the availability of resources, the study found that Financial Resources (FR) and Human Resources (HR) significantly influence Change Management Capabilities (CMC) and Organizational Culture (OC). Quantitative data show that FR significantly impacts CMC ($\beta=0.342$, $p<0.001$) and OC ($\beta=0.359$, $p<0.001$), while HR also significantly impacts CMC ($\beta=0.281$, $p<0.001$) and OC ($\beta=0.199$, $p<0.001$). This aligns with Bansal et al. (2023) and Jiang et al. (2023), who asserted that sufficient financial and human resources are vital for successful digital transformation. The qualitative findings supported this, with one interviewee noting the impossibility of their digital transformation initiatives without 'adequate funding and the right people equipped with necessary digital skills'. These results underscore the critical role of financial and human resources in enhancing change management capabilities and fostering a supportive organizational culture.

Change management competency was another significant factor influencing digital transformation readiness (Khalil et al., 2022b). The quantitative analysis revealed that HR ($\beta=0.281$, $p<0.001$), FR ($\beta=0.342$, $p<0.001$), and Technological Resources (TR) ($\beta=0.331$, $p<0.001$) significantly impact CMC. This finding complements the views of Edosomwan and Nwanzu (2021), who underscored the role of effective change management in navigating digital transformation.

Literature supports these findings, highlighting the necessity of robust resources for effective change management. Kotter (1996) emphasized the importance of clear communication and strong leadership in managing change. Similarly, Warner and Wäger (2019) noted that comprehensive change management strategies, including transparent communication and stakeholder engagement, are critical for overcoming

resistance and ensuring successful digital transformation. The qualitative findings align with these perspectives, with one participant observing that ‘transparent communication about the benefits and implications of the digital transformation was vital in gaining employee buy-in’.

These results underscore the importance of financial, human, and technological resources in building robust change management capabilities, essential for successful digital transformation. Additionally, they affirm the literature’s emphasis on the integral role of change management in facilitating digital transformation initiatives (Li et al., 2018; Varshney, 2020).

Employee attitudes towards digital transformation also emerged as a crucial factor. The quantitative analysis indicated a significant relationship between Employee Attitudes (EA) and both Improved Efficiency (IE) ($\beta=0.120$, $p<0.001$) and Increased Innovation (II) ($\beta=0.372$, $p<0.001$). This reflects the qualitative finding that positive attitudes facilitate digital transformation. Crittenden et al. (2019), Schafer and Graham (2002), and Rodríguez-Espíndola et al. (2022) corroborate this, arguing that employees’ openness to digital technologies is essential for transformation. This was encapsulated in an interviewee’s remark that their employees’ enthusiasm greatly facilitated their transformation process (Sirajuddin et al., 2023). These findings underscore the importance of fostering positive employee attitudes towards digital transformation, which significantly contributes to enhanced efficiency and innovation in digital transformation efforts (Annathurai et al., 2023).

The emphasis on innovation was another recurrent theme across the findings. The quantitative results revealed that Organizational Culture (OC) ($\beta=0.607$, $p<0.001$) and Employee Attitudes (EA) ($\beta=0.372$, $p<0.001$) significantly impact Increased Innovation (II), reinforcing the importance of innovation in digital transformation success, as highlighted by Barends and Rousseau (2018) and Casalino et al. (2020). This was also reflected in the qualitative data, with one participant stating that a focus on innovation allowed their organization to take calculated risks and find effective digital solutions. These findings underscore the critical role of fostering a culture of innovation and positive employee attitudes to drive successful digital transformation initiatives (Jing et al., 2023).

Despite not being a direct measure in the quantitative analysis, resistance to change emerged as a common theme from the qualitative data, signifying a potential hurdle in the digital transformation journey (Khalil et al., 2023). This qualitative insight complements the quantitative findings, where paths, such as Employee Attitudes (EA) to Improved Efficiency (IE) ($\beta=0.120$, $p=0.111$) did not show significant direct relationships, suggesting that underlying resistance might dilute the potential impact of positive attitudes. This is in line with Warner and Wäger (2019), who argue that managing resistance to change is a key aspect of implementing digital transformation. One participant remarked that ‘overcoming initial resistance was a major hurdle. However, through consistent training and communication, we managed to alleviate many of their concerns’. This underscores the necessity of addressing resistance to change to fully realize the benefits of digital transformation initiatives (Wai et al., 2024).

In conclusion, this study contributes valuable insights into the interplay of multiple factors influencing organizational readiness for digital transformation (Chawdhury et al., 2022). These findings not only offer empirical support to existing literature but also provide practical implications for organizations embarking on their digital transformation journey.

Implications of the study

Theoretical implications

The theoretical implications of this study’s findings, which explored the readiness for digital transformation in the Malaysian manufacturing sector, reinforce and extend several established theories, including Dynamic Capabilities Theory, the Resource-Based View, and Change Management Theories. These implications are discussed in light of the quantitative and qualitative results obtained.

The findings enhance the understanding of Dynamic Capabilities Theory by illustrating how sensing, seizing, and transforming capabilities are crucial for digital transformation. The quantitative data showed significant impacts of human resources (HR), financial resources (FR), and technological resources (TR) on change management capabilities (CMC). This highlights the importance of these resources in building effective change management practices, supporting the argument that dynamic capabilities evolve from

an organization's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments. Qualitative data further supported this by emphasizing that adequate resources and sensing capabilities are critical for effective change management.

The Resource-Based View (RBV) is supported by the findings, which underscore the importance of human, financial, and technological resources as critical enablers of change management capabilities and organizational culture (OC) (Wan et al., 2023). The quantitative data showed significant impacts of FR and HR on both CMC and OC. This validates the RBV by suggesting that strategic management of these resources is crucial for digital transformation. The qualitative findings reinforced this by highlighting the necessity of financial and human resources in successful digital initiatives, aligning with the RBV's emphasis on valuable, rare, inimitable, and non-substitutable resources.

Change Management Theories are also underscored by the findings, particularly the importance of managing resistance to change (Barman et al., 2023). The qualitative data identified resistance to change as a significant theme, indicating it as a potential hurdle in the digital transformation journey. This finding is consistent with theories, such as Kotter's eight steps for leading change, which argue that successful change initiatives require broad employee support and should be embedded within the organizational culture (Kaur et al., 2022). The quantitative data, showing the significant relationship between OC and both Improved Efficiency (IE) and Increased Innovation (II), further emphasizes the role of a supportive culture in facilitating digital transformation. These insights align with Warner and Wäger (2019), who emphasize managing the human side of change to ensure success.

In conclusion, the integration of Dynamic Capabilities Theory, the Resource-Based View, and Change Management Theories provides a comprehensive framework for understanding digital transformation readiness. The study's findings highlight the critical roles of sensing capabilities, resource management, and effective change management in driving successful digital transformation, offering valuable insights into managing and strategizing for change in an increasingly digital world.

Practical implications

The findings from this study offer several practical implications for enhancing digital transformation readiness in the Malaysian manufacturing sector, focusing on the critical roles of resources, organizational culture, and change management capabilities, as well as strategies to address resistance to change.

Manufacturing firms should prioritize the allocation of human, financial, and technological resources to support digital transformation. The significant impact of these resources on change management capabilities and organizational culture, as evidenced in the quantitative analysis, suggests that firms need to invest in training and development programs to enhance employees' digital skills, allocate sufficient budget for technological upgrades, and ensure access to advanced tools and systems (Fei et al., 2024).

Furthermore, fostering a culture that promotes innovation and continuous learning is essential for successful digital transformation. Firms should encourage an environment that supports experimentation, risk-taking, and collaboration. Leadership should actively promote a culture of curiosity and improvement, as highlighted by the significant relationships between organizational culture and both improved efficiency and increased innovation. Practical steps include setting up innovation hubs, recognizing and rewarding innovative efforts, and promoting open communication channels (Haibao & Haque, 2023).

Effective change management is critical to navigating digital transformation. Companies should adopt structured change management frameworks, such as Kotter's eight steps, to guide their transformation efforts. This includes establishing a sense of urgency, forming a guiding coalition, developing a vision and strategy, and communicating the vision. Training programs and workshops on change management can equip leaders and managers with the necessary skills to handle resistance and drive transformation (Ying et al., 2023).

Addressing resistance to change is crucial, as it emerged as a significant barrier in the qualitative data. To mitigate this, firms should engage employees early in the transformation process, clearly communicate the benefits and implications of digital changes, and provide continuous support and training. Addressing concerns and involving employees in decision-making can reduce resistance and foster a sense of ownership and commitment to the transformation process (Wahab et al., 2024).

Organizations should also focus on enhancing their sensing, seizing, and transforming capabilities to better navigate the digital landscape. This involves continuously scanning the external environment for technological trends and opportunities, effectively allocating resources to seize these opportunities, and reconfiguring organizational processes to support digital initiatives. Practical actions include investing in market research, establishing cross-functional teams to explore new technologies, and creating flexible structures that can adapt to change (Haque et al., 2024).

The integration of resource-based and change management strategies is essential for a holistic approach to digital transformation. Firms should ensure that their resource allocation strategies are aligned with their change management practices supporting a smooth transition. This can be achieved by developing comprehensive digital transformation plans that outline resource needs, timelines, and change management activities (Ifedi et al., 2024).

In summary, the practical implications of this study emphasize the need for manufacturing firms to invest in resources, cultivate a supportive culture, enhance change management practices, address resistance to change, and leverage dynamic capabilities. By adopting these strategies, firms can improve their readiness for digital transformation and achieve greater efficiency, productivity, and innovation.

Conclusions and limitations of this study

This study has examined the readiness for digital transformation within the Malaysian manufacturing sector, highlighting the significant roles of resources, organizational culture, and change management capabilities. The findings underscore the critical importance of human, financial, and technological resources in facilitating effective change management and fostering a culture conducive to digital innovation. Quantitative data demonstrated significant relationships between these resources and key outcomes, such as improved efficiency and increased innovation, confirming the theoretical perspectives of Dynamic Capabilities Theory and the Resource-Based View.

Qualitative insights further emphasized the necessity of a supportive organizational culture and effective change management practices in overcoming resistance to change (Ramalingam et al., 2024). The study revealed that addressing employee attitudes and fostering a culture of continuous learning and innovation are vital for successful digital transformation. These findings align with Change Management Theories, reinforcing the importance of managing the human side of change to ensure the successful implementation of digital initiatives (Narayanan et al., 2023).

Overall, this research contributes to the understanding of digital transformation readiness by integrating theoretical frameworks with empirical evidence. The study provides valuable insights for industry practitioners, suggesting that prioritizing resource allocation, cultivating a supportive culture, enhancing change management practices, and leveraging dynamic capabilities are essential strategies for achieving digital transformation success (Francis et al., 2023).

Despite the valuable insights provided, this study has several limitations. The cross-sectional design limits the ability to capture the dynamic nature of digital transformation over time. Future research could employ longitudinal studies to better understand how digital transformation readiness evolves and impacts organizational performance in the long term (Lee et al., 2023). The study focused exclusively on the Malaysian manufacturing sector, which may limit the generalizability of the findings to other industries or geographical contexts. Future studies could explore digital transformation readiness in different sectors and regions to provide a more comprehensive understanding of the factors influencing digital transformation. While the study used a mixed-methods approach to capture both quantitative and qualitative data, the sample size for the qualitative phase was relatively small. Expanding the qualitative sample size in future research could provide a richer and more nuanced understanding of the experiences and perspectives of industry professionals. Additionally, the study primarily examined internal organizational factors, such as resources, culture, and change management capabilities. External factors, such as government policies, market conditions, and technological advancements, were not extensively explored. Future research could incorporate these external factors to provide a more holistic view of the determinants of digital transformation readiness.

In conclusion, while this study offers important insights into digital transformation readiness within the Malaysian manufacturing sector, addressing its limitations in future research could further enhance

the understanding and support the development of more effective strategies for achieving digital transformation success.

Ethical approval

Formal ethical approval has been waived by the Institutional Review Board of MAHSA University Malaysia, as of 28 May 2024 (ref: MAHSA/AC/RIE/FOBAF/2024/001). This decision falls under Category 2: Educational Testing, Survey Procedures, Interview Procedures, and Observation of Public Behavior, as outlined in the Department of Health and Human Services (DHHS) regulations for the protection of human subjects (45 CFR 46.101(b)) criteria.

This study adhered to the principles of the Declaration of Helsinki, following strict ethical standards. Participation was anonymous, confidential, and voluntary, with informed oral consent obtained from all participants. Participants had the freedom to withdraw from the study at any point.

Author contributions

S.A. played a pivotal role in conceptualizing the study and was also involved in data curation, formal analysis, investigation, software development, visualization, and drafting the original manuscript. Furthermore, S.A. contributed to reviewing and editing the manuscript. N.A.A. contributed to the conceptualization of the study, oversaw the project as a supervisor, and participated in data curation. R.H. was involved in formal analysis, investigation, contributed to drafting the original manuscript, and acted as a supervisor alongside N.A.A., A.R.B.S.S., and S.Z.Q. took part in data curation, contributed to drafting the original manuscript, and was involved in reviewing and editing the manuscript. All authors have read and agreed to the published version of the manuscript.

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Data availability statement

Data will be made available on reasonable request to the corresponding author.

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Appendix A

Quantitative measurement items

Change Management Capabilities (CMC)

- CMC1: Our organization effectively communicates the purpose and benefits of digital transformation initiatives.
- CMC2: We have a structured process for managing changes associated with digital transformation.
- CMC3: Our organization is proficient in addressing and overcoming resistance to digital changes.

Employee Attitudes (EA)

- EA1: I feel positive about the digital transformation efforts within our organization.
- EA2: I believe digital transformation is essential for our organization's future success.
- EA3: I am willing to adapt my work practices to accommodate new digital technologies.

Financial Resources (FR)

- FR1: Our organization allocates sufficient budget for digital transformation initiatives.
- FR2: Financial investments in digital technologies are seen as strategic investments in our organization.
- FR3: Our organization has the financial flexibility to experiment with new digital innovations.

Human Resources (HR)

- HR1: Our workforce possesses the skills necessary for adopting new digital technologies.
- HR2: Our organization invests in training programs to enhance employees' digital competencies.
- HR3: We have sufficient staffing levels to support our digital transformation initiatives.

Improved Efficiency (IE)

- IE1: Digital transformation initiatives have led to faster execution of business processes.
- IE2: We have seen a reduction in operational costs due to digital transformation.
- IE3: Our organization's productivity has improved as a result of adopting digital technologies.

Increased Innovation (II)

- II1: Digital transformation has enhanced our organization's ability to innovate products/services.
- II2: We are able to respond more quickly to market changes due to digital transformation.
- II3: Our organization has entered new markets or segments as a result of digital innovations.

Organizational Culture (OC)

- OC1: Our organizational culture supports taking risks associated with digital innovation.
- OC2: Collaboration and sharing knowledge about digital technologies are encouraged in our organization.
- OC3: Our organization values continuous learning and development in the digital domain.

Technological Resources (TR)

- TR1: Our organization has access to up-to-date digital tools and platforms.
- TR2: We continuously invest in upgrading our technological infrastructure to support digital transformation.
- TR3: Our technological resources are sufficient to meet our current and future digital needs.

Qualitative questions

General Questions

1. Can you describe your organization's journey towards digital transformation?
2. What motivated your organization to undertake digital transformation initiatives?

Change Management Capabilities (CMC)

3. How does your organization manage the changes brought about by digital transformation?
4. Can you share an example of a digital transformation initiative and how change was managed?
5. What challenges have you faced in managing change during digital transformation efforts?

Employee Attitudes (EA)

6. How do employees in your organization generally feel about digital transformation?
7. Can you describe how employees' attitudes towards digital transformation have evolved?
8. What strategies have been effective in engaging employees with digital transformation initiatives?

Financial Resources (FR)

9. How does your organization allocate financial resources for digital transformation?
10. Have there been any financial challenges in pursuing digital transformation efforts?

Human Resources (HR)

11. What role do human resources play in your organization's digital transformation?
12. How has your organization addressed the skills gap for digital transformation?

Improved Efficiency (IE)

13. In what ways has digital transformation led to improved efficiency in your organization?
14. Can you provide examples of processes that have become more efficient as a result of digital technologies?

Increased Innovation (II)

15. How has digital transformation impacted innovation within your organization?
16. Can you share a particular innovation that was made possible through digital transformation?

Organizational Culture (OC)

17. How would you describe your organization's culture in the context of digital transformation?
18. What cultural changes have been necessary to support digital transformation?

Technological Resources (TR)

19. What technological resources have been critical to your organization's digital transformation?
20. How does your organization decide on investing in new technologies for digital transformation?