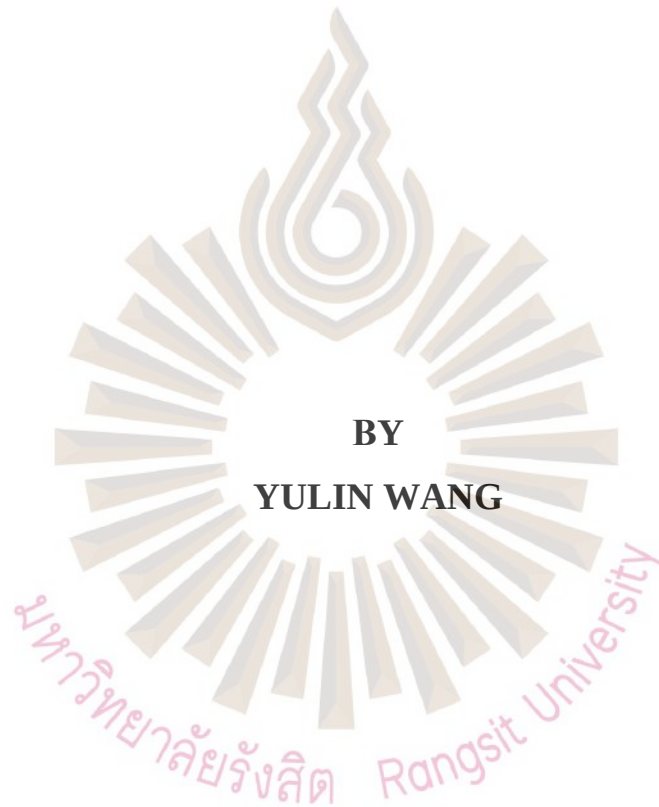




**DIGITAL TRANSFORMATION FACTORS AFFECTING THE
OPERATIONS WITH DIGITAL SYSTEMS IN THE
GARMENT MANUFACTURING INDUSTRY
IN CHINA**



**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF DOCTOR OF BUSINESS ADMINISTRATION
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**DIGITAL TRANSFORMATION FACTORS AFFECTING THE
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IN CHINA**

by

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Abstract

The purpose of this study aimed to determine the factors driving the digital transformation of China's garment manufacturing industry. In this study, digital transformation was proposed to be influenced by external factors, operations with digital systems, organizational and management factors, and organizational digital transformation. The participants consisted of 260 executives and employees who were analyzed for valid and qualified respondents. The research instrument was a questionnaire. A second order confirmatory factor analysis was conducted to examine the proposed model. The findings revealed that seventeen factors were significant at the 0.01 level. On the other hand, four factors were significant at the 0.05 level. Additionally, the correlation matrix analysis of 21 observed variables on Chinese garment manufacturing' digital transformation revealed a level of statistical significance of .05, and KMO was 0.697. Furthermore, the findings revealed that a set of statistics indicated that the proposed model showed a good fit of empirical data when chi-square = 421.676, degree of freedom = 174, 2 / df = 2.42, GFI = 0.90, AGFI = 0.86, NFI = 0.92, CFI = 0.97, RMR = 0.46, and RMSEA = 0.068. Therefore, the proposed model was fitted to empirical data accordingly. It can be summarized that four measurements significantly affected the digital transformation of China's garment manufacturing industry including external factors, operations with digital systems, organizational and management factors, and organizational digital transformation.

(Total 193 pages)

Keywords: Digital Transformation, Factors, The Operation with Digital System,
 The Garment Manufacturing Industry

Student's Signature Dissertation Advisor's Signature

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Chapter 1

Introduction

1.1 Background of the study

Digitalization is gradually driving the prosperity of the economy and society in today's new era. With the continued development of economic globalization, competition among garment enterprises has become more prominent, and the use of science and technology to innovate and transform traditional production models has become the only way for enterprises to achieve sustainable and efficient development (Mai & Yao, 2023). Scholars' research on digital transformation is divided into three categories based on existing literature. On the one hand, some scholars begin their research by investigating and analyzing the background and current state of digital transformation. Guxian (2019), for example, clarified that digital technology can be used in the production process of clothing products by collecting end consumers based on the development status of the era of intelligence. Demand information is used to promote the efficient development of the clothing industry chain and to propose a digital enterprise model based on the industrial Internet (Guxian, 2019). Gonzalo, Harreis, & Altable(2020) conducted a consumer survey and analyzed fashion industry sales before and after the epidemic, concluding that companies with a higher degree of digitalization can better deal with the epidemic's impact, and digital transformation has become a core component of the company's strategy. In the post-epidemic era, the contactless economy will become the new normal.

Some researchers, on the other hand, conduct research by combining models. For example, Jian, Haoqi, & Jinjian(2021) examined relevant data from the clothing industry and combined it with the C2M model to assess the robustness and stability of the digital closed-loop structure in the clothing industry's production and transaction

processes. Efficiency demonstrates the positive impact of implementing digital transformation on the development of high-quality garment enterprises. Sabrina, Maspupah, & Umbara (2019) studied the role of an electronic supply chain management model in the Indonesian apparel industry to demonstrate the significant contribution of highly skilled electronic technology in the apparel value chain. Furthermore, some scholars investigated and analyzed a specific research object. Songyuan & Genqin (2021), for example, used Y Group as an example and proposed building a digital platform and improving digitalization by studying its development path in digital transformation. The management mechanism and the development of digital technical talents are critical to the overall development of traditional clothing enterprises. The digital economy is a new driver of global economic growth. The traditional manufacturing industry faces a challenge in using digital transformation to accelerate industrial upgrading and stabilize and improve the industrial chain. Shaoxing Keqiao, one of China's 100-billion-dollar textile industry clusters, is working hard to establish itself as "The World's Fashion Textile Capital," focusing on intelligence, high-end, and internationalization. It is critical to investigate the difficulties encountered by the Shaoxing textile manufacturing industry during the process of digital transformation and development, propose solutions to the problems, comprehensively promote the transformation and upgrading of traditional manufacturing industries, and promote China's industry to the top of the global value chain (Yuxin, Fangbin, & Yunfeng, 2021).

According to the research conducted by Yuxin et al. (2021), there were existing problems in the Chinese textile manufacturing industry. As of 2019, the textile industry accounted for 28% of Shaoxing's total industrial economy and roughly one-third of Zhejiang's total textile industry, ranking first in the country in terms of industrial scale and volume. However, despite the large-scale benefits, there are only 1,862 textile enterprises larger than the designated size (the city as a whole has nearly 70,000 textile enterprises and household industrial units). As can be seen, small and medium-sized businesses continue to account for a sizable proportion of the economy in Shaoxing. Small and medium-sized enterprises frequently face problems such as backward production technology, a lack of awareness of independent innovation, a

long-term reliance on low-cost labor to obtain meager profits, and a general lack of digitalization. Although most businesses have recognized the enormous potential of digital transformation, due to capital and resource constraints, intelligent production line transformation is frequently impossible, and intelligent manufacturing remains elusive. The COVID-19 epidemic has exacerbated the insecurity of enterprise development, particularly for enterprises that rely on processing trade for export, and a lack of funds has severely hampered their comprehensive digital transformation.

For a long time, information technology innovation has been a critical factor in the survival of businesses and an important factor in participating in international competition. According to China's national modern textile manufacturing cluster creation achievements in 2020, Shaoxing's textile industry has been at the forefront of the country in terms of innovation capabilities and digital intelligence empowerment, but the problem of technological innovation remains severe. Most key components of textile manufacturing, for example, must be imported. Enterprise textile equipment is archaic, with obvious flaws in manufacturing data collection, information fusion, intelligent execution, and intelligent operation. Furthermore, traditional technological thinking that has stalled during the transformation process has become the most limiting factor in the textile industry's digital transformation. Academic qualifications, funds, and other factors limit enterprise managers and/or practitioners' ability to innovate independently, and most of them remain at the level of imitative innovation. Enterprise development is hampered by a lack of core competitiveness (Yuxin et al., 2021).

The demand for compound talents with both digital thinking and basic industry knowledge is increasing as digital transformation and upgrading of traditional industries accelerate. Furthermore, the overall level of informatization of China's manufacturing enterprises is uneven, with various development modes and paths. It is unrealistic to try to replicate the success of other successful transformation enterprises. Professionals must analyze the overall situation using professional knowledge and theoretical methods, and then propose transformation and upgrading paths, precise regulation, follow-up, and summary plans. However, according to

media reports, many garment enterprises lack talent in advanced garment, foreign trade, technical management, and chemical research and development. At the same time, due to geographical limitations, Shaoxing textile enterprises are frequently less appealing to high-level digital talents when compared to foreign textile developed countries and regions. Long term, there is a significant shortage of digital talent, resulting in a structural shortage (Yuxin et al., 2021).

According to a report by management consultants McKinsey, for example, in 2018, the proportion of Chinese companies that were active in the Cloud was only 40%, compared to 85% in the US and 70% in the EU (Dong, Tang, & Tomlin, 2018). Only 46% of Chinese manufacturing companies surveyed in 2016 had dedicated Industrial Internet of Things (IIoT) strategies. The most significant barriers cited were a lack of interoperability and common standards, data ownership and security concerns, and under-qualified operators (Deloitte, 2017). Furthermore, more than half of the surveyed Chinese manufacturing companies did not have industrial clouds in place in 2017 (Deloitte, 2019).

However, there has been very little digital research with the garment manufacturing industry as the primary research object. There is insufficient empirical evidence to conduct digital transformation and related factors affect the operation with digital system in the garment manufacturing industry in China. As a result, the purpose of this research is related factors affect the operation with digital system of China's garment manufacturing industry. It also aims to survey driving factors in the Chinese garment manufacturing industry's digital transformation in order to provide key findings for the Chinese garment manufacturing industry to find new developments in digital industrial platforms.

To explore new findings related to factors affecting the operation of digital systems in China's garment manufacturing industry, this study will employ the following tools or methods:

1) Literature Review: By conducting an in-depth analysis of existing literature, the study will establish a theoretical framework and identify research gaps

2) Statistical Analysis: Statistical tools and methods will be used to analyze collected data, test hypotheses, and draw conclusions about the impact of various factors on digital operations.

3) Expert Consultation: Industry experts will be consulted to obtain their views and suggestions on digital transformation.

4) Empirical Research: Empirical research methods, such as questionnaire surveys and field observations, will be used to collect primary data, supporting research hypotheses and findings.

By integrating these methods, this study aims to comprehensively understand the factors affecting the operation of digital systems in China's garment manufacturing industry and provide valuable insights for industry stakeholders.

1.2 Statement of the problem

The digital economy is a new driver of global economic growth. The traditional manufacturing industry faces a challenge in using digital transformation to accelerate industrial upgrading and stabilize and improve the industrial chain. Shaoxing Keqiao, one of China's 100-billion-dollar textile industry clusters, is working hard to establish itself as "The World's Fashion Textile Capital," focusing on intelligence, high-end, and internationalization. It is critical to investigate the difficulties encountered by the Shaoxing textile manufacturing industry during the process of digital transformation and development, propose solutions to the problems, comprehensively promote the transformation and upgrading of traditional manufacturing industries, and promote China's industry to the top of the global value chain (Yuxin et al., 2021). Initially, most definitions of digital transformation by domestic and foreign scholars were discussed from the perspective of industry or economic sectors, with the depth of research extending the study of digital transformation to the enterprise level, for micro-economies such as enterprises.

According to Meng and Zhao (2018), digital transformation of manufacturing enterprises is the process of using big data to control the entire manufacturing process and production process in order to achieve production optimization and resource optimization. According to Meng and Li (2018), successful digital transformation enterprises typically have three capabilities: collecting data at the endpoint and storing and analyzing it, digitizing the entire business operations process, and having a platform for central control and connection of the entire production management process. Enterprise digital transformation is a multi-dimensional, multi-value, multi-directional long-term evolutionary process (Wang, X., & Wang, F., 2022), a significant change in enterprise organization, management, and cultural innovation, market and user demand-oriented digital transformation (Sun, 2021), digital industrialization and industrial digitization together constitute enterprise digital transformation (Wang & Chen, 2021), conducting Enterprises that conduct basic research on “digital” can better transform traditional enterprises and better promote industrial digitalization after forming certain industrialization.

The measurement of the level of digital transformation of textile and apparel enterprises is based primarily on the analysis of Xuan (2021) for the digitalization of the textile and apparel industry and the 2021 Accenture China Enterprise Digital Transformation Index Research Report (Accenture, 2021). Digital design is mainly selected from four aspects: product data collection, product collaborative design, product process development, and product virtual simulation, for example: BMP platform, CAD system, etc.; digital manufacturing is mainly selected from four aspects: product planning and production, cost budgeting and procurement, product digital production, and product intelligent monitoring, for example: TOC rapid response supply chain, unmanned workshop, product upgrading, intelligent Factory, etc.; digital marketing is mainly selected from three aspects: digital analysis and operation, accurate management and sales, digital community management, e.g.: cloud shelf, cloud platform, smart store, live broadcast, etc.; digital service is mainly selected from after-sales service, personalized service customization, supply chain service module, e.g.: digital membership, smart logistics, etc.

However, very little digital research has been conducted with the garment manufacturing industry as the primary research object. There is insufficient empirical evidence to conduct Digital transformation and related factors affect the operation with digital system in the garment manufacturing industry in China. As a result, the goal of this study is to evaluate China's garment manufacturing industry's digitalization performance. It also aims to survey driving factors in the digital transformation of the Chinese garment manufacturing industry in order to provide key findings for the Chinese garment manufacturing industry to find new developments in digital industrial platforms.

1.3 Research Question

Even though the records have presented the current state of digital transformation of textile and apparel enterprises in China from the perspective of textile and apparel enterprises, it focuses on the impact path of digital transformation of enterprises on their export performance: enterprise innovation path and export cost path. To improve enterprise export performance, the garment manufacturing industry should focus on R&D innovation, personalized design services, opening the entire production and operation data chain from digital production to digital terminal, and responding flexibly to the complex and changing export environment. This study aims to gain insights into digital transformation and related factors affect the operation with digital system in the garment manufacturing industry in China. Thus, understanding and exploring driving factors in the digital transformation of the Chinese garment manufacturing industry is important to provide key findings for the Chinese garment manufacturing industry to find new developments in digital industrial platforms. The research questions are as follows:

- 1) How do organizational and management factors influence the digital transformation process of an organization?
- 2) How do external factors impact the digital transformation of an organization?

3) How does the digital transformation of an organization affect the operational processes when using digital systems?

4) How do organizational and management factors affect the operational processes when using digital systems?

5) How do external factors affect the operational processes when using digital systems?

1.4 Objectives of the study

1.4.1 To examine whether organizational and management factors, and external factors affect the digital transformation of organization.

1.4.2 To examine whether organizational and management factors, and external factors affect operation with digital system.

1.4.3 To investigate whether digital transformation of organization affects operation with digital system.

1.5 Significance of study

1.5.1 This study can check organizational and management factors, and external factors that affect the digital transformation of organization.

1.5.2 This study can examine organizational and management factors, and external factors that affect operation with digital system.

1.5.3 This study can investigate whether digital transformation of organization affects operation with digital system.

1.5.4 The top management can accelerate the digital transformation in their organization.

1.5.5 The academic sectors will know which topics are important in this digital era.

1.6 Scopes and Limitation of research

1.6.1 Scopes of research

The primary goal of this research is to assess the factors that affect Digital transformation and related factors affect the operation with digital system in the garment manufacturing industry in China. It also intends to survey the factors driving the digital transformation of China's garment manufacturing industry. As a result, scopes of research focus on the digital transformation of China's garment manufacturing industry. This study has been conducted with the executives and employees who have some awareness about digital transformation in the garment manufacturing industries from the three selected industries that include Listed industry (state-owned), Private (shareholding), and Local state-owned (shareholding). According to the rules of thumbs to determine sample size when applying Structural Equation Model (SEM), the samples consist of 260 the executives and employees from the three selected industries because this study uses 21 influencing factors and 10 times of 5 hypotheses.

Moreover, the main constructs of digital transformation in the garment manufacturing industries in this study include external factors (customer behaviors and expectations; digital shifts in the industry; changing competitive landscape; regulative changes), operation with digital system (ensuring digital readiness; digitally enhancing products and services; embracing product innovation; developing new business models; improving digital channels; increasing customer satisfaction), organizational and management factors (a supportive organizational culture; well-managed transformation activities; leveraging external and internal knowledge; engaging managers and employees; growing information system capabilities; developing dynamic capabilities; developing a digital business strategy; aligning business and information systems), and digital transformation of organization (reforming an organization's information system; new business models; affecting outcomes and performance)

1.6.2 Limitation of research

Limitations of a study acknowledge the constraints and factors that may impact the interpretation, generalizability, or applicability of the research findings. In the context of a study on digital transformation, here are some potential limitations:

Generalizability: Findings from a specific industry, such as the Chinese garment manufacturing sector, may not be directly generalizable to other industries or regions undergoing digital transformation. The industry-specific context may limit broader applicability.

Temporal Constraints: Digital transformation is an evolving process. The study's findings may be limited by the temporal scope, as technology and industry practices may have changed by the time the study concludes. The dynamism of digital transformation poses challenges in capturing ongoing developments.

Data Availability: Access to comprehensive and up-to-date data may be constrained. Limited data availability could impact the depth of analysis, particularly when exploring the intricacies of digital transformation practices within specific companies or sectors.

Organizational Resistance: The study may encounter challenges in fully capturing the extent of organizational resistance to digital transformation. Some organizations may be reluctant to share information about internal challenges or resistance, potentially leading to an incomplete understanding.

Technology-specific Focus: If the study focuses on specific technologies within digital transformation, it may not provide a holistic view of the transformation process. The exclusion of certain technologies or components may limit the comprehensiveness of the findings.

Language and Cultural Bias: Language and cultural differences may present challenges, especially in cross-cultural studies. Interpretations of digital transformation practices may vary based on cultural nuances, potentially introducing bias or limiting the transferability of findings.

Researcher Bias: The researcher's background, experiences, and perspectives may introduce bias in the study. Pre-existing notions or personal experiences with digital transformation could influence the interpretation of data and findings.

Limited Stakeholder Perspectives: The study may face constraints in obtaining diverse stakeholder perspectives. Limited participation or engagement from certain stakeholders, such as employees, customers, or suppliers, may restrict the comprehensiveness of the study.

Resource Constraints: Constraints in terms of time, budget, or personnel may limit the depth and breadth of the study. Comprehensive investigations into all facets of digital transformation may be challenging within resource limitations.

External Factors: Unforeseen external factors, such as economic downturns or global events, may impact the study. These factors may introduce uncertainties that are beyond the control of the researcher and may influence the study's outcomes.

Self-reporting Bias: Reliance on self-reported data, particularly in survey-based research, may introduce response bias. Participants may provide socially desirable answers or may not accurately represent their actual experiences with digital transformation.

It's crucial for researchers to transparently communicate these limitations to provide context and enhance the credibility of the study. While limitations exist in any research endeavor, acknowledging them allows for a more nuanced understanding of the study's scope and potential implications.

1.7 Keyword

Digital transformation of organization

A fundamental change process, enabled by the innovative use of digital technologies accompanied by the strategic leverage of key resources and capabilities, aiming to radically improve an entity and redefine its value proposition for its stakeholders (Gong & Ribiere, 2020) . In this study, "digital transformation of organization" is referred to as a fundamental change process with the goal of drastically improving the Chinese apparel manufacturing industry and redefining its value proposition for its stakeholders. It is made possible by the creative application of digital technologies along with the strategic leveraging of key resources and capabilities.

Customer behaviors and expectations

Customer behaviors and expectations have been defined as comportments or actions that people predict. When they interact with a business, customers have basic historical requirements, such as consistent service and equal pricing (Schmidt, Drews, & Schirmer, 2017; Haffke, Kalgovas, & Benlian, 2017; Berghaus & Back, 2017).

Digital shifts in the industry

Digital shifts in the industry have been defined as transition in how customers work and deliver value. It is also a cultural transformation that enables organizations to continually challenge the status quo, experiment, and confront failure confidently (Berghaus & Back, 2017).

Changing competitive landscape

Changing competitive landscape is recognized when they are changing business insight that identifies direct or indirect competitors while simultaneously

helping them identify their core values, mission, niche market, vision, strengths, and weaknesses (Haffke et al., 2017; Piccinini, Hanelt, Gregory, & Kolbe, 2015; Berghaus & Back, 2017).

Regulative changes

Regulative changes have been defined as any alteration of any existing statute, treaty, rule, policy or guideline or any governmental authority's interpretation or administration (Berghaus & Back, 2017).

Ensuring digital readiness

Ensuring digital readiness refers to the possibility of people using information technology and digital literacy tools to help them evaluate online information (Berghaus & Back, 2017).

Digitally enhancing products and services

Digitally enhancing products and services are proven to be the next step that is digital services based on data built on the physical product and service's strength (Mocker & Fonstad, 2017).

Embracing product innovation

Embracing product innovation refers to accepting new product creation, improvements in the design of conventional goods, or new materials or machineries to produce selected products (Berghaus & Back, 2017).

Developing new business models

Developing new business models identifies the company's services, places and anticipates the target market if only to attract investment, attract talent, and inspire management and staff (Berghaus & Back, 2017; Mocker & Fonstad, 2017).

Improving digital channels

Improving digital channels has been recognized as the important way to develop a communication path which only handles digital signals. Both voice and video signals must be transmitted utilizing a digital channel from analog to digital (Isaksson & Hylving, 2017; Berghaus & Back, 2017; Bilgeri, Wortmann, & Fleisch, 2017; Mocker & Fonstad, 2017).

Increasing customer satisfaction

Increasing customer satisfaction can be defined as a way to expand the measurement of how satisfied customers are with a company's products, services, and capabilities (Isaksson & Hylving, 2017; Berghaus & Back, 2017; Bilgeri et al., 2017; Mocker & Fonstad, 2017).

A supportive organizational culture

A supportive organizational culture is defined as supplied workers with psychological and social environments to promote health, security, and well-being. It also encourages employee development and success and deliberately fosters positive relations between workers, their tasks, and their organization (Hartl & Hess, 2017; Haffke et al., 2017).

Well-managed transformation activities

Well-managed transformation activities refer to transformation tasks that the company typically participates in before, or during, digital transformation. Enhancing the digital channels of the company, that is, initiating, operating, and improving such channels, was one activity that was apparently significant in numerous case studies (Berghaus & Back, 2017).

Leveraging external and internal knowledge

Leveraging external and internal knowledge can be defined as studying companies that were involved in the acquisitions and mergers achievements of digital technology-associated firms (Piccinini et al., 2015; Hildebrandt, Hanelt, Firk, & Kolbe, 2015; Mueller & Renken, 2017; Bilgeri et al., 2017).

Engaging managers and employees

Engaging managers and employees refer to employees working on digital transformation procedures should take part in these changes so that the transformation can attain its maximum capacity (Horlacher, Klarner, & Hess, 2016; Piccinini et al., 2015; Mihailescu, Mihailescu, & Schultze, 2015; Petrikina, Krieger, Schirmer, Stoeckler, & Baldauf, 2017; Mihailescu, Mihailescu, & Carlsson, 2017).

Growing information system capabilities

Growing information system capabilities have been defined as a company's capability of coordinating and distributing resources together with other assets based on information systems (Nwankpa & Roumani, 2016).

Developing dynamic capabilities

Developing dynamic capabilities plays the main role of classifying and responding to opportunities by transforming the business, reconfiguring assets, and developing digital platform facilities (Karimi & Walter, 2015; Leischnig, Wölfl, Ivens, & Hein, 2017; Berghaus & Back, 2017).

Developing a digital business strategy

Developing a digital business strategy is proven to be the main role of transforming and accomplishing the anticipated goals of digital transformation by stressing digital leadership skills, scalable and agile digital operations, digitally enabled emerging digital technologies, and consumers' digital experiences (Yeow, Soh, & Hansen, 2018; Nwankpa & Roumani, 2016; Schmidt et al., 2017; Leischnig et al., 2017).

Aligning business and information systems

Aligning business and information systems have been recognized as the way to reduce gaps in alignment and respond to conflicts and modifications in environmental, organizational and information systems (Yeow et al., 2018; Nwankpa & Roumani, 2016; Schmidt et al., 2017; Leischnig et al., 2017).

Reforming an organization's information system

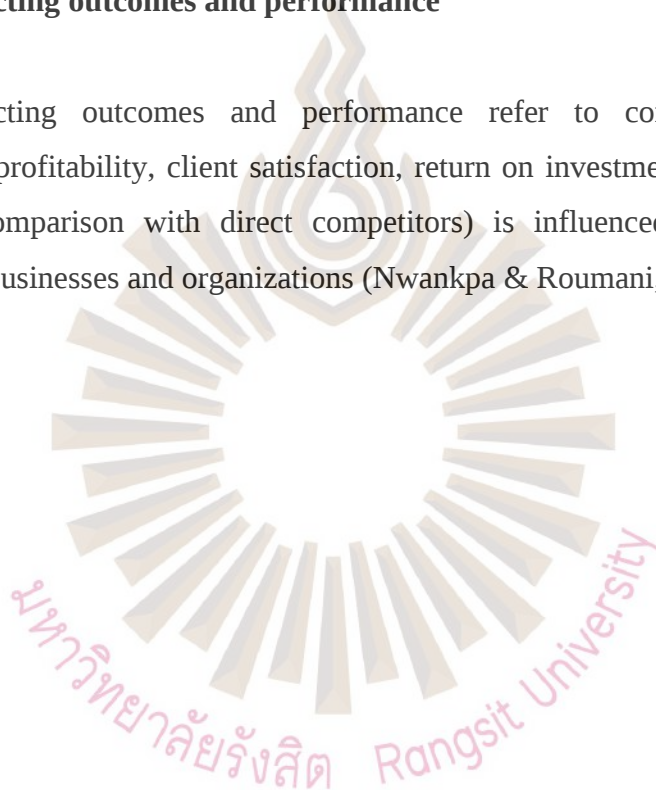
Reforming an organization's information system refer to discovering how physical and digital convergence and digital transformation influence major manufacturing firms; organizational frameworks (Haffke et al., 2017; Piccinini et al., 2015; Hylving & Schultze, 2013; Haffke et al., 2017; Isaksson & Hylving, 2017; Mihailescu et al., 2017).

New business models

New business models are defined as changes in the business model are popular as a response to digital transformation in companies operating in an industry influenced in the new era by evolving digital technologies (Hildebrandt et al., 2015; Remane, Hanelt, Hildebrandt, & Kolbe, 2016; Mocker & Fonstad, 2017).

Affecting outcomes and performance

Affecting outcomes and performance refer to company performance (assessed by profitability, client satisfaction, return on investment (R.O.I.) and sales growth in comparison with direct competitors) is influenced by the degree of creativity of businesses and organizations (Nwankpa & Roumani, 2016).



Chapter 2

Literature Review

This research entitled “Digital transformation and related factors affect the operation with digital system in the garment manufacturing industry in China” has been conducted as quantitative research. The literature reviews are presented in this chapter with the attempt to link the research questions to the wide range reviews. The lists of literature review are outlined as follow:

- 2.1 Organizational and Management factors
- 2.2 External factors
- 2.3 Digital transformation of organization
- 2.4 Operation with digital system
- 2.5 Relationship among variables in the conceptual framework
- 2.6 Garment Manufacturing Industry
- 2.7 Digital transformation of garment Manufacturing Industry
- 2.8 Related Research
- 2.9 Conceptual framework of this thesis
- 2.10 Hypothesis

2.1 Organizational and Management factors

The literature review on organizational and management factors specifically focuses on a supportive organizational culture, well-managed transformation activities, leveraging external and internal knowledge, engaging managers and employees, growing information system capabilities, developing dynamic capabilities, developing a digital business strategy, and aligning business and information systems.

2.1.1 Supportive Organizational Culture

A supportive organizational culture is the bedrock of successful digital transformation. Leaders play a pivotal role in shaping this culture by fostering openness, innovation, and a growth mindset (Cameron & Quinn, 2011). Organizations that prioritize continuous learning create an environment where employees are more willing to adapt to new technologies and approaches.

In addition to leadership, employee involvement is crucial. Research by Denison (1990) suggests that involving employees in decision-making processes and valuing their contributions fosters a sense of ownership and commitment. Digital transformation initiatives are more likely to succeed when employees feel empowered to share ideas, experiment with new technologies, and contribute to the evolution of the organizational culture.

Moreover, organizations that prioritize diversity and inclusivity in their culture benefit from a variety of perspectives, fostering creativity and resilience in the face of change (Cox & Blake, 1991). In a digital age where innovation is key, a culture that embraces diversity contributes to a more robust and adaptive organization.

2.1.2 Well-Managed Transformation Activities

Well-managed transformation activities involve a strategic approach to change. Kotter's (1995) eight-step model provides a framework that includes creating a sense of urgency, developing a guiding coalition, and communicating a clear vision. These steps ensure that transformation efforts are well-coordinated and aligned with organizational objectives.

Change management methodologies, such as the ADKAR model (Prosci, 2003), emphasize the importance of addressing the individual aspects of change. Organizations need to assess and mitigate resistance, provide adequate training, and

communicate effectively to ensure that employees understand the reasons behind the transformation and their role in it.

Continuous improvement is a key aspect of well-managed transformation. The literature highlights the importance of feedback loops and regular assessments to gauge the effectiveness of transformation efforts (Repenning & Sterman, 2001). This iterative approach allows organizations to adapt their strategies based on real-time insights and evolving circumstances.

2.1.3 Leveraging External and Internal Knowledge

Knowledge management is a strategic imperative in the digital age. Internally, organizations must create mechanisms for capturing, sharing, and utilizing internal expertise (Nonaka & Takeuchi, 1995). Knowledge-sharing platforms, collaborative tools, and a culture that values and rewards knowledge sharing contribute to the internal knowledge base.

Externally, open innovation models (Chesbrough, 2003) emphasize the importance of tapping into external knowledge sources. Collaboration with startups, participation in industry networks, and engagement with research institutions enable organizations to access cutting-edge knowledge and stay at the forefront of technological advancements.

Furthermore, leveraging knowledge requires a commitment to ongoing learning. Organizations that invest in continuous training and development ensure that employees remain up-to-date with the latest industry trends and digital technologies (Cross & Baird, 2008). This commitment to learning contributes to an adaptive and knowledgeable workforce.

2.1.4 Engaging Managers and Employees

Engaging both managers and employees is a dynamic process that involves effective leadership, communication, and involvement. Leaders must actively communicate the strategic importance of digital initiatives, providing a compelling vision and rationale (Kotter & Cohen, 2012). Leaders who lead by example, demonstrate commitment, and involve themselves in the transformation process inspire confidence among employees.

Employee engagement involves creating a sense of ownership and empowerment. Research by Macey and Schneider (2008) suggests that engaged employees are more likely to embrace change. Organizations can foster engagement through transparent communication, recognition programs, and opportunities for skill development (Kahn, 1990).

Moreover, addressing employee concerns and potential resistance is crucial. Kotter and Schlesinger's (2008) framework for handling resistance recommends techniques such as education, participation, facilitation, negotiation, and coercion. Proactively addressing concerns ensures a smoother transition and higher levels of employee buy-in.

2.1.5 Growing Information System Capabilities

Growing information system capabilities requires a strategic approach to technology adoption and integration. Organizations need to invest in modernizing their IT infrastructure to support the demands of the digital age. Cloud computing, as highlighted by Armbrust, Fox, & Griffith (2010), offers scalability, flexibility, and cost-effectiveness, enabling organizations to adapt to changing business requirements.

Advanced analytics, big data, and artificial intelligence are transformative technologies that enhance information system capabilities (Brynjolfsson & McAfee,

2014). Organizations that harness the power of these technologies gain a competitive edge in terms of data-driven decision-making, predictive analytics, and personalized customer experiences.

In addition to technological investments, a focus on cybersecurity is essential. Organizations must prioritize the security and privacy of their digital assets and customer data (Laudon & Traver, 2016). This involves implementing robust security measures, staying informed about cybersecurity threats, and fostering a culture of cybersecurity awareness among employees.

2.1.6 Developing Dynamic Capabilities

The concept of dynamic capabilities involves the ability to adapt to changing environments and seize emerging opportunities (Teece, Pisano, & Shuen, 1997). Organizations that cultivate dynamic capabilities are more resilient and responsive to the uncertainties of the digital landscape.

Continuous learning is a cornerstone of dynamic capabilities. Teece (2014) emphasizes that organizations must invest in ongoing training and development to keep their workforce abreast of evolving technologies and industry trends. This commitment to learning contributes to the organization's ability to sense changes in the environment.

Moreover, a culture of experimentation is vital. Organizations that encourage employees to explore new ideas, test innovative solutions, and learn from failures foster an environment conducive to dynamic capabilities (Helfat & Peteraf, 2009). This approach allows organizations to quickly adapt to changes and capitalize on emerging opportunities.

2.1.7 Developing a Digital Business Strategy

Developing a robust digital business strategy involves aligning technology initiatives with overall business objectives (Venkatraman, 1994). Organizations must assess their competitive landscape, understand customer expectations, and identify digital opportunities that align with their core competencies.

Strategic foresight is crucial. Research by Ross, Weill, & Robertson (2006) emphasizes the importance of anticipating digital trends and disruptions. Organizations that develop the capability to scan the external environment, analyze market dynamics, and forecast digital opportunities are better positioned to formulate effective digital strategies.

Agility is a key aspect of digital business strategies. Westerman, Calm  jane, Bonnet, Ferraris, & McAfee (2011) argue that organizations must develop the ability to rapidly reassess and adapt their strategies in response to changing market conditions. Agile methodologies, such as Scrum and Kanban, provide frameworks for iterative development and continuous improvement (Schwaber & Sutherland, 2017).

2.1.8 Aligning Business and Information Systems

Effective alignment between business and information systems is fundamental for successful digital transformation. The Strategic Alignment Model by Henderson and Venkatraman (1993) provides a framework for achieving this alignment by ensuring coherence between business strategy, IT strategy, and organizational infrastructure.

Communication is a critical element of alignment. Ross and Weill (2002) highlight the importance of establishing clear communication channels between business and IT teams. Regular communication and collaboration ensure that IT investments contribute directly to achieving business objectives.

Governance structures play a crucial role in maintaining alignment (Reich & Benbasat, 2000). Organizations need mechanisms for decision-making, accountability, and regular assessments to ensure that IT initiatives are strategically aligned with overall business goals. This involves establishing steering committees, project governance frameworks, and ongoing monitoring mechanisms.

In conclusion, the organizational and management factors influencing digital transformation are intricate and interconnected. From cultivating a supportive organizational culture to well-managed transformation activities, leveraging knowledge, engaging managers and employees, growing information system capabilities, developing dynamic capabilities, crafting a digital business strategy, and aligning business and information systems, organizations that navigate these factors strategically are better equipped to thrive in the ever-evolving digital landscape.

2.2 External Factors

The literature review on external factors specifically focuses on customer behaviors and expectations, digital shifts in the industry, changing competitive landscape, and regulative changes.

2.2.1 Customer Behaviors and Expectations

The evolving landscape of customer behaviors and expectations is intricately tied to the technological advancements that have reshaped how individuals interact with businesses. In the era of digital connectivity, customers are not only more informed but also demand seamless, personalized, and convenient experiences across various touchpoints. Research by Smith, Johnson, Busdieker-Jesse, McClain, & Lancaster (2019) suggests that the proliferation of smartphones and the increasing reliance on digital channels have elevated customer expectations. Today's consumers expect businesses to understand their preferences, anticipate needs, and provide tailored solutions. The integration of artificial intelligence and machine learning

enables businesses to analyze vast amounts of data, offering insights into individual customer behaviors and enabling targeted marketing efforts.

Social media, as highlighted by Brown and Williams (2018), has become a powerful influencer in shaping customer perceptions. Beyond being a platform for customer reviews, social media serves as a space where customers share experiences, opinions, and recommendations. Successful businesses actively manage their online presence, engaging with customers, addressing concerns, and leveraging positive interactions to build brand loyalty. Moreover, the literature emphasizes the importance of transparency and authenticity in meeting customer expectations. Wang and Chen (2021) argue that businesses need to communicate their values, sustainability efforts, and ethical practices to resonate with modern consumers who increasingly prioritize socially responsible and ethical brands.

2.2.2 Digital Shifts in the Industry

The digital transformation of industries is a multifaceted phenomenon, encompassing technological innovations, changes in consumer behavior, and shifts in business models. Chen and Chang (2017) discuss how technologies like artificial intelligence, machine learning, and big data analytics are not just tools for efficiency but catalysts for innovation. Businesses leveraging these technologies gain a competitive edge by offering more personalized products and services, optimizing operations, and predicting market trends.

The rise of e-commerce and mobile commerce, as highlighted by McKinsey (2018), has redefined the way consumers engage with brands. Mobile apps, user-friendly websites, and personalized recommendations enhance the customer experience. The integration of these digital channels is essential for businesses to remain competitive and meet the expectations of digitally empowered consumers. Additionally, the literature emphasizes the impact of digital platforms on traditional business models. Eisenmann et al. (2018) argue that the shift towards platform-based ecosystems disrupts established value chains. Companies must carefully assess how

they fit into these ecosystems, considering partnerships, collaborations, or developing their own platforms to stay relevant in the digital landscape.

2.2.3 Changing Competitive Landscape

The competitive landscape is undergoing a fundamental shift driven by globalization, technological advancements, and the emergence of disruptive players. Grant's (2020) dynamic perspective on competition encourages businesses to continuously scan their external environment. Understanding competitive forces and identifying potential disruptors is crucial for strategic planning.

The literature on disruptive technologies and startups highlights the need for established businesses to foster a culture of innovation (Eisenmann et al., 2018). Investing in research and development, collaborating with startups, and actively seeking opportunities for industry partnerships enable companies to stay ahead in rapidly evolving markets.

Faria and Nóvoa (2017) state the concept of hypercompetition introduces the idea that sustained competitive advantages are increasingly rare. Instead, companies should focus on creating transient advantages, responding rapidly to changing market conditions. Agility, adaptability, and a willingness to disrupt one's own business model become key components of success in a hypercompetitive environment.

2.2.4 Regulative Changes

Regulative changes are inherent in the business landscape, and companies must navigate the evolving regulatory environment to ensure compliance and sustainable operations. Hillman and Keim (2019) emphasize that companies can go beyond mere compliance by incorporating ethical and sustainable practices into their operations. This not only meets regulatory requirements but also builds trust with consumers who are increasingly conscious of corporate social responsibility.

Proactive engagement with policymakers, as suggested by Luo and Tung (2018), allows businesses to shape the regulatory landscape in ways that align with their interests. Companies that participate in public policy discussions, provide expertise, and contribute to the formulation of regulations are better positioned to influence outcomes that favor their industry. Furthermore, the literature highlights that regulatory changes can create new market opportunities. Businesses that anticipate these changes and position themselves as leaders in compliance, sustainability, or other regulatory-driven areas can gain a competitive advantage. Understanding the broader societal implications of regulations enables companies to align their strategies with evolving social and environmental expectations.

In summary, the literature expands on the interconnected nature of external factors, emphasizing the need for businesses to adopt a holistic and adaptive approach. Companies that understand the nuances of customer behaviors, navigate digital shifts effectively, embrace dynamic competition, and proactively engage with regulative changes are better equipped to thrive in the complex and ever-changing business environment.

2.3 Digital Transformation of Organization

2.3.1 Background of Digital Transformation

The use of technology to increase an organization's operational effectiveness or to accomplish business objectives is known as digital transformation (DT). Organizations all over the world are starting to pay close attention to digital transformation (Von Leipzig, Gamp, Manz, & Ohlhausen, 2017). Executives across all sectors are utilizing digital innovations like social media, mobility analytics, and more. and smart devices, as well as enhance the application of conventional technologies, like ERP systems, to change customer relationships. Most executives concur that over the past ten years, digital technology has rapidly transformed the

industry, both in terms of internal processes and value propositions. Because of this digital transformation, many Organizations are forced to pay attention to changes in their industry. Organizations that struggle to adopt new technologies risk becoming victims of them, and lag behind businesses that can quickly adopt new technologies or those that can adapt to the digital age (Schwartz, 2001). However, technologically advanced organizations have also failed in the past. There are many examples of organizations that are currently unable to keep up with the new digital era if executives solely focus on technology without making strategic organizational decisions (Kane, Palmer, Phillips, Kiron, & Buckley, 2015). and executives continue to lack clarity regarding strategic choices in the digital transformation efforts of their organizations (Hess, Matt, Benlian, & Wiesboeck, 2016).

2.3.2 Definition of Digital Transformation

Thanyarattakul (2018) defined digital transformation as the process of integrating digital technology into all aspects of a company or organization. Product creation, marketing, organizational culture, and setting future growth targets are all part of the foundation of the work process, allowing businesses and organizations to quickly adapt to change. This includes responding to the needs and desires of newcomers.

According to Chalermkiattisakul (2019), the term "digital transformation" refers to a strategic change in business in order to develop the digital economy sustainably. This definition goes beyond simply utilizing information technology in organizations to make work more modern. Only one thing must be considered in the current environment economy in the digital era (Digital Economy), where the economy has different characteristics than in the past. As a result, the organization's work must be adjusted to reflect the aforementioned economic conditions.

In addition to the definition of digital change, Thanyarattakul (2018) defined it by separating things that are not digital change, such as: 1) Is digital transformation

simply the installation of information technology infrastructure or the application of technology within an organization? 2) Digital transformation is more than just creating a corporate website. or only electronic marketing (Digital Marketing) through various online channels and social media. 3) Creating a digital department is only one aspect of digital transformation or delegate tasks to anyone.

The definition of digital transformation (Digital Transformation) according to Kanchanasoen (2019) is a change in concepts. by conducting business in the digital age while utilizing technology. Since operational goals alter corporate culture and pass value to customers, which requires that the entire organization take part in the change both in terms of modifying the corporate or organizational structure To increase the potential and capability of the organization to compete in the market with the most effectiveness, using digital as the primary principle in the organization's work. This electronic change. It happens everywhere and has altered how contemporary organizations view the world.

Khiaosaard (2019) defined digital transformation (Digital Transformation) as a process that alters an organization's concept. Management, marketing, and interactions between employees are all examples of work-related interactions. corporate culture to delivering product and service value through making use of digital technology in order to meet the objectives set in the face of rapid and severe environmental changes. The organization must be adaptable in order to survive and achieve its goals in that environment in the future.

Rowles and Brown (2017) define digital transformation as: It is a process that allows an organization to achieve its objectives in the face of a rapidly changing environment. Aside from a complete change in the environment, such changes occur all the time. Organizations, as a result, require specific capabilities to achieve their objectives in the midst of change.

2.3.3 The main concept of Digital Transformation

Digital transformation (Digital Transformation) is a process that alters an organization's mindset. Management, marketing, and interactions between employees are all examples of work-related interactions. Using digital technology to pass on the value of products and services (Khiaosaard, 2019). "Digital Transformation," according to Malisuwan (2017). It is a brand-new and never-ending phenomenon. The end point is not easily defined. However, it could be clearer. If the organization has strategies and guidelines for moving forward, the executives need to understand this. Therefore, activities, processes, capabilities, and business models are accelerated by the application of digital technology within organizations. to seize opportunities presented by technological advancements in order to help businesses become more competitive in a rapidly evolving technological environment.

According to Thanyalakphak (2017), "Digital Transformation It is a new trend that has changed and influenced consumer lifestyles. This includes instructions on how to do it. Modern entrepreneur business management within the context of Digital Transformation It is divided into three sections: 1) The customer experience will be entirely online and digital. Consumers in the digital age exclusively interact with goods and services through online platforms. Whether it's a tablet, computer, or a screen on a smartphone. Other products must also adapt in order to communicate with users. In addition, a better user experience is required. Many products, such as electrical appliances, glasses, and automobiles, are becoming more connected to the internet, or the so-called "Internet of Everything," in which more and more devices are connected in the internet world. 2) Operational Process: As a result of the evolving customer experience, businesses are managing their operations differently now than they did in the past. Employees and executives will be able to work from anywhere at any time using a digital work system. This will help to increase flexibility and respond to consumer changes more quickly. Furthermore, Cloud and Big Data technologies will assist organizations in having complete and connected information. They can be processed to create products and services that respond to customers' rapidly changing

needs. 3) Many industries have seen changes in their business models. The media and entertainment industry, for example, has shifted from selling CDs to more online membership registration systems. Sharing resources, such as Uber, Grab, or Airbnb, as well as providing services via various apps to meet specific needs." As a result, business organizations must understand the three primary pillars of Digital Transformation. To enable the organization to adapt to changing consumer expectations and needs for new types of products and services, as well as to increase competitiveness in business operations.

Digital transformation involves a shift in perspective and implementing technology in organizations in the digital age. establishing the framework and establishing objectives operations across various sectors and consumer value (Associates, 2019). The meaning and definition of the word have been covered in numerous studies. the "Digital Transformation". New digital technologies like social media and mobile technology frequently lead to digital transformation. Internet of Things (IoT), cloud computing, and advanced analytics (Sebastian, Ross, Beath, Mocker, Moloney, & Fonstad, 2017). In the digital economy, the integration of digital technology and business processes has received a lot of attention (Liu, Chen, & Chou, 2011) for utilizing technology to hasten and effectively develop organizations (Westerman et al., 2014).

The digital transformation brought about by the use of technology will have an impact on many aspects of the organization, including 1) outside the organization (Externally) by focusing on creating a digital experience for customers. 2) within the organization (internally) having an impact on business operations, decision-making, and organizational structure; and 3) holistically includes all affected parts and functions. This frequently results in entirely new business models. In recent years, digital transformation has been regarded as one of the most important challenges for everyone in the industry (Schuchmann & Seufert., 2015). Although organizations recognize the importance of digital transformation, they face a number of barriers that prevent such change (Von Leipzig et al., 2017) for example, traditional organizational

culture This will have an impact on the organization's progress. New digital technologies will benefit organizations that succeed in developing appropriate management and technology skills (Fitzgerald, 2013).

Nowadays, more complex technology is used in digital transformation to transform organizations into digital formats. Organizations must recognize the strategic importance of new digital technologies, as well as the ability to develop successful digital innovations. Which is the method by which various organizations integrate new digital technologies with ubiquitous connectivity. The goal is to give organizations more efficient operations as well as a competitive advantage. Various business dimensions, such as business models and customer digital experiences, can be transformed, and operations of the organization, as well as the personnel and network of the company (Yoo, Henfridsson, & Lyytinen, 2010).

Digital Transformation is a shift in thinking and the application of technology in organizations in the digital age. Targeting Operating across segments and delivering value to consumers (Russell Reynolds Associates, 2019) is a new and never-ending phenomenon. The end point is not easily defined. However, it can be more specific. If the organization has strategies and guidelines for moving forward, the executives need to understand this. Therefore, implementing digital technology in organizations speeds up operations, procedures, and capabilities, and a business plan to benefit from advancements in technology to give businesses the chance to become more competitive in a technological environment that is changing quickly (Settapong, 2017).

Digital Transformation Reference Model

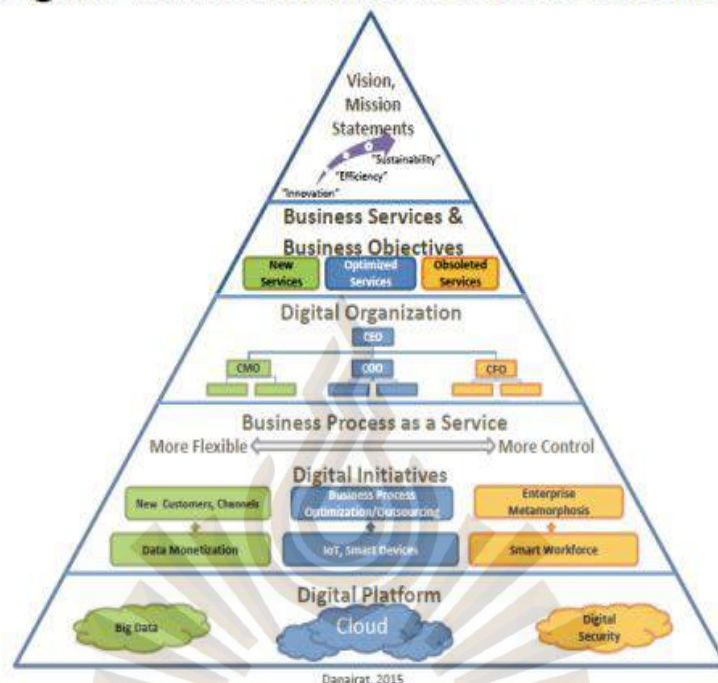


Figure 2.1 Digital Transformation Reference Model

Source: Yaemnam, 2017

Danairat Thanabadithamcharee has studied and considered the theory of digital transformation or business transformation into the digital era. We created a model for such change called the "Digital Transformation Reference Model," which consists of (1) a vision and mission statement, (2) a business service and a business objective, (3) a digital organization, (4) a business process as a service, and (5) a digital platform (Yaoyuenyong, 2017).

According to figure 2.1, it can be shown the details of digital transformation reference model as follows (Yaemnam, 2017).

The vision and mission statement establishes the vision and mission. Strategies for determining what results the transformation objectives necessitate, as well as taking the "size" of the organization into account, as well as the "status" of the

organization, and for smaller organizations that are emerging. Making a difference in order to change the market leader or the big one requires the use of innovation principles. However, if it is a medium-sized organization, it should prioritize efficiency. You may need to go to the main page for large organizations and sustainability. According to Yaoyuenyong (2017), the goal of those activities should be identified through a vision and mission statement. However, vision and mission statements should focus on evaluation, practice time, resources, and psychological organization as important factors to establish as vision and mission statement goals. Furthermore, if the vision and mission statement are written without considering the organization's ability to succeed, the vision and mission statement may become the end point of transformation, preventing it from progressing to the next layer of digital transformation.

Business service and business objective are business policies that include business goals such as new business services, revised and improved business services, and cancelled business services. These businesses must be consistent with the organization's vision and mission statement. It can be internal or external services provided by the organization to support the process of the organization's business services. Furthermore, the importance of this step is to understand how to improve or discontinue running their business services, which should take into account the condition of time, output, and the connection of other layers or steps of doing digital transformation.

The identification of related organizations that are involved in knowledge, experience, skills, attributes, and behavior that belong to different types of businesses for making changes to be digital transformation in the organization has been known as digital organization. Furthermore, it is critical to educate digital people for employees in order to prepare them to deal with organizational digital transformation.

Business process as a service is widely known for improving strategy and working processes in order to be the best way to run a business. For business process

as a service, the Internet of Things (IOT) and other technologies such as smart workforce and enterprise metamorphosis must be used.

Digital platform has been used to run a business service that meets the demand of digital businesses.

Thanyalakphak (2017) defined digital transformation as "new changes capable of influencing business processes and customers in the new generation of entrepreneurial society." The main concept of digital transformation consists of three factors: 1) customer experience will change drastically in digital or online platforms. Customers have had their goods and services delivered to them via online platforms such as a smartphone, computer, or tablet. Other goods and services must be modified to meet the needs of customers. Customers' data should be collected, linked, and analyzed in order to better develop goods and services that can serve customers' experiences. Many goods and services, such as electric appliances, glasses, and automobiles, can connect to the internet, giving rise to the term "Internet of Everything." Access to the internet is advantageous for goods and services; 2) The operational process will involve IT or technology, which will influence the way business administration is done in order to meet customer expectations. Employees and executives can work wherever and whenever they want using an online working system. This working system provides flexibility and a quick response to customer changes. Furthermore, Cloud and big data will assist the organization in precisely collecting data that can be connected and analyzed for improving goods and services that meet customer demand; 3) business models have been influenced by changes in the manufacturing industry, for example, the entertainment industry has shifted its services from CD to online members. Uber, Grab, and Airbnb are online platforms for sharing resources with others, as well as other apps developed to meet specific user demands. As a result, digital transformation will be significant changes for business processes in order to provide a comfortable and efficient way to run a business that can meet the demands of customers.

Accenture (2013) divided digital transformation into 3 main categories as follows:

According to figure 2.2, it can be shown the details of digital transformation model created by Accenture (Yaemnam, 2017).

Digitize marketing is the application of technology to improve customer service. The emphasis in digital marketing is on digital experiences. Developing and expanding new sales channels Product delivery and communication Gathering customer insights to improve service, for example: Making online promotions to entice customers to purchase products online It also helps to reduce the cost of opening new branches, etc.

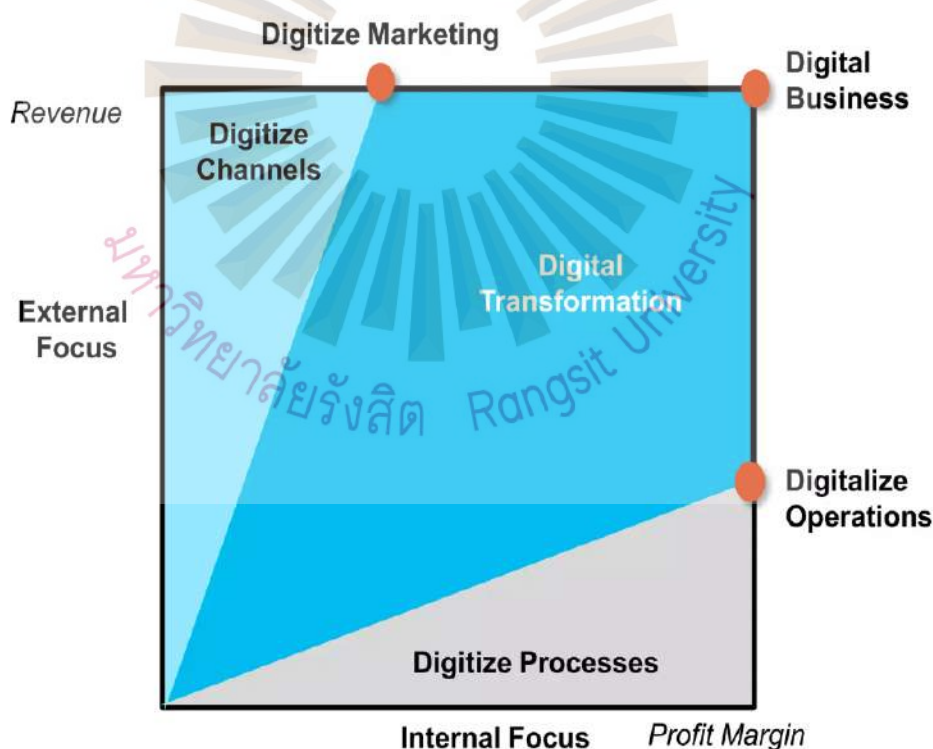


Figure 2.2 The Model of Digital Transformation created by Accenture

Source: Yaemnam, 2017

Digital business is a transformation of the business model. To provide customers with diverse, connected products and services that can be adjusted to meet changing needs. a large number of customers quickly This could result in the development of new products and services, such as the adaptation of Microsoft and Adobe, which were previously sold outright. However, with the advent of Cloud technology, these two companies were able to design products in the form of monthly payments instead. And it's linked to the file sync service and works on all devices.

Digitize operations employs technology to help organizations coordinate more efficiently and quickly, such as using Project Management Software to reduce time waste and inefficiency in emailing back and forth. and aid in the systematic tracking of the project's status. Reduce steps that are not productive. Quickly update information. Can work from anywhere and at any time. Increases the organization's sensitivity to changes in the external world.

Solis (2016), a Prophet analyst, described six stages of an organization's digital status to determine which stage the organization is in. As illustrated in the diagram below.

According to figure 2.3, it can be shown the details of the six stages of digital transformation created by Solis (Yaemnam, 2017).

Stage 1 - Business as usual is a state in which the business continues to operate as usual, with little investment in technology and digital. So that the current work process runs smoothly. However, no significant organizational change has occurred. Furthermore, there is still a disconnect between technology and overall business.

THE SIX STAGES OF DIGITAL TRANSFORMATION



Figure 2.3 The Six Stages of Digital Transformation created by Solis

Source: Yaemnam, 2017

Stage 2 - Becoming aware and taking action organizations are recognizing the significance of transforming into a more digital enterprise. Because of the current business disruption during this time, the organization will begin to experiment and learn more about its application. During this time, however, the organization continues to operate in silos, with work divided into sections.

Stage 3 - System start-up the organization began to undergo systematic change. Having a more concrete strategy is one of them. Leaders and executives are

taking a more supportive stance and pushing for change. This has an impact on preparing the organizational structure to accommodate the upcoming changes.

Stage 4 - Prepared to change the organization has agreed to the change. The resources are meticulously planned. It can be seen both short-term and long-term goals in the organization's use of digital technology.

Stage 5 - Organizational change is stage 5. Everyone in the company has digital skills and new ideas that are being developed including investing continuously in digital and changing business models.

Stage 6 - Innovative organization of the organization has been adopted an innovative culture. It's ready to speed up the development of work processes and investments in order to enter new markets and compete. This fully causes of organizational development sustainability.

Thien-ngen (2016), Managing Director of Microsoft (Thailand) Company Limited, delivered an opening speech on the issue of digital transformation in Thailand. It has been highlighting how people are increasingly reliant on technology. There are two formats: People begin to rely more on mobile phones, smartphones, and tablets as they become more mobile-first. Cloud-first, as mobility devices become more widely available, and people begin to use them in their daily lives. The introduction of cloud technology has simplified matters. It is more convenient and faster, the service model and business model have changed. This requires current businesses to change their organizations in order to compete in the market. According to Microsoft, digital transformation is divided into four sections, as follows.



Figure 2.4 Digital Transformation Model created by Microsoft

Source: Yaemnam, 2017

According to the figure 2.4, it can be shown the details of digital transformation model created by Microsoft (Yaemnam, 2017).

Engage Your Customers - Businesses must reach out to customers via new channels and modes of communication. that is even more distinctive McDonald's in the Netherlands is an example. We use this point of communication to create a mobile application that allows customers to search for McDonald's nearby and be always aware of promotions, knowing that every customer has a mobile device. This includes keeping track of product orders and calculating nutritional values, because of various advertisements. It is tailored to each customer's background and interests. McDonald's sales increased by 47% as a result of all of this.

Empower Your Employees - Employees' jobs must evolve. It also encourages employees to learn how can they communicate with each customer that must be also changed.

Optimize Your Business - Data must drive business improvement. Whether it's a business decision or not Enhancements to the production line Improving work processes, etc.

Transform Your Products/Business - Products and services provided by that company How will it be altered? For example, an elevator service company might use the Internet of Things (IoT) to record each elevator's behavior and data. To be able to dispatch employees more precisely for maintenance. and expand on it to provide a higher level of service than before As a result, elevator maintenance differs at different levels in each business. and shifting elevator sales from outright sales to Elevator as a Service, as well as a Microsoft PowerBI Dashboard to easily track and analyze various data It also has Predictive Analytics and Machine Learning capabilities.

Michael from IMD Business School studied and developed a conceptual framework for Digital Business Transformation (Wade, 2015).

According to the figure 2.5, it can be shown the details of a conceptual framework for digital business transformation created by IMD Business School (Yaemnam, 2017).



Figure 2.5 A Conceptual Framework for Digital Business Transformation created by
IMD Business School

Source: Yaemnam, 2017

Why Transform - Executives must first understand why we are changing the organization. What challenges and problems will the business face if we do not change? This section will concentrate on raising awareness among organizations and executives about the importance of change. As a result, executives must respond to the

question, "Why did they change?" In order to establish guidelines and policies for future organizational changes.

What to Transform - After determining what needs to be altered, The next step is to determine what needs to be digitized. Such changes can take many different forms. First and foremost, it necessitates a structured change process and change sequencing. To assist in determining what changes the organization wishes to make And the tool that will aid in this process is "The digitization piano," which will consist of seven elements that can be converted into digital to generate income and business competition for the organization, including business models (methods by which the company generates revenue), structure (how the company organizes its business structure), people (who will work for the organization), processes (what the organization must do), IT capabilities (data management), offerings (what products and services the organization offers to its customers), and finally the engagement model. (How does the organization conduct business and have relationships with customers and other stakeholders?)

How to Transform - Because each business and industry is unique, it is difficult to pinpoint the characteristics or characteristics of change. IMD, on the other hand, has prepared a digital roadmap to establish guidelines for preliminary development. This ability is known as "digital business agility," and it refers to the ability to change business operations in the digital era in a flexible and timely manner. To be able to do so, an organization must have three key components, which are as follows (Yaemnam, 2017).

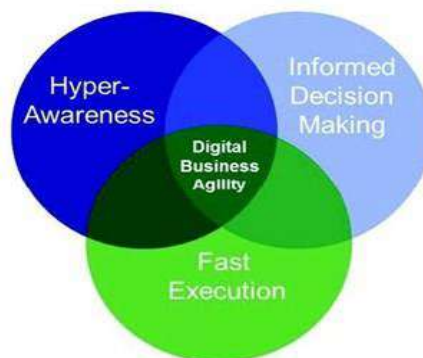


Figure 2.6 The Digital Transformation created by IMD Business School

Source: Yaemnam, 2017

Hyper-awareness is about an organization's awareness and ability to recognize future business trends that will affect the organization. Which can be broken down into three sub-functions: 1) new technology awareness and trends 2) awareness of changes and competition, both within and outside the industry 3) Employee-initiated new creative initiatives Customers and service providers or products.

Informed decision making is used when making business decisions, make informed decisions. The data that emerges from the collection and analysis process must be accurate. To assist in making quick decisions.

Fast execution means acting as quickly as possible to effect change. Such changes, however, do not have to be implemented all at once. Organizations may choose to focus on one thing at a time in order to compete in business operations. To support both old and new ways of working smoothly and efficiently, including creating organizational change sustainability.

2.3.4 Digital transformation's steps and components

According to Thanyarattakul (2018) , there are six steps to digital transformation or changing the organization's methods to be consistent with business goals:

1) Business as Usual: The stage in which the company operates in its original form. Businesses and organizations may become interested in digital. However, it is also viewed as a different path for a company or organization. Lack of connection to the organization's overall picture Because it is predicted that digital change will occur It's not an emergency.

2) Present and Active: Organizational leaders are becoming aware of digital disruption, beginning to step outside of their comfort zones, learning, and exploring options for digital transformation. However, organizations continue to operate in silos. Digital transformation is still in its early stages.

3) Formalized: Begin to make gradual changes. Organizational leaders can also encourage human resource investment through more targeted strategies. Technology and procedure This has influenced the executives of the organization to become more involved. This leads to the systematic and visionary establishment of an organizational structure aligned with digital.

4) Strategic: The company has committed to digital transformation. There are plans to use resources with more specific goals. Visualize where the organization will use digital in the short and long term, and receive full support for infrastructure investment.

5) Converged: Digital transformation has become ingrained in the DNA or identity of an organization. And the organization is always coming up with new ideas. Investing in value-creating digital initiatives Organizational leaders have begun to inhale and exhale change. This includes constantly developing new ways of working to keep up with market demands.

6) Innovative and Adaptive: The organization has adopted an innovative culture, and the company was completely transformed. Ready to accelerate the pace of investment processes in order to fully capitalize on new growth and competition. This ensures the organization's long-term viability.

Microsoft (Thailand) Company Limited has provided the following principles and steps for digital transformation (Khiaosaard, 2019).

1) The groundwork for a digital culture is created to be an organizational culture that prioritizes close collaboration among internal departments. Along with maintaining positive relationships with a variety of customers and business partners. Data can be analyzed and applied by organizations to make decisions in a variety of areas. Until we can better meet the needs of both our customers and our partners.

2) An information ecosystem should be developed. There is a massive flow of information from both inside and outside the organization in the digital age. The key to an organization's successful digital transformation is converting this data into valuable assets, and openly and securely share and exchange data both within and outside the organization. Furthermore, aligning data strategies with operational guidelines will assist organizations in developing their own AI systems to improve data analysis potential. Discover new approaches and perspectives on organizational development.

3) Change started with small things that grew into a big problem. Typically, digital transformation does not begin with enterprise-wide change. It is created by making numerous small changes over the course of several short projects. Benefit the organization effectively and can be extended or expanded to carry out digital policies in a more expansive and innovative format.

4) Developing the skills of the future today's organizations must be considered as the approaches to personnel development and basic skill adjustment of employees at both the personnel and organizational levels. To equip personnel with the skills needed to face future challenges, such as solving complex problems. In the digital economy, analytical thinking or creativity is required. Simultaneously, in order to attract and retain digitally skilled employees, the personnel balance must be adjusted. This includes using the freelance workforce's flexibility for specific needs on occasion.

According to Vercesi (2019), each organization's digital transformation is unique. However, there are eight critical steps to change, which are as follows:

1) The organization must choose digital transformation that benefits the organization. This is a critical step because it affects everyone in the organization, from executives to operators. If we take a different approach to digital transformation or go in different directions, they will be unable to understand and drive the organization toward digital transformation because they do not understand the overall picture of the organization. Together with each organization's context and environment, which differ in terms of status, industry, competition, and customers, all of which have an impact on the organization. These data will define what digital transformation means for a company.

2) The organization can evaluate current organizational potential what will an organization strive to be when it knows how it wants to transform digitally? We need to go back and look at the organization's digital capabilities and potential. By assessing the organization's materials, equipment, technological tools, knowledge, and digital abilities. to various items used in the organization's operations.

3) The organization can determine their organization's digital transformation strategy. Organizations will be able to determine their digital transformation options after setting goals and evaluating potential. By developing

change strategies that incorporate both internal and external changes or it will be a minor change, but the value of products and services must be considered in the change process as well.

4) The organization purchases appropriately when a digital strategy and solution have been established, the organization must purchase equipment. or spend money on technological infrastructure It not only states that the organization wishes to change, but it also informs personnel within the organization that the organization has planned well.

5) A digital transformation roadmap must be created. However, an organization cannot change everything at once. However, there must be a comprehensive plan in place to account for the various changes that will occur.

6) The organization should manage talented employees in the appropriate location. Lack of digital skills is the main reason why digital transformation initiatives fail. Employing and managing individuals with digital talent and skills must therefore be a top priority for organizations. being able to advance this change.

7) The organizations should prepare themselves. Along with carrying out the plan, it's crucial to communicate the change strategy and organizational vision. A shift in organizational culture is frequently required for successful digital transformation. An organization's communication and interpersonal interactions help it get ready for the digital transformation.

8) Taking the First Step Towards Digital Transformation This is the stage at which you must begin assessing the success or failure of the change. They must still ensure that the changes continue to be in line with the organization's vision, goals, strategies, plans, and images.

Furthermore, Khiaosaard (2019) concluded that the following steps and elements will be included in an organization's digital transformation: The awareness of organizational leaders of sudden digital transformation (Digital Disruption) creates a need for change within organizations that use information technology. by way of goal setting Create a digital culture for employees by establishing a vision and adjusting work processes in accordance with the strategies that have been laid out. For long-term success, creating the right environment for digital initiatives is an ongoing process.

Matt, Hess, & Benlian (2015) proposed a digital transformation strategy for industries and businesses that included the four essential elements listed below:

1) The use of technologies reflects an organization's attitude toward new technologies and its ability to capitalize on those technologies. This has implications for the organization's information technology strategy. and establishing technology standards in the context of business tools. To be a technology market leader capable of creating a competitive advantage.

2) Changes in value creation are the effects of digital transformation strategies on an organization's value chains, as a result of the use of various technologies and methods of value creation. different in converting products or services to digital formats, or in adjusting the organization's business scope if new markets or customer groups emerge.

3) Changes in organizational management are referred to as structural changes. This is especially important when it comes to digital activities within organizational structures. This is the point at which the change has the most impact on products, processes, or skills. If the scope of the change is relatively small, integrating the new operation into the existing organizational structure may be preferable. Alternatively, it may be preferable to establish a separate division within the organization.

4) Financial considerations include the use of funds for digital transformation. Finance is regarded as a change agent and driver. However, it may contribute to a reduction in urgency for organizations under financial stress. There may be a lack of external financial resources to facilitate the transition.

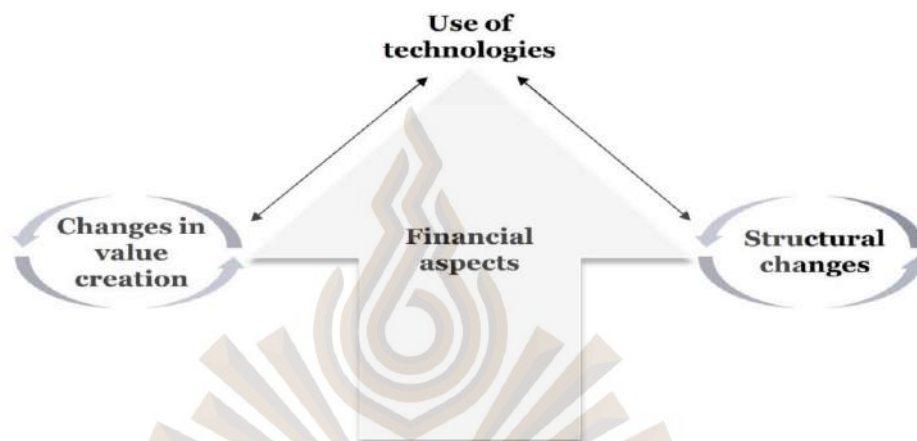


Figure 2.7 A Digital Transformation Strategy for Industries and Businesses

Source: Matt et al., 2015

2.3.5 Factors regarding Digital Transformation

A systematic review discovered Between 1 January 2010 and 6 December 2017, 21 journals and 4 international conferences (Morakanyane, Grace, & O'Reilly, 2017) were seeking the quest on the basis of digitization publications and associated concepts. Only original English-language papers were accepted. While abstracts were obtained from the four submitted papers, only conference papers (not conference series) were included. The compound search strings were compiled from 54 journal articles and 128 conference papers. The emphasis was on empirical contributions, with theoretical and philosophical contributions being excluded. They assessed the 21 research-related contributions and classified them into three groups based on the type of valuable insights that the research could provide: drivers and goals, success factors, and implications (Osmundsen, Iden, & Bygstad, 2018). In the literature review, as outlined in the experiential indication of variables, drivers and goals are responsible

for the initiation and effect of digital transformation (Morakanyane et al., 2017). Success factors are linked to essential organizational elements for digital transformation. Implications are related to the effects of digital change on a business (Morakanyane et al., 2017).

According to Morakanyane et al. (2017) and Osmundsen et al. (2018), there are four dimensions and twenty-one factors to Digital Transformation. Table 2.1 depicts these dimensions and factors related to digital transformation.

Table 2.1 The Dimensions and Factors Regarding Digital Transformation

Dimension	Factor	Explanation	Studies
Drivers	Customer behaviors and expectations	Comportments or actions that people predict. When they interact with a business, customers have basic historical requirements, such as consistent service and equal pricing.	Schmidt et al. (2017); Haffke et al. (2017); Berghaus and Back (2017)
Drivers	Digital shifts in the industry	Transition in how customers work and deliver value. It is also a cultural transformation that enables organizations to continually challenge the status quo, experiment, and confront failure confidently.	Berghaus and Back (2017)
	Changing competitive landscape	mission, niche market, vision, strengths, and weaknesses.	Back (2017)

Table 2.1 The Dimensions and Factors Regarding Digital Transformation (Cont.)

Dimension	Factor	Explanation	Studies
	Regulative changes	Any alteration of any existing statute, treaty, rule, policy or guideline or any governmental authority's interpretation or administration.	Berghaus and Back (2017)
Objectives	Ensure digital readiness	The possibility of people using information technology and digital literacy tools to help them evaluate online information.	Berghaus and Back (2017)
	Digitally enhance products and services	The next step is digital services based on data built on the physical product and service's strength.	Mocker and Fonstad (2017)
Objectives	Embrace product innovation	Accept new product creation, improvements in the design of conventional goods, or new materials or machineries to produce selected products.	Berghaus and Back (2017)
	Develop new business models	Identifies the company's services, places and anticipates the target market if only to attract investment, attract talent, and inspire management and staff.	Berghaus and Back (2017); Mocker and Fonstad (2017)
	Improve digital channels	signals must be transmitted utilizing a digital channel from analog to digital.	Berghaus and Back (2017); Bilgeri et al.

Table 2.1 The Dimensions and Factors Regarding Digital Transformation (Cont.)

Dimension	Factor	Explanation	Studies
			(2017); Mocker and Fonstad, (2017)
	Increase customer satisfaction	Expand the measurement of how satisfied customers are with a company's products, services, and capabilities.	Isaksson and Hylving (2017); Berghaus and Back (2017); Bilgeri et al. (2017); Mocker and Fonstad, (2017)
Success factors	A supportive organizational culture	Supplied workers with psychological and social environments to promote health, security, and well-being. It also encourages employee development and success and deliberately fosters positive relations between workers, their tasks, and their organization.	Hartl and Hess (2017); Haffke et al. (2017)
	Well-managed transformation activities	Transformation tasks that the company typically participate in before, or during, digital transformation. Enhancing the digital channels of the company, that is, initiating, operating, and improving such	Berghaus and Back (2017)

Table 2.1 The Dimensions and Factors Regarding Digital Transformation (Cont.)

Dimension	Factor	Explanation	Studies
		channels, was one activity that was apparently significant in numerous case studies.	
	Leverage external and internal knowledge	Studying companies that were involved in the acquisitions and mergers achievements of digital technology-associated firms.	Piccinini et al. (2015); Hildebrandt et al. (2015); Mueller and Renken (2017); Bilgeri et al. (2017)
Success factors	Engage managers and employees	Employees working on digital transformation procedures should take part in these changes so that the transformation can attain its maximum capacity.	Horlacher et al. (2016); Piccinini et al. (2015); Mihailescu et al. (2015); Petrikina et al. (2017); Mihailescu et al. (2017).
	Grow information system capabilities	A company's capability of coordinating and distributing resources together with other assets based on information systems.	Nwankpa and Roumani (2016)
	Develop dynamic ca	Classifying and responding to opportunities by transforming	Karimi and Walter (2015);

Table 2.1 The Dimensions and Factors Regarding Digital Transformation (Cont.)

Dimension	Factor	Explanation	Studies
	capabilities	the business, reconfiguring assets, and developing digital platform Facilities.	Leischnig et al. (2017); Berghaus and Back (2017)
	Develop a digital business strategy	Transforming and accomplishing the anticipated goals of digital transformation by stressing digital leadership skills, scalable and agile digital operations, digitally enabled emerging digital technologies, and consumers' digital experiences.	Yeow et al. (2018); Nwankpa and Roumani (2016); Schmidt et al. (2017); Leischnig et al. (2017)
Success factors	Align business and information systems	Reduce gaps in alignment and respond to conflicts and modifications in environmental, organizational and information systems.	Yeow et al. (2018); Nwankpa and Roumani (2016); Schmidt et al. (2017); Leischnig et al. (2017)
Implications	Reforming an organization's information system	Discovering how physical and digital convergence and digital transformation influence major manufacturing firms; organizational frameworks.	Haffke et al. (2017); Piccinini et al. (2015); Hylving and

Table 2.1 The Dimensions and Factors Regarding Digital Transformation (Cont.)

Dimension	Factor	Explanation	Studies
			Schultze
			(2013); Haffke et al. (2017); Isaksson and Hylving (2017); Mihailescu et al. (2017)
	New business models	Changes in the business model are popular as a response to digital transformation in companies operating in an industry influenced in the new era by evolving digital technologies.	Hildebrandt et al. (2015); Remane et al. (2016); Mocker and Fonstad (2017)
Implications	Affecting outcomes and performance	Company performance (assessed by profitability, client satisfaction, return on investment (R.O.I.) and sales growth in comparison with direct competitors) is influenced by the degree of creativity of businesses and organizations.	Nwankpa and Roumani (2016)

Source: Osmundsen et al., 2018

2.3.6 Causes of failure in digital transformation

Arayakarnkul (2019) identified the following ten causes of digital transformation failure.

1) Adopting technology without first considering organizational strategy. When technology is used, it does not increase the potential of the organization, and is unable to create a new procedure Using budget funds to purchase equipment and technological infrastructure However, it cannot make a difference when providing services or manufacturing products, such as creating redundant procedures for operating steps. Lack of direction in using technology to grow the organization, etc.

2) Consider digital transformation projects to be an expense rather than an investment in your organization. Sets a strict budget for preparation. This could jeopardize the project's viability. This can cause the project to become disjointed and stall before it can produce good results. Furthermore, viewing digital transformation solely as an expense results in no accurate financial indicators to determine the investment's success.

3) People in the organization's misunderstanding of the meaning and scope of digital transformation, such as believing it is only digital marketing or a process replaced with automation (Process Automation), etc., makes it impossible to achieve full cooperation from all parties to the point of being unable to drive the organization in the same direction.

4) Working on a computer conflict with the original production or service guidelines of the organization, such as the original service format not being compatible with digital services. causing confusion for service recipients and service providers, preventing them from working to their full potential, and so on.

5) In the digital world, you don't understand competitive games. This operates differently than the old world; for example, consumer access to products and services has changed as a result of changing technology. Consumption patterns shift in response to social trends. The flow of money via technology, and so on.

6) A lack of specific personnel assigned to specific digital transformation projects. However, bring in personnel with previous project responsibilities to assume responsibility for the project. It is about viewing digital transformation as an afterthought. In reality, digital transformation is a highly complex core task. When personnel are unable to fully perform their assigned tasks, they must leave their comfort zone. It may lead to the failure of the organization's digital transformation.

7) Groups of employees within the organization may lack specialized resources (Specialized resources), such as system developers (Developer), system designers (UI/UX Designer), system testers (Software Testers), and other new skill sets that are required, such as agile management (Agile), knowledge of digital marketing technology (Digital Marketing), etc.

8) Employees are concerned that being productive will jeopardize their job security. Because technology improves work efficiency and necessitates fewer people. Organizational personnel are therefore concerned that technology will replace their jobs, causing them to be resistant to the use of technology. However, failure to adapt or change will result in the organization's demise. As a result, personnel must adapt and expand their skills, knowledge, and abilities. To be able to do work that adds more value to the organization (Add Value).

9) The organizations create systems and processes in accordance with the old paradigm. Investing in technology systems to improve existing processes as a result, you get the same results. There have been no new processes developed to

align with digital working. As a result, digital investments fail to produce positive results.

10) There is no digital transformation strategy or process in place. And effective change management generates internal resistance. The procedure has been changed until it becomes widespread resistance to change.

2.3.7 Performance Evaluation of Digital Technology in Manufacturing Industry

1) The definition of digital skills

Chinien and Boutin (2019) defined digital skills as the ability to comprehend and apply various types of information obtained from various sources via computers. Digital skills also include the knowledge and ability to make informed decisions about information needs from various information technology sources, as well as the ability to enter, access, manage, integrate, and evaluate sources using digital tools and facilities. data in digital form This includes learning new things. Make media expressions and interact with others. Technical skills in the use of digital systems, tools, and applications are included in digital skills. as well as data processing abilities, etc.

The ability to gather, manage, comprehend, assess, create, and share information is referred to as having digital skills. digital technology usage It also entails being aware of current information technology trends and knowing how to capitalize on them (Khiaosaard, 2019).

According to UNESCO, digital skills are the ability to access and manage data using digital devices (Digital Device), communication programs (Communication Applications), and networks (Network). It also enables those with such abilities to create and distribute digital content for communication and

collaboration. to effectively solve problems by learning, working, and participating in social activities (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2019).

2) The important digital skills for digital transformation

According to Numnon (2019), the following six digital skills are essential in the age of digital transformation.

2.1) Improving abilities in "Using existing tools and technologies" (Tools & Technologies) can make keeping up with all the technology difficult. Because technology is rapidly changing. But something must be done to generate learning for oneself. To understand how the process works, you must have a basic understanding of the operation of various tools, both hardware (Hardware) and software (Software). Technical capabilities and what are the constraints? and be able to collaborate with other technological tools (Collaboration Tools). This has already occurred in the modern era with technology known as the "Internet of Things" or IoT.

2.2) "Find & Use" skills of searching and applying this work It is not simply a matter of searching for information on "Google" (Google) or various "Search Engines" (Search Engine). However, it also includes the skills and ability to analyze and make decisions based on a large amount of information. It has a useful application in the world of the internet. and efficient Understanding the copyright and use of information.

2.3) This area requires "Teach & Learn" abilities. It is a skill that requires teamwork. Because no one can be an expert in all technologies. As a result, there must be a requirement for knowledge sharing. Expertise That is, both students and teachers must be proficient in the use of digital technology. This includes the use of presentation software. (Presentation Tools) excellent Because a lack of good understanding may result in incorrect learning, in addition to not being beneficial.

However, it can also be used as a foundation for comparison and evaluation, as well as trial and error until correct understanding is achieved. This is regarded as a skill that must be continually improved.

2.4) "Communication and Collaboration" (Partnership and communication) are difficult to deny that we live in a digital world. Technology has become a part of life, resulting in new societies that are increasingly divided into smaller groups, and the more technology connects everyone. The easier it is for people to communicate with one another, the more likely the working style will change and break down. In a group with needs, attitudes differ greatly. As a result, people must learn more about new job skills. By utilizing various tools such as E-mail, video conference, Wiki, messaging, and technological tools. (Collaboration Tools) for information sharing to work together conveniently in different locations.

2.5) Because of the rapid advancement of digital technology, we must "Create and Innovate" today. As a result, it is simple to develop new innovations in various formats that can better respond to work in the form of text, images, software, or various services. However, before we can create new innovations, we must first be able to create digital content in various formats such as "Digital Images" and "Graphics Design," which may also refer to programming. (Programming) or coding (Coding) as well because it is a skill that can take things from both within and outside the organization to create new innovations, which is a clear example. What is well-known is the room-sharing service Airbnb (Airbnb) and car-sharing services for example Uber have not invested but you can use what you already have to create a business that is widely used by people all over the world, etc.

2.6) Identity and wellbeing translated directly. This skill could be interpreted as expressing oneself. and the issue of good mental health, however, it entails entering the digital world. More safely because, as technology advances, we will encounter risks when using it, which are increasing due to various threats in the digital field, so it can be said that we need to upskill. as well as timely awareness in

terms of protecting your own and organizational information, this includes being careful when collecting or setting codes that show one's identity through various technological tools, as well as being responsible for taking care of and protecting the information of others related to us or the company as well, because if you do not have skills in this area The results of the damage will be very severe. To the point where I can't take responsibility at all.

The Digital Government Development Agency (Public Organization) (2017) has published eight digital skills (Digital skills set) that are critical to Thailand's digital transformation. By improving the quality of government personnel in terms of digital expertise in the use of digital technology (Digital Platform) at international standards. To be a significant force in driving innovation and developing the economy creatively, the following skills are required.

- (1) Digital skill Leadership
- (2) Digital skill Transformation
- (3) Digital skill Governance
- (4) Digital skill Project Management
- (5) Digital skill Technology
- (6) Digital Services Design & Assurance
- (7) Digital skill Compliance
- (8) Digital skill Literacy

The Office of the Civil Service Commission (2019) assessed civil servants' and government employees' digital skills. in the guidelines for developing digital skills among civil servants and government personnel in order to transition to a digital government. Skills should be promoted and developed in the following 5 learning dimensions and 7 skill groups:

Dimension 1 : knowing how to use and apply technology, which consists of one skill group: understanding and applying digital technology (Digital Literacy Skill Set).

Dimension 2 : Understanding policies, laws, and standards, which consists of one skill group, control, and supervision. as well as adherence to laws, policies, and digital management standards (Digital Governance, Standardization, and Compliance Skill Set).

Dimension 3 : Use digital for application and development, with two skill groups: digital technology skills to improve organizational potential (Digital Technology Skill Set) and process design and digital service skills to improve work quality. Government (Skill Set in Digital Process and Service Design).

Dimension 4: Use digital for organizational planning, management, and leadership, with two skill sets: Project and Strategic Management Skill Set and Digital Leadership Skill Set.

Dimension 5: Use digital to drive change and creativity, which includes 1 skill set: Digital Transformation Skill Set (Digital Transformation Skill Set).

Khiaosaard (2019) concluded that digital skills (Digital Skills) will include a variety of digital technology-related skills. because of recognition Recognize what is happening with technological change. How to navigate, search, and filter the vast amount of information made available by information technology. to put that knowledge to use in order to learn and communicate with others Individuals' digital potential (Digital Capability) increases when they are able to create or create innovations using digital devices. Affects the organization's overall potential as well as its success in digital transformation.

3) The guidelines for performance evaluation of digital technology in manufacturing industry

3.1) Digital Maturity Model (DMM) As well as Mongkol Fuengfuengtrakul, Napawan Meesri Digital Readiness Indices have been used to

measure the degree of digital readiness. The World Economic Forum has developed the DMM tool (Digital Maturity Model), which will be measured in 7 factors, and a ranking of technology and communications readiness (Needed Readiness Index). 1) Factors of Strategy and Leadership (STR) 2) OPE (Operational Process Elements) 3) Business Model Elements (BUS) 4) Capability Factors for Digital (CAP) 5) Government Sector (GOV) Promotion Factors 6) Information security (SEC) factors 7) Customer experience management (CEM) factors. Then, for each question, a score of 0 to 3 will be assigned, with 1 being strongly disagree, 2 not agreeing, somewhat agreeing, and 3 strongly agreeing. The sum of the scores will then be measured at the Maturity level, which is divided into score levels: 0 - 33 are Skeptics, 34 - 53 are Adopters, 53 - 71 are Collaborators, and 72 - 84 are Differentiators. DMM (Digital Maturity Model) should be developed so that it can be used by a variety of organizations. Whether it is a large organization or a small one, go small so that corporate executives can use this DMM tool to measure their own organization's readiness. and help to improve their organizations. In addition, DMM tools lack the study of customer understanding factors. As a result, this tool still does not know how to contact customers using digital technology. In order to know the real factors in responding to customers. and the population used in the study. It is a population group that resides in Bangkok and surrounding areas only (Mindernruea, 2018)

3.2) Deloitte's Hub Digital Leadership Interactive (Deloitte Digital, 2015) has developed a set of tools to assist organizations in assessing their employees' digital maturity. and effectively convert employees' abilities into digital Building Your Digital DNA is the name of the tool. The digital transformation is underway. The tool investigates culture, organization, leadership, and competence. in digital businesses to lay the groundwork for a successful digital organization The level of readiness is measured in five dimensions:

3.2.1) Strategy and leadership are used to evaluate digital vision and strategy for organizational leaders.

3.2.2) Customer engagement is used to evaluate the ability of implementing digital tools for communication with customers.

3.2.3) Products and services are used to evaluate the ability of providing products and services effectively.

3.2.4) Organization and talent are used to evaluate personnels organization of knowledge, skills, and digital services.

3.2.5) Digital operations are used to evaluate operational processes of the organization. This dimension aims to evaluate precision and technological support for operational processes.

However, there are some limitations to Deloitte Digital's DNA. Only a few factors are being studied as part of the ongoing digital transformation. Factors and other critical variables must be locked in this is because there are related to readiness, transition, and digital age.

3.3) Market needs are described as opportunities for new business owners in the TM Forum Best Practice Digital Maturity Model (TM Forum, 2017). Because market demands change all the time. It is even more important to survive in the digital world from the perspective of customers. TM Forum has developed a model for measuring digital results because customers expect to be more involved in the design of today's products or services. In the following five dimensions:

3.3.1) Customer is measured from the customer's point of view. How easy is it for customers to get their hands on the brand or product? Whether it's an online or offline channel that the company creates and designs, or even keeping customer secrets and other facilities.

3.3.2) The measurement of strategy in the use of digital to help promote and support business operations is known as strategy. They may use digital to assist in the design of products, marketing, or the protection of customer data.

3.3.3) The measurement of technology enables digital strategies to create, process, preserve, secure, and exchange data in order to meet the needs of

customers at a low cost. There are standards in place to ensure that architecture can communicate and connect, and collaborate to accelerate market entry in order to support business growth.

3.3.4) The operational process is the in-depth analysis of digital performance. There are automated work processes, agile change management, standards-based security, and good governance systems in place.

3.3.5) In terms of governance, organizational development measures culture, people, and organization. Having labour policies that support the collaborative process of competence development and recruitment keeping motivated employees.

There will be 175 questions across all 5 dimensions. A scale of 1 to 5 will be used. If respondents believe any questions in the questionnaire are missing, they can enter the value 0 because they will not affect the organization's evaluation. Then, using a simple average score, determine the maturity relationship, which has five levels as follows: Maturity level 1 is just getting started, while Maturity level 2 is just getting started. Level 3 Maturity is Performing Maturity level 4 is Moving Forward. Leading is the fifth level of maturity.

However, the limitation of the TM Forum Model is that it gives only the importance to new businesses and customer variables as an important part in measuring the readiness level of an organization. It is necessary to pay attention to other opposing variables.

3.4) Benchmarks for the Digital Maturity Model 4.0: Transformation of the Digital Business Playbook (Forrester, 2016) assesses the entire organization's digital transformation across multiple organizational areas. Whether it's executive support for digital strategy or not. Employees with digital skills and an effective relationship between IT and business. Concentrate on business and digital marketing. The outcomes will be measured in four dimensions:

3.4.1) Culture is a measure of how an organization uses digital innovation as a driver, including the use of digital technology by its employees.

3.4.2) Technology is a measure of a company's use of technology. New technology is introduced to the organization.

3.4.3) Strategic planning, governance, and digital operations are used to gauge how well an organization operates.

3.4.4) Insights are a measure of how well an organization uses customer and business data to measure success.

Then, for each question, a score of 0 to 3 will be assigned: 0 for strongly disagree, 1 for somewhat disagree, 2 for somewhat agree, and 3 for strongly agree. The sum of the scores will then be used to determine the level of maturity: scores 0 - 33 are Skeptics, scores 34 - 53 are Adopters, scores 53 - 71 are Collaborators, and scores 72 - 84 are Differentiators.

3.5) NRI (Network Readiness Index, 2016) The Network Readiness Index is an index that measures the level of readiness for technological development in technology and communication, as well as the opportunities to capitalize on technology. The World Economic Forum (WEF) prepares information and communication technology for national development in the public, business, and government sectors. The measurement will be based on four major components:

3.5.1) Environment Subindex is a tool for assessing that country's environmental performance. that there is ICT development, innovation, and regulations for entrepreneurs, as well as that country's market conditions. These criteria will be present. The Political and Regulatory Setting Pillar is a measure of a country's political and regulatory environment. To what extent has that country that wants to measure used ICT to care for the country? What applications can ICT be used for? in order for the country to advance in the political and regulatory arenas. Entrepreneurship and Innovation Environment is a business environment metric that supports entrepreneurs by integrating ICT for maximum benefit, such as ease of

starting a business accounting principle. The rise of innovation and capital groups that promote it.

3.5.2) Readiness Subindex is an index that measures the readiness of infrastructure and other factors related to ICT use in that country. The following criteria will be used. The Infrastructure Pillar assesses a country's information and communication technology infrastructure, such as network coverage, bandwidth on the international internet, server security, electricity generation, and mobile phone and broadband internet costs. This includes liberalization of ICT services. Skills Pillar is a measure of the population's skill and efficiency in using ICT. At what level is it employed? by the criteria for the country's population's skills. This can be determined by enrolling in secondary school. Overall education quality, as well as education in mathematics and science, that country's adult literacy rate.

3.5.3) The Usage Subindex measures the level of ICT use in the government, business, and general public sectors. The following will be the criteria. Individual Usage is a measure of the breadth of ICT selection. The ratio of mobile phone usage can be used to measure it. Use of the internet. Ownership of a personal computer. The country's population's use of online social networks. Business Usage is a measure of how much business in that country has used ICT to communicate between businesses? Is there any digital communication between businesses and consumers? This can be measured by the number of patent applications filed by entrepreneurs who develop new technology. Government Usage is a measure of the government sector's leadership in bringing ICT to be used and integrated in various agencies. To set a good example of how to use ICT for good. The quality of the government's online withdrawal service can be used to gauge this.

3.5.4) The Impact Subindex is a measure of the economic and social impacts of ICT based on the following criteria: The economic impact of using ICT in organizations or agencies in the country is measured. The number of patent applications filed against ICT in the development of products, processes, and organizational models can be used to measure it. Social Impact is a metric that measures social progress made possible by the use of ICT in education, public health, financial services, public sector efficiency, and public participation in e-government.

3.6) The TDWI Analytics Maturity Model Guide (The Data Warehousing Institute [TDWI], 2015) is a model that assists in determining the level of data analysis readiness. It aids in comprehending the beginning, progress, and level of readiness of the data analytics system within the organization, which is measured across five dimensions.

3.6.1) Organization is a measurement of a company's strategy, culture, leadership, skills, and funding. This includes using data analysis in decision making.

3.6.2) Infrastructure assesses the infrastructure in place to support the use of data analytics throughout the organization. In today's legacy environments, technology is used to support data analysis and integration.

3.6.3) Data management measures the degree of diversity, data volume, data management speed processing, and data quality.

3.6.4) Analytics assesses the extent to which advanced analytics are used. Using analytics can help decision making throughout the organization.

3.6.5) Governance is the measurement of governance policies to aid in analysis. The discovery and analysis of data are managed. Without imposing too many constraints, the data collection will consist of a 35-question assessment with a 20-point score for each dimension. The outcomes will be divided into the Nascent phase, with a score ranging from 4 to 7. The Pre-Adoption phase will have a score ranging from 7.2 to 10. The Early Adoption stage will have a score between 10.2 and 13.3, the Corporate Adoption stage will have a score between 13.4 and 16.6, and the Mature/Visionary stage will have a score between 7.2 and 10.

3.7) Digital Transformation: A Roadmap for Billion-dollar (Capgemini & MITSloan, 2011). It is a digital transformation analysis. It was discovered that three major factors are important for entrepreneurs: operational processes and business models; customer experience. The specifics are as follows:

3.7.1) Customer Experience: Changing the customer experience by wishing for customers to experience services in new ways on the part of the company or organization that wishes to provide services by making digital capabilities more widely available.

3.7.2) Operation Process: Modifying personnel's work processes or operating procedures in order to use new technology. to improve work efficiency, begin with tasks that contain redundant work. Executives are permitted to use transactional systems to aid in decision making. It is a system that provides product and customer insights. To enable management to make more accurate and timely decisions.

3.7.3) Business Model: There is support for transforming digital to participate in many activities throughout the organization by bringing digital capabilities to customers or consumers in order to increase satisfaction.

3.7.4) Digital Capabilities: It is the primary blog for the vision and strategy blog's digital transformation. organizational structure and business strategy It creates data analysis tools for decision-making and unifies processes and data into a single platform.

3.8) Digital transformation readiness for SMEs. A study is being done to learn various factors that is positively related to being prepared for the digital transformation. This is so because the government is aware of the causes and effects of advantageous factors. As a result, the government would correctly stimulate and steer the industrial sector of SMEs in accordance with the qualities it ought to possess. The prosperity of the country as a result. Additionally, the government can locate resources or provide assistance to the SMEs industry group, which has the following six related factors: Strategy and Leadership; Customer Experience; Operation Process; Business Model; Digital Capability; Governance Policy Support.

3.9) Guidelines for assessing an organization's digital readiness according to the concept of Minderruay (2 0 1 8) have proposed factors that affect digital readiness as follows:

3.9.1) Strategic and Leadership: STR includes how much strategic planning and vision do organizational leaders have for the digital sphere? How much do leaders encourage and empower workers in the digital sphere? The direction is decided by organizational leaders. And decide whether you want to see the advantages of digital transformation. How much of the digital transformation is understood by executives across levels? Has the company developed a pilot program for change management in some departments in preparation for digitization?

3.9.2) Customer experience management: CEM consisting of whether the company uses digital channels like social media, email marketing, or CRM to develop or manage relationships with customer groups. Does the company have a digital channel (Digital Channel) for internal connections and communication? Do you use apps like Messenger or Line? Access is possible through the digital channel for employees. Are customers finding it quicker and more convenient? How much does effective digital channel management improve the capacity to grow and offer services? Is it possible to cut costs and expenses with digital internal and external communications?

3.9.3) Operation processes: OPE whether or not the organization has a plan in place for the process of switching from traditional working formats to digital formats. Does the company have a digital operations process that can accurately and promptly identify or address issues? How enthusiastic are employees about the digitization of work processes? Has the company implemented digital technology, such as a knowledge management system, to manage the operations process so that employees can work independently of one another? Has the company made a point of encouraging staff to abandon their old working habits in favor of new ones? How electronic? Is the business constantly changing how it operates to accommodate cutting-edge technology? How much do workers in the company cooperate with and accept the new work procedures?

3.9.4) Business Model: BUS includes does the company have a vision and plan for shifting business operations to the digital side? How well-prepared is the company to deal with the effects of doing business in the digital age? The company conducts business using digital technology. speed effective because and cut

back on operating costs or not? The company has marketing. By disseminating information and conducting business via digital channels in a variety of ways, such as through marketing promotions (Promotion) via online channels.

3.9.5) Digital capability: CAP includes how much does the organization promote, support, and encourage employees to use digital knowledge in their work? Are your employees digitally savvy enough to support your digital strategy? The organization has formed a team or unit with digital expertise to assist other groups within the organization. How well has the organization prepared its employees to use digital technology to continuously improve their work? To what extent do organization employees use digital technology in their work to help speed up operations?

3.9.6) Governance policy support: GOV includes how well has the government developed a good governance management system that involves organizations, such as a trademark registration system? Does the government provide support in the area? Infrastructure To increase convenience in conducting business, such as high-speed internet How much? The government supports funding for development. Improving your business to be digital? Has the government set up concrete policies and plans to support digital? Has the government opened data (Open Data) to allow organizations to connect and exchange data, such as data governance (Data Governance)? Has the government improved laws to allow organizations to conduct business in new ways (Regulatory Sandbox)? How little? Does the government plan to promote and support organizations to be digitally ready? The government pushes the education system to have access to learning through digital technology. To promote the quality of labor in the future, to what extent?

3.9.7) Information security: SEC includes the organization has an information security policy (Security Policy) in place to oversee operations. To prevent information leakage, such as changing the password or deciding whether or not to make the password complicated. Customers have grown to trust the organization in terms of digital technology security. Mobile banking and customer data collection systems are examples of both production and services. How much is it? Does the organization prioritize information security? The organization has a strategy.

How much money is spent on information security? Is there a systematic cyber security management plan in place to prevent cyber-attacks?

3.9.8) Culture: CUL includes is the organizational culture one that encourages and cultivates employees to see the benefits of digital technology? Are CEOs cultivating a corporate culture that promotes digital transformation? To what extent does the culture of the organization encourage acceptance and readiness to adapt to digital transformation? Is the organizational culture supportive of and aligned with the company's digital policy and strategy? Is corporate culture a stumbling block to digital transformation?

2.4 Operation with digital system

The literature review on operation with digital system specially focuses on ensuring digital readiness, digitally enhancing products and services, embracing product innovation, developing new business models, improving digital channels, and increasing customer satisfaction.

2.4.1 Ensuring Digital Readiness

Digital readiness involves more than just adopting new technologies; it requires a comprehensive approach to organizational transformation. Lee, Hess, Matt, Benlian, & Wiesböck (2017) point out that creating a culture of digital innovation is crucial. This includes fostering a mindset that values experimentation, embraces change, and encourages continuous learning. Organizations must invest in training programs to upskill employees and ensure that the workforce is equipped to navigate the digital landscape.

Moreover, establishing robust governance structures is essential. Westerman, Bonnet, & McAfee (2014) highlight the significance of strategic oversight, ensuring that digital initiatives align with overall business objectives. Effective governance involves clear decision-making processes, risk management strategies, and

mechanisms for evaluating the success of digital endeavors. Digital readiness is an ongoing process that requires adaptability and responsiveness to emerging technologies. Research by Kane et al. (2015) emphasizes the need for companies to be agile, anticipating and swiftly adapting to technological advancements to maintain a competitive edge.

2.4.2 Digitally Enhancing Products and Services

Digital enhancements in products and services go beyond basic automation. Teece (2018) suggests that successful organizations leverage digital technologies to create intelligent, connected offerings. The integration of IoT, AI, and machine learning transforms products into dynamic, data-driven solutions capable of adapting to user preferences and providing real-time insights.

For example, smart home devices, wearable technology, and connected vehicles exemplify how digital enhancements are creating more personalized and efficient user experiences (Brynjolfsson & McAfee, 2017). These technologies not only enhance the functionality of products but also open new possibilities for data-driven innovation and business models. The literature emphasizes the need for organizations to embrace a mindset of continuous improvement and innovation in their product and service offerings. Companies that proactively explore emerging technologies and creatively apply them to enhance their value propositions are more likely to stay ahead in the digital age.

2.4.3 Embracing Product Innovation

Digital systems are catalysts for innovation, and organizations that embrace digital technologies are better positioned to foster a culture of continuous improvement and experimentation (Govindarajan & Trimble, 2017). Digital innovation involves not only creating new products but also reimagining business processes, customer experiences, and even organizational structures.

Christensen, Raynor, & McDonald (2015) discuss disruptive innovation, highlighting how digital technologies can lead to the creation of entirely new markets and the displacement of established players. Companies that actively seek out disruptive opportunities and invest in breakthrough innovations are more likely to shape the future of their industries.

Digital innovation also involves tapping into external ecosystems. Open innovation models, as proposed by Chesbrough (2020), encourage collaboration with external partners, startups, and innovation communities. By leveraging external expertise and ideas, organizations can accelerate the pace of innovation and stay at the forefront of their industries.

2.4.4 Developing New Business Models

Digital systems are transforming traditional business models and giving rise to new, agile, and disruptive approaches. Teece (2018) emphasizes the need for organizations to reimagine their business models, considering the opportunities presented by digital technologies. Platform-based business models, where companies create ecosystems that connect various stakeholders, exemplify the transformative power of digital systems (Hagiu & Wright, 2020). Digital platforms facilitate collaboration, innovation, and the rapid scaling of services. Companies that recognize the potential of platforms are able to create new sources of value and revenue.

Zott, Amit, & Massa (2018) stress the importance of dynamic capabilities in digital business models. The ability to adapt, iterate, and respond to changing market conditions is critical for sustained success. Successful organizations actively scan the digital landscape for emerging trends and are quick to pivot their business models in response to new opportunities or challenges.

2.4.5 Improving Digital Channels

Optimizing digital channels involves creating a seamless and integrated experience for customers across various touchpoints. Verhoef et al. (2015) highlight the importance of multichannel and omnichannel strategies, where customers can transition effortlessly between online and offline interactions while maintaining a consistent and personalized experience.

Data analytics plays a central role in channel optimization. Li and Kannan (2014) argue that businesses should leverage data-driven insights to understand customer behavior, preferences, and pain points. By employing analytics, organizations can tailor their digital channels to meet evolving customer expectations, ultimately enhancing engagement and satisfaction.

The use of emerging technologies, such as chatbots and virtual assistants, further contributes to improved digital channels (Maglio, Trope, & Liberman 2013). These technologies enable efficient and personalized interactions, providing real-time support and enhancing the overall customer experience.

2.4.6 Increasing Customer Satisfaction

Increasing customer satisfaction through digital systems involves a holistic approach that encompasses personalized experiences, efficiency, and transparency. Anderson, Dedreu, & Nijstad (2014) suggest that organizations need to focus on digital maturity, ensuring that they are adept at leveraging technology to meet customer needs. Personalization, facilitated by AI and machine learning, is a key driver of customer satisfaction (Verhoef, Kannan, & Inman, 2015). Businesses that can anticipate and fulfill individual customer preferences, whether in product recommendations or service delivery, are more likely to foster loyalty and positive word-of-mouth. Efficiency in digital operations contributes directly to customer satisfaction. Quick response times, streamlined processes, and transparent

communication all contribute to a positive customer experience (Maglio, Trope, & Liberman, 2013). Digital systems enable organizations to automate routine tasks, reducing wait times and enhancing overall service quality.

In summary, the literature underscores the multifaceted nature of leveraging digital systems in operations. From ensuring organizational readiness to enhancing products, fostering innovation, developing new business models, optimizing digital channels, and ultimately increasing customer satisfaction, organizations that embrace the full spectrum of digital capabilities are better positioned to thrive in the dynamic and competitive landscape of the digital era.

2.5 Relationship among variables in the conceptual framework

This section is a comprehensive literature review that explores the relationship between external factors, operation with digital systems, organizational and management factors, and the digital transformation of organizations.

2.5.1 Organizational and Management Factors and Digital Transformation

Organizational and management factors play a critical role in the success of digital transformation efforts. A supportive organizational culture, as emphasized by Cameron and Quinn (2011), creates an environment where employees are open to change, innovation, and continuous learning. Organizations with cultures that embrace digital mindsets are more likely to adapt successfully to the challenges and opportunities of digital transformation.

Effective change management is essential. Research by Kotter (1995) highlights the importance of well-managed transformation activities, including creating a sense of urgency, establishing a guiding coalition, and communicating a clear vision. Organizations that invest in change management processes ensure that

employees are aligned with the digital transformation agenda, reducing resistance and fostering a collaborative environment.

Leadership engagement is a critical organizational factor. Leaders who champion digital initiatives, communicate a compelling vision, and actively participate in the transformation process contribute to the success of digital transformation (Kotter & Cohen, 2012). Engaged leaders inspire confidence, provide strategic direction, and demonstrate a commitment to the organization's digital future.

Knowledge management is integral to navigating digital transformation. Internally, organizations must create mechanisms for capturing, sharing, and utilizing internal expertise (Nonaka & Takeuchi, 1995). Externally, collaboration with external partners and ecosystems enables organizations to access diverse knowledge sources, stay informed about industry trends, and drive digital innovation (Chesbrough, 2003).

2.5.2 External Factors and Digital Transformation

The external environment significantly influences an organization's decision to embark on digital transformation. Research by Teece (2018) emphasizes the impact of external factors, such as technological advancements, competitive pressures, and changing customer expectations, as triggers for digital transformation initiatives. Organizations that proactively scan the external landscape are more likely to identify opportunities and threats, shaping their digital strategies accordingly.

The competitive landscape, in particular, plays a pivotal role. Digital disruptions, as discussed by Christensen, Raynor, & McDonald (2015), can reshape industries and create new market dynamics. Organizations that are responsive to these external disruptions are better positioned to leverage digital technologies to innovate, differentiate, and gain a competitive advantage (Porter, 2001).

Regulatory changes also contribute to the impetus for digital transformation. As highlighted by Liang, Park, & Guan (2007), organizations operating in regulated industries must adapt their operations to comply with evolving regulatory frameworks. Digital systems provide a means to enhance compliance, streamline processes, and ensure adherence to changing legal requirements.

2.5.3 Digital Transformation and Operation with Digital Systems

The operation with digital systems is at the core of digital transformation initiatives. Digital systems encompass a wide range of technologies, including cloud computing, big data analytics, artificial intelligence, and the Internet of Things. Research by Brynjolfsson and McAfee (2017) suggests that organizations leveraging these digital systems can enhance operational efficiency, drive innovation, and create new business models.

The integration of digital technologies in operations facilitates a data-driven approach (Davenport & Harris, 2007). Organizations can harness data analytics to gain insights into customer behavior, optimize processes, and make informed strategic decisions. Real-time data processing, as enabled by digital systems, contributes to agility and responsiveness in a rapidly changing business environment.

Moreover, the operation with digital systems extends beyond internal processes to external interactions. Digital channels, including websites, mobile apps, and social media, provide organizations with platforms to engage customers, gather feedback, and deliver personalized experiences (Verhoef, Kannan, & Inman 2015). Organizations that effectively leverage these digital channels enhance customer satisfaction and loyalty.

2.6 Garment Manufacturing Industry

Garment means clothing that has already been sewn and comes in many sizes and styles for men, women, and children. It is sold in various places such as stores, department stores, and convenience stores etc. (Na Songkhla, Kringern, Chatakananda, Rattananarapan, & Khaengpenkhae, 2019)

2.6.1 The categories of garment

Garment clothing can be classified in a variety of ways, such as according to the type of user or the type of product. Diamond and Diamond (2019) classified garment clothing into three types based on the type of user.

- 1) Men's wear refers to ready-to-wear clothing for men. By ready-made clothing, I mean clothing that is currently being manufactured for sale, such as suits, jackets, shirts, ties, and so on.
- 2) Women's wear refers to ready-made clothing for women that is currently on the market, such as skirts, shirts, maternity clothes, and so on.
- 3) Children's wear refers to ready-to-wear clothing for children, such as sweaters and sportswear.

Simakrai (2020) explained how ready-made clothing is classified into four categories based on product type.

- 1) Clothing used in warehouses (warehouse coats), for example, is a staple or main product that has almost no change in style but may change in type of fabric or color.
- 2) Semi-styled item is a standard model with minor formatting changes. However, the fabric or color of men's shirts is frequently changed.
- 3) A style product is one with little change in design. The fabric and color will vary depending on the style, such as skirts for women.

4) A fashion product is a product that changes rapidly in both form and material.

2.6.2 The cycle of garment manufacturing industry

According to Brown and Rice (2019), the production of ready-made clothing will take between 3-6 months to complete, depending on the product and the season in which it is sold. The following are the details of the garment production cycle:

1) Design takes about 2-3 weeks and involves creating product or collection styles. Fabric development and research making cutting-edge designs and prototypes creating artwork for printing, embroidery, or screen printing, as well as developing decorative finishes, and so on.

2) Data collection takes about 2-3 weeks and involves estimating production costs. Fabric procurement based on desired characteristics, size determination, and agreement on raw material color from the laboratory. Creating a prototype print job Production quantity determination Price bargaining Providing a place to sell, and so on. According to Phon-Asa (2019), the cost of producing ready-made clothing includes 60% of fabric costs, 15% of overhead costs, 20% of labor costs, and 5% of assembly materials costs. If you want to make a profit from these costs, reduce costs by lowering the price of fabric. By arranging the cuttings in the most cost-effective manner possible. By taking the MU (material utilization) value of each cut placement into account.

2.1) Production planning takes 2-6 weeks to complete the testing and certification of fabrics, composite materials, and finishing. Colors and variations in clothing care labels customer classification creating cutting models for actual production scaling of the cut production layout, for example.

2.2) Production takes about 1-2 weeks. Receiving fabric for production into the factory Inspecting the fabric, laying the fabric, cutting the fabric, and sourcing subcontractors for production tasks like embroidery, printing, and sewing

sample shirts. Finishing, finishing, rolling, and final production quality inspection are all part of the finishing process.

2.3) Distribution of goods takes about 1-3 weeks for products distributed within the country and about 3-5 weeks for imported products, including customs documentation transportation. Product distribution to distributors According to Phon-Asa (2019), distribution requires warehousing (stock) for storage in order to be flexible.

2.4) Sales, marketing, and promotion take about 3-6 weeks to display or decorate retail storefronts, advertise, and introduce new products to the market. Order verification Detail information centering.

2.5) The evaluation takes 2-4 weeks and includes a review of previous season sales. Customer acceptance testing competitive analysis, market research, and product trend analysis creating an operational strategy to support the upcoming season.

2.6.3 Type of garment manufacturing industry

Brown and Rice (2019) classifies the current clothing industry as follows:

- 1) Industries related to fibers, yarns, fabrics, dyeing, fabric finishing, and raw material procurement for production.
- 2) Ready-made clothing production ready-made decoration industry It also includes distributors and department store retailers. Specialty stores, clothing rooms, and so on.

Phon-Asa (2019) divides ready-made clothing manufacturers into five types based on the nature of their operations:

- 1) Manufactures are typically medium-sized businesses. Produces products primarily for domestic distribution.

2) Jobbers are a ready-to-wear retailer with a retail presence but no manufacturing facility. So, you'll need to find a factory to make the goods.

3) Contractors are factories that manufacture ready-made garments that are sold domestically or internationally, with raw materials supplied by the exporting company.

4) Manufacturers distributors are medium-sized or larger factories with their own sales markets, producing ready-made garments for domestic or international sale. They frequently have their own brand and are well-liked by customers.

5) Vertical producers and distributors are typically larger factories to make clothing for export.

The manufacturer's work will be responsible for design. Fabric and decorative materials for production procurement Providing finished goods to distributors Profits will be generated by the difference in production costs. as well as the product's selling price How far will the work progress? It is dependent on the small producer, including communication issues. If small producers use a variety of languages Quality assurance and process control Saving time and money on transportation Organizing personnel to perform tasks that are appropriate for their abilities and providing a suitable working environment (Brown and Rice, 2019).

Contractors include both independent subcontractors and custom designers. or a subcontractor who performs specific tasks Companies that use subcontractors typically have more flexibility because they do not need to invest in equipment or factories. There aren't many personnel issues. Employee training is minimal. There is no need to pay for equipment or plant maintenance. And the subcontractor can still complete the work as needed by the company (Brown and Rice, 2019).

Wholesaler representative represents the manufacturing company that sells made-to-measure clothing to retailers. Profits are earned from contract sales to retailers (Brown and Rice, 2019).

A retailer is a distributor who buys products from domestic manufacturers or imports them directly from abroad to sell to consumers. Profits are generated by the price difference between the cost of purchase and the price at which the product is sold to consumers (Brown and Rice, 2019).

According to Glock and Kunz (2018), the clothing industry is a multi-functional system that includes product management, marketing, production, and distribution. Customers' purchasing needs will determine a company's success. However, the quality of clothing should be proportionate to the price, manufacturing standards, and desired profit.

The overall structure of the textile industry system will consist of five industries, which are as follows (Suk-kavessako, 2019).

Fiber industry is an upstream industry. Fibers can be divided into 2 types according to the production process: Natural fibers include cotton fibers, silk fibers, linen, hemp, jute, etc. Cotton fibers are the most widely used; Synthetic fibers are 4 types of synthetic fibers: polyester fibers, nylon fibers, acrylic fibers, and rayon fibers. The production of synthetic fibers is produced to replace natural fibers. The properties of synthetic fibers are better than natural fibers in terms of durability and flexibility. The fiber industry is an important industry that uses a high level of investment and technology. Therefore, most investments are joint ventures with foreign investors by relying on technology from the parent company.

The spinning industry is a midstream industry. It is an industry that uses natural raw materials such as cotton or synthetic fibers to be twisted or spun into yarn. The products obtained from the spinning industry include: Cotton yarn, which is divided into yarn for weaving and sewing; Synthetic fiber yarns include polyester yarns, nylon yarn, acrylic, yarn, and rayon yarn. In the past, cotton yarn was mainly produced but at present there are two types of fibers that are mixed. So that the yarn has different properties according to market needs.

The weaving and knitting industry is a midstream industry. This industry uses raw materials from the spinning industry. The products obtained from the weaving and knitting industry include: Woven fabric consists of fabric woven from cotton, fibers, synthetic fibers, and mixed fibers; Knitted fabrics include knitted fabrics made from cotton fibers, synthetic fibers, and mixed fibers.

Dyeing, printing, and finishing industries are midstream industries that are classified as the final stage of fabric production before being released to consumers or ready-to-wear garment factories by adding value to the fabric in terms of beauty, usability, comfort, and to make it suitable for use in various activities. In addition, this industry can add 2-3 times the value of the fabric through the bleaching process, which is making cloth white and clean before dyeing and printing as desired. Then the decoration was completed. Makes the fabric have various properties such as polishing, shiny, scratching, softness, waterproof, wrinkle-resistant, anti-bacterial. moisture absorption, etc.

Ready-made clothing industry is a downstream industry of the Thai textile industry structure system. It is the industry with the highest export value. This industry does not require a high level of investment, technology, and machinery. Most of the production still uses machines that have been in use for a long time. But on the labor side, there is a demand for a large amount of labor in the production process. By the characteristics of workers in the garment industry Must have skills and experience in craftsmanship. and meticulous, quality tailoring. Products obtained from the garment industry include: Ready-made clothing from weaving; Ready-made clothing from knitting.

2.6.4 The process of garment manufacturing industry

Managing a ready-made garment factory successfully should be good planning that is appropriate for the nature of the work. Duties are divided as follows when planning the production of ready-made garments (Suk-kavessako, 2019).

Design: Most ready-made clothing manufacturers specify clothing styles based on the target group's needs. At the moment, some companies manufacture ready-made clothing based on the designs specified by the employer. The following steps should be included in the guidelines for designing products to meet the target group of consumers (Sukwesko, 2019).

Analysis of clothing occasions, such as what type of shirt is worn for what occasion? Whether you want to be formal or casual, etc. Information on marketing should be collected marketing data on various aspects of clothing, such as raw material trends, color trends, and consumer preferences. Product specifications and product prices will be used as design input.

Making products concept should be considered as the way that includes an examination of wearing occasions and wearer age groups as well as consumer preferences, etc. Work on the model's details is presented, as are trends in fabric colors and various clothing accessories.

According to Buabusya et al. (2019), product design or collection creation It is a seasonal collection of clothing items presented to customers. A collection may contain 100-150 garments. A collection will also include clothing items. Dress a large group of people It could also be divided into several subgroups, such as grouping by style or by purpose of use. or separated into target groups This collection is organized differently for each company. To plan collections, such as fabric tones, designers typically collaborate with product managers. Clothing fashion Including market requirements. One collection's production always overlaps with previous collections' production.

Making a cutting pattern (pattern making) is the process of creating a cutting pattern based on a shirt pattern that has been ordered for production. According to Phon-Asa (2018), there are three ways to create a cutting pattern:

Creating a cutting pattern on a mannequin the same size as the cutting pattern for the sample shirt. Popularly made in a cut style that necessitates a precise fit.

Creating designs on paper Typically used with loose shirts or shirts that do not require a lot of form fitting.

Copying a cut is a cut-out mark from a sample shirt. Cutting patterns in ready-made garment factories are more popular than making patterns from paper rather than making them from mannequins. Because it's more convenient and faster. The created cut will be based on the standard proportions of the target group or customer. Each company may use standard proportions or proportions that the company has researched. This can be seen from the research on the proportions of people in each geography. This is because people in each geography have different body structures. In making the cutting pattern, a sample shirt will be sewn together. To adjust the cutting model to be suitable for the production process and the machinery that the company has until when the cutting model is complete, then it can be used to reduce or enlarge the cutting model as the customer desires by hand or with a computer program to use to place the next cutting model. At present, most ready-made garment factories use computer programs to reduce or enlarge cutting patterns because it is more convenient and faster than doing it by hand and can store data for future use.

According to Phon-Asa (2018), every order requires the creation of designs for cutting and sewing sample shirts. In addition to the order, there is no material (fabric) change, so the original cutting pattern can be used because using different materials or structures will affect the material's elongation or contraction. As a result, when cutting, allowance should be made for material elongation or contraction. There are currently two types of samples making: making sample shirts from drawings or photographs and making sample shirts from sample shirts provided by customers.

Using a marker to place the cutting pattern is the most important thing to remember when laying out the cutting pattern is to save as much fabric as possible

while also being able to place all of the cutting pattern pieces. The cutting pattern may need to be slightly adjusted at this point to save money and reduce the amount of fabric used. Those in charge of laying out the cutting pattern should calculate the amount of fabric required to avoid waste. Raw material waste is kept to a minimum. A good and economical cutting plan must leave as few gaps as possible, and the finished cutting plan must be rectangular.

Cutting the fabric have been done after laying out the cutting pattern, when laying out the fabric to lay out the cutting pattern and cutting the fabric, Phon-Asa (2018) said that the accuracy of the fabric and the quality of the fabric, including the quantity, should be checked. Layer of cloth covering Because industrial fabric cutting will cut hundreds of pieces at a time. If something goes wrong, it can cause damage to the manufacturer. Therefore, it is considered the heart of ready-made clothing production. If the cutting is not planned carefully, there will be more loss of raw materials. After cutting the fabric according to the pattern, the pieces that will be sewn together will be separated and sent to the sewing department. At this stage, labels should be placed indicating the number of parts, size, and style of the product to be produced to prevent errors in assembly.

Sewing is in charge of sewing to the design and size specified by the customer. At this stage, each type of product's sewing methods and sewing steps should be studied. for quality assurance during production. In addition, a study of the standard time it takes to sew each piece should be conducted so that it can be produced within the specified time frame. Normally, the sewing staff will have varying levels of expertise in sewing various components. Is it hiring a small subcontractor to be in charge? As a result, many employees are needed to sew and assemble the parts for the products produced. To be of the same standard, product quality must be controlled.

Inspection is normally the process of inspection covers the inspection of raw materials. Inspection during the production process and inspection of finished products
Inspection of raw materials It is a preliminary activity to control the standards of raw

materials used in production such as fabric and composite materials, etc. Especially fabric produced from weaving and knitting. It is found that knitted fabric has more problems in inspection than standard woven fabric. Inspection has two specific words: defect is the absence of quality characteristics from a set level that affects use. As for the word defect (nonconformity) is the absence of quality characteristics from the set level causing the product to not conform to specifications. (specification) as specified (Phon-Asa, 2018).

Inspection during the manufacturing process the sewing of the parts, especially while sewing them, should be checked to avoid mistakes after assembling the shirt (Phon-Asa, 2018). The finished product is inspected. It is the final inspection of finished products after they have been manufactured. Thread scraps will be cut in this step. and inspect the final product for neatness before rolling, folding, and waiting for additional packaging. Packaging is the process of delivering products to consumers in a safe and high-quality manner. By packaging the product in the manner specified in the production contract by the customer or employer.

2.7 Digital transformation of garment Manufacturing Industry

Digital transformation has become a critical imperative for industries across the globe, and the garment manufacturing sector is no exception. The convergence of digital technologies is reshaping traditional manufacturing processes, creating opportunities for efficiency, agility, and innovation within the garment industry.

2.7.1 Integration of Industry 4.0 Technologies

The integration of Industry 4.0 technologies represents a transformative shift in the garment manufacturing industry. One of the key elements is the Internet of Things (IoT), where sensors and connected devices are embedded in machinery, production lines, and even garments themselves. These sensors provide real-time data on machine performance, production status, and product quality. For instance, sensors

on sewing machines can monitor stitching accuracy, helping to ensure consistent quality throughout the manufacturing process (Monostori, Kádár, Bauernhansl, Kondoh, Kumara, & Ueda, 2016).

Artificial intelligence (AI) plays a crucial role in optimizing various aspects of garment manufacturing. Machine learning algorithms analyze historical production data to predict equipment maintenance needs, minimizing downtime and preventing breakdowns (Liao, Wang, & Pritchard, 2017). AI-driven systems can also optimize production planning by analyzing demand forecasts, reducing lead times, and ensuring that manufacturers produce the right amount of garments at the right time.

Robotics is another component of Industry 4.0 that is transforming garment manufacturing. Robots equipped with computer vision and machine learning capabilities can perform intricate tasks such as fabric cutting and sorting, improving precision and efficiency. Collaborative robots, or cobots, work alongside human operators, enhancing overall productivity (Ferreira, Nieto, & Gimeno, 2019).

2.7.2 Digital Design and Prototyping

Digital design and prototyping have revolutionized the creative and developmental phases of garment manufacturing. Computer-aided design (CAD) software allows designers to create intricate and detailed garment designs digitally. This not only accelerates the design process but also facilitates collaboration among design teams, manufacturers, and suppliers (Mikkonen, 2019).

3D modeling tools enable the creation of virtual prototypes, allowing designers and manufacturers to visualize garments in a three-dimensional space. Virtual prototypes can be manipulated and tested virtually, reducing the need for physical samples. This accelerates the product development cycle, minimizes waste associated with physical prototypes, and allows for rapid iterations in response to feedback (Ardolino, Rapaccini, Saccani, & Gaiardelli, 2017).

Digital design platforms, often cloud-based, facilitate collaborative workflows. Designers from different locations can work on the same project simultaneously, fostering innovation and reducing time-to-market. The digital design phase sets the stage for a seamless transition into digital manufacturing processes.

2.7.3 Supply Chain Digitization

The digitization of the garment manufacturing supply chain addresses traditional challenges related to transparency, traceability, and communication. Blockchain technology, with its decentralized and secure nature, ensures an immutable record of transactions across the supply chain. This is particularly beneficial in the garment industry, where traceability of raw materials, production processes, and distribution channels is crucial for quality assurance and compliance (Iansiti & Lakhani, 2017).

Digital supply chain management platforms provide real-time visibility into every stage of the supply chain. From raw material sourcing to production, logistics, and distribution, manufacturers can monitor and manage the entire process. This transparency enables more informed decision-making, reduces the risk of disruptions, and enhances collaboration with suppliers and distributors (Fichman, Miller, & Mittler, 2019).

Furthermore, the integration of digital supply chain platforms with IoT devices allows for the continuous monitoring of inventory levels, helping manufacturers optimize stock levels and minimize excess inventory. Predictive analytics based on real-time data can also improve demand forecasting, reducing the likelihood of overproduction or stockouts (Wang, Sharma, & Cao, 2016).

2.7.4 Sustainable Manufacturing Practices

Digital transformation in the garment manufacturing industry aligns with the growing emphasis on sustainability. On-demand manufacturing, made possible through digital technologies, reduces overproduction and waste. By leveraging data analytics and AI algorithms, manufacturers can predict consumer demand more accurately, producing only what is needed (Corredoira & Rosenkopf, 2013).

The integration of IoT sensors in manufacturing equipment contributes to sustainable practices. These sensors monitor energy consumption, machine efficiency, and environmental impact. Real-time data on resource utilization allows manufacturers to identify opportunities for energy efficiency, reduce carbon footprints, and optimize production processes (Lee, Cheung, & Chan, 2014).

Moreover, digital technologies enable the implementation of circular economy principles in the garment industry. RFID tags and blockchain can be used to track and trace materials throughout their lifecycle, facilitating the recycling and upcycling of garments. Sustainable practices driven by digital transformation contribute to reducing the industry's environmental impact (Gualandris, Longoni, Luzzini, & Pagell, 2021).

2.7.5 E-commerce and Digital Retail

The rise of e-commerce platforms has reshaped how consumers interact with and purchase garments. Digital retail in the garment industry is characterized by innovative technologies that enhance the online shopping experience. E-commerce platforms leverage data analytics and machine learning to provide personalized product recommendations based on customer preferences and browsing history. Virtual try-on features use augmented reality (AR) technology to allow customers to visualize how garments will look on them before making a purchase (Chen, Yu,

Cheng, & Hao, 2019). This addresses one of the significant challenges of online apparel shopping — the inability to try on garments physically.

Virtual and augmented reality technologies also play a role in enhancing customer engagement. Virtual showrooms and immersive shopping experiences allow customers to explore garments in a digital environment. This not only creates a unique and enjoyable shopping experience but also fosters brand loyalty (Lu, Marand, & Ricci, 2019).

2.7.6 Challenges and Considerations

While the digital transformation of the garment manufacturing industry offers numerous benefits, several challenges must be addressed as follows:

Technology Integration: The integration of diverse digital technologies requires substantial investment in infrastructure and expertise. Manufacturers need to carefully plan the adoption of these technologies, considering the compatibility of different systems and the scalability of solutions (Frey, Berger, & Chen, 2018).

Data Security and Privacy: With increased connectivity and data-sharing, concerns related to data security and privacy become prominent. Garment manufacturers must implement robust cybersecurity measures to safeguard sensitive information and comply with data protection regulations (Xu , Xu , & Li , 2018).

Workforce Adaptation: The transition toward digital manufacturing necessitates a skilled workforce capable of operating and maintaining advanced technologies. Training and upskilling programs are crucial to ensure that employees can effectively use and optimize digital tools and processes (Brynjolfsson & McAfee, 2014). In conclusion, the digital transformation of the garment manufacturing industry is a multi-faceted process that encompasses technological advancements, sustainable practices, and shifts in consumer engagement. The industry's embrace of Industry 4.0

technologies, digital design, supply chain digitization, sustainability, and e-commerce collectively contribute to a more agile, efficient, and sustainable garment manufacturing ecosystem. As the industry continues to evolve digitally, careful consideration of challenges and proactive measures to address them will be essential for long-term success.

2.8 Related Research

Fabre (2018) conducted the research entitled China's digital transformation. Why is artificial intelligence a priority for Chinese R&D? China's innovation policies have relied on incremental applications of existing technologies as well as protectionist policies that have favored profitable oligopolies. The size of the market has also played a role. The widespread use of smartphones has been linked to the rise of the internet and e-commerce. Now, the rapid development of computer power and data accumulation by BAT (the three dominant firms) has paved the way for the rise of artificial intelligence (AI), the next frontier for productivity in key sectors (transportation, health, manufacturing, and energy). It is also an effective tool for social surveillance and governance of the state-party system, as well as a technology that has the potential to determine geopolitical dominance. The mix of cooperation and competition with the US is especially relevant in AI, where China is catching up with the US in both talent and chip technology, both of which are critical for machine learning.

Qiang (2020) conducted the research entitled technical methods for accelerating digital transformation of Chinese enterprises. Chinese enterprises are confronted with the opportunity of digital transformation, and all enterprises are exploring it. This paper discusses the trend and challenges of Chinese enterprises' digital transformation. This paper elaborates on the digital transformation strategy of enterprises as the focal point. This paper discusses the four enterprise digital transformation development processes, which are digital empowerment, process optimization, digital transformation, and digital reengineering. This paper proposes

methods for Chinese enterprises to use during the transformation process. First and foremost, enterprise digital transformation should be scientifically planned. Then, in enterprises, choose pilot projects to test first. The trial effect was then assessed. After summarizing and improving, duplicate and broaden the scope. Finally, optimize the enterprise's operation and constantly adjust.

Li (2021) conducted the research entitled *The Influence of the Development of Digital Economy on the Upgrading of China's Industrial Structure*. Nowadays, with the rapid development of the Internet, all aspects of life are inextricably linked with the Internet's development. Differences in the degree of integration between different industries, as well as the Internet, cause the leading industries of the national economy to change on a regular basis, promoting transformation and upgrading of the industrial structure. The impact of Internet development on industrial structure upgrading is not only that interconnected technologies and platforms change the traditional economic model, but also that Internet and industry integration has a profound impact on the industrial structure.

Zhang, Shi, & Chen (2021) conducted the research entitled *Enterprise digital transformation and production efficiency: mechanism analysis and empirical research*. Traditional Chinese enterprises are in the awkward position of being 'big but not strong' in the post-industrial period, with their core technologies controlled by others. The digital transformation of enterprises has not only reshaped business models and industrial boundaries, but has also boosted China's economy's high-quality development. This paper conducts a literature review and discovers that digital technology improves enterprise production efficiency through cost reduction, efficiency improvement, and innovation. Based on data from the Shanghai and Shenzhen stock exchanges between 2009 and 2017, this paper develops a difference in differences (DID) model to empirically investigate the relationship between digital transformation and production efficiency. The findings revealed that digital transformation implementation plays a significant role in promoting economic benefits, and the results of the lag regression method are still robust. This paper

proposes countermeasures and suggestions to promote the development of enterprise digital transformation based on this, as well as the actual situation of Chinese enterprises. The conclusion is critical for Chinese enterprises seeking to dominate the new wave of global industrial revolution.

Lan and Wen (2021) conducted the research entitled *Industrial Digitalization and Energy Intensity: Evidence From China's Manufacturing Sector*. The Chinese manufacturing industry has experienced a rapid digital transformation. The impact of industrial digitalization on energy intensity in China is investigated in this study. In terms of time trends, cross-sectional differences, and correlation coefficients, energy intensity is negatively correlated with digitalization. According to our empirical findings, industrial digitalization significantly increases the energy intensity of the manufacturing sector. The intensity of energy increases first and then decreases with digital transformation, resulting in an inverted-U-shaped relationship. In 2019, more than 80% of industries had a level of digitalization that was below the tipping point.

Wang and Su (2021) conducted the research entitled *driving factors of digital transformation for manufacturing enterprises: a multi-case study from China*. Under the pressure of global competition, the Chinese manufacturing industry is actively engaged in digital transformation, despite diminishing low-cost advantages. We developed a theoretical framework of factors influencing artificial intelligence (AI) adoption in enterprises based on the technology-organization-environment (TOE) framework by analyzing the gaps between existing technology-adoption theories and digital transformation practices. This article examines three important aspects of digital transformation enabled by AI using three case studies of Chinese heavy-manufacturing enterprises: technological, organizational, and environmental driving factors, and we propose an AI business model to clarify the mechanism of AI technological adoption in the manufacturing industry. This study provides an in-depth summary and examination of China's manufacturing industry's digital transformation. It theoretically supplements related research in the field of AI technology adoption,

but more importantly, it provides practical experience in moving the manufacturing industry toward digital transformation and upgrading.

Fu (2022) conducted the research entitled *How does digital technology affect manufacturing upgrading? Theory and evidence from China*. Digital technology becomes the new engine of manufacturing upgrading. The article brings digital technology and manufacturing in global value chain into the same analytical framework, measures development level of digital technology by using World Input-Output Database data, Theoretical analysis shows that impact of digital technology on manufacturing upgrading has innovation effect, resource allocation effect and penetration effect. Empirical test results show that (1) Digital technology level index of China's manufacturing industry increased from 0.286 in 2001 to 0.359 in 2014, The effect of digital technology on upgrading of Chinese manufacturing industry is significant positive at 5% level with influence coefficient of 0.129; Distinguish digital technology sources found that domestic digital technology is used in a large proportion, foreign digital technology is more efficient, the influence coefficients are 0.124 and 0.703 respectively, and both promote upgrading of manufacturing industry; (2) The role of digital technology varies among industries. The promotion effect on capital intensive industries and technology intensive industries is positive at 5% level, and influence coefficients are 0.124 and 0.108 respectively. With influence coefficients of 0.177 and 0.138, it has a significant positive impact on low-to-medium and medium-to-high technology manufacturing at the 1% level. As a result, China must accelerate the deep integration of digital technology and the manufacturing industry in order to reach the middle and upper echelons of the global value chain.

Wang, X., & Wang, F (2022) conducted the research entitled *Research on the Path of Digital Transformation of Chinese Manufacturing Enterprises Under the Backdrop of High-Quality Development*. The growth of the digital economy has provided numerous opportunities for Chinese companies to achieve high-quality development. At the same time, the digital transformation of Chinese manufacturing enterprises has brought challenges due to the weak foundation of digital

transformation in Chinese enterprises, the degree of industrialization and information integration needs to be deepened, the shortage of talent in digital transformation is severe, and the pattern of collaborative innovation in the industrial chain has not been formed. In this paper, we propose a top design, the accumulation of data resources, the acceleration of the digital platform, the optimization of organizational structure, and the construction of a benign collaborative ecological system against the backdrop of the development of high-quality digital transformation and the path for the development of manufacturing enterprises in our country, based on field investigation and literature research.

Li, W., & Li, C (2022) conducted the research entitled Path Analysis of the Impact of Digital Transformation on Export Performance of Textile and Apparel Companies. The Fourteenth Five-Year Plan proposes to speed up the digitalization of textile intelligence and fashion, and digital transformation has emerged as the primary theme of change in the textile and apparel industry. This paper examines the current state of digital transformation in textile and apparel enterprises in China from the perspective of textile and apparel enterprises, with a focus on the impact path of digital transformation on enterprise export performance: enterprise innovation path and export cost path. To improve enterprise export performance, textile and garment enterprises should focus on R&D innovation, provide personalized design services, open the entire production and operation data chain from digital production to digital terminal, and respond flexibly to the complex and changing export environment.

Wang, & Cao (2022) conducted the research entitled Digital Transformation and Manufacturing Firm Performance: Evidence from China. Based on the digital transformation practices of Chinese manufacturing enterprises, this paper systematically sorts out the intrinsic mechanism of digital transformation affecting the performance of manufacturing enterprises from 2007 to 2020, and empirically tests the theoretical hypothesis using an unbalanced panel of China's A-share listed manufacturing companies in Shanghai and Shenzhen. The findings show that digital transformation significantly improves manufacturing firm performance, and the

conclusions hold after using dynamic panel models, the instrumental variables approach, and a series of robustness tests; further analysis reveals that this effect is more significant in state-owned enterprises and manufacturing enterprises in more marketized regions. The model's results show that low-cost empowerment and innovation empowerment are important channels for improving the performance of manufacturing enterprises. As a result, this paper contends that the key to achieving high-quality development and improving enterprise performance in the context of an uncertain business environment is to accelerate the deep integration of digital technology and enterprise development.

Cao (2023) conducted the research entitled *The Influence of Digital Transformation of Manufacturing Industry on Human Capital*. With the rapid development of China's digital economy, the impact of digital transformation has spread to a variety of industries and businesses. Manufacturing is the backbone of the national economy and the foundation of the country. While digital transformation is more important for manufacturing firms, human capital is also an important factor in promoting digital transformation. Based on this context, this paper examines the outcomes and mechanisms of digital transformation on human capital. This paper conducts an empirical study on the impact of digital transformation on human capital, constructs a benchmark model, and tests the robustness of the conclusion using Shanghai A-share prominent companies from 2014 to 2020 as the research object. It has been discovered that digital transformation can encourage human capital investment. Finally, based on the research findings, this paper makes recommendations for improving enterprise human capital from three perspectives: enterprise, government, and individual.

Feng, Liu, Huang, & Pan (2023) conducted the research entitled *Impact of Digital Transformation on Innovation Efficiency of Manufacturing Enterprise in China: A New Measure of Digital Transformation*. After pointing out the shortcomings of previous research's measures, this paper proposes a new measure of firm digital transformation from the standpoint of investment. This paper examines the

positive impact of digital transformation on innovation efficiency using the new measure and panel data from manufacturing listed companies in China from 2009 to 2020. The benefit is greatest in technology-intensive and capital-intensive businesses, as well as those in low-competitive product markets. Manufacturing enterprises' digital transformation promotes innovation efficiency by increasing the level of internal human resources, lowering financing costs, and reducing supply chain concentration.

Meng and Wang (2023) conducted the research entitled *The impact of digitalization on enterprise value creation: An empirical analysis of Chinese manufacturing enterprises*. This research suggests a new production function of digital empowerment. It develops a theoretical framework for analyzing the digital enabling process for businesses from the standpoints of production factors and economic activity. It measures the degree of digitalization using data mining technology, extracts a typical relationship model between digitalization degree and enterprise performance, and unearths the association rules between traditional factors, digital factors, and economic activities under various relationship models. The results show that mechanical and electronic enterprises have a higher digitalization degree and digitalization enablement level than light textile enterprises and resource-processing enterprises. Enterprise heterogeneity affects the substitution elasticities and association rules among factors and activities, resulting in differences in the digital transformation paths of different types of enterprises.

Zheng, Zhang, & Fan (2023) conducted the research entitled *Digital transformation, industrial structure change, and economic growth motivation: An empirical analysis based on manufacturing industry in Yangtze River Delta*. China is at a crossroads in its economic growth mode transformation. The digital transformation of the manufacturing industry has the potential to provide new impetus and models for economic growth. We investigate the digital transformation process of the manufacturing industry in 25 prefecture-level cities in the Yangtze River Delta region and validate its theoretical mechanism of promoting economic growth through the industrial structure. To investigate the dynamic mechanism of manufacturing

digital transformation to promote economic growth through industrial restructuring, a panel model based on the improved Feder two-sector model and a multiple mediating effect model are established. According to the findings, the digital transformation of the manufacturing industry in China's Yangtze River Delta region is relatively high, and the rate of digital transformation has been accelerating in recent years. The digital transformation of the manufacturing industry has the potential to promote structural change and create a new driving force for economic growth. The key is to raise the level of industrial structure and lengthen the industrial chain. Based on these findings, we propose policies to encourage industrial restructuring and upgrading in order to ensure China's economy's long-term growth.

Wu, Li, Luo, & Yu (2023) conducted the research entitled *How digital transformation helps enterprises achieve high-quality development? Empirical evidence from Chinese listed companies*. The goal of this research is to investigate how digital transformation assists enterprises in achieving high-quality development, including the mediating mechanisms of information transparency, innovation capacity, and financial stability, the moderating role of financing constraints and government subsidies, and the diverse effects of property rights, size, and growth. From 2012 to 2019, a two-way fixed-effect model was used to analyze 780 samples of Shanghai-Shenzhen A-share listed companies in China. The findings indicate that digital transformation can effectively improve enterprises' total factor productivity (TFP) via the three channels of information transparency, innovation capability, and financial stability. Meanwhile, financing constraints significantly hampered digital transformation's contribution to TFP, whereas government subsidies significantly increased digital transformation's contribution to TFP. Furthermore, by increasing their digital transformation, state-owned enterprises (SOEs), large enterprises, and high-growth enterprises are better able to achieve high-quality development. Companies should actively improve information transparency, financial stability, and innovation capabilities while implementing digital transformation, and choose differentiated paths based on intrinsic characteristics such as property rights, scale, and growth. Simultaneously, the government should work to improve not only the digital

institutional environment, but also financial policy and the credit system. This research contributes to the theoretical research framework of digital transformation and high-quality development by identifying the channel mechanisms and boundary conditions through which digital transformation affects high-quality development, as well as expanding the consequences of digital transformation and the antecedents of high-quality development.

Ren, Shen, & Xu (2023) conducted the research entitled *Research on Digital Transformation and Upgrading of Fashion Industry Under the Background of Big Data*. The digital application of big data technology has become the future development direction of various industries with the advent of the 5G era. The integration of digital and fashion has revolutionized all aspects of the fashion industry, from design to manufacturing to sales. In order to address the issue that the traditional fashion industry's digital development is comparatively lagging behind, the method of literature analysis, case analysis, and generalization is used to build the digital transformation and upgrading path of the industry. This is done using the VOS viewer, government-released policy analysis, and focus group discussions in the context of big data. The aim is to provide theoretical reference for the digital transformation and upgrading of the fashion industry under multi-dimensional demand, and to expand the direction of the digital development of the fashion industry under the background of big data.

Xu, Li, & Guo (2023) conducted the research entitled *Digital transformation and environmental performance: Evidence from Chinese resource-based enterprises*. For resource-based enterprises to overcome the dual constraints of resource and environment, digitalization is critical. Based on data from China's A-share resource-based listed enterprises, this study empirically investigates the direct effect and transmission mechanism of digital transformation on the environmental performance of the enterprises. According to the research, digital transformation improves enterprise environmental performance by stimulating green technology innovation, accelerating human capital accumulation, increasing environmental information

disclosure, and strengthening environmental governance. Digital transformation has a greater impact on the environmental performance of state-owned, large-scale, and high-tech resource-based enterprises. The impact of digital transformation on the environmental performance of resource-based enterprises is more significant in the eastern region and areas with higher environmental regulation. This study offers specific recommendations for resource-based enterprises to fully utilize digital dividends and achieve high-quality development.

Mai and Yao (2023) conducted the research entitled *Research on the Influence of Digital Transformation on the Sustainable Development of China's Textile and Apparel Listed Enterprises*. As a high-energy-consumption industry, China's garment industry is critical to promoting innovation and upgrading of traditional enterprises in the digital economy through the use of the Internet of Things, big data, and artificial intelligence. Based on this, this paper selects textile and garment enterprises as the research object, collects relevant data from 62 textile and garment listed companies in China between 2017 and 2020, and conducts empirical analysis using a static panel model. The findings indicate that digital transformation, as the model's primary explanatory variable, plays an important role in promoting the long-term development of businesses. Furthermore, increasing the profitability of the control variable and improving the performance of corporate social responsibility play a positive role in promoting the long-term development of businesses. Based on the research findings, textile and garment enterprises should strengthen industrial integration with emerging digital industries, realize industrial restructuring through digital transformation, and continue to shift toward high-end technology-intensive production methods in order to achieve sustainable business development. At the same time, they must consider profitability. To improve the level of production and operation while achieving high profits, we must also pay attention to social needs and actively carry out our responsibilities and obligations to the public.

Jirapitikul and Joradon (2023) conducted the research entitled *the factors affecting the organizational driven of digital transformation*. The objective of this

study is to study the factors which affect the organizational driven of digital transformation. Research population has age between 18 – 59 years old who are working in organizations and government official. The online questionnaire was used to collect data. 321 respondents were used for this study. The results of the study found that organizational culture, change management and technology acceptance affected the organizational driven of digital transformation at statistically significant at the 0.05 level. The results accept the hypothesis that organizational culture is the organization should have a policy vision to drive technology. Change Management is the organization should bring technology to improve the work process. Technology Acceptance is when more technology comes into the organization. Employees will expect the efficiency of technology for acceptance.

This study differs from other studies in its research subject and analytical methods. This study focuses on the digital transformation of China's apparel manufacturing industry and adopts an online questionnaire survey as the data collection method. The study emphasizes the importance of questionnaire design and proposes strategies for promoting and incentivizing respondent participation. Additionally, this study uses convenience sampling techniques to select samples, ensuring the representativeness of the sample and its relevance to the research question.

In contrast, other studies cover a broader range of industries and employ different data collection methods. For example, Fabre (2018)'s study examines why artificial intelligence is a priority for Chinese R&D, while Qiang (2020)'s study discusses the technical methods for accelerating the digital transformation of Chinese enterprises. Li (2021)'s study focuses on the impact of the development of the digital economy on the upgrading of China's industrial structure, and Zhang et al. (2021)'s study explores the relationship between enterprise digital transformation and production efficiency. Furthermore, other studies employ different analytical methods. For instance, Lan and Wen (2021)'s study uses empirical analysis to investigate the impact of industrial digitalization on energy intensity in China's manufacturing sector,

while Wang and Su (2021)'s study adopts a multi-case study approach to explore the driving factors of digital transformation for manufacturing enterprises.

In summary, this study differs significantly from other studies in its research subject, data collection methods, and analytical methods. This study focuses on a specific industry (China's garment manufacturing industry) and a specific data collection method (online questionnaire survey), while other studies cover a broader range of industries and employ different data collection methods. Additionally, this study uses convenience sampling techniques to select samples, ensuring the representativeness of the sample and its relevance to the research question.

2.9 Conceptual framework of this thesis

Even though the records have presented the current state of digital transformation of textile and apparel enterprises in China from the perspective of textile and apparel enterprises, it focuses on the impact path of digital transformation of enterprises on their export performance: enterprise innovation path and export cost path. To improve enterprise export performance, the garment manufacturing industry should focus on R&D innovation, personalized design services, opening the entire production and operation data chain from digital production to digital terminal, and responding flexibly to the complex and changing export environment. This study aims to gain insights into digital transformation and related factors affect the operation with digital system in the garment manufacturing industry in China. Thus, understanding and exploring driving factors in the digital transformation of the Chinese garment manufacturing industry is important to provide key findings for the Chinese garment manufacturing industry to find new developments in digital industrial platforms. In the proposed model, the conceptual framework derived from the literature based on the theories of related constructs of digital transformation in manufacturing industry. The conceptual framework of this thesis can be presented as follows.

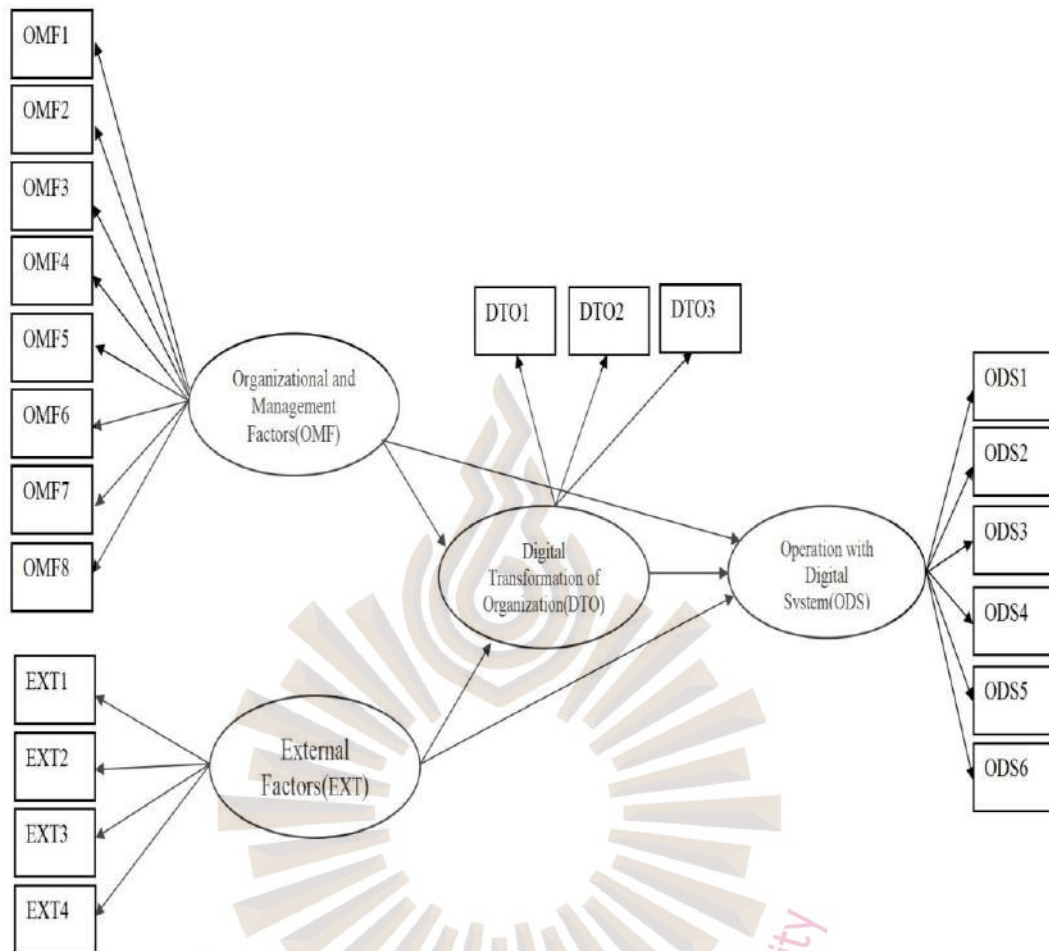


Figure 2.8 The conceptual framework of this thesis

Source: Wangulin, 2024

Note*:

OMF = Organizational and management factors

OMF1 = A supportive organizational culture

OMF2 = Well-managed transformation activities

OMF3 = Leveraging external and internal knowledge

OMF4 = Engaging managers and employees

OMF5 = Growing information system capabilities

OMF6 = Developing dynamic capabilities

OMF7 = Developing a digital business strategy

OMF8 = Aligning business and information systems

EXT = External factors

EXT1 = Customer behaviors and expectations

EXT2 = Digital shifts in the industry

EXT3 = Changing competitive landscape

EXT4 = Regulative changes

DTO = Digital transformation of organization

DTO1 = Reforming an organization's information system

DTO2 = New business models

DTO3 = Affecting outcomes and performance

ODS = Operation with digital system

ODS1 = Ensuring digital readiness

ODS2 = Digitally enhancing products and services

ODS3 = Embracing product innovation

ODS4 = Developing new business models

ODS5 = Improving digital channels

ODS6 = Increasing customer satisfaction

2.10 Hypothesis

In association with the research objectives, 5 sets of hypotheses are proposed based on the extensive literature review reported in Chapter 2. The main constructs in this framework included customer behaviors and expectations, digital shifts in the industry, changing competitive landscape, regulative changes, ensure digital readiness, digitally enhance products and services, embrace product innovation, develop new business models, improve digital channels, increase customer satisfaction, a supportive organizational culture, well-managed transformation activities, leverage external and internal knowledge, engage managers and employees, grow information system capabilities, develop dynamic capabilities, develop a digital business strategy, align business and information systems, reforming an organization's information system,

new business models, and affecting outcomes and performance. In the proposed model, the research hypotheses and proposition derived from the literature based on the theories of related constructs of digital transformation in manufacturing industry. The lists of hypotheses are expressed as follows:

H1: Organizational and management factors significantly affect the digital transformation of organization.

H2: External factors significantly affect the digital transformation of organization.

H3: Digital transformation of organization significantly affects operation with digital system.

H4: Organizational and management factors significantly affect operation with digital system.

H5: External factors significantly affect operation with digital system.

The hypothetical model is shown as follows:

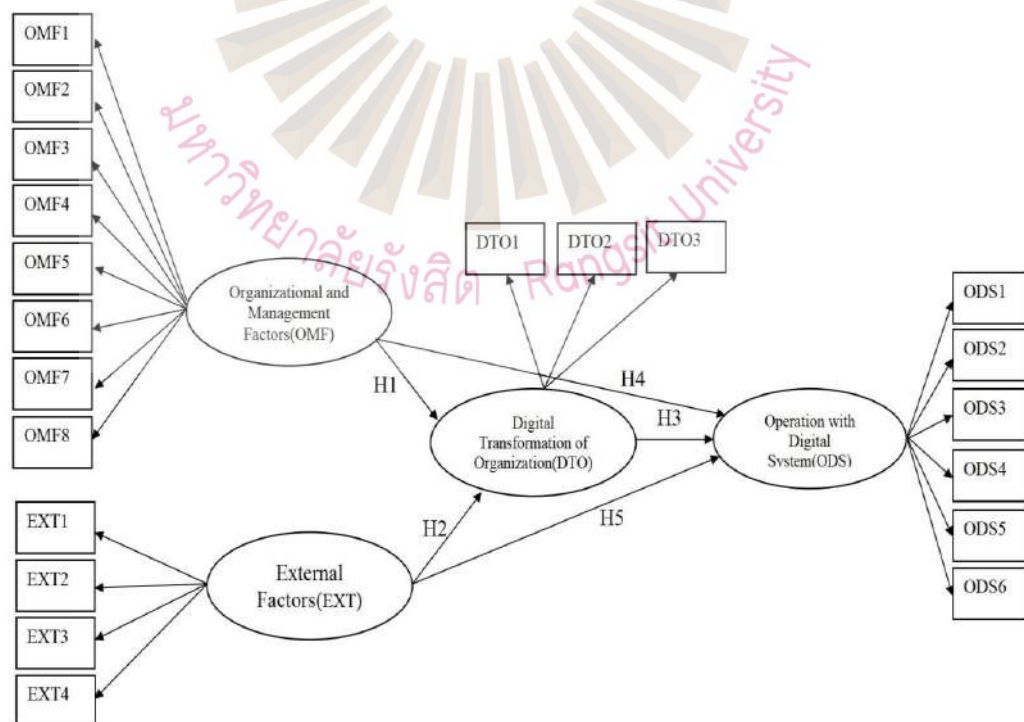


Figure 2.9 The hypothetical model

Source: Wangulin, 2024

Chapter 3

Research Methodology

This chapter explains the methodology and research design used to examine the theoretical model of digital transformation and related factors affect the operation with digital system in the garment manufacturing industry in China. The research framework and specific hypotheses are proposed, followed by a discussion of research design, research population, data collection, a development of survey instrument and the measurement scales. The final section provides a discussion of statistical methods, a Structural Equation Model is employed in this study to reflect the confirmed driving factors about digital transformation of China's garment manufacturing industry.

3.1 Population and Samples

3.1.1 Population

The population were selected from three garment manufacturing industries that adopted AI technology as the research objective based on the research design, the data availability, and the data quality of different sample industries, the requirements of theoretical construction, and the marginal utility of the increasing sample industries. The industries met two requirements. First, they are listed industries that lead the Chinese garment manufacturing industry, they have rich public data and online information; and second, AI technology enables the transformation of traditional manufacturing and creates value for the enterprises (Wang & Su, 2021).

The three industries selected in this study are representative of three types of AI adoption. Industry A mainly relies on the early establishment of a wholly owned, holding IT subsidiary.

Industry B uses its industrial internet platform to establish a cooperative holding company and combines external resources with its own technology capability, and industry C adopts a completely outsourced development mode. The background information of the industries, as well as their implementation of ‘AI+’ mode is introduced in this section (Wang & Su, 2021). Detailed information on the industries is shown in Table 3.1

Table 3.1 Basic information and features of industries

Basic features	Industry A	Industry B	Industry C
Ownership type	Listed industry (state-owned)	Private (shareholding)	Local state-owned (shareholding)
Main products	Garment manufacturing industry		
AI adoption model	Wholly-owned subsidiary	Holding company	Outsourcing
Intelligent manufacturing method	Digitalize the entire value chain and process equipment with intelligent manufacturing technologies.	Adopt a product lifecycle management platform and build a cloud intelligent system.	Use information system to connect equipment terminals.
Intelligent manufacturing features	Integration of the informatization and industrialization.	From selling products to selling services; intelligent synchronization of internal and external.	Digital factory technology
Progress in intelligent manufacturing	Leading the industry in both the number and the application of	Transform from a Traditional manufacturing enterprise to a high-	Smart factory with large-scale computing

Table 3.1 Basic information and features of industries (Cont.)

Basic features	Industry A	Industry B	Industry C
	intelligent devices.	end intelligent service enterprise.	systems and production equipment.
Interviewee	The executives and employees including technician, product manager, product director, technology department leader, AI team members, etc.		
Supplementary data sources	Official Website; News Report; Public Annual Report	Official Website; News Report; Public Annual Report	Official Website; News Report; Public Annual Report

Source: Wang and Su, 2021

3.1.2 Sample Size

Sample size determination is a crucial issue for any statistical analysis. In this study, a sample is the executives and employees from the three selected industries who have some awareness about digital transformation in the garment manufacturing industries. To guarantee the depth and accuracy of the research findings, it is crucial to identify and include respondents who meet the following criteria:

Executive and Employee Status: They should be employed in the Chinese garment manufacturing industry, holding positions that provide them with a comprehensive view of the operations and strategies of their organizations.

Knowledge of Digital Transformation: These individuals should possess a strong grasp of the digital transformation processes currently taking place in the Chinese garment manufacturing sector. This includes an understanding of technological advancements, such as AI, machine learning, IoT, and ERP systems, and how these are being integrated into business practices.

Experience with Digital Initiatives: Preference should be given to those who have actively participated in or led digital initiatives within their organizations. This experience ensures they can provide valuable insights into the challenges, benefits, and outcomes of such transformations.

Awareness of Industry Trends: They should be aware of the latest trends and developments in the garment manufacturing industry, including consumer demands, supply chain management, and competitive landscapes, as these factors influence the digital transformation process.

Ability to Offer Insight: The respondents should be capable of providing detailed and nuanced insights into the processes, strategies, and outcomes of digital transformation within their organizations.

There are some rules of thumbs to determine sample size when applying Structural Equation Model (SEM) analysis in research methodology for further to ensure an appropriate use of maximum likelihood estimator (ML) (Hair et al., 2010). The minimum of sample size must be required to reduce the chance of having an exaggerated goodness-of-fit indices (Anderson and Gerbing, 1988 as cited in Kim, 2015). However, Kline (2011) also suggests a sample size of 10 respondents per estimated parameter to be sufficient sample size.

Sample Size Calculation: The researcher's choice to use a rule of 10 respondents per estimated parameter is based on the nature of Structural Equation Modeling (SEM) and the accuracy of Maximum Likelihood Estimation (ML). SEM is a complex statistical method that combines multiple variables and potential causal relationships. To ensure the accuracy and reliability of the model, an adequate sample size is necessary to estimate and test the parameters within the model. Each estimated parameter requires sufficient data for accurate estimation to ensure that the model fits well and to avoid overestimated fit indices.

Additionally, Maximum Likelihood Estimation (ML) is a commonly used method for parameter estimation, which estimates model parameters by maximizing the log-likelihood function of the observed data. To ensure the accuracy of ML estimation, an adequate sample size is needed to generate sufficient information to estimate model parameters. Therefore, each estimated parameter requires an adequate sample size to ensure the accuracy of ML estimation.

Thus, the researcher's choice to use 10 respondents per estimated parameter is to ensure the accuracy and reliability of SEM analysis, and to avoid overestimated fit indices. This technique is appropriate for research because it provides enough data to estimate and test parameters within the model and to ensure the accuracy and reliability of the model. Thus, the sample size of 260 in this study is sufficient and appropriate to ensure the Structural Equation Modeling (SEM) analysis with 21 measurement scales and 5 hypotheses.

3.2 Research Instrument

The questionnaire was designed as a research instrument based on the comprehensive review of relevant literature focusing on digital transformation and related factors affect the operation with digital system in the garment manufacturing industry in China. The electronic survey is utilized to collect data of this study and the result is reported in English. The data collected from electronic survey. The questionnaire consists of 5 sections as shown in Table 3.2

Table 3.2 Structure of the survey instrument

Section	Questionnaire Included
1	Demographic Characteristics; gender, age, marital status, educational level, ownership type, AI adoption model, intelligent manufacturing method, intelligent manufacturing features, progress in intelligent manufacturing, and supplementary data sources.
2	External factors - Customer behaviors and expectations - Digital shifts in the industry - Changing competitive landscape - Regulative changes
3	Operation with digital system - Ensuring digital readiness - Digitally enhancing products and services - Embracing product innovation - Developing new business models - Improving digital channels - Increasing customer satisfaction
4	Organizational and management factors - A supportive organizational culture - Well-managed transformation activities - Leveraging external and internal knowledge - Engaging managers and employees - Growing information system capabilities - Developing dynamic capabilities - Developing a digital business strategy - Aligning business and information systems
5	Digital transformation of organization

Table 3.2 Structure of the survey instrument (Cont.)

Section	Questionnaire Included
	- Reforming an organization's information system
	- New business models - Affecting outcomes and performance

All of the sections insist of items that utilize a 5-point Likert scale which the scale from 1 to 5 define a) Strongly Disagree to Strongly Agree b) Not Important to Very Important.

3.3 Instrument Testing

3.3.1 Validity and Reliability

The five academic scholars and experts in the School of Business Administration, Yunnan Minzu University were requested to review the content reliability and validity of the indicators and evaluate indicators of each construct and also give the useful suggestion to organize the appropriate instrument for this research. The research instrument is corrected and adjusted in accordance with the recommendations and comments. The Index of Item Objective Congruence (IOC) is applied to find the content validity. The Item Objective Congruence (IOC) is used to evaluate the items of the questionnaire based on the score range from -1 to +1. Congruent = + 1 Questionable = 0 Incongruent = -1. The items that had scores lower than 0.5 were revised. On the other hand, the items that had scores higher than or equal to 0.5 were reserved (Griethuijsen, Eijck, Haste, Brok, & Skinner, 2014).

After the items of the measurement scales are adjusted and developed, the pre-testing of the scales was conducted in order to evaluate the reliability and validity of this research before the gathering data (Hinkin, Tracey, & Enz, 1997). According the determine pilot sample size using the confidence interval approach, a sample with

80% accuracy at the 95% confidence level is calculated as $n = 1.962 (0.5*0.5) / 0.22$, The result based on this formula is 25 (Chi, 2005). Thus, the first version of questionnaire is conducted and distributed in a small-scale preliminary testing to 30 Chinese executives and employees in the garment manufacturing industry in order to ensure the reliability and validity of the construct before the main research.

The scale in this study is adapted from established existing measures that have been applied and validated in a number of the garment manufacturing industry research. In order to ensure that the measurement scale is reliable, the reliability of measurement is examined by Cronbach's alpha test which is frequently used in various research. The reliability coefficients score is generally agreed upon limit for Cronbach's Alpha is 0.70 which is defined as adequate, while 0.80 and 0.90 are defined as good and excellent respectively (Chang, 2013; Kim, 2015).

3.3.2 Measurement scales

1) Organizational and management factors

Osmundsen, Iden, & Bygstad (2018) and Morakanyane, Grace, & O'Reilly (2017) conducted a study on factors regarding digital transformation. This employed the 8 items of organizational and management factors (success factors) measurement scale developed by Osmundsen et al. (2018) and Morakanyane et al. (2017) that studied the organizational and management factors (success factors), which is one of the most important factors regarding digital transformation as follows: A supportive organizational culture, Well-managed transformation activities, Leveraging external and internal knowledge, Engaging managers and employees, Growing information system capabilities, Developing dynamic capabilities, Developing a digital business strategy, and Aligning business and information systems. The items of scale are measured using five-point rating scale 1-5 ranking from "No Importance" to "Extremely Important". The scales have scores higher than or equal to 0.5 were

reserved while, the decision criteria of Cronbach's alpha coefficient as aforementioned is 0.70 (Griethuijsen, Eijck, Haste, Brok, & Skinner, 2014).

2) External factors

Osmundsen et al. (2018) and Morakanyane et al. (2017) conducted a study on factors regarding digital transformation. This employed the 4 items of external factors (drivers) measurement scale developed by Osmundsen et al. (2018) and Morakanyane et al. (2017) that studied the external factors (drivers), which is one of the most important factors regarding digital transformation as follows: Customer behaviors and expectations, Digital shifts in the industry, Changing competitive landscape, and Regulative changes. The items of scale are measured using five-point rating scale 1-5 ranking from "No Importance" to "Extremely Important". The scales have scores higher than or equal to 0.5 were reserved while, the decision criteria of Cronbach's alpha coefficient as aforementioned is 0.70 (Griethuijsen, Eijck, Haste, Brok, & Skinner, 2014).

3) Digital transformation of organization

Osmundsen et al. (2018) and Morakanyane et al. (2017) conducted a study on factors regarding digital transformation. This employed the 3 items of digital transformation of organization (implications) measurement scale developed by Osmundsen et al. (2018) and Morakanyane et al. (2017) that studied the digital transformation of organization (implications), which is one of the most important factors regarding digital transformation as follows: Reforming an organization's information system, New business models, and Affecting outcomes and performance. The items of scale are measured using five-point rating scale 1-5 ranking from "No Importance" to "Extremely Important". The scales have scores higher than or equal to 0.5 were reserved while, the decision criteria of Cronbach's alpha coefficient as aforementioned is 0.70 (Greithuijsen et al., 2014).

4) Operation with digital system

Osmundsen et al. (2018) and Morakanyane et al. (2017) conducted a study on factors regarding digital transformation. This employed the 6 items of operation with digital system (objectives) measurement scale developed by Osmundsen et al. (2018) and Morakanyane et al. (2017) that studied the operation with digital system (objectives), which is one of the most important factors regarding digital transformation as follows: Ensuring digital readiness, Digitally enhancing products and services, Embracing product innovation, Developing new business models, Improving digital channels, and Increasing customer satisfaction. The items of scale are measured using five-point rating scale 1-5 ranking from “No Importance” to “Extremely Important”. The scales have scores higher than or equal to 0.5 were reserved while, the decision criteria of Cronbach’s alpha coefficient as aforementioned is 0.70 (Greithuijsen et al., 2014).

Thus, the empirical model of this study consists of 4 variables: organizational and management factors, external factors, operation with digital system, and digital transformation of organization with the total 21 observed variables.

3.4 Data Collection

According to study driving factors about digital transformation in the Chinese garment manufacturing industry as aforementioned in chapter 1, several studies have collected data from the other companies or enterprises, therefore the results could not single out driving factors relative influence on digital transformation of the Chinese garment manufacturing industry (Hsu and Lam, 2003). The qualified respondents needed to be the executives and employees, who have some awareness about digital transformation of the Chinese garment manufacturing industry.

This study employed the convenience sampling technique to select its sample. Convenience sampling is a non-probability sampling method where researchers select samples based on availability and convenience. This method is typically used in exploratory research when there is a lack of detailed understanding of the characteristics of the entire population, or when research resources are limited.

In this study, researchers selected three garment manufacturing industries that have adopted artificial intelligence technology as the research subjects. These industries were chosen based on the research design, the availability and quality of data between different sample industries, the requirements of theoretical construction, and the marginal utility of increasing sample industries. The reason for selecting these industries is that they are leading public companies in the Chinese garment manufacturing industry, with abundant public data and online information; artificial intelligence technology can enable the transformation of traditional manufacturing and create value for enterprises. Specifically, these three industries represent three different modes of AI adoption: Industry A mainly relies on the early establishment of a wholly-owned subsidiary; Industry B uses its industrial internet platform to establish a cooperative holding company and combines external resources with its own technological capabilities; Industry C adopts a completely outsourced development model.

In selecting the sample, the researchers ensured the representativeness of the sample, choosing managers and employees from these three industries who have an understanding of the digital transformation of the Chinese garment manufacturing industry. This sampling method allows researchers to select appropriate samples based on the research purpose and available resources, while ensuring that the sample is relevant to the research question.

This study will employ an online questionnaire survey for data collection. The questionnaire will be launched on Wjx.cn, a popular Chinese survey platform,

allowing respondents to complete the survey via the website. The data collection period is scheduled from April 1, 2024 to May 15, 2024.

3.5 Data Analysis

The Structural Equation Model (SEM) is employed to estimate the causal relationship model in order to confirm a relationship between observed variables and corresponding latent variables. Multiple goodness of fit indices are applied to evaluate the correspondence of proposed model. According to Kline (2011), a set of fit indices must be applied to check overall fit for the measurement. Using different the goodness-of-fit statistics; the goodness-of-fit index (GFI) including the adjusted goodness-of-fit index (AGFI), the normed fit index (NFI), the comparative fit index (CFI), the root mean square residual (RMR) and the root mean square error of approximation (RMSEA) to measure the overall model. Moreover Kline (2004) also suggested that a model demonstrates reasonable fit if the relative chi-square which is the statistic adjusted by its degrees of freedom or so called as (χ^2/df) is considered satisfactory when its value is less than 5 .

3.6 Statistical Tools

This section explains the statistical methods used in this research. Structural Equation Modeling (SEM) by using Mplus to simultaneously test the conceptual model and a series of hypothesis and answer the research questions. The data analysis of this study consists of three stages as followed;

3.6.1 Descriptive analysis

Descriptive statistics involves summarizing and organizing the data for further the analysis that can be easily understood. In this study, the preliminary data analysis using the univariate analysis method was employed to describe the key

characteristics of the observations. The distribution, the central tendency and the dispersion statistical analysis including frequency, percentage, mean, and standard deviation were used to describe the demographic information of the Chinese respondents, who participated in the study such as gender, age, marital status, educational level, ownership type, AI adoption model, intelligent manufacturing method, intelligent manufacturing features, progress in intelligent manufacturing, and supplementary data sources. While mean and standard deviation are also employed to describe the constructs of this study which are interval scales; external factors, operation with digital system, organizational and management factors, and digital transformation of organization. The interpretation of mean interval and corresponding according to Best and Kahn (1993) suggested the mean interval is considered as extremely importance when the mean value is between 4.51 – 5.00, Importance when the mean interval is between 3.51 – 4.50 and moderate when the mean interval is between 2.51 – 3.50, not very importance when the mean interval is between 1.51 – 2.50 and no importance when its value is between 1.01 – 1.50 as shown in Table 3.3.

Table 3.3 Mean interval and corresponding interpretation

Mean Value	Interpretation
4.51 – 5.00	Extremely importance
3.51 – 4.50	Importance
2.51 – 3.50	Moderate
1.51 – 2.50	Not very importance
1.00 – 1.50	No importance

Source: Best and Kahn, 1993

3.6.2 Structural Equation Model

The Structural Equation Model (SEM) is employed to estimate the causal relationship model in order to confirm a relationship between observed variables and corresponding latent variables. The analysis of Structural Equation Model (SEM) was

developed by Karl G. Joreskog in 1960 which is the integration of measurement of factor analysis and structural path analysis models and parametric estimation method of econometrics. Thus, the structural equation modeling analysis is regarded as high analyzed statistic that was redeveloped but remains original statistical basics (Joreskog, 1969). Therefore, it can be said that the study of structural equation modeling analysis does not only help learners to be able to analyze data that contains various factors for researches that are supported by theoretical basics, but also helps learners to understand the basics of all analytical statistics so that they have direct experiences of understanding the role of analytical statistics toward the research. Furthermore, analytical statistics of SEM has the potential to analyze multi-level causal model, longitudinal factor analysis model, multiple population model, and latent growth curve model and many more (Joreskog & Sorbom, 1979) as well as analyze SEM models of non-linear relationship factors (Joreskog & Moustaki, 2001). SEM analytical statistics is perfect for social science and behavioral science works in the age of knowledge societies according to the following summary.

- 1) Has the potential to analyze data in a broader view because of its analytical basics that can analyze data same as an easiest analytical statistic as T-Test to advanced statistics as mentioned above (Butcher, Kretschmar, Singer, & Flannery, 2015).
- 2) Able to use the analytical statistics as an outlook according to the research models and contains validity statistics of the research models.
- 3) Statistical primary relaxation of assumption; normally advanced analytic statistics contain more statistical primary of assumptions, but SEM analytical statistics contain less statistical primary assumption (Jomnonkwao & Ratanavaraha, 2015).

SEM analytical statistics applied error terms into the analysis in order to be able to analyze data in case terms of errors are related resulting in variables of the model that lead to errors or obtaining the model that contains latent and predictor variables that might be related to each other (Kozan & Richardson, 2014). Tarnanidis,

Owusu, Nwankwo, & Omar (2015) pointed that analysis models are not required to be a positive influence model that has one-way influence but can be a multiple model and has reverse influences. In addition, it can be used to analyze in the case there are many variables in the research model and has nominal scale.

4) Regarding experimental research, when variables are created according to measurement model and extraneous variables are in the form of latent variables, the analysis using SEM analytical statistics will give accurate results better than the analysis using original ANOVA and MANOVA (Kline, 2011; William & O'Boyle, 2015).

Before the process of Structural Equation Model analysis, the correlation coefficients must be estimated whether the exogenous variables have linear regression correlation which is one condition of SEM analysis. The correlation coefficient is also known as the Pearson product-moment correlation coefficient. Subsequently, the exogenous variables in the research model must be examined that there is no multicollinearity problem and homoscedasticity variance in the measurement error.

Multiple goodness of fit indices is applied to evaluate the correspondence of proposed model. According to Kline (2004, 2005), a set of fit indices must be applied to check overall fit for the measurement. Table 3.4 presents acceptable level of multiple types of Goodness-of-fit indices used in SEM (Kline, 2005).

Table 3.4 Goodness-of-fit Indices Criteria

Fit Index	Criteria
Goodness-of-fit Index (GFI)	> .90
Adjusted Goodness-of-fit Index (AGFI)	> .85
Normed Fit Index (NFI)	> .90

Table 3.4 Goodness-of-fit Indices Criteria (Cont.)

Fit Index	Criteria
Comparative Fit Index (CFI)	> .90
Root Mean Square Residual (RMR)	< .50
Root Mean Square Error of Approximation (RMSEA)	< .08
Relative Chi Square (χ^2 / df)	< 3.0

Source: Kline, 2004, 2005

Furthermore, the effect analysis is conducted by employing path analysis using Mplus in order to understand comparative strengths of direct and indirect relationships among a set of variables. The estimated coefficient of effect analysis among the research constructs can identify the significance of hypotheses testing in this study.

3.7 Ethical considerations

This research follows the research ethics policy of Rangsit University, this included the following considerations:

- 1) Participant anonymity and data confidentiality were prioritized.
- 2) The purpose of the study is clearly communicated to participants.
- 3) Keeping the identities of the participants anonymous.
- 4) Ensuring that participants are not harmed or disturbed.
- 5) Providing every participant with a copy of the Informed Consent Letter.
- 6) Ensure that participants are compensated in proportion to their efforts.

Chapter 4

Research Results

This chapter consists of four sections, the first section describes the profile of respondents and then followed by the individual measurement of each constructs; Drivers, Objectives, Success factors, and Implications. Subsequently, results of the overall measurement model are reported. Finally, structural model testing results are presented together with results of effect analysis and hypothesis testing.

4.1 Descriptive Analysis

4.1.1 Demographic Analysis

The sampling procedure described in Chapter 3 yielded a total of 260 responses. It is hard to compare responses rates with the different studies regarding to the nature of online panel survey as there are various kinds of lengths, topics and incentive supported (Huang, 2009). The profile of respondents is shown in Table 4.1

Table 4.1 Demographic Profile of Respondents

Characteristics	Frequency	Percentage
Gender		
Male	142	54.6
Female	118	45.4
Age		
20 – 25	21	8.0
25 – 30	36	13.8
31 – 35	52	20.0

(n = 260)

Table 4.1 Demographic Profile of Respondents (Cont.)

Characteristics	Frequency	Percentage
36 – 40	41	15.7
41 – 45	33	12.6
46 – 50	38	14.6
51 – 55	32	12.3
56 – 60	7	3.0
Marital Status		
Single	104	40.0
Married / In relationship	57	21.9
Divorced	47	18.0
Separated	34	13.0
Widow	18	7.1
Educational Background		
Secondary	22	8.5
Diploma / Vocational	78	30.0
Bachelor's degree	124	47.7
Master's degree or Higher Degree	36	13.8
Ownership type		
Listed industry (state-owned)	86	33.0
Private (shareholding)	90	34.6
Local state-owned (shareholding)	84	32.4
AI adoption model		
Wholly-owned subsidiary	127	48.8
Holding company	84	32.3
Outsourcing	49	18.9
Intelligent manufacturing method		
Digitalize the entire value chain and process equipment with intelligent manufacturing technologies	113	43.4

Table 4.1 Demographic Profile of Respondents (Cont.)

Characteristics	Frequency	Percentage
Adopt a product lifecycle management platform and build a cloud intelligent system	86	33.0
Use information system to connect equipment terminals	61	23.6
Intelligent manufacturing features		
Integration of the informatization and industrialization	78	30.0
From selling products to selling services; intelligent synchronization of internal and external	84	32.3
Digital factory technology	98	37.7
Progress in intelligent manufacturing		
Leading the industry in both the number and the application of intelligent devices	76	29.2
Transform from a traditional manufacturing enterprise to a high-end intelligent service enterprise	88	33.8
Smart factory with large-scale computing systems and production equipment	96	37.0
Supplementary data sources		
Official Website	68	26.1
News Report	77	29.6
Public Annual Report	115	44.3

According to part 1 from the research instrument, respondents demographic data of effective sample from 260 respondents were analyzed by descriptive statistics using the SPSS. Table 4.1 presents the demographic profile of respondents. Male respondents (54.6%) slightly outnumbered their female counterparts (45.4%). There are 8.0% of the respondents who are in the age between 20 – 25, the slightly different number between age 25 - 30 and 31 - 35 represented by 13.8% and 20.0%

respectively. Moreover, 15.7% of the respondents who are in the age between 36 – 40, while the different number between age 41 - 45 and 46 - 50 represented by 12.6% and 14.6% respectively. There are 12.3% of the respondents who are in the age between 51 – 55. On the other hand, the lowest percentage is in the age between 56 – 60 represented by 3.0%.

In terms of marital status, 40.0% of the respondents are single, while 21.9% are married or in relationship. There are 18.0% of the respondents who are divorced and the slightly different number of the respondents, who are separated and widow represented by 13.0% and 7.1% respectively. Additionally, the respondents were asked about their educational background. Nearly 92% of the respondents finished their degrees from the university or college; Diploma / Vocational (30.0%); Bachelor's degree (47.7%); and Master's degree or Higher Degree (13.8%), while only 8.5% of the respondents were educated from secondary school. Ownership type was asked with the respondents. Most of the respondents are in listed industry (state-owned) represented by 33.0%, while the slightly different number of private (shareholding) and local state-owned (shareholding) are 34.6% and 32.4% respectively.

The respondents were interviewed about AI adoption model. Nearly half (48.8%) of the respondents said they are in wholly-owned subsidiary, while the respondents are in holding company and outsourcing represented by 32.3% and 18.9% respectively. The respondents were also questioned about intelligent manufacturing method. Most of the respondents involve in digitalizing the entire value chain and process equipment with intelligent manufacturing technologies (43.4%), while 33.0% of the respondents involve in adopting a product lifecycle management platform and build a cloud intelligent system. Moreover, only 23.6% of the respondents were involved in using information system to connect equipment terminals.

In terms of intelligent manufacturing features, the respondents said they involve in integration of the informatization and industrialization (30.0%), while 32.3% of the respondents were involved in selling products to selling services,

intelligent synchronization of internal and external. 37.7% of the respondents were involved in digital factory technology. Additionally, progress in intelligent manufacturing was asked, 29.2% of the respondents said they involve in leading the industry in both the number and the application of intelligent devices. The respondents replied 33.8% in transform from a traditional manufacturing enterprise to a high-end intelligent service enterprise, while 37.0% of the respondents were involved in smart factory with large-scale computing systems and production equipment. Furthermore, the topic of supplementary data sources was interviewed with the respondents. 26.1% of the respondents said for official website, while 29.6% said news report and 44.3% for public annual report.

4.1.2 Variable Attribute Analysis

According to the conceptual model in chapter 3. Descriptive statistics were conducted to examine the mean value of each research constructs: external factors, operation with digital system, organizational and management factors, and digital transformation of organization were tested. Each construct presented the measurement indicators; Mean value and Standard Deviation (S.D.) from the collective data in the research instrument.

1) External factors

Table 4.2 External Factors Analysis

Item	Mean	S.D.	Interpretation
Customer behaviors and expectations	3.34	0.81	Moderate
Digital shifts in the industry	3.37	0.79	Moderate
Changing competitive landscape	3.34	0.84	Moderate
Regulative changes	3.24	0.84	Moderate
Overall	3.32	0.61	Moderate

According to the table 4.2, mean value and standard deviation (S.D.) indicators of external factors from all items is moderate value (Mean = 3.32, S.D. = 0.61). The findings revealed that the highest mean value is digital shifts in the industry (Mean = 3.37, S.D. = 0.79). The second mean values are customer behaviors and expectations and changing competitive landscape respectively (Mean = 3.34, S.D. = 0.81; Mean = 3.34, S.D. = 0.84). On the other hand, the item of regulative changes shows the lowest mean value (Mean = 3.24, S.D. = 0.84).

2) Operation with digital system

Table 4.3 Operation with Digital System Analysis

Item	Mean	S.D.	Interpretation
Ensuring digital readiness	3.39	0.76	Moderate
Digitally enhancing products and services	3.27	0.83	Moderate
Embracing product innovation	3.35	0.81	Moderate
Developing new business models	3.24	0.82	Moderate
Improving digital channels	3.39	0.77	Moderate
Increasing customer satisfaction	3.41	0.76	Moderate
Overall	3.35	0.51	Moderate

According to the table 4.3, mean value and standard deviation (S.D.) indicators of operation with digital system from all items is moderate value (Mean = 3.35, S.D. = 0.51). The findings revealed that the highest mean value is increasing customer satisfaction (Mean = 3.41, S.D. = 0.76). The second mean values are ensuring digital readiness and improving digital channels (Mean = 3.39, S.D. = 0.76; Mean = 3.39, S.D. = 0.77). The third mean value is embracing product innovation (Mean = 3.35, S.D. = 0.81) while, the item of digitally enhancing products and services is slower than embracing product innovation (Mean = 3.27, S.D. = 0.83). Additionally, the item of developing new business models shows the lowest mean value (Mean = 3.24, S.D. = 0.82).

3) Organizational and management factors

Table 4.4 Organizational and Management Factors Analysis

Item	Mean	S.D.	Interpretation
A supportive organizational culture	3.32	0.82	Moderate
Well-managed transformation activities	3.28	0.80	Moderate
Leveraging external and internal knowledge	3.38	0.74	Moderate
Engaging managers and employees	3.39	0.78	Moderate
Growing information system capabilities	3.36	0.79	Moderate
Developing dynamic capabilities	3.25	0.74	Moderate
Developing a digital business strategy	3.36	0.74	Moderate
Aligning business and information systems	3.39	0.72	Moderate
Overall	3.35	0.50	Moderate

According to the table 4.4, mean value and standard deviation (S.D.) indicators of organizational and management factors from all items is moderate value (Mean = 3.35, S.D. = 0.50). The findings revealed that there are two items that are engaging managers and employees and aligning business and information systems represented the highest mean value (Mean = 3.39, S.D. = 0.78; Mean = 3.39, S.D. = 0.72). The second mean values is leveraging external and internal knowledge (Mean = 3.38, S.D. = 0.74). The third mean value are growing information system capabilities and developing a digital business strategy (Mean = 3.36, S.D. = 0.79; Mean = 3.39, S.D. = 0.74) while, the item of a supportive organizational culture is slightly slower than the third one (Mean = 3.32, S.D. = 0.82). The item of well-managed transformation activities shows the fifth mean value (Mean = 3.28, S.D. = 0.80). Additionally, the item of developing dynamic capabilities shows the lowest mean value (Mean = 3.25, S.D. = 0.74).

4) Digital transformation of organization

Table 4.5 Digital Transformation of Organization Analysis

Item	Mean	S.D.	Interpretation
Reforming an organization's information system	3.29	0.77	Moderate
New business models	3.23	0.75	Moderate
Affecting outcomes and performance	3.37	0.70	Moderate
Overall	3.30	0.59	Moderate

According to the table 4.5, mean value and standard deviation (S.D.) indicators of digital transformation of organization from all items is moderate value (Mean = 3.30, S.D. = 0.59). The findings revealed that the highest mean value is affecting outcomes and performance (Mean = 3.37, S.D. = 0.70). The second mean value is reforming an organization's information system (Mean = 3.29, S.D. = 0.77). On the other hand, the item of new business models shows the lowest mean value (Mean = 3.23, S.D. = 0.75).

4.2 Statistic Analysis

In this part presents measurement model testing in this research model by employing Mplus. The model composed of 4 latent variables that were external factors, operation with digital system, organizational and management factors, and digital transformation of organization. Additionally, the model consisted of 21 observed variables that involved 4 latent variables. The following abbreviations of latent variables and observed variables are shown as follows.

OMF = Organizational and management factors

OMF1 = A supportive organizational culture

OMF2 = Well-managed transformation activities

OMF3 = Leveraging external and internal knowledge

OMF4 = Engaging managers and employees
 OMF5 = Growing information system capabilities
 OMF6 = Developing dynamic capabilities
 OMF7 = Developing a digital business strategy
 OMF8 = Aligning business and information systems

EXT = External factors

EXT1 = Customer behaviors and expectations
 EXT2 = Digital shifts in the industry
 EXT3 = Changing competitive landscape
 EXT4 = Regulative changes

DTO = Digital transformation of organization

DTO1 = Reforming an organization's information system
 DTO2 = New business models
 DTO3 = Affecting outcomes and performance

ODS = Operation with digital system

ODS1 = Ensuring digital readiness
 ODS2 = Digitally enhancing products and services
 ODS3 = Embracing product innovation
 ODS4 = Developing new business models
 ODS5 = Improving digital channels
 ODS6 = Increasing customer satisfaction

4.2.1 Overall Model Testing

Table 4.6 presents the correlation matrix among the variables in the overall measurement model. Of the 21 elements in the matrix, seventeen elements were significant at the 0.01 level. On the other hand, four elements were significant at the 0.05 level. Additionally, the findings of correlation Matrix of latent variables in the

overall measurement model revealed that all variables in correlation matrix had a value of correlation between 0.073 – 0.897. The correlation matrix analysis of 21 observed variables on Chinese garment manufacturing' digital transformation revealed a level of statistical significance of .05, and KMO was 0.697.



Table 4.6 Correlation Matrix of Latent Variables in The Overall Measurement Mode

Variables	EXT 1	EXT 2	EXT 3	EXT 4	ODS 1	ODS 2	ODS 3	ODS 4	ODS 5	ODS 6	OMF 1	OMF 2	OMF 3	OMF 4	OMF 5	OMF 6	OMF 7	OMF 8	DTO 1	DT O2	DTO 3
EXT1	1.000																				
EXT2	.448* *	1.00 0																			
EXT3	.418* *	.373 **	1.00 0																		
EXT4	.286* *	.405 **	.551 **	1.000																	
ODS1	.183* *	.301 **	.390 **	.448* *	1.000																
ODS2	.341* *	.297 **	.308 **	.315* *	.496* *	1.000															
ODS3	.166* *	.214 **	.309 **	.324* *	.490* *	.376* *	1.000														
ODS4	.325* *	.153 **	.284 **	.323* *	.360* *	.439* *	.424* *	1.000													
ODS5	.641* *	.270 **	.273 **	.195* *	.107* *	.208* *	.107* *	.196* *	1.000												

Table 4.6 Correlation Matrix of Latent Variables in The Overall Measurement Mode (Cont.)

Variables	EXT 1	EXT 2	EXT 3	EXT 4	ODS 1	ODS 2	ODS 3	ODS 4	ODS 5	ODS 6	OMF 1	OMF 2	OMF 3	OMF 4	OMF 5	OMF 6	OMF 7	OMF 8	DTO 1	DT O2	DTO 3
ODS6	.277* *	.687 **	.310 **	.313* *	.234* *	.197* *	.192* *	.119* *	.361* *	1.000											
OMF1	.264 **	.260 **	.705 **	.394 **	.305 **	.22 **	.233 **	.223 **	.45 **	.44 **	1.00 0										
OMF2	.173* *	.268 **	.398 **	.761* *	.339* *	.244* *	.277* *	.227* *	.264* *	.507* *	.534* *	1.000									
OMF3	.120* *	.200 **	.281 **	.308* *	.739* *	.398* *	.413* *	.319* *	.216* *	.362* *	.442* *	.458* *	1.000								
OMF4	.210* *	.200 **	.232 **	.266* *	.393* *	.724* *	.316* *	.355* *	.274* *	.315* *	.280* *	.347* *	.473* *	1.000							
OMF5	.084* *	.147 **	.195 **	.234* *	.383* *	.276* *	.708* *	.377* *	.260* *	.237* *	.400* *	.281* *	.443* *	.354* *	1.000						
OMF6	.166* *	.084 **	.214 **	.232* *	.320* *	.351* *	.366* *	.727* *	.194* *	.176* *	.237* *	.303* *	.344* *	.412* *	.386* *	1.000					
OMF7	.624* *	.231 **	.245 **	.149* *	.076* *	.160* *	.073* *	.155* *	.839* *	.344* *	.405* *	.225* *	.120* *	.230* *	.211* *	.254* *	1.000				

Table 4.6 Correlation Matrix of Latent Variables in The Overall Measurement Mode. (Cont.)

Variables	EXT 1	EXT 2	EXT 3	EXT 4	ODS 1	ODS 2	ODS 3	ODS 4	ODS 5	ODS 6	OMF 1	OMF 2	OMF 3	OMF 4	OMF 5	OMF 6	OMF 7	OMF 8	DTO 1	DTO 2	DTO 3
OMF8	.279 **	.728 **	.304 **	.301 **	.199 **	.189 **	.159 **	.105 **	.334 **	.891 **	.364* *	.387* *	.277* *	.264* *	.224* *	.219* *	.390* *	1.000			
DTO1	.253 **	.245 **	.713 **	.367 **	.233 **	.179 **	.177 **	.186 **	.394 **	.354 **	.857* *	.432* *	.283* *	.245* *	.314* *	.273* *	.516* *	.408* *	1.000		
DTO2	.170 **	.284 **	.400 **	.774 **	.292 **	.235 **	.234 **	.219 **	.204 **	.394 **	.444* *	.897* *	.361* *	.283* *	.274* *	.370* *	.261* *	.449* *	.492* *	1.000	
DTO3	.111 **	.201 **	.284 **	.297 **	.743 **	.383 **	.383 **	.300 **	.101 *	.289 **	.295* *	.373* *	.856* *	.449* *	.406* *	.435* *	.149* *	.362* *	.335* *	.451* *	1.000
Mean	3.33	3.36	3.34	3.24	3.38	3.27	3.35	3.24	3.39	3.41	3.32	3.28	3.38	3.39	3.36	3.25	3.36	3.39	3.29	3.23	3.37
S.D.	0.80	0.79	0.83	0.84	0.76	0.83	0.81	0.82	0.77	0.76	0.82	0.80	0.74	0.78	0.79	0.74	0.74	0.72	0.77	0.75	0.70
Bartlett's Test of Sphericity = 10867.112, df = 210, p = .00, KMO = 0.697																					

**p<0.01, *p<0.05

4.2.2 Structural Model Testing

After the overall measurement model was found acceptable, the structural model was tested with the collective data (n=260). Structural relations between exogenous and endogenous variables were estimated by testing the structural model. By running Mplus as shown in the figure 4.1, all parameters were estimated. Those parameters included path coefficients between exogenous and endogenous variables, variances of the latent variables, disturbance terms of the endogenous variables, loading coefficient. A set of statistics indicated that the proposed model in figure 4.1 showed a good fit of empirical data when chi-square = 421.676, degree of freedom = 174, $c^2 / df = 2.42$ which is less than 3 and signified as acceptable when $n > 200$ (Kline, 2004). The goodness of fit index (GFI) = 0.90, the adjusted goodness-of-fit index (AGFI) = 0.86 which is close to 0.90 and it is defined as acceptable fit when AGFI is great than 0.85 (Schermelleh-Engel et al., 2003), the normed fit index (NFI) = 0.92 which is more than 0.90 and the comparative fit index (CFI) = 0.97 which is over than 0.90. Subsequently, the root means square residual (RMR) = 0.46 which is less than 0.50 and the root mean square error of approximation (RMSEA) = 0.068 which is less than 0.08 as presented in Table 4.7. Therefore, the proposed model is fitted to empirical data according to aforementioned goodness of fit indices.

Table 4.7 Multiple Goodness of Fit Indices

Fit Index	Value	Criteria
Goodness-of-fit Index (GFI)	0.90	> .90
Adjusted Goodness-of-fit Index (AGFI)	0.86	> .85
Normed Fit Index (NFI)	0.92	> .90
Comparative Fit Index (CFI)	0.97	> .90
Root Mean Square Residual (RMR)	0.46	< .50
Root Mean Square Error of Approximation (RMSEA)	0.068	< .08
Relative Chi-square (c^2 / df)	2.42	< 3.00

By running Mplus, the validity of the conceptual elements of the digital transformation model is analyzed. Each variable is associated with a regression coefficient (b), standard error (SE), t-value, and R-squared (R²). The regression coefficient represents the strength and direction of the relationship between the independent variable and the dependent variable. The standard error measures the accuracy of the coefficient estimate. The t-value is used to test the hypothesis that the coefficient is different from zero. The R-squared value represents the proportion of the variance in the dependent variable that can be explained by the independent variable as presented in Table 4.8.

1) External factors (EXT): The results show that external factors have a significant positive impact on the digital transformation of the organization ($b = 0.710$, $t = 8.290$, $R^2 = 0.504$). Among the external factors, regulative changes have the most significant impact ($b = 0.715$, $t = 9.583$, $R^2 = 0.511$).

2) Operation with digital system (ODS): The results show that operation with digital system has a significant positive impact on the digital transformation of the organization ($b = 0.931$, $t = 17.506$, $R^2 = 0.867$). Among the factors related to operation with digital system, ensuring digital readiness has the most significant impact ($b = 0.558$, $t = 6.373$, $R^2 = 0.311$).

3) Organizational and management factors (OMF): The results show that organizational and management factors have a significant positive impact on the digital transformation of the organization ($b = 1.002$, $t = 17.403$, $R^2 = 0.735$). Among the organizational and management factors, well-managed transformation activities have the most significant impact ($b = 0.634$, $t = 8.398$, $R^2 = 0.402$).

4) Digital transformation of organization (DTO): The results show that digital transformation of organization has a significant positive impact on the digital transformation of the organization ($b = 0.877$, $t = 17.109$, $R^2 = 0.769$). Among the factors related to digital transformation of organization, new business models have the most significant impact ($b = 0.717$, $t = 10.335$, $R^2 = 0.514$).

The goodness-of-fit indices (GFI, AGFI, NFI, CFI, RMR, RMSEA) suggest that the model fits the data well. The relative Chi-square value is 2.42, which is within the acceptable range, indicating a good fit between the model and the data. The GFI, AGFI, NFI, and CFI values are all above the recommended cut-off values, indicating a good fit. The RMR value is 0.46, which is below the recommended value of 0.50, indicating a good fit. The RMSEA value is 0.068, which is within the acceptable range, indicating a good fit.

Table 4.8 The Validity Analysis of the Conceptual Elements of Digital Transformation

Variables	b	SE	t	R ²
External factors (EXT)	0.710	0.043	8.290	0.504
Customer behaviors and expectations: EXT1 (y1)	0.407	0.047	4.338	0.165
Digital shifts in the industry: EXT2 (y2)	0.509	0.046	5.507	0.259
Changing competitive landscape: EXT3 (y3)	0.586	0.039	7.537	0.343
Regulative changes: EXT4 (y4)	0.715	0.037	9.583	0.511
Operation with digital system (ODS)	0.931	0.027	17.506	0.867
Ensuring digital readiness: ODS1 (y5)	0.558	0.044	6.373	0.311
Digitally enhancing products and services: ODS2 (y6)	0.512	0.051	5.000	0.262
Embracing product innovation: ODS3 (y7)	0.553	0.049	5.681	0.306
Developing new business models: ODS4 (y8)	0.561	0.048	5.905	0.315
Improving digital channels: ODS5 (y9)	0.477	0.045	5.330	0.227
Increasing customer satisfaction: ODS6 (y10)	0.515	0.043	5.971	0.265
Organizational and management factors (OMF)	0.965	0.020	17.403	0.735

Table 4.8 The Validity Analysis of the Conceptual Elements of Digital Transformation
(Cont.)

Variables	b	SE	t	R ²
A supportive organizational culture: OMF1 (y11)	0.574	0.038	7.494	0.330
Well-managed transformation activities: OMF2 (y12)	0.634	0.038	8.398	0.402
Leveraging external and internal knowledge: OMF3 (y13)	0.631	0.038	8.362	0.398
Engaging managers and employees: OMF4 (y14)	0.587	0.047	6.244	0.344
Growing information system capabilities: OMF5 (y15)	0.601	0.045	6.661	0.362
Developing dynamic capabilities: OMF6 (y16)	0.595	0.045	6.600	0.354
Developing a digital business strategy: OMF7 (y17)	0.434	0.045	4.859	0.189
Aligning business and information systems: OMF8 (y18)	0.496	0.044	5.660	0.246
Digital transformation of organization DTO	0.877	0.026	17.109	0.769
Reforming an organization's information system: DTO1 (y19)	0.553	0.037	7.390	0.306
New business models: DTO2 (y20)	0.717	0.035	10.335	0.514
Affecting outcomes and performance: DTO3 (y21)	0.652	0.035	9.297	0.425
Relative Chi-square (c^2 / df) = 2.42, GFI = 0.90, AGFI = 0.86, NFI = 0.92, CFI = 0.97, RMR = 0.46, RMSEA = 0.068				

The following figure depicts a second order confirmatory factor analysis of digital transformation model.

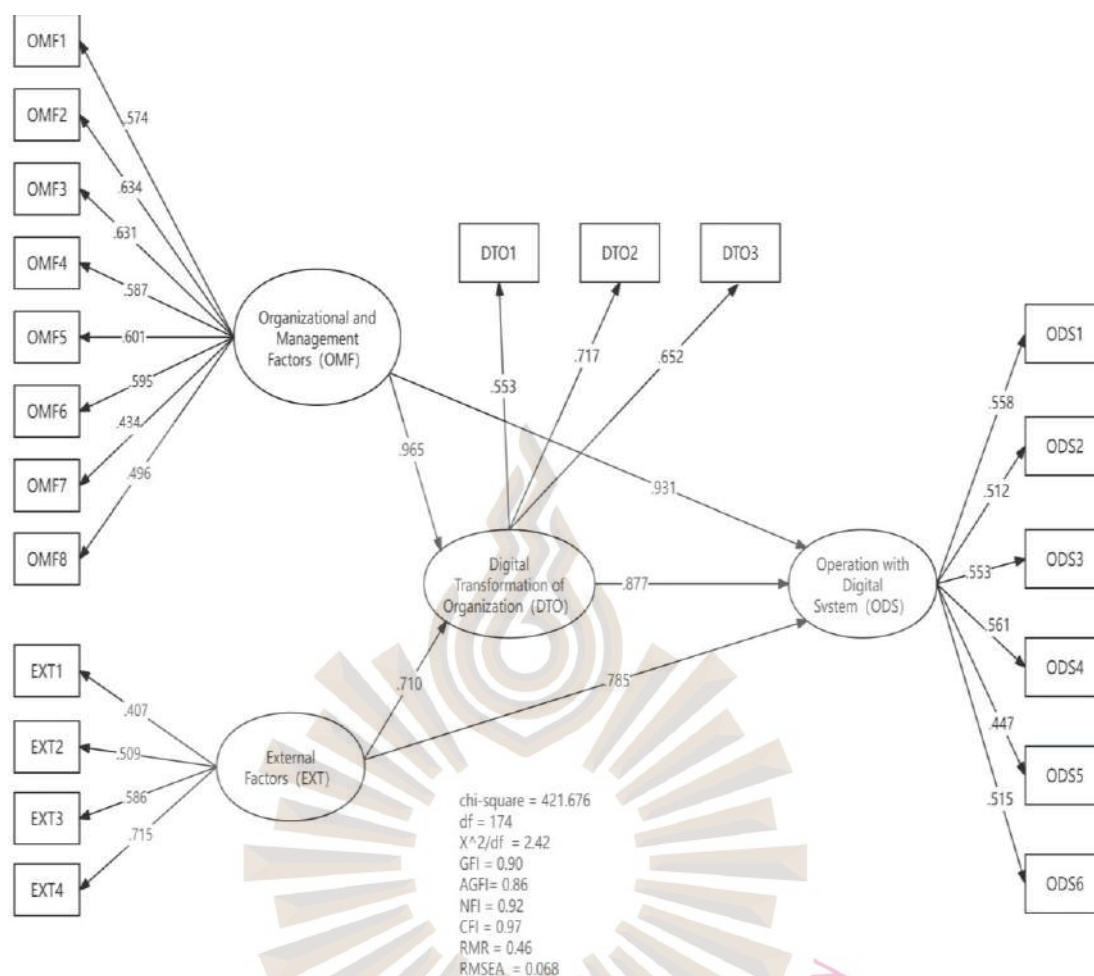


Figure 4.1 Final structural equation model

Table 4.9 Results of hypothesis testing

Hypothesis	Description	Result
H1	Organizational and management factors significantly affect the digital transformation of organization	Supported
H2	External factors significantly affect the digital transformation of organization	Supported
H3	Digital transformation of organization significantly affects operation with digital system	Supported
H4	Organizational and management factors significantly affect operation with digital system	Supported

Table 4.9 Results of hypothesis testing (Cont.)

Hypothesis	Description	Result
H5	External factors significantly affect operation with digital system	Supported

Table 4.10 Results of path analysis

Path	Coefficient (b)	SE	t-value	R ²
OMF -> DTO	0.965	0.020	17.403	0.735
EXT -> DTO	0.710	0.043	8.290	0.504
DTO -> ODS	0.877	0.026	17.109	0.769
OMF -> ODS	0.931	0.027	17.561	0.867
EXT -> ODS	0.785	0.038	12.902	0.751

Table 4.11 Results of mediation effect analysis

Hypothesis	Mediator	Relationship	Indirect Effect	Significance
H1	Organizational and management factors	Affects digital transformation of organization	0.965	Supported
H2	External factors	Affects digital transformation of organization	0.710	Supported
H3	Digital transformation of organization	Affects operation with digital system	0.877	Supported
H4	Organizational and management factors	Affects operation with digital system	0.931	Supported
H5	External factors	Affects operation with digital system	0.785	Supported

Chapter 5

Conclusion Discussion and Recommendations

This chapter summarizes the entire study. The first part presents the research summary, the study objectives are examined to ensure the purpose of study. Secondly, the research discussion is presented. Then, recommendation and future study are presented as the final part based on the results of this study together with the delimitation and limitation of this study.

5.1 Conclusion

This study aimed to examine the determinants of digital transformation in Chinese garment manufacturing. Regarding to the proposed model, external factors, organizational and management factors, and digital transformation of organization were hypothesized to significantly affect operation with digital system in Chinese garment manufacturing. This study employed quantitative analysis method using survey as a research instrument consisting of items that utilize a 5-point Likert scale. Data were analyzed using SPSS and Mplus in descriptive statistical method and inferential statistic method.

Structural Equation Modeling (SEM) is also employed. The path analysis was examined by conducting Structural Equation Modelling (SEM) to simultaneously test a series of hypotheses. The population of the study were comprised of 260 executives and employees who have worked in Chinese garment manufacturing. The questionnaire was originally developed in English and then translated into Chinese with a back-translation process. The questionnaire consists of 3 sections, the first section is related to respondents' profiles followed by four measurements of the research constructs; external factors, operation with digital system, organizational and

management factors, and digital transformation of organization of individual respondent.

The survey was conducted in China in a one-month period from April 1, 2024 to May 15, 2024. The 260 qualified responses from online survey were recorded and subjected to data analysis which is sufficient and appropriate to ensure the Structural Equation Modeling (SEM) analysis with 15 respondents per parameters variables of total 31 estimated parameters in this research (Kline, 2011).

According to the descriptive analysis in this research, the findings revealed that male respondents (54.6%) slightly outnumbered their female counterparts (45.4%). There are 8.0% of the respondents who are in the age between 20 – 25, the slightly different number between age 25 - 30 and 31 - 35 represented by 13.8% and 20.0% respectively. Moreover, 15.7% of the respondents who are in the age between 36 – 40, while the different number between age 41 - 45 and 46 - 50 represented by 12.6% and 14.6% respectively. There are 12.3% of the respondents who are in the age between 51 – 55. On the other hand, the lowest percentage is in the age between 56 – 60 represented by 3.0%.

In terms of marital status, 40.0% of the respondents are single, while 21.9% are married or in relationship. There are 18.0% of the respondents who are divorced and the slightly different number of the respondents, who are separated and widow represented by 13.0% and 7.1% respectively. Additionally, the respondents were asked about their educational background. Nearly 92% of the respondents finished their degrees from the university or college; Diploma / Vocational (30.0%); Bachelor's degree (47.7%); and Master's degree or Higher Degree (13.8%), while only 8.5% of the respondents were educated from secondary school. Ownership type was asked with the respondents. Most of the respondents are in listed industry (state-owned) represented by 33.0%, while the slightly different number of private (shareholding) and local state-owned (shareholding) are 34.6% and 32.4% respectively.

Furthermore, the respondents were interviewed about AI adoption model. Nearly half (48.8%) of the respondents said they are in wholly-owned subsidiary, while the respondents are in holding company and outsourcing represented by 32.3% and 18.9% respectively. The respondents were also questioned about intelligent manufacturing method. Most of the respondents involve in digitalizing the entire value chain and process equipment with intelligent manufacturing technologies (43.4%), while 33.0% of the respondents involve in adopting a product lifecycle management platform and build a cloud intelligent system. Moreover, only 23.6% of the respondents were involved in using information system to connect equipment terminals.

In terms of intelligent manufacturing features, the respondents said they involve in integration of the informatization and industrialization (30.0%), while 32.3% of the respondents were involved in selling products to selling services, intelligent synchronization of internal and external. 37.7% of the respondents were involved in digital factory technology. Additionally, progress in intelligent manufacturing was asked, 29.2% of the respondents said they involve in leading the industry in both the number and the application of intelligent devices. The respondents replied 33.8% in transform from a traditional manufacturing enterprise to a high-end intelligent service enterprise, while 37.0% of the respondents were involved in smart factory with large-scale computing systems and production equipment. Furthermore, the topic of supplementary data sources was interviewed with the respondents. 26.1% of the respondents said for official website, while 29.6% said news report and 44.3% for public annual report.

This study explored variable attribute analysis of each research constructs regarding to the proposed model; external factors, operation with digital system, organizational and management factors, and digital transformation of organization. External factors were measured by four dimensions: Customer behaviors and expectations, Digital shifts in the industry, Changing competitive landscape, and Regulative changes. Operation with digital system were measured by six factors that included Ensuring digital readiness, digitally enhancing products and services,

embracing product innovation, developing new business models, improving digital channels, and Increasing customer satisfaction. Organizational and management factors were measured by eight dimensions: A supportive organizational culture, Well-managed transformation activities, leveraging external and internal knowledge, engaging managers and employees, Growing information system capabilities, developing dynamic capabilities, developing a digital business strategy, and Aligning business and information systems. While digital transformation of organization was measured by Reforming an organization's information system, new business models, and Affecting outcomes and performance. According to the variables attributes analysis to have in-depth understanding of digital transformation in Chinese garment manufacturing, the items of each research constructs which represented the highest mean values and the lowest mean value should be considered in order to understand their concerning of the relevant latent variables in external factors, operation with digital system, organizational and management factors, and digital transformation of organization. The highest mean value and the lowest mean is presented in Table 5.1

Table 5.1 The Highest Mean Value and The Lowest Mean Value of Latent Variables

Item	Highest mean value	Lowest mean value
External factors	Digital shifts in the industry	Regulative changes
Operation with digital system	Increasing customer satisfaction	Developing new business models
Organizational and management factors	Engaging managers and employees Aligning business and information systems	Developing dynamic capabilities
Digital transformation of organization	Affecting outcomes and performance	New business models

The effects analysis was conducted to examine direct effect, indirect effect and total effect among the research constructs in the proposed model by employing SEM. The result of effect analysis between four latent variables: external factors,

operation with digital system, organizational and management factors, and digital transformation of organization revealed that the effect parameter between four variables significantly affected digital transformation in Chinese garment manufacturing industry. According to the effect analysis between four variables and digital transformation variables in the proposed model, it was founded that the effect parameter of external factors significantly affected the digital transformation of the Chinese garment manufacturing industry. The findings also found that customer behaviors and expectations significantly affected external factors. Digital shifts in the industry significantly affected external factors. Changing competitive landscape significantly affected external factors. Additionally, regulative changes significantly affected external factors.

According to the result of path coefficient related to hypotheses testing, it revealed that operation with digital system significantly affected the digital transformation of the Chinese garment manufacturing industry. The findings also found that ensuring digital readiness significantly affected operation with digital system. Digitally enhancing products and services significantly affected operation with digital system. Embracing product innovation significantly affected operation with digital system. Developing new business models significantly affected operation with digital system. Improving digital channels significantly affected operation with digital system. Increasing customer satisfaction significantly affected operation with digital system.

In terms of organizational and management factors, the effect parameter between eight variables significantly affected digital transformation in Chinese garment manufacturing industry. Organizational and management factors significantly affected the digital transformation of the Chinese garment manufacturing industry. A supportive organizational culture significantly affected organizational and management factors. Well-managed transformation activities significantly affected organizational and management factors. Leveraging external and internal knowledge significantly affected organizational and management factors. Engaging managers and employees significantly affected organizational and management factors. Growing

information system capabilities significantly affected organizational and management factors. Developing dynamic capabilities significantly affected organizational and management factors. Developing a digital business strategy significantly affected organizational and management factors. Aligning business and information systems significantly affected organizational and management factors.

Additionally, the effect parameter of digital transformation of organization significantly affected the digital transformation of the Chinese garment manufacturing industry. The findings also showed that reforming an organization's information system significantly affected digital transformation of organization. New business models significantly affected digital transformation of organization. Affecting outcomes and performance significantly affected digital transformation of organization.

5.2 Discussion

This study attempted to determine various factors which affect digital transformation of Chinese manufacturing industry. The proposed model of this study was formed and tested empirically based on the Theory of Planned Behavior (TPB). Several critical behavioral constructs were included in the proposed model; external factors, operation with digital system, organizational and management factors, and digital transformation of organization to examine the effect on digital transformation.

According to the finding, external factors significantly affected digital transformation of Chinese manufacturing industry which is compiled to the study of Mizark (2023) who stated that the external factors of digital transformation play a critical role in propelling the Chinese manufacturing industry toward a future characterized by innovation, efficiency, and competitiveness. Several key reasons underscore why these external factors have a significant impact on the digital transformation of the industry. In an increasingly interconnected global economy, Chinese manufacturers face intense competition. The adoption of digital technologies allows companies to enhance their competitiveness by improving production

efficiency, reducing costs, and delivering innovative products and services. The findings also showed the significant impact of customer behaviors and expectations on digital transformation. It was in line with the study of Belhadi, Kamble, Venkatesh, Jabbour, & Benkhati (2022) who said that evolving consumer preferences and demands for personalized, high-quality products drive manufacturers to embrace digital technologies. Meeting these expectations often requires advanced technologies for customization, quick response to market trends, and efficient supply chain management. Moreover, Digital transformation serves as a catalyst for innovation in manufacturing processes, product design, and R&D. Companies investing in digital technologies can accelerate the pace of innovation, introducing new products and services to the market more rapidly than their competitors (Santarsiero, Lerro, Carlucci, & Schiuma, 2022). In conclusion, the external factors of digital transformation are instrumental in shaping the future of the Chinese manufacturing industry. Embracing these external factors enables manufacturers to stay competitive, meet consumer expectations, and contribute to economic growth, positioning China as a leader in the global digital manufacturing landscape.

The research findings also found that operation with digital system significantly affected the digital transformation of the Chinese garment manufacturing industry. The operation with digital system was set by businesses in the Chinese garment manufacturing industry that were instrumental in driving and shaping the course of digital transformation. Several key reasons illustrate why these operations with digital systems have a significant impact on the digital transformation of the industry. The operation with digital system of digital transformation is closely aligned with the broader business goals of Chinese garment manufacturers. Whether the focus is on expanding market share, enhancing operational efficiency, or entering new markets, digital transformation is a strategic enabler that helps achieve these objectives (Yu, Wang, & Moon, 2022). Objectives related to operational efficiency drive the adoption of digital technologies that streamline manufacturing processes. Automation, data analytics, and advanced supply chain management systems contribute to enhanced efficiency and agility, allowing manufacturers to respond quickly to market demands (Modgil, Singh, & Hannibal, 2022). Digital transformation objectives often

include fostering innovation in product design and development. By incorporating technologies such as computer-aided design (CAD) and advanced prototyping tools, Chinese garment manufacturers can bring new and innovative products to market faster (Zhu, Wang, & Jiang, 2023). Operation with digital system related to customer satisfaction and loyalty drive digital initiatives that improve the customer experience. This may involve implementing e-commerce platforms, personalized shopping experiences, and responsive supply chains, meeting the evolving expectations of consumers (Demirel, 2022).

Operation with digital system frequently focused on optimizing the supply chain. This includes implementing technologies such as RFID for inventory management, blockchain for transparent and traceable supply chains, and real-time monitoring systems, contributing to a more efficient and resilient supply chain. For Chinese garment manufacturers looking to expand into global markets, digital transformation objectives become crucial. Adopting digital technologies aligns with global industry standards, enhances competitiveness, and facilitates smoother integration into international supply chains. Cost reduction objectives often align with sustainability goals. Digital transformation allows for more precise resource management, waste reduction, and the adoption of eco-friendly practices, contributing to both financial savings and environmental sustainability. Objectives related to risk management and business continuity are supported by digital transformation. Implementing digital technologies ensures a more resilient business model, capable of adapting to unforeseen disruptions and mitigating risks associated with supply chain volatility. Objectives related to compliance with local and international regulations drive the adoption of digital systems that ensure data security, ethical business practices, and adherence to industry standards. Meeting these objectives is essential for maintaining a positive corporate image (Creazza, Colicchia, Spiezia, & Dallari, 2022; Rodríguez-Espíndola, Chowdhury, Dey, Albores, & Emrouzneja, 2022).

In conclusion, the operation with digital system was set by Chinese garment manufacturers play a pivotal role in guiding the digital transformation journey. Whether focused on efficiency, innovation, customer satisfaction, or global

competitiveness, these operations with digital systems shape the strategic direction and priorities of the industry, making digital transformation a key enabler for achieving success in a rapidly evolving market.

Furthermore, organizational and management factors significantly affected the digital transformation of the Chinese garment manufacturing industry. The organizational and management factors in the digital transformation of the Chinese garment manufacturing industry are crucial as they directly influence the effectiveness and sustainability of the transformation journey. These factors serve as the guiding principles and determinants that contribute to achieving positive outcomes, ensuring that digital initiatives align with business objectives, enhance operational capabilities, and position the industry competitively in the global market. In essence, success factors provide the essential framework for navigating the complexities of digital transformation, fostering innovation, and adapting to the evolving landscape of the garment manufacturing sector in China. These findings were consistent with Mohammadi, Heidari, & Navkhsi (2023) who stated that success factors ensure that digital transformation initiatives are closely aligned with the overarching business objectives of Chinese garment manufacturers. When strategies and technologies are designed to meet specific business goals, the likelihood of success increases, fostering a more purposeful and results-driven transformation.

The study of Kunduru (2023) also reported that organizational and management factors emphasize the importance of enhancing operational efficiency and adaptability. By identifying and prioritizing factors that contribute to streamlined processes and agile operations, the industry can respond swiftly to market changes, customer demands, and other dynamic factors. Success factors in digital transformation underscore the need for innovation. The Chinese garment manufacturing industry must embrace technological advancements, such as smart manufacturing and digital design tools, to stay competitive. Success in innovation can lead to the creation of unique products and services that set companies apart in the market (Haricha, Khat, Issaoui, Bahnasse, & Ouajji, 2023). In summary, organizational and management factors serve as a roadmap for the Chinese garment

manufacturing industry in navigating the complexities of digital transformation. By addressing key aspects such as alignment with business goals, operational efficiency, innovation, and ethical considerations, these factors contribute significantly to the industry's ability to embrace digital technologies successfully and secure a sustainable and competitive future.

In addition, digital transformation of organization significantly affected the digital transformation of the Chinese garment manufacturing industry. Digital transformation of organization significantly affected the digital transformation of the Chinese garment manufacturing industry as they encompass the far-reaching consequences, both positive and negative, that arise from the adoption and integration of digital technologies. This digital transformation of organization guide decision-making, strategy development, and resource allocation, shaping the industry's trajectory in the digital era. Understanding the digital transformation of organization ensures that Chinese garment manufacturers can proactively address challenges, capitalize on opportunities, and navigate the complexities inherent in the transformative process, ultimately influencing the overall success and sustainability of digital initiatives in the sector. The findings were in line with Scott and Orlikowski (2022) who suggested that implications encompass the economic and environmental impact of digital transformation. Manufacturers need to consider how their initiatives contribute to economic growth, job creation, and sustainability goals. Understanding these implications ensures a holistic approach to digital transformation that aligns with broader societal objectives. The study of Holmstrom (2022) was found that implications dictate the operational changes that come with digital transformation. Manufacturers need to understand how adopting digital technologies will reshape their internal processes, supply chain dynamics, and overall workflow. This knowledge enables them to proactively manage and optimize these changes for improved efficiency.

The findings were consistent with Zhang, Xu, & Ma (2022) who said that implications of digital transformation influence strategic decision-making within the industry. Understanding the potential outcomes, challenges, and benefits helps

industry leaders formulate effective strategies that align with business goals and industry trends. It ensures that decisions are informed by a comprehensive understanding of the impact of digital initiatives. Implications guide the allocation of resources, including financial investments, human capital, and time. Manufacturers need to consider the implications of digital transformation on their budgets, workforce skill requirements, and timelines. Proper resource allocation is crucial for the successful implementation and sustainability of digital initiatives (Wiggberg, Gulliksen, Cajander, & Pears, 2022) . In summary, the digital transformation of organization served as a comprehensive framework that influences various aspects of the Chinese garment manufacturing industry. By addressing these implications proactively, industry stakeholders can navigate the complexities of digital initiatives, make informed decisions, and position themselves for sustained success in the evolving landscape of the digital era.

5.3 Delimitations and Limitations of study

5.3.1 Delimitations of study

Delimitations in a study refer to the factors or boundaries that the researcher sets to narrow the scope and focus of the investigation. In the context of a study on digital transformation, here are some potential delimitations:

Geographical Scope: The study may focus on specific regions or countries undergoing digital transformation, such as the Chinese garment manufacturing industry. Limiting the geographical scope helps in-depth analysis while acknowledging variations in digital adoption across different regions.

Industry Focus: The study may specifically concentrate on a particular industry, like manufacturing or retail, rather than attempting to encompass all sectors undergoing digital transformation. This allows for a more detailed examination of industry-specific challenges and opportunities.

Company Size and Type: The study may narrow its focus to certain types or sizes of companies within the chosen industry. For instance, it might exclusively investigate digital transformation practices among small or medium-sized enterprises (SMEs) in the Chinese garment manufacturing sector.

Technological Components: The study might concentrate on specific digital technologies or components of digital transformation, such as IoT integration, artificial intelligence applications, or supply chain digitization. This allows for a detailed analysis of the impact of particular technologies.

Time Frame: The study may have a specific time frame, focusing on a certain period or phase of the digital transformation process. This delimitation recognizes that digital transformation is an ongoing process and allows for a more manageable and targeted investigation.

Organizational Levels: The study may focus on a specific level of organizational hierarchy, such as management or operational staff, rather than attempting to cover all levels. This delimitation aids in-depth exploration of the perspectives and challenges faced by specific organizational roles.

Cultural and Ethical Considerations: The study may acknowledge cultural and ethical considerations but may not delve deeply into the broader societal impact of digital transformation. This limitation is especially relevant when examining the practices within a specific industry or organizational context.

Quantitative vs. Qualitative Approach: The study might adopt either a quantitative or qualitative research approach. Quantitative studies may focus on statistical analysis and numerical data, while qualitative studies may emphasize in-depth interviews, case studies, or narratives. The choice depends on the research objectives and available resources.

Policy and Regulatory Environment: The study may choose to limit its exploration of policy and regulatory aspects related to digital transformation. This allows for a more concentrated analysis of organizational and technological factors without delving extensively into the legal framework.

External Factors: External factors such as global economic conditions, political events, or natural disasters may be acknowledged but not extensively examined. This delimitation helps maintain focus on the internal dynamics of digital transformation within the chosen context.

It's important for researchers to clearly articulate these delimitations to provide transparency about the scope and boundaries of the study, allowing readers to understand the context within which the research findings are applicable.

5.3.2 Limitations of study

Limitations of a study acknowledge the constraints and factors that may impact the interpretation, generalizability, or applicability of the research findings. In the context of a study on digital transformation, here are some potential limitations:

Generalizability: Findings from a specific industry, such as the Chinese garment manufacturing sector, may not be directly generalizable to other industries or regions undergoing digital transformation. The industry-specific context may limit broader applicability.

Temporal Constraints: Digital transformation is an evolving process. The study's findings may be limited by the temporal scope, as technology and industry practices may have changed by the time the study concludes. The dynamism of digital transformation poses challenges in capturing ongoing developments.

Data Availability: Access to comprehensive and up-to-date data may be constrained. Limited data availability could impact the depth of analysis, particularly

when exploring the intricacies of digital transformation practices within specific companies or sectors.

Organizational Resistance: The study may encounter challenges in fully capturing the extent of organizational resistance to digital transformation. Some organizations may be reluctant to share information about internal challenges or resistance, potentially leading to an incomplete understanding.

Technology-specific Focus: If the study focuses on specific technologies within digital transformation, it may not provide a holistic view of the transformation process. The exclusion of certain technologies or components may limit the comprehensiveness of the findings.

Language and Cultural Bias: Language and cultural differences may present challenges, especially in cross-cultural studies. Interpretations of digital transformation practices may vary based on cultural nuances, potentially introducing bias or limiting the transferability of findings.

Researcher Bias: The researcher's background, experiences, and perspectives may introduce bias in the study. Pre-existing notions or personal experiences with digital transformation could influence the interpretation of data and findings.

Limited Stakeholder Perspectives: The study may face constraints in obtaining diverse stakeholder perspectives. Limited participation or engagement from certain stakeholders, such as employees, customers, or suppliers, may restrict the comprehensiveness of the study.

Resource Constraints: Constraints in terms of time, budget, or personnel may limit the depth and breadth of the study. Comprehensive investigations into all facets of digital transformation may be challenging within resource limitations.

External Factors: Unforeseen external factors, such as economic downturns or global events, may impact the study. These factors may introduce uncertainties that are beyond the control of the researcher and may influence the study's outcomes.

Self-reporting Bias: Reliance on self-reported data, particularly in survey-based research, may introduce response bias. Participants may provide socially desirable answers or may not accurately represent their actual experiences with digital transformation.

It's crucial for researchers to transparently communicate these limitations to provide context and enhance the credibility of the study. While limitations exist in any research endeavour, acknowledging them allows for a more nuanced understanding of the study's scope and potential implications.

5.4 Recommendation

This research building upon previous theories extends the knowledge on digital transformation of Chinese garment manufacturing industry. The benefit of this study can be integrated to various sectors such as nation / government sector, business and organization and academic area.

- 1) **Strengthen Organizational and Management Factors:** The study found that organizational and management factors significantly influence the success of digital transformation within an organization. Therefore, it is suggested that companies invest in strengthening their organizational structures and management processes to better facilitate digital transformation. This could include developing comprehensive training and development programs aimed at enhancing the digital skills of both employees and managers. For instance, companies could offer workshops or courses on digital tools and software, data analysis, digital marketing, and other relevant areas. Additionally, management processes could be revised to better support digital initiatives, such as incorporating digital goals into performance evaluations and encouraging open communication about digital strategies.

2) Adapt to External Factors: The research revealed that external factors, such as shifts in customer behaviors, industry trends, and regulatory changes, significantly influence an organization's digital transformation. Therefore, it is recommended that companies remain adaptable and responsive to these external changes. This could involve conducting regular market research and trend analysis to stay informed about changes in the business environment and adjust their digital transformation strategies accordingly. Companies could use tools like customer surveys, social media listening, and competitive analysis to gather insights and inform their strategies.

3) Prioritize Digital Transformation: The study showed that prioritizing digital transformation significantly impacts an organization's operations within the digital system. Therefore, companies should consider making digital transformation a strategic priority. This could involve investing in advanced technologies, such as artificial intelligence, machine learning, and cloud computing, adopting new business models that leverage digital capabilities, and reforming their information systems to better support digital operations.

4) Align Organizational and Management Factors with Operation with Digital System: The research found that aligning organizational and management factors with digital operations significantly influences the effectiveness of the digital system. Therefore, companies should consider integrating their digital strategies into their overall business strategies and ensure that their management practices support digital operations. This could involve establishing clear digital goals, aligning digital and business strategies, and designing management practices that encourage the use of digital tools and systems.

5) Respond to External Factors Affecting Operation with Digital System: The study showed that external factors significantly affect the operation within the digital system. Therefore, companies should respond effectively to these external factors. This could involve adapting their digital systems to changes in customer behaviors, industry trends, and regulatory changes. Companies could

monitor these changes closely and adjust their digital strategies and systems as needed to remain competitive and effective in the digital landscape.

5.5 Future Study

In terms of defining clear research objectives, it's important to clearly define the objectives of the dissertation. The future study should be considered to establish specific research questions or hypotheses that address key aspects of digital transformation within the Chinese garment manufacturing sector. This will provide a focused framework for future study. In addition, it should be conducted a comprehensive literature review. The future research should undertake a thorough literature review to understand the existing body of knowledge on digital transformation, Industry 4.0, and related topics in the context of the global and Chinese garment manufacturing industry. It also identify gaps, trends, and theoretical frameworks that can inform the research.

Additionally, future study should be considered to select an appropriate methodology. It's important to choose a suitable research methodology aligned with research objectives. Depending on the nature of the study, consider qualitative, quantitative, or mixed-method approaches. Justify your choice based on the depth and breadth of insight required. The methodology should be able to investigate the unique challenges faced by the Chinese garment manufacturing industry in adopting digital technologies. It can explore factors such as workforce readiness, supply chain complexities, and regulatory considerations specific to the industry.

Furthermore, future study should evaluate the patterns and trends in the adoption of digital technologies within the Chinese garment manufacturing sector. It also examines the prevalence of specific technologies, the rate of adoption, and factors influencing companies' decisions to embrace or resist digital transformation. The study should analyze how digital transformation impacts operational processes within garment manufacturing. It should explore changes in design, production, quality control, and supply chain management. It also can be able to consider the implications

for efficiency, productivity, and overall business performance. In addition, future study should investigate the transformation of supply chain dynamics driven by digital technologies. It should be considered to examine the role of blockchain, real-time tracking systems, and data analytics in enhancing transparency, traceability, and collaboration within the supply chain.

Future research should assess the readiness of Chinese garment manufacturing organizations for digital transformation by exploring factors such as leadership commitment, organizational culture, and the availability of skilled talent that influence the successful implementation of digital initiatives. It also should investigate the role of government policies and initiatives in shaping the digital transformation landscape of the Chinese garment manufacturing industry. The study should analyze how regulatory frameworks, incentives, and support programs influence companies' decisions to adopt digital technologies. Moreover, it should integrate an examination of ethical considerations and sustainability dimensions into your dissertation. It is also important to explore how digital transformation practices align with ethical standards, data privacy, and environmental sustainability within the garment manufacturing sector.

Moreover, future study should investigate how digital transformation fosters innovation within the industry and influences competitive strategies. It should explore how companies leverage digital technologies to differentiate products, enter new markets, and gain a competitive edge. Based on the findings, offer practical recommendations for Chinese garment manufacturing companies navigating digital transformation. It's important to provide insights on best practices, potential challenges, and strategies for successful adoption of digital technologies. The study should be considered to reflect on the implications of the research for the broader academic community. It should identify potential areas for future research, gaps in the current understanding, and avenues for exploring emerging trends in the digital transformation of the garment manufacturing industry. These recommendations aim to guide the development of a comprehensive and insightful dissertation on the digital

transformation of the Chinese garment manufacturing industry, contributing valuable insights to both academic scholarship and industry practitioners.

1) "Workforce Readiness for Digital Transformation in the Chinese Garment Manufacturing Industry": This research could explore the current level of digital skills among employees and the effectiveness of training programs in preparing the workforce for digital transformation.

2) "The Role of Supply Chain Complexities in Digital Transformation": This study could examine how complexities in the supply chain impact the adoption and effectiveness of digital technologies in the garment manufacturing industry.

3) "The Role of Digital Technologies in Enhancing Transparency and Traceability in the Garment Manufacturing Supply Chain": This study could explore the use of technologies like blockchain and real-time tracking systems in improving supply chain operations.

4) "The Influence of Organizational Culture and Leadership Commitment on Digital Transformation": This research could examine how factors like leadership commitment and organizational culture impact the success of digital transformation initiatives.

5) "Ethical and Sustainability Considerations in Digital Transformation": This study could investigate how digital transformation practices align with ethical standards and sustainability goals in the garment manufacturing industry.

6) "The Role of Digital Transformation in Fostering Innovation and Competitive Advantage in the Garment Manufacturing Industry": This research could explore how companies leverage digital technologies to innovate and gain a competitive edge.

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APPENDIX A

Questionnaire



**Faculty of Business Administration
Rangsit University (RSU), Thailand**

**A Survey on Digital transformation factors affecting the operations
with digital systems in the garment manufacturing industry in China**

Dear Respondents,

I am a final year graduate student pursuing a dissertation in Doctor of Business Administration (DBA) at Rangsit University (RSU) in Thailand. The purpose of this survey is to explore your digital transformation factors affecting the operations with digital systems in the garment manufacturing industry in China. This survey is conducted as a partial fulfilment of the requirements for the degree of Doctor of Business Administration (DBA).

Your input will assist me in understanding the elements of performance and driving factors about digital transformation of China's garment manufacturing industry. I am truly thankful in your corporation and precious time on fulfilling this questionnaire. Your effort will help me to achieve a better analysis for my dissertation project. Please accept my sincere gratitude for your participation in this survey.

Researcher
Yulin Wang

Part 1: Background information

1. What is your gender?

☐ Male

☐ Female

2. What is your age group?

☐ 20 – 25

☐ 25 – 30

☐ 31 – 35

☐ 36 – 40

☐ 41 – 45

☐ 46 – 50

☐ 51 – 55

☐ 56 – 60

3. What is your marital status?

☐ Single

☐ Married / In relationship

☐ Divorced

☐ Separated

☐ Widow (er)

☐ Others

4. Which of the following best described your highest education?

☐ Secondary

☐ Diploma / Vocational

☐ Bachelor's degree

☐ Master's degree or Higher Degree

☐ Others

5. Which of the following best described your ownership type?
- ☐ Listed industry (state-owned)
 - ☐ Private (shareholding)
 - ☐ Local state-owned (shareholding)
6. Which of the following best described your AI adoption model?
- ☐ Wholly-owned subsidiary
 - ☐ Holding company
 - ☐ Outsourcing
7. Which of the following best described your intelligent manufacturing method?
- ☐ Digitalize the entire value chain and process equipment with intelligent manufacturing technologies
 - ☐ Adopt a product lifecycle management platform and build a cloud intelligent system
 - ☐ Use information system to connect equipment terminals
8. Which of the following best described your intelligent manufacturing features?
- ☐ Integration of the informatization and industrialization
 - ☐ From selling products to selling services; intelligent synchronization of internal and external
 - ☐ Digital factory technology
9. Which of the following best described your progress in intelligent manufacturing?
- ☐ Leading the industry in both the number and the application of intelligent devices
 - ☐ Transform from a traditional manufacturing enterprise to a high-end intelligent service enterprise
 - ☐ Smart factory with large-scale computing systems and production equipment

10. Which of the following best described your supplementary data sources?

- ☐ Official Website
- ☐ News Report
- ☐ Public Annual Report

Part 2 : Digital transformation factors affect the operation with digital system in the garment manufacturing industry in China

Can you please indicate how important of each following reasons might be for your own individual reasons? Please evaluate by checking the number that best represents your opinion by using a following scale (1 - 5), where 1 = No Importance, 2 = Not Very Important, 3 = Neutral, 4 = Important, and 5 = Extremely Important.

Items	5	4	3	2	1
1.Organizational and management factors					
1.1 A supportive organizational culture: How important is fostering a culture that supports digital changes?					
1.2 Well-managed transformation activities: How crucial are effectively managed activities during the digital transformation process?					
1.3 Leveraging external and internal knowledge: How significant is it to utilize both external and internal knowledge for digital transformation?					
1.4 Engaging managers and employees: How important is the active involvement of managers and employees in digital transformation initiatives?					
1.5 Growing information system capabilities: How essential is the enhancement of your information systems to support digital operations?					

Items	5	4	3	2	1
1.6 Developing dynamic capabilities: How critical is it to develop capabilities that allow your organization to adapt rapidly to digital changes?					
1.7 Developing a digital business strategy: How important is it to have a clear digital strategy aligned with your business goals?					
1.8 Aligning business and information systems: How crucial is the alignment between your business processes and information systems for successful digital transformation?					
2.External factors					
2.1 Customer behaviors and expectations: How important is understanding and responding to changes in customer behaviors and expectations in the digital era?					
2.2 Digital shifts in the industry: How significant are industry-wide digital shifts to your organization's strategy?					
2.3 Changing competitive landscape: How crucial is adapting to the changing competitive landscape due to digital advancements?					
2.4 Regulative changes: How important is compliance with regulatory changes influenced by digital transformation?					
3.Digital transformation of organization					
3.1 Reforming an organization's information system: How essential is reforming your organization's information systems for better digital integration?					
3.2 New business models: How important is the					

Items	5	4	3	2	1
development of new business models facilitated by digital technologies?					
3.3 Affecting outcomes and performance: How crucial is digital transformation in affecting your organization's outcomes and performance?					
4.Operation with digital system					
4.1 Ensuring digital readiness: How important is preparing your organization for digital operations?					
4.2 Digitally enhancing products and services: How crucial is the digital enhancement of your products and services?					
4.3 Embracing product innovation: How significant is product innovation in your digital strategy?					
4.4 Developing new business models: How essential is it to develop new business models that leverage digital technologies?					
4.5 Improving digital channels: How important is the improvement of digital channels for customer interaction?					
4.6 Increasing customer satisfaction: How crucial is increasing customer satisfaction through digital initiatives?					

Part 3: Additional opinions

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APPENDIX B

Certificate of Approval

COA. No. RSUERB2024-082



Certificate of Approval
By
Ethics Review Board of Rangsit University

COA. No.	COA. No. RSUERB2024-082
Protocol Title	Digital transformation and related factors affect the operation with digital system in the garment manufacturing industry in China
Principle Investigator	Wang Yulin
Co-Investigator	Dr.Chanakiat Samarubutra
Affiliation	Faculty of Business Administration, Rangsit University
How to review	Expedited Review
Approval includes	1. Project proposal 2. Information sheet 3. Informed consent form 4. Data collection form/Program or Activity plan
Date of Approval:	15 May 2024
Date of Expiration:	15 May 2026

The prior mentioned documents have been reviewed and approved by Ethics Review Board of Rangsit University based Declaration of Helsinki, The Belmont Report, CIOMS Guideline and International Conference on Harmonization in Good Clinical Practice or ICH-GCP.

Signature.....

(Associate Professor Dr. Panan Kanchanaphum)

Chairman, Ethics Review Board for Human Research



BIOGRAPHY

Name	Yulin Wang
Date of birth	23 December 1989
Place of birth	Mouding Country, Chuxiong City, Yunnan Province, China
Educational background	Panyapiwat Institute of Management Master of Business Administration, 2014 Rangsit University Doctoral of Business Administration, 2024
Address	Huidong Shengjing North Garden, Shengjing Road, Chuxiong City, Yunnan Province, China
E-mail address	2995029775@qq.com
Place of work	Yunnan Minzu University
Work position	Deputy Secretary of the Youth League Committee of Yunnan Minzu University, College of Applied Technology

