

Identifying criteria, models, and assessing the digital transformation readiness levels of enterprises in Vietnam

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Abstract Digital transformation is an inevitable trend for businesses around the world. This study provides an overview of the criteria and models for evaluating the level of digital transformation in businesses. Additionally, it analyzes the current state of digital transformation readiness among small and medium-sized enterprises in Vietnam for 2022 and 2023. The overview results indicate that, although many studies have addressed digital transformation, there are still few that provide evaluation models tailored to the specific characteristics of each industry. In Vietnam, the index for evaluating the readiness level for digital transformation in businesses consists of 7 pillars and 34 component criteria, including: strategic objectives; customer experience & omni-channel; supply chain; IT systems & data management; risk management & cybersecurity; financial management, accounting, planning, legal & HR management; and human & organization. However, this index is a common set for all types of businesses across different industries. The criteria used in these indices are currently assumed to have the same level of importance. In reality, their importance should vary between criteria and across different industries and types of businesses. The analysis results show that the average level of digital transformation readiness in 2023 tends to increase in all aspects compared to 2022. Notably, the readiness level for digital transformation in the strategic objectives aspect is the highest, and the most significant improvement is seen in the risk management & cybersecurity aspect. Based on the literature review and the analysis of the current situation, the study provides several discussions to enhance the digital transformation of businesses in Vietnam.

Keywords: digital transformation, enterprises, Vietnam

1. Introduction

The Fourth Industrial Revolution represents the fusion of digital technology with various aspects of life, ushering in entirely new production capabilities and profoundly impacting the global economic, political, and social landscape (Castelo-Branco et al., 2022). Furthermore, the coronavirus disease 2019 (COVID-19) pandemic has markedly accelerated the digital transformation of global businesses, compelling them to adapt to survive and thrive (Wu et al., 2024). During this period, businesses were intensifying their efforts to digitize production and operations, enable remote work for employees, bolster e-commerce activities, enhance digital customer interactions, and establish agile business models and resilient supply chains (Soto-Acosta, 2020; Priyono et al., 2020; Khurana et al., 2022).

The assessment of enterprises' digital transformation readiness plays a critical role in helping businesses pinpoint areas for improvement to optimize the digital transformation process. Additionally, evaluating the digital transformation readiness of enterprises offers governments and local authorities a comprehensive understanding of the driving factors behind businesses' digital transformation, empowering them to formulate tailored policies to support and foster digital transformation efforts. A review of the literature reveals a plethora of indices and models developed globally to assess the digital transformation readiness of enterprises during the Fourth Industrial Revolution. Examples include the Industry 4 Readiness Assessment Tool (Agca et al., 2017), Industry 4.0 Readiness Online Self-Check for Businesses (Lichtblau et al., 2015), Readiness for Digital Transformation Assessment (Stoianova et al., 2020), and a suite of indices for evaluating enterprises' digital transformation readiness and supporting digital transformation initiatives by the Ministry of Information and Communications (2023).

Studies that assess the level of digital transformation readiness employ various methodologies, such as multiple-criteria decision-making (MCDM), the analytic hierarchy process (AHP), text mining, and machine learning (Erbay and Yıldırım, 2018; Güler and Büyükożkan, 2019). Each method has its own strengths and weaknesses, and they can be utilized individually or in combination to furnish additional insights for evaluating the digital transformation process.



Overall, research underscores the multifaceted nature of assessing enterprises' digital transformation readiness, encompassing aspects related to products and services, production technology, strategy and organization, the supply chain, the business model, the legal environment, the business environment, culture, and awareness. The evaluation criteria encompass both quantitative and qualitative attributes with varying measurement units and scales. The MCDM model has emerged as a fitting tool for constructing this comprehensive evaluation criterion system.

2. Overview of criteria and assessment models for enterprises' digital transformation readiness

2.1. General overview of the digital economy and digital transformation

The concept of the digital economy can be traced back to 1996 in a book directly addressing it by Tapscott (1996). However, there is currently no consensus definition of the digital economy. In fact, various researchers have proposed different definitions, which have evolved over time. During the early formation of the concept, scholars used the term "digital economy" to distinguish the emergence of a new economy with rudimentary ideas, such as the concept of an information economy. It can be said that the digital economy bears resemblance to the idea of an information economy because a characteristic of its early phase is information technologies and websites disseminating static information. In addition to static information systems, the early digital economy also involved communication and interactive activities through network systems, which later shaped subsequent definitions to differentiate between the concept of an information economy and the digital economy.

The concept of the digital economy was further clarified in 1999 when the concept of business activities based on information technology was formed (Margherio et al., 1999). Concurrently with technologies enabling commercial transactions via the internet, the dot-com bubble propelled the development of business activities, digital commerce, and the emergence of new definitions, initially distinguishing the digital economy from the concept of an information economy. Through the concept of business activities based on information technology, the digital economy was shaped by four components, including digital products and services sold through digital platforms, physical products provided through digital platforms, products and services entirely based on information technology, and information technology products and services such as computer manufacturing and network system deployment.

Although there are other studies and publications mentioning the digital economy, its definition truly began to be clarified and became more comprehensive compared to rudimentary definitions through a report by the European Commission in 2013. The digital economy was defined through characteristics such as business development through new sources of financing, such as venture capital, the importance of intangible assets to businesses, cross-border e-commerce capabilities, and business models developed based on digital platforms. Although gradually improving over time, the digital economy is often generally defined by business activities based on digital technology and conducting transactions through network systems.

Digital transformation is one of the top development directions for many countries. Referring to the use of new digital technologies to enhance competitiveness for business activities in the era of digital technology explosion, digital transformation encompasses converting products and services into online formats, including public services and administrative management. As an essential developmental stage, digital transformation is defined as a way to restructure business models to meet new consumer product and service demands for the private sector and citizen service users for the public sector (Berman, 2012). By changing the method of delivering products and services to online formats, digital transformation also alters how businesses and governments interact with beneficiaries or consumers.

Enhancing user experiences by changing interaction methods has created a new type of value through connecting people based on digital platforms, exemplified by social networking systems. Alongside the ability to interact through digital platforms such as social media, conducting commercial transactions or using public services has also become easier through digital systems designed to autonomously resolve typical user issues, such as Chatbot applications for advising and assisting users with artificial and human intelligence. In addition to increasing connectivity between individuals, digital transformation also includes upgrading smart products so that they can evolve over time and improve new breakthrough services to entirely replace current solutions. A prominent example of digital transformation is the decline of the traditional taxi industry with the emergence of technology-based taxis, starting with Uber. With rapid customer connections via phones and resolving many existing issues of the traditional taxi industry, such as service costs, passenger pickup speed, or service safety, technology-based taxis have completely replaced the traditional taxi industry with rapid market penetration. For the private sector, digital transformation can be shaped as a business model development strategy to increase market share or penetrate and open new markets while increasing customer volume and minimizing operational costs.

Digital economic transformation should not be understood as a sudden complete replacement of the old economic system with entirely new innovations, but it should be understood that these disruptive technologies are gradually integrating into the existing economy to change and enhance the quality of daily life. In this integration process, certain characteristics of digital economic transformation need to be carefully considered, such as the existence of technology giants, influential factors affecting the economies of many countries, and holding onto leading digital technologies.

Digital economic transformation also brings seemingly impossible opportunities. One of these is that we can maximize the use of existing resources and create more jobs by encouraging people to use spare time for services, such as food delivery or taxi services, to increase income through applications and software (Gutbrod, 2020). Another highlight of the digital economic transformation process is the formation of digital currency systems. This is a type of reserve asset and investment for new innovative ideas based on digital technologies. The development of digital currency systems has partly contributed to driving the growth of the global digital economy. However, whether it is leading technology companies or utilizing digital resources or systems, there are negative aspects to consider. From putting pressure on road systems and infrastructure through delivery and technology-based taxi applications to dependence on large technology companies to illicit activities such as money laundering, digital economic transformation should be viewed from both sides. The digital economy brings new development opportunities but also brings many challenges, such as copyright issues related to intellectual property products, cybersecurity, and the digital knowledge requirements of society as a whole. Therefore, to move toward a digital economy, digital transformation needs to be implemented in both the public and private sectors.

2.2. Overview of models and assessment criteria for enterprises' digital transformation readiness

As the digital economy continues to evolve, digital transformation has emerged as a subject of significant interest, leading to diverse independent research endeavors. However, these efforts are often characterized by specialized approaches and field-specific limitations (Hausberg et al., 2019). This transformation profoundly affects entire organizations, triggering changes across various dimensions, such as business models, operational processes, infrastructure, production techniques, and human resource management (Haverkort & Zimmermann, 2017; Hausberg et al., 2019). Nevertheless, in practice, businesses frequently struggle to comprehend novel concepts such as the Fourth Industrial Revolution due to misalignment with their industry and business strategies or challenges in pinpointing their current position amidst ongoing innovations, thereby hindering the development of appropriate programs and projects (Schumacher et al., 2016). Consequently, organizations not only fail to capitalize on digitization opportunities but also encounter difficulties in transitioning to business models that accurately reflect the economic characteristics and mechanisms of digitization (Weill & Woerner, 2015). This failure often stems from a lack of preparedness and readiness for transformation within organizations (Lokuge et al., 2019).

Readiness, conceptualized as a state of psychological and behavioral preparedness to undertake action, encompasses multiple dimensions that reflect a company's ability to respond to and navigate opportunities and challenges within its industry environment (Timmor & Zif, 2010). Assessing readiness entails a systematic analysis of an organization's ability to manage and implement the transformation process, identify associated risks, opportunities, and latent challenges, and empower the organization to identify and overcome barriers hindering successful transformation (Pirola et al., 2020). Given the dynamic nature of technological advancements, readiness for change is assumed to have increasing significance. Successful digital transformation necessitates businesses' ability to adapt to both internal and external changes. Importantly, readiness for change is not a static state but can be enhanced through strategic business direction, decentralized decision-making processes, technological innovation, and operational agility (Timmor & Zif, 2010). Consequently, there is a need for methodologies and tools to guide and support businesses in aligning and refining their strategies and operations. This underscores the importance of developing models to assess enterprises' readiness for digital transformation. Table 1 provides an overview of models proposed in international studies aimed at facilitating and directing enterprises through the digital transformation process.

However, existing models tend to approach various types of businesses from different perspectives. For instance, models such as IMPULS, DRL 4.0, and the organizational readiness assessment model for digital innovation by Lokuge et al. (2019) focus on businesses in general or small and medium-sized enterprises without restrictions based on geography or specific industries. On the other hand, Machado et al.'s (2021) digital readiness model for enterprises specifically targets manufacturing businesses and outlines the step-by-step conditions for digital transformation. However, these models lack consistency in their format and presentation of evaluation results. Although models such as KRI, DLR 4.0, and IMPULS categorize businesses into readiness levels, each model features a different number of levels (ranging from 3 to 6 levels).

Currently, there are few models available for assessing the extent of digital transformation across various types of businesses or considering the distinct characteristics of each industry. Moreover, the pressure for change stemming from the environment, including competitive dynamics and the evolution of individual industries, varies significantly. As a result, businesses within each industry face unique conditions and challenges during digital transformation efforts. The existing tools often fail to address these differences, as they typically require all participants to respond to every question, even when many questions are not relevant to the specific context of the business. This can lead to potentially low overall scores (Pirola et al., 2020).

Hizam-Hanafiah et al. (2020) compiled 30 models to assess businesses' readiness for digital transformation (as illustrated in Table 2). In general, the most prevalent aspects used to evaluate digital readiness include technology, human resources, strategy, leadership, processes, and innovation.

Table 1 Overview of studies assessing enterprises' readiness for digital transformation.

Models	References	Enterprise/industry	Result	Evaluation perspectives
Industry 4 readiness assessment tool	Agca et al. (2017)	Enterprise	Measuring the readiness and future ambitions of enterprises in the digital age	Products and services; Manufacturing and operations; Strategy and organization; Supply chain; Business model; Legal considerations
Industry 4.0 Readiness Online Self-Check for Businesses (IMPULS)	Lichtblau et al. (2015)	Small and medium-sized enterprises	Six levels of measuring readiness for Industry 4.0	Strategy and organization, smart factories, smart operations, smart products, data-driven services, employees
Organizational readiness for digital innovation	Lokuge et al. (2019)	Enterprise	Twenty-one scales divided into 7 groups	Resource readiness, culture, strategy, IT, innovation value, awareness, partnerships
Enterprise digital readiness model	Machado et al. (2021)	Manufacturing enterprises	The assessment questionnaire includes minimum conditions for readiness to transform. It can be used as a dialog tool to promote connectivity and engagement of stakeholders	Strategic needs and benefits of digital transformation; opportunities and risks of digital transformation; capabilities, capacities, and resources for digital transformation; promoting digital leadership and involvement of units, agencies; vision, goals, and digital transformation strategy; promoting and enabling clear information to all stakeholders; digital transformation progress (KPIs); digital knowledge management mechanisms; empowering stakeholders; digital transformation across the entire value chain (horizontal integration)
DRL 4.0 model	Pirola et al (2020)	Small and medium-sized enterprises	Five levels are divided based on the comprehensive index from the assessment of aspects	Strategy, people, processes, technology, integration
Readiness for digital transformation assessment (DTRA)	Stoianova et al (2020)	Enterprise	Level of digital transformation readiness	System management, enterprise architecture, current state of data usage and corporate culture
Industry 4.0: Building the digital enterprise (PwC Global 4.0 survey)	Geissbauer et al (2016)	Enterprise	Assessing the readiness of businesses in the digital transformation process helps them plan for the future toward Industry 4.0	Digital business model and customer engagement; Digitizing products and supply services; Digitizing and integrating vertical and horizontal value chains; Storing and analyzing business data is a core feature; Having flexible information technology systems; Compliance with laws, information security, and tax obligations; Employees within the organization and "digital culture"
Key Readiness Indicators (KRI)	Wengler et al (2021)	Small and medium-sized manufacturing enterprises	A readiness model with three levels. Scores are based on self-assessment questionnaires	Strategy, technology requirements, awareness, capabilities
Retail Digitalization Index	Shnorr (2020)	Retail industry	Digitalization index for the overall retail industry	Percentage of retail businesses with broadband internet access among 100 businesses, level of cloud technology adoption, level of RFID technology adoption, level of ERP system deployment, percentage of retail businesses participating in e-Commerce.

Table 2 Models for Evaluating Enterprises' Digital Transformation Readiness.

No.	Models
1	Industry 4.0 Readiness Evaluation for Manufacturing Enterprises
2	Industry 4.0 Maturity Model
3	Future Readiness Level (FRL)/Industry 4.0 Future Readiness
4	E-Business Industry 4.0 Readiness Model
5	Benchmarking Readiness I4.0
6	SMEs Maturity Model Assessment of IR4.0 Digital Transformation
7	Readiness for Industry 4.0
8	SSCM Assessment for Industry 4.0
9	Industry 4.0 Business Model Innovations Tool
10	Industry 4.0 Maturity Model
11	Manufacturing Companies Industry 4.0 Adoption Model
12	BMS Smart Industry Research Roadmap (Behavioral, Management, Social Sciences)- SIRM
13	ACATECH Industrie 4.0 Maturity Index
14	Enterprise 4.0 Assessment
15	Industry 4.0 Maturity Model- SPICE (Software Process Improvement and Capability dEtermination)
16	Academia 16 Industry 4.0 Readiness Model for Tool Management
17	Three Stages Maturity Model in SME's toward Industry 4.0
18	Design Business Modeling for Industry 4.0
19	SIMMI 4.0–System Integration Maturity Model Industry 4.0
20	Industry 4.0 Introduction Strategy
21	Roadmap Industry 4.0
22	Assessment Model for Organizational Adoption of Industry 4.0 Based on Multicriteria Decision Techniques
23	Industry 4.0 Maturity Mode
24	Reference Architecture Model for the Industry 4.0 (RAMI4.0)
25	Industry 4.0 Hindering Factors Model
26	IMPULS-Industrie 4.0 Readiness
27	Industry 4.0 Barometer
28	Roland Berger Industry 4.0 Readiness Index
29	Fraunhofer Industrie 4.0 Layer Model
30	Industry 4.0 Readiness Model for Manufacturing

2.3. Overview of criteria for assessing the digital transformation readiness of enterprises

The degree of digital transformation has been addressed in numerous foreign studies in terms of "maturity of digital transformation" or "digital transformation readiness." While there have been many studies on digital transformation models worldwide, research focusing on digital transformation models in specific industries remains limited. Models for assessing the degree of digital transformation readiness of enterprises allow researchers to grasp dependent and independent variables as well as their impact, further strengthening existing theories and enhancing our understanding of the reality of the issue (Lokuge et al., 2019). From the perspective of internal factors within an enterprise, Stoianova et al. (2020) constructed an assessment framework for the digital transformation readiness of companies based on four main groups of indices: system management, enterprise architecture, data usage status, and corporate culture. Similarly, Bollweg et al. (2019) concluded that the readiness for digital transformation of enterprises is affected at different levels by factors such as available resources, the digital orientation of the enterprise, the current level of digital application, and external pressures. Savytska et al. (2022) proposed an index set consisting of 4 groups of component indices to evaluate the level of digital transformation of retail businesses, including top management intent, digital culture, digital potential, and digital strategy.

In addition to scientific research conducted by researchers, universities, and consulting firms, criteria systems have also been proposed for evaluation, notably including those by PwC (PricewaterhouseCoopers) (Geissbauer et al., 2016) and Uni-Warwick (University of Warwick) (Agca et al., 2017). The criteria system developed by PwC aims not only to assess the readiness of businesses in the digital transformation process but also to serve as a crucial basis for helping businesses plan for the future of Industry 4.0. This assessment tool comprises 7 fundamental standards, each of which is evaluated across four readiness levels (getting started with digital transformation, vertical digital transformation integration, full digital transformation integration both vertically and horizontally, successful digital transformation). The assessed standards include (1) a digital business model and customer engagement; (2) digitizing products and supply services; (3) digitizing and integrating vertical and horizontal value chains; (4) storing and analyzing business data as a core feature; (5) having flexible information technology systems; (6) compliance with laws, information security, and tax obligations; and (7) employees within the organization and "digital culture" (Geissbauer et al., 2016). A unique aspect of the tool proposed by PwC is the consideration of the "compliance,

security, legal, and tax" aspect, which measures the extent to which businesses comply with the challenges of the "digitalization" process, such as information security issues, legal compliance, and tax obligations. This criteria system is publicly available on the PwC website, directly serving businesses in their self-assessment process, and has attracted survey responses from over 2000 companies from 26 countries worldwide. However, interpretations of the standards and the level of assessment for each standard are still difficult for small and medium-sized enterprises (SMEs) to access. The assessment tool developed by Uni-Warwick was jointly developed by the university, Crimson & Co., and Pinsent Masons. The main goal of this tool is to provide simple, intuitive information for businesses to measure their readiness and future ambitions in the digital age. The tool comprises 6 standards: (1) products and services; (2) manufacturing and operations; (3) strategy and organization; (4) supply chain; (5) business model; and (6) legal considerations. Each standard is evaluated across four readiness levels: beginner, intermediate, experience, and expert. This tool is considered relatively comprehensive because it considers multiple aspects of business operations and describes standards and levels clearly and accessibly. Fifty-three businesses in 22 countries have used this tool (Agca et al., 2017).

In Vietnam, as part of the tasks assigned by the Ministry of Science and Technology on "Supporting organizations and businesses to recover, enhance productivity during and after the COVID-19 pandemic through practical guidance on improving productivity, quality based on information technology applications," the ViPa (Vietnam Innovation Productivity Assessment) tool assesses the readiness of businesses for digital transformation and smart manufacturing on the journey to Industry 4.0 of Vietnamese industrial enterprises. This model was made available for free on the digital platform <http://vipa.vnpi.vn> in 2020 to help businesses assess the reality of their business management, productivity, and infrastructure and prepare business transformation initiatives through self-assessment to receive recommendations on appropriate vision and transformation roadmaps from the Vietnam Productivity Institute. The model is built on four main pillars: (1) business management, (2) productivity management, (3) infrastructure for digital transformation, and (4) smart manufacturing. Each pillar is further divided into 4 subcontent areas, each assessed by 16 appropriate indices. These 16 indices form the basis for measuring the readiness of businesses for digital transformation and smart manufacturing. The data used in this tool are collected through online surveys of businesses. In cases where businesses need further understanding of the standards, experts from the Vietnam Productivity Institute will conduct direct assessments at the businesses and provide consultancy on the roadmap for digital transformation and smart manufacturing. Each standard is assessed on a 5-level scale (1 to 5), including minimum requirements that must be met to complete each level. Level 1 describes businesses that do nothing or very little or have no foundation to prepare for digital transformation. Level 5 describes the best-performing businesses—those that have successfully implemented all activities of digital business transformation. Level 5 of the model also describes the state of fully implementing the target vision—when the entire value chain is integrated in real time and can interact with each other. The specific standards within each pillar are as follows: (1) business management: leadership, customer, human resources, and innovation culture; (2) productivity management: management standards/tools, application level, process control, and performance measurement; (3) infrastructure for digital transformation: infrastructure, enterprise digital transformation strategy, application of IT for digital transformation in enterprises, and management of innovative activities in enterprises; and (4) smart manufacturing: use of sensor systems to monitor processes (sensors), build IT solutions to exploit and manage data, synthesize and build databases based on cloud computing platforms, and apply technology solutions 4.0 to exploit data and business management. In 2023, the Ministry of Information and Communications issued a decision to approve the project to identify the index system for assessing the level of digital transformation of enterprises and support the promotion of digital transformation of enterprises (details of the index system in Table 4). The main goals of the project are to use the digital transformation business index (hereinafter referred to as the DBI) standardized by the Ministry of Information and Communications and the Ministry of Planning and Investment; to provide tools for measuring, identifying, and monitoring the level of digital transformation of enterprises; to compare enterprises in the same industry; to help businesses access digital transformation according to qualitative criteria as a basis for building appropriate transformation plans and roadmaps; to establish and update a database on the digital transformation of enterprises to help functional agencies develop plans and solutions to manage and promote the process of digital transformation of enterprises in general and digital economic development; and to identify practical examples of digital transformation in businesses for lessons learned or nationwide replication.

Table 4 Index for assessing the level of digital transformation of enterprises.

Aspect	Component index
Strategic objectives	Business leadership comprehends industry trends and digital transformation solutions applicable to their sector. Digital transformation goals have been integrated into the core mission of the enterprise by business leadership. The business allocates a budget for innovative activities or digital transformation initiatives within its organization. The enterprise has been and is currently implementing digital transformation solutions and data analysis to support strategic decisions, including business model transformation, product/service changes, fundraising, and seeking strategic investors.



Customer experience & omni-channel	<p>The enterprise has been and is currently employing digital transformation solutions to enhance marketing, distribution, and sales processes, aiming to improve customer experience and gain a competitive advantage in the market.</p> <p>Digital transformation solutions are being utilized by the enterprise to fortify customer care activities, create differentiated customer services, and enhance overall customer experience.</p> <p>The Customer Relationship Management system of the enterprise is capable of integrating with other systems to upgrade and supplement additional functions as needed.</p> <p>Digital transformation solutions are applied by the enterprise to analyze marketing, sales, and customer care activities for performance measurement.</p>
supply chain	<p>The enterprise employs digital transformation solutions to analyze and forecast sales results, providing a basis for adjusting marketing, sales, and customer care strategies.</p> <p>Digital transformation solutions are used by the enterprise to evaluate business operations and forecast sales results. The enterprise utilizes digital transformation solutions to support supply chain management processes, encompassing market demand forecasting, in-house supply, and supplier sourcing for raw materials.</p> <p>Digital transformation solutions are being applied by the enterprise to develop synchronized budget plans aligned with business strategies and manage their execution.</p> <p>The enterprise employs digital transformation solutions to flexibly and promptly manage its supply chain operations in response to market fluctuations.</p> <p>Digital transformation solutions are applied by the enterprise to automate internal production operations at an advanced level.</p> <p>The enterprise utilizes digital transformation solutions to manage inventory with a high level of automation, efficiently responding to production and business activities while reducing operational costs.</p> <p>Digital transformation solutions can analyze data related to procurement, manufacturing, and sales to identify emerging issues and assist the enterprise in developing appropriate action plans.</p>
Financial management, accounting, planning, legal & HR management	<p>The current digital transformation solution being implemented by the enterprise is capable of measuring, evaluating, and analyzing cost and profit aspects to provide optimal economic proposals for business decisions.</p> <p>Human resource tasks are managed with efficiency and objectivity through digital transformation solutions, contributing to employee satisfaction in related departments.</p> <p>Digital transformation solutions provide sufficient information for the enterprise to proactively identify risks and assess their impact on production and business activities.</p>
IT systems & data management	<p>The enterprise benefits from digital transformation solutions that automatically update with the latest technology solutions from market suppliers, enabling proactive research into new technology trends.</p> <p>Emerging digital technologies such as cloud computing, mobile technology, artificial intelligence, machine learning, and big data help the enterprise minimize costs and enhance the effectiveness of production and business management activities.</p> <p>The current digital transformation solutions being implemented by the enterprise seamlessly integrate with new solutions without requiring reinvestment from scratch.</p> <p>The enterprise is prepared to allocate resources (both human and financial) to upgrade and innovate information systems and software as needed.</p> <p>Effective policies and operational procedures are in place for each business department to prepare for the digital transformation process.</p>
Risk management & cybersecurity	<p>The enterprise has a comprehensive understanding of the risks associated with the digital transformation process, including risks related to data management and network security.</p> <p>Digital transformation solutions support information systems management and data analysis within the enterprise, capable of early detection of risks and providing guidance solutions to prevent them.</p> <p>Digital transformation solutions for information management and network security implemented by the enterprise have the ability to periodically review and evaluate risks related to system security and provide timely alerts when abnormalities are detected.</p>
Human & organization	<p>The enterprise has established procedures for handling information technology and network security incidents.</p> <p>The workforce involved in the enterprise's digital transformation process is adept at quickly and positively adapting to changes.</p> <p>The internal organizational structure of the enterprise is designed to flexibly respond to both internal and external changes.</p> <p>The workforce involved in the enterprise's digital transformation process possesses sufficient knowledge, skills, and experience in digital transformation activities.</p> <p>The enterprise has effective policies for attracting, recruiting, and developing information technology personnel committed to long-term work with the organization.</p> <p>Effective internal training programs and tools are implemented to share experiences and enhance skills, expertise, and experience for the professional development of the workforce.</p> <p>The enterprise's digital transformation solution system continuously and timely shares data information, effectively supporting the management of internal and external activities of the enterprise.</p>



3. The present status of digital transformation in Vietnamese businesses

In Vietnam, the advancement of digital economic transformation has rapidly progressed, particularly because of the COVID-19 pandemic. Enterprises themselves have come to acknowledge the indispensable role of digital technology in business growth, bolstering operational efficiency and competitiveness. Consequently, the effects of digital transformation are palpable across various sectors. For example, in the tourism industry, customer experience is a pivotal factor determining sustainability. To enhance service quality, a myriad of digital applications have been introduced to increase the customer experience before, during, and after service consumption (Ngo, 2019). Notably, most tourist destinations, restaurants, and hotels now furnish information on internet platforms, facilitating user research and decision-making. This amalgamation integrates traditional static information websites with social media platforms, where businesses vie for market share using digital applications. With a keen eye on customer experience, enterprises continuously adapt to emerging trends such as virtual reality tourism, leveraging smart applications to enable users to customize their service experience by reserving meals in rooms or accessing supplementary services via mobile applications. Furthermore, businesses in this sector leverage the Internet of Things and big data to glean insights into customer preferences, with the aim of enhancing service quality and staying agile in response to market demands (Askhatovich et al., 2022).

This section presents an assessment of the current state of digital transformation among Vietnamese businesses. The readiness index for digital transformation comprises seven key aspects: strategic objectives; customer experience and omni-channel; supply chain; IT systems and data management; risk management and cybersecurity; financial management, accounting, planning, legal and HR management; and human and organizational factors. According to the 2023 survey conducted by the Ministry of Planning and Investment, 500 small and medium-sized enterprises in Vietnam participated, with the majority hailing from the manufacturing and processing industries (accounting for 25%) and agriculture, forestry, fisheries, and education sectors (approximately 13%). Figure 1 illustrates the level of readiness for digital transformation across these various aspects among Vietnamese businesses. The findings reveal a positive trend in the average readiness for digital transformation across all aspects compared to that in 2022. Notably, the level of readiness for digital transformation in the strategic objective aspect reached its zenith at 3.3, with the most notable improvement observed in the risk management and cybersecurity aspect, which increased from 2.4 in 2022 to 3.0 in 2023. These results underscore the increasing awareness among enterprises of the advantages and imperative nature of technology adoption in enhancing operational efficiency.

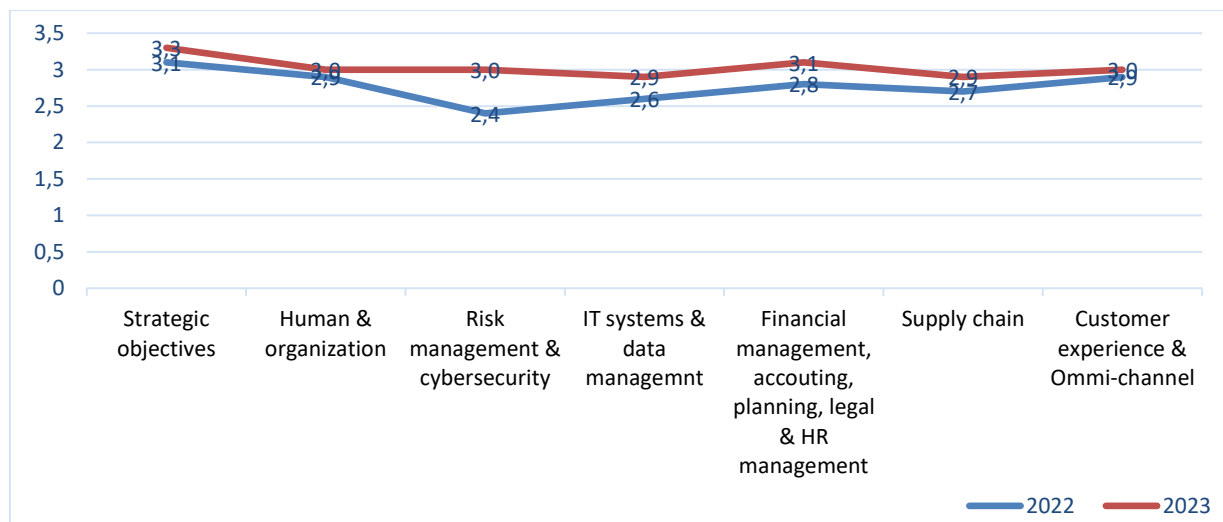


Figure 1 Transformation readiness levels across various facets of businesses in Vietnam.

Figure 2 illustrates the digital transformation readiness levels by industry in 2023. The findings indicate significant improvements across all industries in their digital transformation readiness levels, all surpassing the average threshold of >2.5. Notably, industries such as Education, Professional and Scientific Activities, Accommodation and Food & Beverage, and Logistics & Warehousing have experienced remarkable increases in digital readiness compared to the previous year. Of particular note is the education industry, which has demonstrated remarkable growth, surpassed all other industries and topped the readiness list in 2023. In contrast, the manufacturing and processing industry showed minimal growth over the course of one year, maintaining a readiness score of 2.9.

Figures 3-4 present the assessment results of digital transformation readiness levels within the education and logistics and warehousing sectors. The findings indicate an increase in digital transformation preparedness across various dimensions in these industries. In the education sector, the practicality of the situation during the COVID-19 pandemic showcased the prevalence of online learning activities in Vietnam (Huy et al., 2023). Furthermore, educational institutions have bolstered the integration of technology in their operations and have fortified capacity-building initiatives for teachers and lecturers.



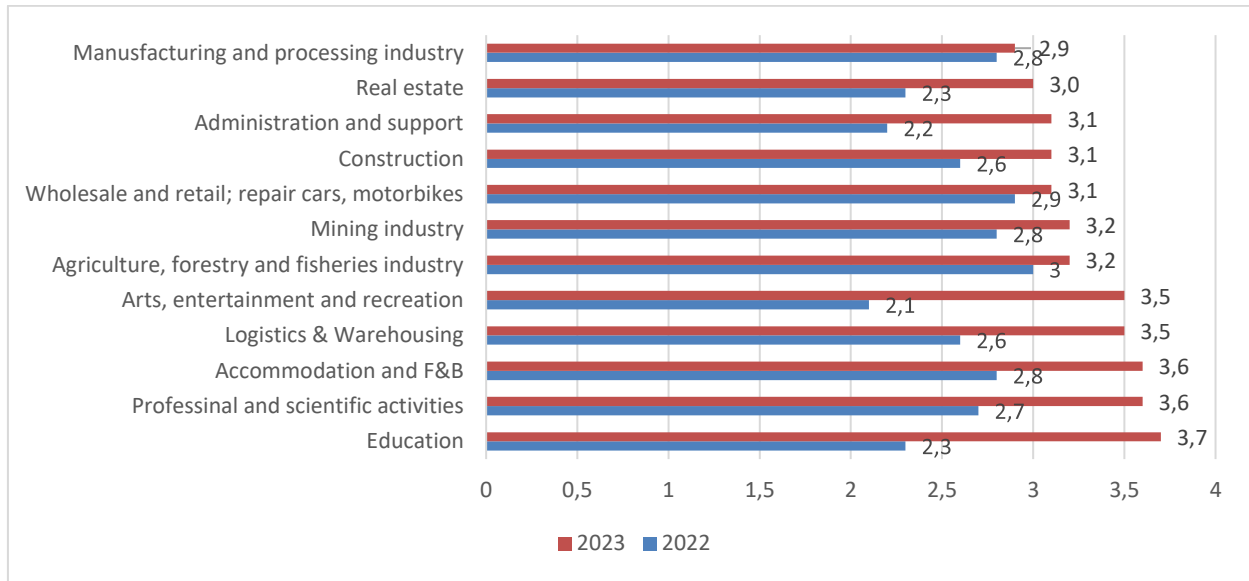


Figure 2 Digital Transformation Readiness Levels by Industry.

Concerning the logistics and warehousing sector, the escalating demand for domestic transportation of goods and logistics services, coupled with advancements in international trade and economic integration, has underscored the need for digital technology enhancements to fortify the domestic transportation network. Simultaneously, the surge in the e-commerce sector in recent years has propelled the call for digital transformation within Vietnam's logistics industry. Consequently, aspects such as strategic objectives, human resources and organizational management, and financial management, accounting, planning, legal and HR management have attained relatively high readiness levels, with scores of 3.7, 3.5, and 3.6, respectively. In practice, businesses in 2023 have heightened their efforts toward digital transformation to enrich customer experiences, bolster interaction, and streamline transactions on e-commerce platforms.

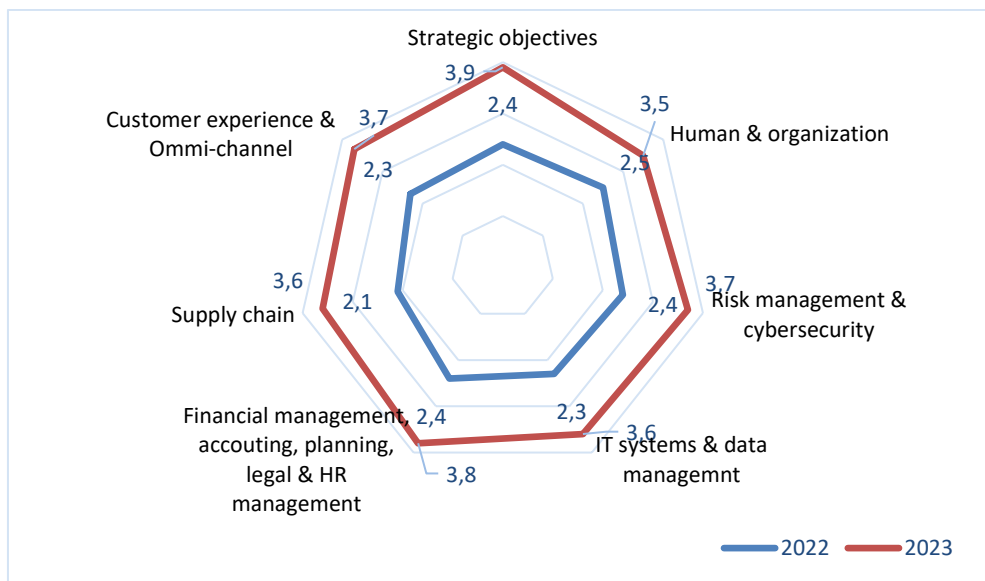


Figure 3 Digital readiness in education.

Figure 5 illustrates the digital readiness of the Accommodation and F&B sector. The industry's average digital transformation readiness level will significantly increase from 2.8 in 2022 to 3.6 in 2023. Within this improvement, individual component scores range from 3.4 to 3.8, indicating an advanced level of readiness. The proliferation of online booking platforms in the accommodation and F&B industry has fundamentally altered how customers seek and book services. This shift in consumer behavior necessitates businesses to promptly adopt digital transformation strategies to adapt and enhance operational efficiency. Businesses have implemented integrated property management systems, inventory management software, and automated processes to streamline operations and reduce manual errors. Additionally, they have equipped their staff with the necessary knowledge and skills to effectively operate these online platforms.

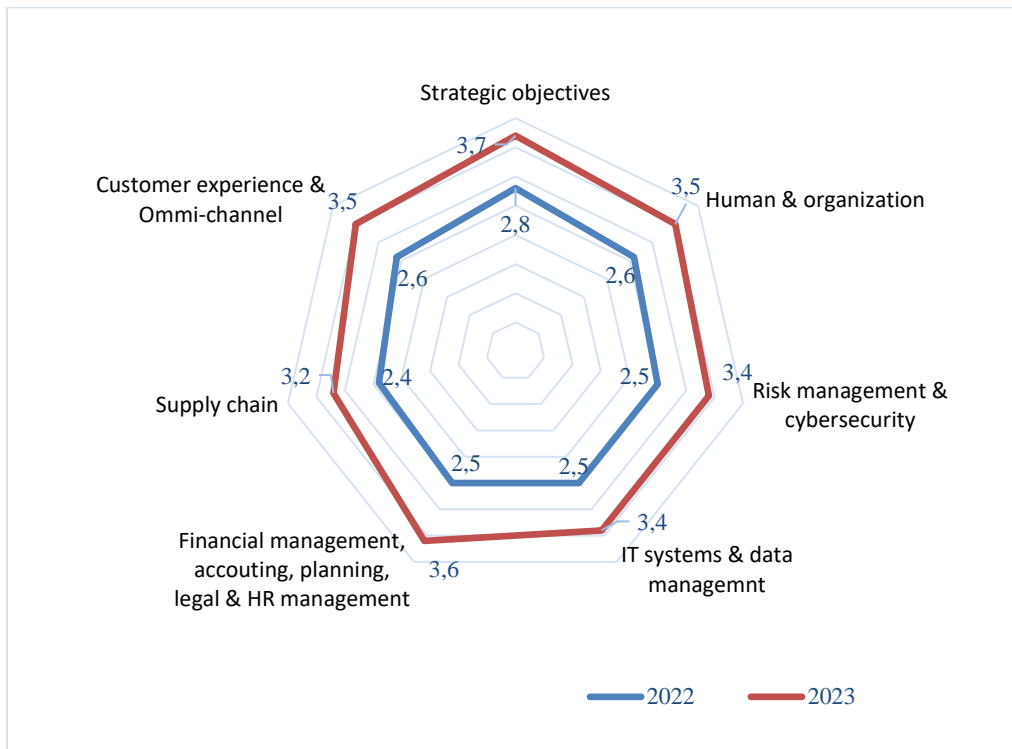


Figure 4 Digital readiness in logistics & warehousing.

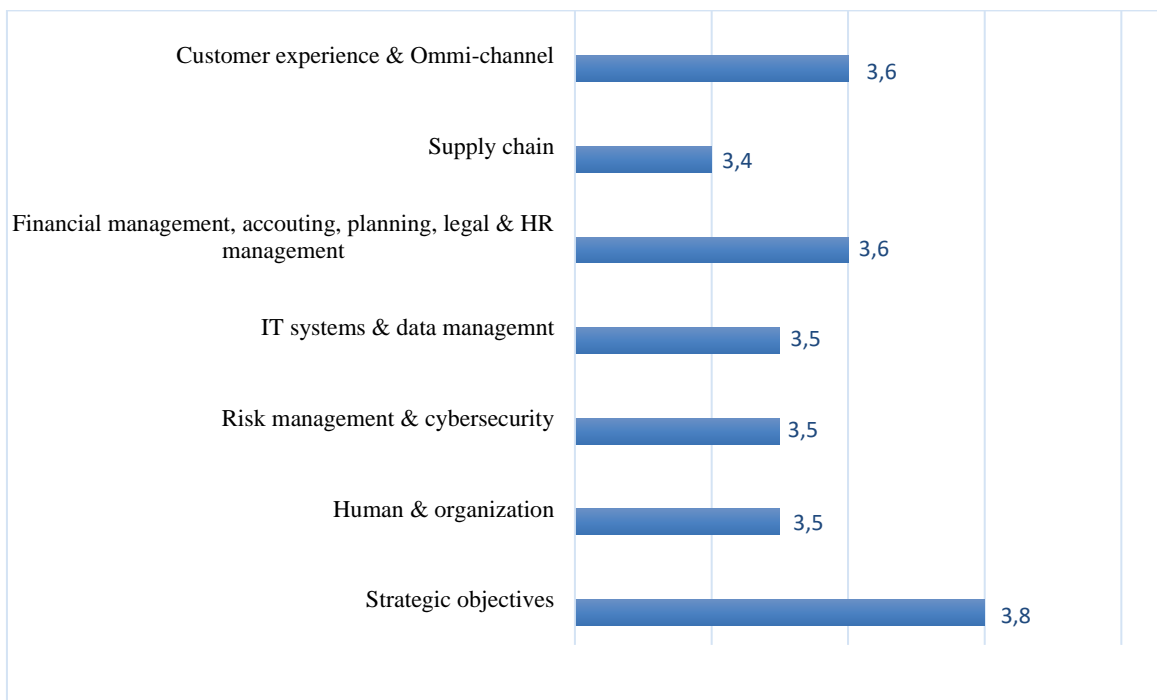


Figure 5 Digital readiness for accommodation and F&B.

To promote the digital transformation of businesses, from 2021 to 2023, the Agency for Enterprise Development under the Ministry of Planning and Investment coordinated with various ministries, sectors, localities, business associations, and sponsors to implement numerous activities and solutions. These efforts focused on raising awareness and enhancing understanding of digital transformation among businesses in 63 provinces and cities, as well as on the Program's digital platforms and mass media. As a result, businesses have significantly improved their awareness of the necessity of digital transformation. Many businesses have entered the data digitization phase, standardized processes, applied digital technologies, and moved toward a more extensive and synchronized digital transformation. Additionally, an ecosystem supporting businesses in digital transformation has been built and developed.

4. Conclusion

Digital transformation is an undeniable trend that shapes businesses globally. This study reviews the models and criteria used to assess the digital transformation readiness of enterprises. The findings from this overview reveal a scarcity of evaluation models tailored to different types of enterprises and adaptable to the unique characteristics of each industry. In Vietnam, the Ministry of Information and Communications approved a set of indices for evaluating the digital transformation readiness of enterprises as part of a project aimed at identifying such indices and promoting digital transformation in 2023. This index set encompasses seven aspects and 34 component criteria: strategic objectives; customer experience and omnichannel; supply chain; IT systems and data management; risk management and cybersecurity; financial management, accounting, planning, legal and HR management; and human and organization. However, these indices are applied uniformly across various industries and types of businesses. It is assumed implicitly that the current criteria hold equal importance, whereas in reality, the significance varies among indicators, industries, and enterprise types. Presently, there are limited evaluation models that are tailored to diverse enterprises and consider industry-specific traits. Additionally, environmental pressures, particularly competitive dynamics and industry developments, differ, resulting in varied conditions and challenges for businesses embarking on digital transformation journeys. The existing tools lack accommodation for such differences, obliging participants to respond to all questions, even when they are irrelevant to their specific enterprise context, potentially yielding artificially low composite indices (Pirola et al., 2020).

The analysis of the digital transformation readiness status of businesses in Vietnam in 2023 reveals an overall upward trend across all aspects compared to that in 2022. Notably, the readiness level for strategic objectives reached a minimum at 3.3, with the most substantial improvement observed in terms of risk management and cybersecurity, increasing from 2.4 in 2022 to 3.0 in 2023. These findings underscore the growing awareness among enterprises of the advantages and imperative nature of technology application in enhancing business operational efficiency.

Ethical considerations

Not applicable.

Conflict of Interest

The author declare no conflicts of interest.

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