International experience in measuring digital transformation and lessons for Vietnam

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Abstract: The strong digitalization process is driving organizations to transform in order to adapt and develop. Accurately identifying the level of digital transformation enables managers to formulate effective policies, optimize resource allocation, and comprehensively promote the transformation process. This article analyzes and synthesizes international experiences in measuring digital transformation from organizations and countries around the world, drawing lessons for Vietnam. By reviewing various measurement models, the article clarifies the trend toward developing integrated and multi-dimensional indicator systems that reflect both effectiveness and readiness for digital transformation at national and organizational levels. At the same time, the article also evaluates the current measurement models in Vietnam and proposes directions for improvement to enhance accuracy, comprehensiveness, and practical relevance.

Keywords: Digital transformation; digital transformation measurement; digital maturity models; ICT index; DTI index.

1. Introduction

In recent years, amid the rapid development of information technology and the far-reaching impact of the Fourth Industrial Revolution, digital transformation has become an inevitable global trend. According to Khuong (2019), the ICT industry in Asian countries, particularly those in Southeast Asia, contributed between 0.5 and 1.6 percentage points to annual GDP growth between 2000 and 2016. In Vietnam, a study by Ngan. et al. (2021) also showed that a 1% increase in the readiness index for ICT application and development could lead to a 0.84% increase in the gross regional domestic product (GRDP) of key Southern economic regions.

These positive impacts indicate that digital transformation is not only a technological trend but also a strategic driver for socio-economic development. However, the process of digital transformation is complex, multidimensional, and cross-sectoral, requiring regular assessment, measurement, and monitoring to ensure effectiveness. According to Agostino & Costantini (2022) and Hary et al. (2024),

measuring digital transformation enables organizations or countries to accurately identify their current level of digital maturity, thereby formulating strategies aligned with their actual capabilities and development objectives.

In Vietnam, the National Digital Transformation Strategy to 2025, with orientations toward 2030 (Decision No. 749/QD-TTg dated June 3, 2020, by the Prime Minister), clearly identifies the requirement to "measure, monitor, and evaluate the level of digital transformation" as a key pillar for achieving the goals of digital government, digital economy, and digital society. However, the current measurement system remains fragmented, lacks integration, and does not fully reflect the actual digital transformation capacity of organizations and localities.

From this practical context, the article focuses on analyzing and synthesizing international experience in measuring digital transformation, drawing lessons and policy recommendations for Vietnam to improve its digital transformation measurement frameworks at both national and organizational levels.

2. Theoretical foundations of digital transformation and its measurement

2.1. Concept of digital transformation

According to the National Digital Transformation Program to 2025, with orientations toward 2030 (Decision No. 749/QD-TTg dated June 3, 2020, by the Prime Minister), digital transformation is understood as the integration of digital technologies across all areas of socio-economic life to transform operational methods, create new value, and optimize resources. The OECD report (2020) emphasizes that digital transformation is a profound economic and social shift driven by the application of digital technologies to restructure processes, products, and services, thereby enhancing productivity and national competitiveness. Meanwhile, a study by McKinsey (2019) argues that digital transformation is not merely the adoption of technology but a comprehensive shift in mindset, culture, and governance models that enables organizations to adapt quickly to disruptions and maintain long-term competitive advantage.

Thus, digital transformation is the process of applying digital technologies across all organizational or business activities to improve operational efficiency, innovate operating models, create new products and services, and enhance the user experience. In other words, it involves replacing manual, traditional processes with modern technological solutions, while shifting from a mindset of "managing through paperwork" to "governing through data."

2.2. Measuring digital transformation

Digital transformation is an interdisciplinary domain that combines information technology, management, economics, and behavioral sciences. Therefore, measuring digital transformation can be understood as the process of assessing the extent to which digital technologies are adopted, integrated, and generate impact within an organization's or a nation's operations.

According to the OECD (2020), measuring digital transformation involves recording and analyzing the degree to which digital technologies are embedded in economic, social, and governance processes, thereby reflecting each entity's transformation capacity and digital readiness. The World Economic Forum (WEF) (2020) emphasizes that such measurement enables the assessment of how digital technologies create new value and reshape operating, business, and user experiences across sectors.

The International Telecommunication Union (ITU) (2020) argues that digital transformation measurement should be based on four core pillars: (1) Accessibility to digital

technologies; (2) Levels of acceptance and use; (3) The ability to apply technologies in daily life and production; and (4) The socio-economic impacts of digital transformation. Complementing this approach, Deloitte (2018) and TM Forum (2017) propose multidimensional measurement frameworks that encompass customer experience, strategy, technology, processes, people, and organizational culture.

Synthesizing these perspectives, digital transformation measurement can be understood as the process of evaluating the degree and effectiveness of digital technology adoption in organizational or national management, operations, and innovation. This measurement not only reflects the current state but also provides an evidence base for policymaking, resource allocation, and monitoring the implementation of digital transformation strategies, thereby contributing to sustainable development in the digital era.

3. International experiences in measuring digital transformation

3.1. Measuring digital transformation at the national level

At the national level, international organizations such as the World Bank (WB), the United Nations (UN), and the Organisation for Economic Co-operation and Development (OECD) have developed comprehensive indicator sets to measure the digital maturity of governments, thereby reflecting their capacity to adopt technology in public administration and public service delivery.

The Government Technology Maturity Index (GTMI), developed by the World Bank in 2021, is considered one of the most comprehensive tools for assessing government digital transformation capacity. GTMI focuses on measuring the readiness and effectiveness of technology deployment in public governance and digital service provision. The index consists of four key components: (1)

Core government digital platforms - reflecting the modernization of internal government management systems, including data infrastructure, cloud computing, and systems for financial, asset, and human resource management; (2) Digital public service delivery - evaluating the completeness and accessibility of online public services for citizens and businesses; (3) Digital citizen engagement - measuring citizens' ability to use digital platforms to provide feedback, interact, and participate in governmental decision-making through online channels and open data; and (4) Enablers of digital government - including policies, strategies, and regulatory frameworks that support public-sector digital transformation. The 2022 GTMI report ranks 198 countries across four maturity levels: 34.8% at very high maturity, 23.2% at high, 26.8% at medium, and 15.2% at low. The findings highlight significant disparities among countries, underscoring the critical roles of institutional capacity and technology investment in public-sector modernization.

Alongside GTMI, the E-Government Development Index (EGDI) of the UN is the most widely used tool for comparing e-government development across nations (United Nations, 2001-present). The 2022 UN report evaluates 193 countries and territories across three pillars: telecommunications infrastructure, human capital, and online services. Telecommunication infrastructure is measured using four equally weighted indicators, including Internet usage, mobile subscriptions, and fixed and mobile broadband subscriptions. Human capital is based on UNESCO data, calculated from adult literacy rates, school enrolment ratios, and expected years of schooling. The online services pillar is assessed through the review of national portals, covering institutional frameworks, service content, service levels, technology, and electronic participation. EGDI reflects not only online service provision but also national capacity to pursue the
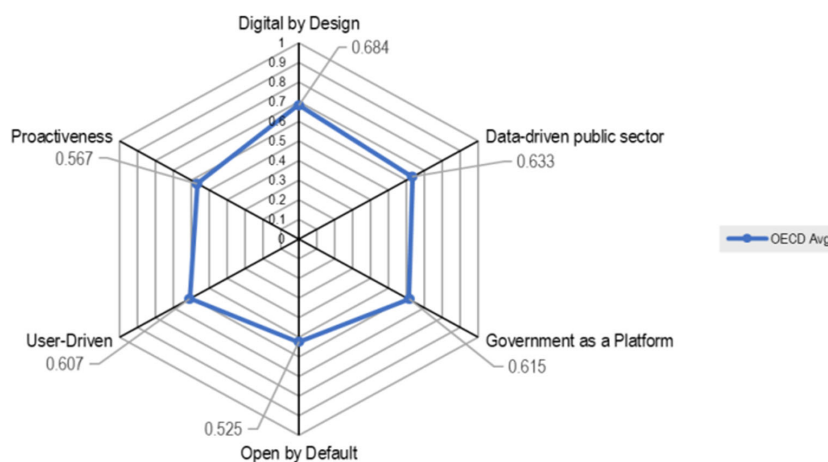
Sustainable Development Goals (SDGs). According to the 2022 report, countries with high EGDI scores typically possess clear digital government strategies, substantial investments in telecommunications, and initiatives to promote digital skills among their citizens.

Additionally, the Digital Government Index (DGI) of the OECD (2019, 2023) was designed to assess the digital maturity of member-country governments based on the OECD Recommendation on Digital Government Strategies (2014). The DGI aims to measure government capability in establishing the foundational conditions for a human-centered, integrated public-sector digital transformation. The index comprises six dimensions: (1) Digital by design - reflecting the integration of digital technologies in policymaking and service design; (2) Data-driven public sector - indicating the ability to govern, share, and use data for policymaking; (3) Government as a platform - measuring the deployment of shared digital tools, digital identity systems, and shared data platforms; (4) Open by default - assessing transparency and open data accessibility; (5) User-driven - capturing the extent to which services are designed based on user needs; and (6) Proactiveness - reflecting the government's ability to anticipate and respond to citizen and business needs *(Figure 1)*. The 2023 DGI report shows that the Covid-19 pandemic accelerated the expansion of digital infrastructure, the growth of online public services, and the advancement of cross-sector data integration. However, many countries continue to face challenges in proactiveness, user-centric design, and openness.

A synthesis of GTMI, EGDI, and DGI indicates that although all three indices aim to measure digital transformation capacity at the national level, each emphasizes different aspects: GTMI focuses on administrative capability and government technology infrastructure; EGDI highlights online service provision and citizen accessibility; whereas DGI emphasizes data-driven maturity, openness, and human-centered design. The combination of these indices provides a comprehensive picture of public-sector digital transformation. It offers valuable insights for countries, including Vietnam, to refine their national-level digital transformation measurement systems in the coming years.

Figure 1. Average values of the six DGI dimensions according to the OECD

Source: OECD Report (2023).

3.2. Measuring digital transformation at the organizational level

(1) Italy's experience in measuring digital transformation

In Italy, the model for measuring digital transformation was developed based on the research of Agostino & Costantini (2022), drawing on widely adopted digital maturity frameworks in Europe and adapting them to the context of small and medium-sized enterprises. The assessment framework focuses on five core dimensions: people, technology, processes, customers, and digital strategy and investment.

The people dimension evaluates employees' digital capabilities, technological adaptability, and internal knowledge management. The technology dimension assesses the use of digital infrastructure, data analytics capability, and the availability of digital connectivity within the organization. The process dimension measures the level of digitalization of internal operations and external interactions, reflecting operational efficiency and the ability to integrate systems. The customer dimension assesses an organization's ability to engage with users through digital platforms and the level of digital awareness among its customers. Finally, the strategy and digital investment dimension evaluates long-term strategic planning and the allocation of resources for technological initiatives.
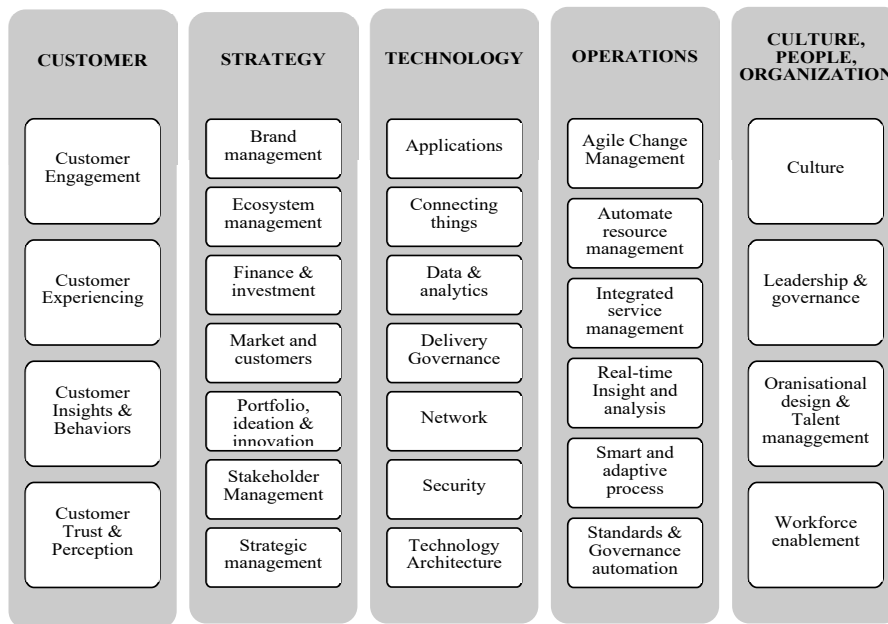
Based on these five dimensions, the model establishes the Digital Readiness Index (DRI) to measure an organization's overall digital maturity. The DRI value is calculated using weighted scores for each dimension (w_i, w_j, w_k) and the score of each criterion (Q_k). Depending on the type of data, Q_k can be determined using three methods: (1) Likert scales normalized to a 0-1 range; (2) binary actual-false questions (0-1); or (3) multiple-choice questions with several correct answers.

The DRI model provides managers with a quantitative tool to objectively assess digital readiness and compare performance across organizations or against national benchmarks. However, a key limitation of the model is that assessments are often conducted at a single point in time, while digital transformation is dynamic and continuously evolving. Therefore, to capture actual conditions and adjust strategies effectively, organizations need to conduct annual assessments.

(2) Digital transformation measurement practices in U.S. technology companies

In the United States, major technology corporations and international consulting organizations have developed several highly standardized frameworks for measuring digital transformation. Among these, the most prominent are the TM Forum Digital Maturity Model (DMM) and Deloitte's framework (2018). The DMM, developed by the TM Forum (2017), is considered one of the most widely adopted frameworks in the telecommunications, technology, and digital services sectors. This assessment framework helps enterprises identify their current position in the digital transformation journey and develop a roadmap aligned with their strategic objectives.

Similarly, the Deloitte (2018) model has been widely applied by financial, technology, and manufacturing corporations in the United States to evaluate organizational transformation capabilities. Both frameworks are structured around five core dimensions - customers, strategy, technology, operations, and organizational culture - which are further specified into 28 sub-dimensions and 175 detailed assessment criteria. This approach enables the measurement of not only technology adoption but also changes in governance models, corporate culture, and the innovative capacity of human resources.

Figure 2. Digital maturity assessment model for technology enterprises

CUSTOMER	STRATEGY	TECHNOLOGY	OPERATIONS	CULTURE, PEOPLE, ORGANIZATION
Customer Engagement	Brand management	Applications	Agile Change Management	Culture
Customer Experiencing	Ecosystem management	Connecting things	Automate resource management	Leadership & governance
Customer Insights & Behaviors	Finance & investment	Data & analytics	Integrated service management	Oranisational design & Talent managgement
Customer Trust & Perception	Market and customers	Delivery Governance	Real-time Insight and analysis	Workforce enablement
	Portfolio, ideation & innovation	Network	Smart and adaptive process	
	Stakeholder Management	Security	Standards & Governance automation	
	Strategic management	Technology Architecture		

Source: TM Forum (2020).

After measuring indicators across each domain, the organization's level of digital transformation is classified into five stages: initiating, emerging, performing, advancing, and leading.

The DMM's flexible design considers variations in vision, strategy, and operational models across organizations during the transformation process. This approach helps organizations avoid common issues, such as fragmented innovation initiatives or insufficient implementation support. Instead of focusing solely on technology, organizations are guided to pursue comprehensive digital transformation across strategy, innovation, people, technology, and customer experience.

A key strength of U.S. models is their flexibility, industry-specific customization, and systematic linkage between strategic goals and performance indicators. However, because these frameworks were developed in technologically advanced private-sector environments, adopting them directly in the public sector or in developing economies requires adjustments to the weights and criteria to align with actual capacity and contextual conditions.

(3) Experiences in measuring digital transformation in selected Southeast Asian countries

In Indonesia, digital transformation is considered a key solution to ensuring adaptability and sustainable development amid increasingly intense competition (Haryanti et al., 2024). Enterprises, particularly in the financial sector, have adopted the Digital Transformation Self-Assessment Maturity Model (DX-SAMM) to assess multidimensional, flexible levels of digital maturity across various fields. This model is built upon three principal dimensions.

First, organization and organizational structure reflect the degree of internal alignment and the dynamism of collaborative networks within the enterprise, which are considered critical inputs for digital transformation. *Second,* the people dimension refers to employees' ability to learn digital skills, their readiness to apply technology in work processes, and their capacity for innovation.

Third, the transformation processes dimension captures the extent to which operational processes are integrated through technology to achieve optimal efficiency, including both internal interactions and interactions with external partners and customers.

Data collected from the assessment of each dimension is used to calculate the overall digital maturity index in three steps.

Step 1: Determine the index J(d,a) - the achievement level of attribute a in dimension d, calculated as the average score from responses of R participants:

$$J_{(d,a)} = \frac{\sum_{q \in Q_{da}} \frac{\sum_{r \in R} H_{(r,q)}}{|R|}}{|Q_{da}|}$$

where Q_{da} is the set of questions measuring attribute a in dimension d; $H_{(r,q)}$ is the score given to question q by respondent r; and $|Q_{da}|$ is the number of questions for that attribute.

Step 2: Calculate the average maturity level of a specific dimension M(d) based on the values of its attributes:

$$M_{(d)} = \frac{\sum_{a \in A_d} J_{(a,d)}}{|A_d|}$$

where A_d is the set of attributes in dimension d.

Step 3: The overall maturity level of an organization M(o) is determined by the minimum value among the maturity levels of all dimensions, reflecting the "bottleneck" in the transformation process:

$M_{(o)} = \min(M_1, M_2, \ldots, M_D)$

The results are ranked based on a five-level maturity model: performed, managed, established, predictable, and optimized. DX-SAMM emphasizes the principle that an organization's overall maturity is sustainable only when all component dimensions meet a minimum threshold.

In Thailand, the model for measuring digital transformation in enterprises is also built on a five-level maturity framework, but expands the assessment to eight dimensions: strategy, leadership, customer experience, operations, people, culture, organization, and technology. This approach reflects the comprehensive nature of digital transformation, which requires not only technological assessment but also changes in organizational culture and user experience.

Implementing these models requires annual surveys to collect updated input data, thereby identifying each organization's position and digital development trajectory. The evaluation results enable managers to track transformation progress, identify gaps between objectives and actual performance, and design appropriate strategic adjustments and investment decisions for the next transformation cycle.

4. The current state of digital transformation measurement in Vietnam

In Vietnam, there are currently two major index systems related to digital transformation measurement: the Information and Communications Technology Readiness Index (ICT Readiness Index) and the Digital Transformation Index (DTI), which are used for ministries, ministerial-level agencies, government-attached agencies, and centrally governed provinces and cities.

4.1. ICT Index measurement model

In Vietnam, the ICT Readiness Index (ICT Index) is published annually to assess the level of ICT readiness among ministries, ministerial-level agencies, government-attached agencies, centrally governed provinces/cities, major corporations, and commercial banks. The index consists of five component groups: (1) Technical infrastructure; (2) Human resources infrastructure; (3) ICT application; (4) Online public services, and (5) The ICT industry of the locality.

Overall, the index contains more than 100 criteria collected through surveys, statistical

reports, and independent verification to ensure objectivity and comparability across units (Ministry of Information and Communications, 2022).

When calculating the index, the initial indicators are standardized using the Z-score method, which aligns varying values onto a uniform scale and eliminates the effects of size and measurement units. The standardization formula is:

$$T^n = T - \mu/\sigma$$

where T^n is the Z-score standardized value; T is the original indicator value; μ is the mean; and σ is the standard deviation.

Next, the average value of each sub-indicator group is calculated using:

$$T_k^j = \frac{1}{m} \sum_{i=1}^{m} T_i^n$$

where m is the number of sub-indicators in group j, and T^n_i is the standardized value of each sub-indicator.

After standardization, component indicators are rescaled to the range [0-1] using the min-max scaling method to ensure comparability among groups. The overall ICT Index is computed differently depending on whether the unit provides online public services.

For units with online public services, the index is computed as:

$$I = \frac{1}{3}\left(I_{HTKT} + I_{HTNL} + \frac{1}{2}\left(I_{UDNB} + I_{DVCTT}\right)\right)$$

For units without online public services, the index is:

$$I = \frac{1}{3}\left(I_{HTKT} + I_{HTNL} + I_{UDCNTT}\right)$$

Where:

I_{HTKT}: technical infrastructure index

I_{HTNL}: human resources infrastructure index

I_{UDNB}: internal application index

I_{DVCTT}: online public service index

I_{UDCNTT}: ICT application index.

Specifically, the technical infrastructure index measures the deployment of security solutions, data management software, and information security systems (e.g., firewalls, anti-spam software). The human resources infrastructure index reflects the proportion of ICT-specialized staff, personnel qualification levels, and the capability to operate ICT systems.

Regarding advantages, the ICT Index possesses high quantitative validity due to its clear standardization and weighting formulas, ensuring objective evaluation and comparability across units. Its structure, divided into three pillars of infrastructure, applications, and human resources, accurately reflects the nature of ICT development. However, in terms of limitations, the model is skewed towards quantity over quality, as higher weights are assigned to technological infrastructure. At the same time, it fails to capture the effectiveness of ICT usage or user satisfaction fully. Factors such as digital service experience, citizen, and business satisfaction remain insufficiently quantified. Moreover, feedback collection from enterprises and end-users remains limited, resulting in discontinuous data that does not fully reflect the actual progress of digital transformation in localities and organizations.

4.2. The Digital Transformation Index (DTI) measurement model

In addition to the ICT Index, Vietnam currently applies the Digital Transformation Index (DTI), which measures the level of digital transformation across government agencies at three levels: ministries, centrally governed provinces and cities, and the national level. According to the Ministry of Information and Communications (2022), the DTI system is designed to assess the implementation progress of the National Digital Transformation Program to 2025, with orientation toward 2030,

reflecting the level of transformation across three core pillars: digital government, digital economy, and digital society.

At the provincial level, the DTI is structured around the three aforementioned pillars, each comprising seven component indicators: digital awareness transformation, institutional enabling environment, development of digital infrastructure and digital platforms, digital information and data, digital transformation activities, cybersecurity and safety, and training and human resource development. Thus, the provincial DTI framework comprises three pillars, 21 leading indicators, 108 sub-indicators, and 306 assessment criteria, demonstrating a multi-layered, highly detailed measurement structure.

The DTI measurement methodology combines quantitative and qualitative approaches, synthesizing data from multiple sources to ensure objectivity and comprehensiveness. Specifically, 80% of the score is derived from reported data and sociological surveys, reflecting actual implementation through statistics and field surveys; 10% is based on sentiment analysis of information in cyberspace, using social media and official government web portals; and the remaining 10% is drawn from expert interviews, providing in-depth qualitative insights. Data for the DTI model comes from four primary sources: (1) Data provided by ministries, sectors, and localities; (2) data collected from sociological surveys; (3) data derived from online/cyberspace analysis; and (4) independent expert assessments.

The DTI has been piloted since 2020 and improved annually, demonstrating a high degree of timeliness and practical relevance. The index is built on the National Digital Transformation Program. It therefore reflects the three core objectives of the national transformation process: developing digital government, a digital economy, and a digital society. Its criteria are quantitatively designed with precise weighting, independent data collection, and multi-source evaluation, thereby ensuring high measurement reliability. As a result, the DTI has become a valuable tool for monitoring, comparing, and evaluating the annual digital transformation performance of ministries, sectors, localities, and the country as a whole. It also helps identify priority areas for investment in the next phase.

However, the DTI still exhibits several limitations. Most indicators focus on assessing the completion of the national digital transformation program's targets. At the same time, they do not fully capture the effectiveness of technology use, the level of citizen and business interaction, or user experience and satisfaction with digital services. Because it is primarily designed for the public administrative sector, the DTI is not suitable for use in enterprises or non-governmental organizations, where operational characteristics and success criteria often focus on productivity, efficiency, and innovation rather than compliance with administrative plans.

4.3. Other measurement models

In addition to the two widely used models, the ICT Index and DTI, Vietnam is currently implementing and referencing several other specialized digital transformation measurement models that capture specific aspects of the digitalization process in particular sectors. Although these models have a narrower scope, they play a crucial supplementary role in helping to complete a comprehensive picture of the nation's, organizations', and enterprises' digital capabilities.

First, the Open Data Index (ODI) is applied to assess the readiness, accessibility, and usability of open data in government agencies. This model is developed using the Open Knowledge Foundation's methodology and

adapted to Vietnam's context. The ODI typically includes several component indicators: (1) Policies and legal frameworks for open data; (2) Data accessibility, formats, and timeliness; (3) Scope of data sharing and reuse; and (4) The capacity of agencies to manage, secure, and exploit data. Measuring the ODI helps agencies determine their readiness for the data-driven economy and serves as a basis for promoting the national open data strategy.

Second, the AI Readiness Index has also been adopted by several domestic agencies and research institutions as a reference tool for measuring the readiness and capacity to adopt and apply AI technologies. This model focuses on three major groups of factors: (1) Data and computing infrastructure - assessing the ability to collect, process, store, and analyze data for AI; (2) Human resources and digital skills - reflecting the size and quality of AI experts, data scientists, and technology engineers; (3) Innovation policy and ecosystem - capturing government and business-sector support for AI development. This index helps policymakers identify strengths, weaknesses, and opportunities in developing national AI capacity to support digital transformation.

In addition, in particular specialized sectors, Vietnam has piloted the CIO Index (ministerial-level e-government maturity index) and the Cyber Readiness Index (CRI). The CIO Index evaluates the capabilities of IT departments within ministries and sectors by assessing key factors, including IT strategy, infrastructure investment, human resource capacity, and the operational effectiveness of information systems. Meanwhile, the CRI evaluates information security readiness and the ability to respond to cyber risks, including cybersecurity awareness, preventive measures, incident response, data protection policies, and adherence to international security standards.

Overall, these models supplement dimensions not fully captured by the ICT Index and DTI, including data governance, AI capability, cybersecurity readiness, and digital transformation innovation capacity. However, a standard limitation is the lack of integration and synchronization among the models, resulting in fragmented data and making it difficult to compare or aggregate results. Therefore, in the future, it is necessary to establish a national integrated digital transformation measurement framework, in which specialized indices such as the ICT Index, DTI, ODI, AI Readiness Index, CIO Index, and CRI are interconnected, share data, and adopt standardized evaluation methods, thereby providing a more accurate reflection of Vietnam's overall digital transformation capability.

5. Lessons learned

In the context of Vietnam's strong implementation of the National Digital Transformation Strategy to 2025 with a vision to 2030, demand for digital transformation among enterprises and public sector organizations is skyrocketing. Successful digital transformation not only enhances operational efficiency and business performance but also creates a competitive advantage in a volatile and profoundly globalized economy. Drawing on the experience of leading countries, Vietnam can derive several important lessons to enhance its digital transformation measurement system, ensuring practicality, feasibility, and an accurate reflection of digital capability across various sectors.

First, it is essential to standardize measurement indicators according to sector-specific characteristics. At present, composite indicators such as the ICT Index and DTI primarily reflect digital readiness or government agency transformation outcomes, but do not clearly capture the specificities of

each industry or domain. Therefore, it is necessary to develop separate sets of indicators for each area, such as enterprises, education, healthcare, finance, or public administration, to assess digital maturity more accurately. For example, in enterprises, indicators may include the rate of process digitization, the adoption of management systems (such as ERP and CRM), or the proportion of revenue generated through online channels. In healthcare, key indicators may include the adoption rate of electronic medical records, data interoperability, and the use of digital technologies in medical services. In education, measurement may be based on the proportion of digital learning materials, online teaching, and digitized administrative processes. Standardizing sector-specific measurement frameworks helps ensure relevance to actual conditions and facilitates comparability across regions and industries.

Second, measurement indicators must be closely aligned with the strategic goals of the national digital transformation program and with each organization's objectives. A scientifically designed measurement framework should not only reflect the current status but also show progress toward long-term targets. For instance, if the goal is to achieve 100% level 4 online public services by 2025, the measurement framework must incorporate indicators tracking the deployment rate of level 4 services, the proportion of online applications, and citizen satisfaction levels. In this way, the measurement system serves not only as a monitoring tool but also as a roadmap for policy implementation, helping organizations accurately assess their progress toward their intended goals.

Third, indicators should be designed to reflect technological adaptability and human capability. Current measurement systems, such as the ICT Index and DTI, emphasize technical infrastructure, while human

resource readiness and the behavioral aspects of technology use by citizens and businesses remain underrepresented. Experiences from Southeast Asian countries show that human digital capability - including skills, attitudes, and readiness for innovation - is a decisive factor for successful digital transformation. Therefore, measurement frameworks should incorporate criteria such as: the proportion of staff trained in digital skills, the percentage of citizens conducting online transactions, and user satisfaction with digital services. These indicators capture not only the results of infrastructure investment but also the real effectiveness of digital technology adoption in daily life and public service delivery.

Fourth, open data and data-sharing must be integrated into the measurement system. In a digital economy, data is considered a strategic resource; therefore, the ability to manage, share, and utilize data effectively is a key criterion for sustainable digital transformation. The measurement framework should include indicators on the quantity and quality of open datasets, compliance with open data standards, the level of inter-agency data connectivity and data sharing, and the extent to which big data and artificial intelligence (AI) are applied in decision-making processes. Incorporating these dimensions encourages organizations to invest in data governance, thereby enhancing operational effectiveness and improving transparency in the public sector.

Finally, measurement must be updated regularly. Technologies and digital governance models evolve rapidly, so measurement frameworks must be reviewed and updated annually. Continuous monitoring enables policymakers and organizations to gain a comprehensive understanding of digital transformation progress at both national and organizational levels, while also facilitating the assessment of the effectiveness of implemented policies and solutions. This

enables Vietnam to adjust strategies promptly, prioritize resources appropriately, and ensure that digital transformation unfolds sustainably, effectively, and consistently across the entire system.

6. Conclusion

Measuring digital transformation plays a pivotal role in identifying digital capabilities, tracking transformation progress, and guiding policy formulation aligned with each stage of development. International experience shows that successful countries have developed multidimensional, integrated, and flexible measurement frameworks that simultaneously capture infrastructure, human resources, processes, data, and technological readiness. For Vietnam, in the context of implementing the National Digital Transformation Strategy toward 2025, with a vision to 2030, improving the measurement model is an essential requirement to ensure effective governance of the transformation process at both national and organizational levels.

In the future, Vietnam should aim to establish a unified national digital transformation index that integrates existing systems such as the ICT Index, DTI, ODI, and the AI Readiness Index, thereby providing a comprehensive reflection of the country's digital capabilities. Such a framework would not only function as an evaluation tool but also serve as a strategic catalyst, enabling Vietnam to transition from a "technology-applying country" to a "technology-and innovation-leading country" in the digital era.

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