Designing a Performance Management System for the Digital Transformation of the Indonesian Banking Industry

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Abstract

This study aims to design an Indonesian digital banking transformation performance management system (PMS-DT IBI) to assist banks in managing digital transformation performance (DX). This study will answer two research questions, namely how to identify dimensions that can be used as a framework for the Indonesian digital banking transformation and how to measure the digital performance of all dimensions within the framework. This research has an important role in formulating DX performance in a comprehensive, systematic, and measurable manner. We conducted a literature review on the dimensions of digital transformation and the contribution of digital transformation to improving company performance. In PMS-DT IBI, we have formulated digital performance indicators (DPI), which are mapped into 23 dimensions spread across four perspectives: strategic management, ecosystem management, information technology, and organizational strategy. From a strategic management perspective, DPI is formulated on the dimensions of DX strategy, business model, finance, P3M (portfolio, program, and project), and operational management. In ecosystem management, DPI is mapped in terms of ecosystem design, customer, partnership, and value dimensions. The information technology perspective consists of DPI for the dimensions of enterprise architecture, IT GRC, IT capabilities, data governance, system development, new technology, and security. And the organizational strategy perspective consists of DPI for the dimensions of organizational design, competence, change management, culture, leadership, and innovation. This research contributes to the importance of defining performance indicators in all subsystems in general system theory and PMS-DT IBI will assist banks in managing DX performance as a managerial application.

Keywords
Digital transformation, Digital banking transformation, Performance management system, Performance indicator.

1. Introduction
With the advancement of the new economy, digitalization is the trend (Zhai et al. 2022). Digital transformation is the use of new digital technologies to enable major business improvements (Fitsgerald et al. 2014). The literature also refers to DX as applying digital technology in operations, business model innovation or digital strategy to create value for a firm (Dinh et al. 2015; Schallmo et al. 2017; Selimovic et al. 2021; Singh et al. 2021; Verhoef et al. 2021). According to the Annual Report on the Development of Global Digital Economy Competitiveness, the top three countries in economy-wide digitalization are the US, Singapore, and China (Shiyue, 2021). While it is natural that firms are interested in DX, it is not straightforward whether it may bring tangible benefits to firms and enhance shareholder value (Zhai et al. 2022). The use of various technologies in the financial services sector has brought significant changes to the Indonesian banking industry.

Indonesian Financial Services (OJK, 2021) stated that these changes can be seen from four (four) aspects, which then drive changes in the future banking landscape. First, changes in consumer expectations of banking products and services. In general, along with the development of information technology, consumer expectations for a product or service have led to products and services that are easy and safe, personal, not behind the trend, and consumers have the convenience of comparing the quality of various products and services. Second is the use of data to improve the quality of products and services (data-enhanced products and services). Third, is the emergence of new partnerships with big companies and start-ups. Technological developments have led to the formation of a new digital ecosystem with the bank as one of the players in the ecosystem. The bank's partnership with players in the digital ecosystem such as fintech and big-tech provides opportunities for the bank to gain new customers, take advantage of partner innovation, and gain access to data for the development of the bank's products and services. Fourth, change the operational model to a digital business model. The development of information technology, accompanied by changes in consumer behavior, forced the bank to immediately carry out digital transformation. For the bank, the transformation to become a fully digital bank presents an efficient and effective business model, which is expected to increase the penetration and reach of the bank to all levels of society to ultimately encourage increased profitability, inclusiveness, and maintain business existence amidst increasingly fierce competition in the financial services sector.

Zhai et al. (2022) stated that DX implementation is complex because of the enormous cost, learning curve, and adjustment involved. Based on the survey results of Wipro Digital (2017) in the US, 50% of the senior executive respondents revealed that their firms failed in their DX process. From the results of a survey conducted by the Harvard Business Review (HBR, 2019), the world's spending on the DX program was $1.3 trillion and the success rate was 30%, meaning that spending of $900 trillion on DX did not meet the expected business goals. 68% of the organizations studied by the Project Management Institute (PMI, 2021) indicated that they were involved in digital transformation projects in 2020. 35% of the transformation projects failed, and about one-quarter of the projects did not meet the intended goals (PMI, 2021).

To succeed in implementing DX in the Indonesian banking industry, where the benefits of DX do not only include lower cost, better operating efficiency, or enhanced innovation success (Zhai et al. 2022), we propose a performance management system (PMS) design for DX implementation based on all the dimensions that affect the success of DX. Due to the various challenges that affect the successful implementation of DX in various previous studies, it is a dimension of DX that must be managed by the company. Thus, banks can manage all dimensions of DX from the perspective of process, capability, and performance. so that banks can focus on achieving performance from a financial perspective and other perspectives. Banks can also identify problems early on related to the performance of the DX dimension and immediately make improvements to ensure that DX can be carried out more effectively and measurably. In this study, two research questions will be discussed, namely:

RQ1. How to identify dimensions that can be used as a framework for the digital transformation of Indonesian banking?

RQ2. How to measure the digital performance of all dimensions in the Indonesian banking digital transformation framework.

To address the above-mentioned research questions, a literature review approach is used to identify the dimensions of Indonesian digital banking and digital performance indicators (PI) and related elements. The results of this research were framed using the General System Theory (von Bertalanffy, 1972) as the theoretical framework. On the one hand, this research aims to provide a more holistic view from the PMS perspective that may help scholars and practitioners identify the performance outcome needs when designing and implementing digital initiatives. On the other hand, it provides an understanding of PI types and metrics to help decision-makers recognize them and make well-informed decisions to implement DX in the Indonesian banking industry. Also, it highlights possible gaps for future research in this important and timely area of study.

1.1 Objectives

This research aims to design PMS-DT IBI to assist banks in managing digital transformation performance. We propose a conceptual framework of 23 dimensions spread across four perspectives: the strategic management perspective, ecosystem management, information technology, and organizational strategy. For successful DX implementation, we propose a performance measurement of 23 interrelated dimensions of DX. This PMS-DT IBI will serve as guidance for Indonesian banks in managing the performance of each DX dimension comprehensively, to assist banks in identifying the dimensions that perform according to the bank's goals and dimensions that require attention to improve

their performance. Thus, banks can manage DX in a structured manner and can manage various challenges that can lead to the failure of DX implementation in a structured manner.

2. Literature Review

Organizations today recognize the importance of achieving organizational transformation by adopting and incorporating digital technologies into their business processes to improve process efficiency and generate new revenue streams (Nwaiwu, 2018). The word "digital transformation" currently lacks a widely agreed definition (D. Schallmo, 2017). The term "transformation" refers to a major shift in an organization's strategy, structure (Matt et al., 2015), and power structure (Wischnevsky and Damanpour, 2006). DX is defined as a disruptive technological achievement, bringing new business and operating models across all sectors (Ebru Gokalp, et. al., 2021). The process of adapting to a rapidly changing digital landscape to satisfy the digital expectations of customers, employees, and partners is known as digital transformation. This adoption process must be planned, implemented, and carried out in a proactive manner (Berghaus and Back, 2016; Kane et al., 2017).

Furthermore, digital technologies must generate value for customers, businesses, and other key stakeholders (Shallmo and Williams, 2017). Companies must focus on two complementary activities for a successful digital transformation: redesigning consumer value offerings and altering their operations using digital technologies for increased customer connection and collaboration (Berman, 2012). Henriette et al. (2016), in particular, emphasize that in the context of using and adopting digital technology, a holistic transformation of an organization is required to create value. In banking, technologies have disrupted the competitive landscape, shifting sales to relatively digital firms. Not only has the competition become more global, but the intensity has also increased. Consumer behavior is changing as a response to the digital revolution. Market figures show that consumers are shifting their interaction to the online ecosystem, and digital touchpoints have an important role in the customer journey, affecting both online and offline interaction (Kannan & Li, 2017). With the help of new search and social media tools, consumers have become more connected, informed, empowered, and active (e.g., Lamberton & Stephen, 2016; Verhoef et al., 2017). Using digital technologies, consumers can co-create value by designing and customizing products and services, performing last-mile distribution activities, and assisting other customers by sharing product reviews (Beckers, van Doorn, & Verhoef, 2018; Grönroos & Voima, 2013). Mobile devices have become important in today's consumer behavior because they facilitate showrooming, the practice of examining merchandise offline before purchasing it online (e.g., Gensler, Neslin, & Verhoef, 2017). These new digital technologies are likely to structurally change consumer behavior (cf. Hoffman & Novak, 2017; Verhoef et al., 2017), and as a result, their use can quickly become the new norm, defying traditional business rules.

Firms that cannot adapt to these changes become less appealing to customers and are likely to be replaced by firms that use such technologies. According to Nosova (2021), it is obvious that the system of digital transformation in economic integration should have a single coordinating body and a single methodology for digital transformation as this guarantees that all parts of the system follow a single methodology and common standards that take into account the specifics of each division; thus, coordination is extremely important. In that context, DX can potentially impact various aspects of organizations. Performance outcome is one of those aspects that will be the focus of this research paper. Organizational performance can be conceptualized as the ability of organizations to fulfill their aims and goals side by side with their key competitors effectively (Cao and Zhang, 2011), also as the value outcomes from meeting intended determinants (Alsufyani and Gill, 2022). Since the performance measurement should be performed for different classes (dimensions) of organization performance, those performance outcomes could involve financial and non-financial measures (Wardaya et al. 2019).

3. Methods

To design a PMS-DT IBI, we conducted a research method consisting of six processes in two sections. The stages of the process in the research method can be described as follows (Figure 1):

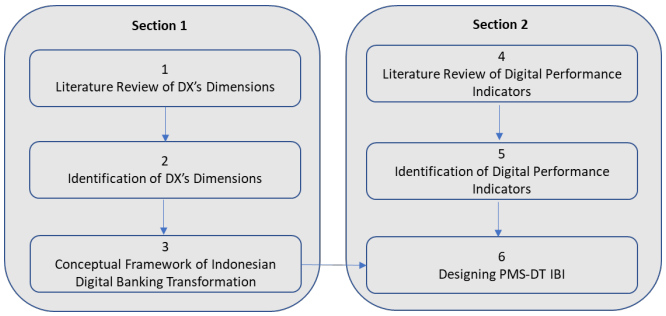

Figure 1. The process of research methods to design PMS-DT IBI

The process of research methods to design PMS-DT IBI can be explained as follows:

1. Section 1 is the part that formulates the conceptual framework of Indonesian digital banking transformation (process 3), which consists of various dimensions based on the literature review related to the DX dimension (process 1) and the results of the identification of the DX dimension (process 2).
2. Section 2 lays out the purpose of this study, namely to design PMS-DT IBI (process 6), which consists of digital performance indicators (DPI) for all dimensions that have been identified (process 3). The PMS-DT IBI design is derived from the identified DPI (process 5), which is sourced from the literature review of DPI (process 4).

4. Results and Discussion

4.1 Dimensions of Indonesian Digital Banking Transformation

To explore the DX dimensions that will be used in the Indonesian digital banking transformation, we conducted a literature review related to Digital Transformation Maturity (DTM). The term "maturity" refers to a state of completeness, perfection, or readiness (Lahrmann et al., 2011) and is the result of system development progress. Maturing systems (for example, organizations) improve their capabilities over time to achieve some desired future state. Digital maturity and digital transformation are sometimes used interchangeably without regard to differences (Leipzig et al., 2017), but digital maturity can be viewed as a systematic way for an organization to transform digitally (Kane et al., 2017). As a result, the term "digital maturity" refers to the state of a company's digital transformation (Chanias and Hess, 2016).

It describes what a company has already accomplished in terms of transformation efforts and how a company prepares systematically to adapt to an increasingly digital environment to remain competitive. Digital maturity encompasses more than just the extent to which a company performs tasks and manages information flows through IT; it also encompasses a managerial interpretation of what a company has already accomplished in terms of performing digital transformation efforts, such as changes in products, services, processes, skills, culture, and abilities related to change process mastery (Chanias and Hess, 2016). As a result, digital maturity includes both a technological and a managerial component and can thus be viewed as a holistic concept.

To learn about previous research on DTM, we carried out an article search strategy by keywords “digital transformation maturity” and “digital maturity” through existing research databases, including Scopus and Google Scholar. In previous research on the DTM, we found that 31 digital maturity models have been built by academia and industry. The DTM that was built by the previous researchers focused on certain industrial areas, including manufacturing, telecommunications, health, banking, retail, and some areas that are more general where DTM can be applied to several industries. From the results of our analysis, the determination of the dimensions of DTM is influenced by the industry area, research focus, organizational behavior, and other aspects that affect the formulation of DTM. The formulation of existing DTM dimensions is influenced by aspects of the business model, business processes, technology, behavior, and corporate culture. Here are 31 DTMs that have been built by researchers, with information on the number of dimensions, the number of maturity levels, and maturity level references (Table 1).

Table 1. Previous research on digital maturity

MM#	Author	Industry	Number of Dimensions	Number of Maturity Level
MM1	Gökalp & Martinez, 2021	Manufacture	13	6
MM2	Mittal et al., 2018	Manufacture	5	5
MM3	Kamalaldin et al., 2021	Manufacture	3	6
MM4	Gill et., al., 2016	General	3	4
MM5	Schumacher et al., 2016	Manufacture	8	4
MM6	Leyh et. al., 2017	General	3	5
MM7	Schuldt et al., 2020	Manufacture, Logistic, Human Resource, Energy, Other	4	6
MM8	De Carolis A et. Al., 2018	Manufacture	3	5
MM9	Bandara et al., 2020	Manufacture	2	5
MM10	Valdez-de-Leon, 2016	Telecommunication	6	5
MM11	Akdil KY Gökalp et. al., 2018	Manufacture, Retail Industry	4	4
MM12	Bandara et al., (2019)	Banking	8	5
MM13	Schallmo & Williams, (2019)	Health Care	5	8
MM14	Colli et al., (2019)	Manufacture, Logistic	5	5
MM15	Schumacher et al., (2019)	Manufacture	8	5
MM16	Rockwell. 2014	Manufacture, Logistic	4	5
MM17	Fleischer, 2015	Manufacture	6	5
MM18	Jung et. al., 2016	Manufacture	5	5
MM19	Price Waterhouse Coopers, 2016	Manufacture, Logistics, Human Resource, Energy Other	9	6
MM20	Hess E et. al., 2017	Manufacture, Logistic, Human Resource, Energy, Other	6	6
MM21	Lee et. al., 2017	Manufacture	6	3
MM22	Kiwook Jung et. AL., 2016	Manufacture	6	6
MM23	Fantini et. al., 2018	Human Resource	2	7
MM24	Jong Hun Woo et. al., 2021	Shipyard	3	5
MM25	Leineweber et. al., 2018	Manufacture	6	6
MM26	Weber et. Al., 2017	Manufacture	3	6
MM27	Santos et. al., 2018	Manufacture	2	6
MM28	Rafael et. al., 2020	Manufacture	6	5
MM29	Pulkkinen, 2019	Manufacture	7	5
MM30	Singapore Economic Development Board, 2020	Manufacture	8	6
MM31	Faezeh Gomeh et. al., 2021	Banking	9	6

From the results of the 31 existing DTMs, it can be stated that each DTM has different dimensions because there is no standardization. It was found that 54 dimensions were used in the 31 DTMs. We have analyzed all dimensions of DTM and performed semantic analysis so that 23 dimensions of DTM are produced as mentioned in Table 2. The formulation of these 23 dimensions resulted from the semantic analysis of each dimension that has similarities. The following is the result of dimension mapping using DTM with semantic dimension (table 2).

Table 2. Categorization of DTM dimensions

NO	DIMENSION	DIMENSION SEMANTIC	NO	DIMENSION	DIMENSION SEMANTIC
1	DX Strategy Development	Digital Business Strategy	28	Information Integration	Enterprise Architecture
2	Business Model Management	Business Model Management	29	Smart Factory	Emerging Technology
3	Portfolio & Program Management	Portfolio, Program & Project Management	30	Digital Twin	Emerging Technology
4	Project Management	Portfolio, Program & Project Management	31	Automation - Shop Floor	Emerging Technology
5	Financial Resource	Finance Management	32	Automation - Enterprise	Emerging Technology
6	Supplier/Partner Management	Partnership Management	33	Automation - Facility	Emerging Technology
7	Product & Service Development	Product & Service Management	34	Intelligence- Shop Floor	Emerging Technology
8	Customers	Customers	35	Intelligence - Enterprise	Emerging Technology
9	Value Management	Value Management	36	Intelligence - Facility	Emerging Technology
10	Ecosystem	Ecosystem	37	Business Process Digitalization	Entrerprise Architecture
11	Operation Management	Operation Management	38	Business Process Vertical Integration	Entrerprise Architecture
12	Production & Logistic Process	Operation Management	39	Business Process Horizontal Integration	Entrerprise Architecture
13	Metrics & Evaluation	Organizational Design	40	Business Process Integration toward Life Cycle	Entrerprise Architecture
15	Technology Strategy Management	IT Capability	42	Organizational Structure Management	Organizational Design
16	Requirement Definition	System Development	43	Organizational Change Management	Change Management
17	Enterprise Architecture Dev	Enterprise Architecture	44	Sustainable Change Management	Change Management
18	Infrastructure Management	IT Capability	45	Performance Management	Organizational Design
19	Data Governance	Data Governance	46	Data-Driven Decision Management	Digital Competences
20	Agile Software Development	System Development	47	Self Optimized Decision Management	Digital Competences
21	Security Management	Security Management	48	Governance	IT Governance
22	EA Integration	Enterprise Architecture	49	Culture Concept	Digital Culture
23	Data Analytics	Emerging Technology	50	Leadership	Leadership
24	Connectivity – Real-Time Capabilities (Shop Floor, Enterprise, Facility)	Emerging Technology	51	Communication	Digital Culture
25	Mobility	Emerging Technology	52	Collaboration	Digital Culture
26	EA Maintenance	Enterprise Architecture	53	Innovation	Innovation
27	Service Oriented Architecture	Enterprise Architecture	54	Risk Tolerance	Digital Culture

We have mapped 23 DTM dimensions with 31 digital maturity models as shown in Table 3. From the results of the mapping that has been carried out, the top-ranking dimensions that are most widely used by researchers are as follows: IT Capability (22), Digital Business Strategy (18), Product and Service Management (16), Operation Management (13), Digital Competences (12), Enterprise Architecture (12), Organizational Design (11) (Table 3).

Table 3. Dimension mapping with previous digital maturity

NO	DIMENSION	MM#	MM														
			MM1	MM2	MM3	MM4	MM5	MM6	MM7	MM8	MM9	MM10	MM11	MM12	MM13	MM14	MM15
1	Digital Business Strategy	17	V	V			V				V	V	V	V			
2	Business Model Management	1															
3	Program & Project Management	3	V							V	V						
4	Finance Management	2	V	V													
5	Partnership Management	2	V														V
6	Product & Services	15		V			V	V					V	V			V
7	Customers	7					V							V			V
8	Value Management	2														V	V
9	Ecosystem	2										V					
10	Operation Management	12					V					V		V	V		
11	IT Capability	21	V		V	V	V	V	V	V		V		V		V	V
12	IT Governance, Risk Management & Compliance	9					V							V		V	V
13	System Development	1	V														
14	Enterprise Architecture	3	V	V	V			V		V			V		V		
15	Data Governance	2	V														
16	Security Management	3	V												V		
17	Emerging Technology	9	V												V	V	
18	Digital Competences	12	V	V	V				V					V		V	V
19	Organizational Design	13	V			V			V			V	V	V			
20	Change Management	2	V														
21	Digital Culture	7				V	V		V						V		
22	Leadership	7					V										V
23	Innovation	2										V					

Table 3. Dimension mapping with previous digital maturity (continued)

NO	DIMENSION	MM#	MM															
			MM16	MM17	MM18	MM19	MM20	MM21	MM22	MM23	MM24	MM25	MM26	MM27	MM28	MM29	MM30	MM31
1	Digital Business Strategy	17		V	V	V	V	V	V		V	V				V	V	V
2	Business Model Management	1				V												
3	Program & Project Management	3																
4	Finance Management	2																
5	Partnership Management	2																
6	Product & Services	15	V	V	V	V		V				V			V	V	V	V
7	Customers	7		V		V												V
8	Value Management	2																
9	Ecosystem	2	V															
10	Operation Management	12		V		V	V	V			V	V				V	V	V
11	IT Capability	21	V	V	V	V	V	V	V	V	V	V						V
12	IT Governance, Risk Management & Compliance	9	V	V	V	V	V											V
13	System Development	1																
14	Enterprise Architecture	3										V		V	V	V	V	
15	Data Governance	2											V					V
16	Security Management	3											V					V
17	Emerging Technology	9							V	V				V	V	V	V	V
18	Digital Competences	12			V		V	V	V				V					
19	Organizational Design	13				V			V						V	V	V	
20	Change Management	2															V	
21	Digital Culture	7				V									V	V		
22	Leadership	7					V	V	V			V					V	
23	Innovation	2													V			

From these identified dimensions, we propose a conceptual framework for the Indonesian digital banking transformation (IDBT) that can be described as follows (Figure 2):

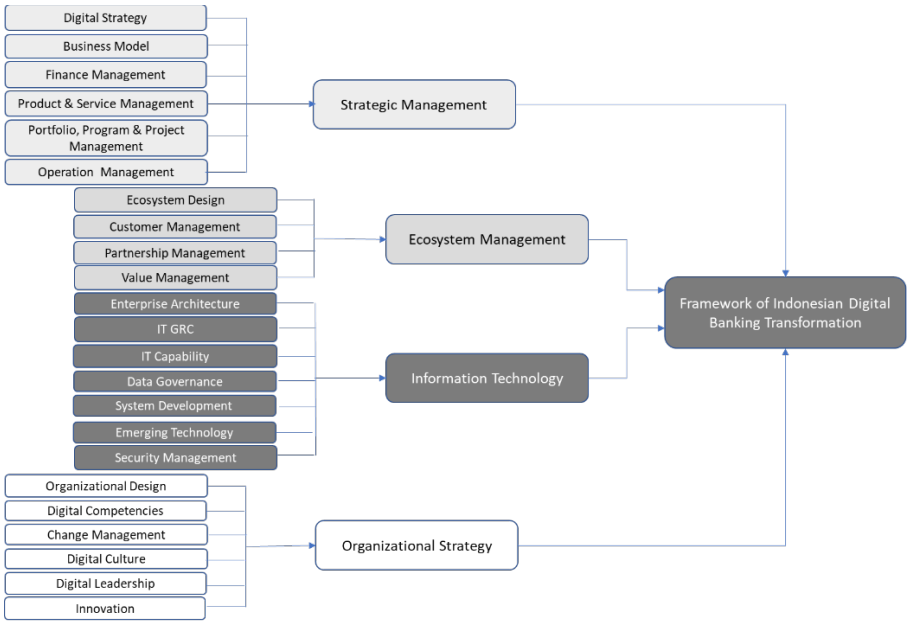

Figure 2. A conceptual framework of Indonesian digital banking transformation

From this conceptual framework, we can explain as follows:

1. The framework of DX is the dependent variable in this conceptual framework.
2. This framework consists of 23 unified dimensions as independent variables that affect the 4 perspectives of the framework, namely strategic management, ecosystem management, information technology, and organizational strategy.
3. The perspective of strategic management is an independent variable to the dependent variable "framework of DX", which consists of the relationship between the dimensions of digital strategy, business model, finance management, product and service management, portfolio, program, and project management, and operation management.
4. The perspective of ecosystem management is an independent variable to the dependent variable "integrated framework of DX", which consists of the relationship between the dimensions of the ecosystem design, customer management, partnership management, and value management dimensions.
5. The perspective of information technology is an independent variable to the dependent variable "integrated framework of DX", which consists of the relationship between the dimensions of enterprise architecture, IT governance, risk management & compliance, IT capability, data governance, system development, emerging technology, and security management.
6. The perspective of organizational strategy is an independent variable to the dependent variable "integrated framework of DX", which consists of the relationship between the dimensions of organizational design, digital competencies, change management, digital culture, digital leadership, and innovation.

This framework consists of 23 dimensions to answer RQ1 regarding how to identify DX dimensions used in the framework of Indonesian digital banking transformation. This framework will also be the basis for designing DPI for PMS-DT IBI, which we will explain in the next section.

This conceptual framework is to address various challenges in implementing DX. Vogelsang et al. (2019) have stated that it is related to missing skills, technical barriers, and individual barriers. Borangiu et al. (2019) have explained that the causes of DX implementation failure include conceptual (system design), societal (human integration), and environmental (risk management). In addition, Mahmood et al. (2019) have stated that the challenges in implementing DX in various organizations are related to a lack of an effective strategy, technological disruption, and strategic alignment. Meanwhile, Tripatti and Gupta (2019) have explained that aspects of data insufficiency, absence of benchmarks and reference architecture, and prediction disability are the causes of the failure of DX implementation. Raj et al. (2019) have also stated that several challenges in DX implementation include high investment in implementation, lack of clarity regarding economic benefits, and challenges in value-chain integration. In another study, Lammers et al. (2019) also stated that the barriers to successful DX implementation are influenced by financial

management, competency development, and compliance with regulatory provisions. We believe that these 23 dimensions can assist banks in managing the challenges of DX implementation as described by previous researchers.

4.2 Digital Performance Indicators of Indonesian Digital Banking Transformation

In this section, we will discuss digital performance indicators (DPI) for all dimensions in the IDBT to make it easier for Indonesian banks to manage the performance of all dimensions. Banks can increase the role of related work units in managing the DX dimension in a structured and measurable manner. In formulating DPI, we use a literature review on "digital performance indicators" and "performance indicators" related to digital transformation and dimensions in IDBT. The following is a proposed DPI for each IDBT dimension, accompanied by an explanation of the DPI and metric description (table 4).

Table 4. Digital performance indicators for IDBT dimensions

No	Dimension	Digital Performance Indicator	Description & Reference	Metric Description
	PERSPECTIVE: STRATEGIC MANAGEMENT			
1	Digital Strategy	Enterprise Agility	The capability of process flexibility and flexible strategy, customer responsiveness via innovation (Murawski, M. et al. 2018)	Mean of enterprise agility
		Business Flexibility	How IT has helped the business respond to internal and external (Aasi, P. and Rusu, L. 2017)	Business flexibility average
2	Business Model Management	Customer of Business Model	Customer segments, customer channels, and customer relationships (Schallmo et al. 2017)	Mean of customers in business model
3	Portfolio, Program & Project Management	On-Time Project Completion	On-time DX project completion monitors the frequency with which projects/ processes are completed on time (Neely and Kinnerly, 2000)	% of projects completed on time during a specified period
		Project Completion to Quality Specifications	Project completion to quality specifications measures the frequency with which projects are completed to the specification in the project (Neely and Kinnerly, 2000)	% of projects/ processes not complying fully with specifications, within the set time and cost parameters, during a specified period.
4	Finance Management	Return on Asset	Net income divided by total assets via e-collaboration capabilities (Chi et al. 2016)	Mean of return on asset
		Operating return on assets	The ratio of operating income to assets" via capabilities of e-collaboration (Chi et al. 2016)	Mean of operating return on assets
		Return on Investment	Via innovation, digital transformation, or IT capabilities relative competitors (Nwankpa and Roumani, 2016)	Mean of return on investment
5	Product & Service Management	Number of products and services	Developing and selling new via digitized a firm's innovation portfolio is measured by the number of new products & services scaled by its R&D capital services/products (Mani et al. 2016)	Number of products and services

No	Dimension	Digital Performance Indicator	Description & Reference	Metric Description
6	Operation Management	Efficiency ratio	The ratio of non-interest expenses to total net income via the interaction between corporate sustainability and digitalization (Forcadell, 2020)	Efficiency ratio or Ratio of operating expenses to operating income
		Operational Performance	Value adding activities and minimizes wait times and waste via digitalized business process (Saldanha et al. 2017)	The ratio of business process digitization to all business processes
	PERSPECTIVE: ECOSYSTEM MANAGEMENT			
7	Ecosystem Design	Enterprise in ecosystem connectivity	Collaborative process (Freitasbel et al. 2017)	Number of members in the ecosystem connectivity
8	Value Management	Income	Net income via digitized business transactions, core services, and customer services access (Saldanha et al. 2017)	Mean of Income
		Profit	Via innovative new or improved product/services or digital transformation relative to competitors (Nwanka et al. 2016)	Mean of profit
		Sales Growth	Via innovative new or improved product/services or digital transformation competitors relative to competitors (Nwanka et al. 2016)	Mean of sales
		Market Value	Market capitalization via digital servitization against previous years (Abou-foul et al. 2020)	Mean of market value
		Market Share	Via digital market capabilities or Financial Determinant Market performance against the previous year (Chinakidzwa and Phiri 2020)	Mean of market share
9	Customer Management	Customer Acquisition	Acquiring new customers via leveraging market value capture and creation relative to competitors (Leischnig, A. et al. 2017)	The ratio of new customers to total customers
		Sales per customer	Via leveraging market value capture and creation relative to competitors Leveraging (Leischnig, A. et al. 2017)	Average of sales per customer
		Customer Retention	Relative to competitors via innovative new or improved product/services or digital transformation (Nwankpa and Roumani 2016)	Mean of customer retention
		Customer Satisfaction	Via digital market capabilities against the previous year (Chinakidzwa and Phiri 2020)	The ratio of a satisfied customer to survey sampling

No	Dimension	Digital Performance Indicator	Description & Reference	Metric Description
10	Partnership Management	Procurement savings	Buying goods and services at appropriate prices, lower or in line with those budgeted via digitalized procurement structure (Patrucco et al. 2020)	Mean of procurement savings
		Purchases quality	Buying goods and services that satisfy the needs of the internal clients via digitalized procurement structure (Patrucco et al. 2020)	Mean of purchases quality
	PERSPECTIVE: INFORMATION TECHNOLOGY			
11	IT Capability	Cost-effective use of IT	Extent, efficiency, and value of IT used in the business (Aasi and Rusu 2017)	Cost-effectiveness average
		IT for growth	How effective IT is in learning, being innovative, gaining competitive advantage, and changing and improving (Aasi and Rusu 2017)	IT effectiveness average
12	IT Governance, Risk Management & Compliance	Consistency of Regulator Requirements	Equality of treatment by regulators is a major requirement of those organizations being regulated, to ensure that all organizations are operating on a 'level playing field' (Neely and Kinnerly, 2000)	% of regulations/regulator requirements that are consistent with all regulated organizations
13	System Development	Rapid Prototyping	Via the development of product prototypes rapidly (Buer et al. 2021)	Number of product prototypes
		Lean Product Development Methodology	Via the implementation of lean product development methodology (Buer et al. 2021)	Number of lean product development
		Cost of Technology Deployment / Redeployment	The deployment/ redeployment of technology can be an important factor in ensuring that technologies are available when required to complete operations and satisfy customers' demand for the organization's products and services (Neely and Kinnerly, 2000)	The average cost of technology deployment/redeployment
14	Enterprise Architecture	Digital Business Architecture Effectivity	Describes the development of a Business Architecture to support an agreed DX Architecture Vision (Rachel Harrison, 2013).	Number of Digital Business Architecture
15	Data Governance	Information visualization	The ability to display data/info visually (Da Silva Freitas et al. 2017)	Number of data types in visualization
16	Security Management	Organizational Controls Effectivity	Collection of evidence (ISO27002, 2022)	Number of evidence in the period
		People Controls Effectivity	Information security event reporting (ISO27002, 2022)	Number of information security in the period

No	Dimension	Digital Performance Indicator	Description & Reference	Metric Description
		Physical Controls Effectivity	Protecting against physical and environmental threats (ISO27002, 2022)	Number of physical and environmental threats
		Technology Controls Effectivity	Security of network services (ISO27002, 2022)	Number of against network services
17	Emerging Technology	IT Investment	Via the level of organization digitalization (Rungi, 2019)	Mean of IT investment
	PERSPECTIVE: ORGANIZATIONAL STRATEGY			
18	Digital Competences	HC Competency Development	Knowledge/skills/professional development via digital transformation (Betchoo, 2016)	Mean of HC Competency Development
		Talent management performance	Creativity and talent via digital transformation (Betchoo, 2016)	Mean of talent management performance
19	Organizational Design	Turnover	Employee turnover via digital servitization against previous years (Abou-foul et al. 2020)	Turn over ratio to total employees
		Employee Job Performance	Task performance, contextual performance, and counterproductive behavior via digital transformation (Guzm´an-Ortiz et al. 2020)	Mean of employee job performance
		HC Efficiency	Increase in: overtime hours, part-time workers, and temporary workers via IT implementation (Park and Saraf, 2016)	HC efficiency average
		HC Flexibility	Job rotation, multi-skilling, and adoption of flexible working hours via IT implementation (Park and Saraf, 2016)	HC flexibility average
20	Change Management	Change Management Effectivity	Develop the Measurement and Benefit Realization Strategy (ACMP, 2019)	The ratio of benefit realization
21	Digital Culture	Collaboration Effectivity	The teams collaborate functionally in the initiatives for the innovation and digital transformation (Martinez-Caro et al. 2020)	Number of work units involved in the DX initiative
22	Leadership	Digital Vision and Roadmap Effectivity	Form business requirements to articulate a digital vision and aligned that vision with all other senior leaders to create a DX road map (Moneim, 2020)	Number of socialization of the DX vision and roadmap carried out by management in a period
		Engagement and Collaboration Effectivity	Leveraging concise communication across their organization managed to explain the business value of the DX clearly and successfully and obtained buy-in from other business leaders (Moneim, 2020).	Number of work units involved in the DX initiative

No	Dimension	Digital Performance Indicator	Description & Reference	Metric Description
23	Innovation	Enterprise innovation efficiency	The ratio of granted patents to the total of inventors involved in their creation digitized a firm innovation portfolio via digitized a firm innovation portfolio (Mani et al. 2016)	Enterprise innovation efficiency ratio
		Enterprise innovative effectiveness	Developing and selling new services/products via DX (Nwankpa and Roumani, 2016)	Enterprise innovative effectiveness ratio/ mean

The Bank may delegate the management of the IDBT dimension to all related work units within the Bank's organizational structure, including the Information Technology Division, PMO (Portfolio/Program/Project Management Office), Human Capital Division, Learning Center, Business Division, Strategic Planning Division, Division Operations, Marketing Division, and other work units. Thus, coordination between work units in the implementation of DX can be carried out more effectively (Nosova, 2021), not only relying on one work unit. This DPI design for each dimension in the PMS-DT IBI is to answer RQ2. about how to measure the digital performance of all dimensions in the Indonesian banking digital transformation framework.

The DPI we propose is different from the DPI proposed by Alsufyani and Gill (2022). Alsufyani and Gill (2022) conducted a digitalization performance assessment study to identify DPI from 30 papers using “adaptive enterprise architecture” (Gill et al. 2020) and “results and determinants” (Fitzgerald, 1991) as theoretical frameworks. They classify DPI into several types of performance, namely competitive, financial, quality, flexibility, resource utilization, and innovation. These six types of performance are mapped to several layers, namely interaction, human, technology, facility, environment, and security. We can identify DPI from a type and performance layer perspective without knowing the dimensions that affect the DX implementation. Thus, our study can complement the research of Alsufyani and Gill (2022) and previous research, where the DPI in IDBT is based on the DX dimension. The advantage of this study is that we can determine the DPI of each dimension, making it easier to control dimensions in the context of activities, sub-systems, and entities in DX implementation.

5. Conclusion

The purpose of this research is to design PMS to increase the success rate of digital transformation of Indonesian banking. We have proposed a set of DPI for 23 dimensions in the IDBT framework. The results of this research contribute to managerial application to Indonesian banks in managing the implementation of DX from the perspective of the dimensions that affect the success of DX. In addition, banks can also manage DX more effectively with DPI which has been formulated in 23 dimensions of DX as guidance for banks in coordinating related work units in managing DX to be more effective and measurable. The results of this research also contribute to general system theory (Bertalanffy, 1972), where the sub-system/dimension will run more effectively in building complex systems such as DX if it has clear performance measures. So that the organization has a measurable mechanism for coordinating DX that involves many work units.

This research can be developed in the future by enriching DPI using empirical data for each DX dimension using qualitative, quantitative, or mixed-methods approaches. This DPI enrichment can increase bank confidence in managing the success of the digital transformation. Other research that can be done is how to assess the level of readiness or maturity of a company's DX by combining the results of the DPI measurement with the results of the digital transformation maturity assessment (DTMA) measurement so that the company can measure the maturity level from the perspective of process, capability, and performance. This holistic approach will assist organizations in providing solutions to various DX implementation challenges.

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