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Assessing the Digital Transformation Landscapes of Organization: The Digital Transformation Self-Assessment Maturity Model (DX-SAMM)

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Abstract

The increasing digitalization of business and society has brought major changes for organizations to transform in an effort to maintain their sustainability. Adaptation to technological developments that impact various adjustments to strategies, business processes, and organizational structures has become an integral part of being able to transformation. This transformation effort is accompanied by monitoring and evaluation to ensure conformity of the transformation with digital transformation maturity level standards. This study proposes an independent digital maturity measurement model (DX-SAMM Digital Transformation Self-Assessment Maturity Model) that allows companies to classify their achievement of digital maturity. The expansion of existing digital maturity measurement models to include multidimensional engagement that dominates Digital Transformation is the focus of the research objectives. Overall, seven dimensions and twenty-one sub-dimensions were defined to measure the maturity level of digital transformation in organizations. This digital maturity measurement application considers various dimensions related to Digital Transformation, namely Strategy, Organizational Structure, Technology, Employees, Customers, Business Processes, and Culture. The Digital Transformation maturity level standard used adopts SPICE. It is part of the ISO/IEC 3300XX family of standards, which specifically serves as a maturity reference for established structures. Case studies as empirical tests of model implementation are presented in this study.

Keywords: Digital Transformation; Digitalization; Maturity Model; Maturity Level

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1. Introduction

Companies face major challenges due to technological, social, economic, and societal development. Transformation, as a form of response and adaptation to immediate changes, is required to maintain sustainability. Technology has developed significantly since Industrial Revolution 4.0. Although it brings great opportunities, disruptive challenges are inevitable, such as artificial intelligence, intelligence of things, and automation of various activities. Companies must be able to transform digitally. Digital Transformation (DX)[1]–[3] itself, as a form of continuous transformation, is complex and plays an important role in shaping the organization's future [4]. DX is becoming increasingly complex and involves various aspects[5]. A comprehensive viewpoint is required to embrace DX, which includes heterogeneous and complex processes with various dimensions[6], [7]. Therefore, over the coming time, both academics and practitioners will continue to strive to improve the efficiency of digital transformation accordingly through various digital integrations and consequent intelligence at both horizontal and vertical levels in organizations. On the other hand, organizations need to identify the state of development of digital transformation that has been carried out to link the transformation carried out with their strategy. Digital transformation involves various dimensions, methods, and tools that adopt related dimensions to digital transformation. The research question posed is: What are the holistic dimensions that support digital transformation, and how can their maturity be measured. In this study, a digital maturity model called the Digital Transformation Self-Assessment Maturity Model (DX-SAMM) was used. DX-SAMM is used to systematically assess the state of development of an organization's digital transformation in relation to its maturity level of digital transformation. The digital maturity measurement involves management levels that understand the strategy and implementation of digital transformation within an organization. The development of this maturity model has both scientific and practical objectives. The scientific goal is to obtain precise data on the current state of an organization's digital transformation and DX achievement strategy. A holistic understanding of the supporting dimensions of Digital Transformation is needed to fill the reference gap in digital maturity across domains. The practical goal is to enable organizations to monitor and rigorously evaluate their own digital maturity. Finally, digital maturity measurements can be used as a guide for developing future strategies. The structure of this paper includes, the first chapter discusses the Background, continued the discussion of Analysis of the use of the Maturity Index level, Calculation of the Maturity Index assessment score, Demonstrate Artifact, Evaluate Artifact and the implementation of the Digital Maturity Model Dashboard in several industry sectors and ends with a conclusion[8]

2. State of the arts of digital maturity models

Digital Transformation in various sectors has experienced unstoppable developments. Various organizations respond to digital transformation by adopting changes in their business processes to compete and survive. Digital maturity monitoring is part of a guide to determine the level of achievement of digital transformation that has been carried out. This also helps organizations formulate strategies in the future. The digital maturity model is often interpreted as an instrument for measuring and conceptualizing organizational readiness under certain conditions and targets. These digital maturity states are identical in capturing the initial conditions that initialize later development. Digital maturity is defined as measuring achievement in a desired future state. Digital transformation is growing rapidly and massively and will continue to be interesting in the future. Researchers and practitioners have conducted extensive research on digital transformation and maturity measurement models. However, these maturity models have diverse dimensions and cannot generally be applied to various sectors. Meanwhile, according to Gokalp and Martinez [4] and Ozkar and Demiror [9] in their work, the maturity model should have standard characteristics that can be widely applied in various sectors. Some of the pre-existing digital maturity models are presented in table 1 [1][2][3][4][9]

The DX-CMM is a digital maturity model that can be used for a variety of sectors, but measurement tools or applications that can be easily used by organizations are still unavailable. Impulse comprehensively and in detail describes the dimensions, items, and value approaches. The impulse also has web-based tools that organizations can easily use to measure digital maturity. However, this maturity model is limited to the manufacturing domain and cannot be used in other domains. Bandara et al. (2019) [11] applied the level of digital maturity specifically to banking. In

addition to being applied to specific domains, this model is not equipped with maturity measurement tools that can be directly accessed by users.

Table 1. Previous research

Model Name	Digital Maturity Assessment	Source
The DX-CMM, 2021	DX measurement dimensions: Capability and Process; Maturity level in the range of 0-incomplete to 5-iinovating; used for all sectors; can be used independently; There is no digital maturity measurement device / application yet	[4]
Industry 4.0 Maturity Model, 2016	Dimensions used: customer, strategy, technology, operations, culture, people and the organization; Maturity level in the range of 1-Initiating to 5-Leading; manufacturing sector, requires a third party to use it	[8]
Digital Maturity Model, 2020	Dimensions used: culture, customer, people, strategy, operations, technology, and the organization; Maturity level in the range of 1-Initiating to 5-Leading; can be used in various sectors, requires a third party to use it	[10]
A model for assessing the maturity of Industry 4.0 in the banking sector, 2019	Dimensions used: Products and services, Governance, Technology and Resources, Operations, Strategy and organization, Employees; Maturity level in the range of 1-Initiating to 5-Digital Oriented; specifically for banking; require a third party to use it	[11]
Deloitte's digital maturity model, 2018	Dimensions used: customer, strategy, culture, people, structure, tasks; can be used in various sectors, requires a third party to use it	[12]
Dreamy, 2017	Dimensions used: Organization, Process, Technology, Monitoring and Control; Maturity level in the range of 1-Initiating to 5-Digital Oriented; specifically for banking; require a third party to use it	[13]
Impulse, 2015	Dimensions used: strategy and organization, smart operations, smart factory, employees, smart products, data-driven services; Maturity level in the range of 1-Top performer to 5-Insider; manufacturing, requires a third party to use it, tools available	[14]

Meanwhile, organizations need digital maturity monitoring as a guide to determine future strategies. Self-monitoring of digital maturity makes it easier for organizations to evaluate the achievement of digital maturity whenever needed. While various maturity models already exist, not all can be used independently by the organization (requiring a third party). In addition, existing maturity models measure digital maturity more specifically. Therefore, this study proposes a form of expansion of digital maturity measurement models and tools, focusing on a multidimensional approach that can be utilized for general use. This measurement model is then equipped with digital maturity measurement tools that can be independently utilized through website-based digital maturity measurement services [4][9][10][11][14] [15] .

3. Methodology

This study proposes the development of a digital maturity model to independently determine the maturity level of digital transformation in organizations. The method used to develop the digital maturity model adopted Becker's approach [17]. This approach focuses on a maturity model with a strong theoretical foundation. The maturity measurement devices developed in this study use the design science approach proposed by Hevner [16]. Based on the Becker [17] procedure, model development is carried out using multiple methodologies, such as a systematic literature review and conceptual validation of the model and its testing. In this study, the development process was divided into several stages. The first stage was an understanding of the domain of digital maturity, and interviews with practitioners and researchers were conducted to help determine the problems and needs of digital maturity measurements. The next step was to conduct a literature review. The literature study was conducted using the keywords' digital maturity' and' digital transformation' from various reputable scientific studies. This literature review produced dozens of models with hundreds of dimensions of digital transformation [16] [17].

The results of the literature review were revalidated in relation to the relevance and suitability of the dimensions, resulting in 44 digital maturity models. This maturity model is considered for further analysis because it offers a relevant framework within which the maturity level assessment has been practically tested. From this work, relevant

concepts were obtained for the structure of the digital maturity development model offered in this study, such as the maturity level. In general, there are five maturity levels, ranging from one as lowest maturity to five as highest maturity.

Table 2. DX-SAMM Dimensions and Sub Dimensions

Dimension	Information	Sub Dimensions
Organization and Structure	The structure of the organization consists of internal organization and dynamic network collaboration. Organization can be defined as an input to DX. Management's readiness to change is needed in achieving digital maturity. Another requirement is continuous learning and restructuring of the organization's business processes in order to prepare for transformation.	Organizational Structure Management, Organization Change Management, Sustainable Learning Management
Technology	Technology represents the ability to effectively plan, deploy, and integrate technology to support digital business.	Information System, Infrastructure, Security Management,
Strategy	Strategy plays an important role in providing input to the organization in shaping organizational readiness to transform. He leads the vision, roadmap, and inspires how existing technology can create value in the future.	Strategy Development, Financial Analysis, Portfolio Management
Customer	Customer involvement in interacting with the organization's digital services provides an experience for customers. An easy user interface is required to support this activity. Good customer experience in interacting increases customer trust in the organization's services.[18]	Customer Engagement, Customer Experience, Customer Trust
Employee	The ease of adaptation of the organization to various changes is supported by continuous learning activities and change management. In addition, the willingness to learn allows for a better process of organizational adaptation.[10]	Awareness, Skills, Continuous learning
Culture	Technology does not add value to an organization until it has a culture in which employees trust the system, known and readily accept it[19][20], [21] .	Social Collaboration, Willingness to Change
Business Process	Process Transformation describes the extent to which processes are integrated through technology for efficiency. The integration referred to at the internal and external levels of organizational and business digitization processes. External integration consists of electronic data exchange with partners.[4][22][23][24][25][26]	Business Process Digitalization, Business proses Vertical Integration, Business Proses Horizontal Integration.

The assessment form uses assessments of several dimensions. Assessments are performed independently or by a third party, and the models are visualized in numbers or graphs. All validated models were rechecked to ensure the completeness and suitability of the dimensions. A comparative analysis of the digital maturity model was carried out to identify the dimensions of success of Digital Transformation, which were then evaluated for their application to the proposed digital maturity development model. The intended comparative analysis involved comparing the similarities of dimensions and sub-dimensions among 44 previously validated models of digital maturity [3]. The dimensions consistently present in these models were grouped together and proposed as the dimensions of digital maturity measurement in this study. The dimensions obtained from the comparative study were then mapped into a questionnaire format on the digital maturity measurement tool (https://bit.ly/Questionnaire_Example). The next stage is to visualize the model as a practical tool that can be used to measure digital maturity. The proposed model is visualized in the form of an artifact, a digital maturity measurement application that can be accessed independently. Construction of this artifact using a design science research approach. The model validation phase used a case study approach. Case studies are a design evaluation approach that can be used to validate the models. In the end, a case study of a transport company is proposed to test the implementation of the development of a digital maturity model [3] [9][15][16]. A case study of a financial company is proposed to test the implementation of digital maturity model development. The financial company was chosen because it is currently striving to undergo digital transformation. With over 200 employees and various branches, an assessment of the maturity of the transformation is required. Therefore, this company was also used to evaluate the success of the proposed digital transformation measurement tool. The questionnaire on digital maturity measurement was filled out by employees at the management level.

4. Digital Maturity Measurement (DX-SAMM Digital Transformation – Self Assessment Maturity Model)

This study proposes the development of a digital maturity model that considers multidimensional involvement to facilitate the monitoring of digital maturity in organizations. Based on the literature review and the Comparative Analysis Technique described in the previous chapter, a distribution of seven dimensions and 21 sub-dimensions supporting the success of digital transformation was obtained. These dimensions and subdimensions were subsequently proposed for inclusion in the development of a digital maturity model, referred to as the Digital Transformation – Self Assessment Model (DX-SAMM), in this research. This model is intended to measure digital maturity in organizations in a general sense [4]. Table 2 presents a general explanation of the proposed dimensions and their accompanying subdimensions. The maturity level used in this study was adopted from the maturity level of SPICE. It is part of the ISO/IEC 3300XX family of standards and is widely used as a reference model for maturity. In addition, SPICE has been widely adopted for maturity measurement in various domains such as organizational agility measurement, automotive, governance, and cross-domains. The maturity levels ranged from 0 to 5. Level 0 is called incomplete and describes the DX requirement to be low. Level 1: Performed, indicating that the DX process had begun Level 2: Managed DX processes are well-managed. Level 3: Established Process, The Digital transition process has been carried out consistently in accordance with established standards. Level 4: Predictable and DX process quantitative techniques are applied. Level 5: Optimizing, DX process evaluation is carried out[4][9][27][28][29].

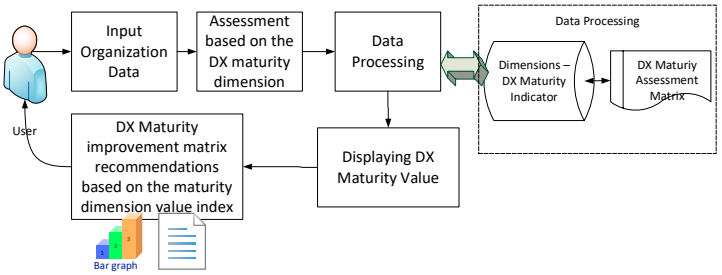

Fig. 1. Digital Maturity Measurement Process[1]

The stages of the DX-SAMM digital maturity measurement are presented in figure 2. Digital maturity assessment was measured through the dimensions and subdimensions of digital transformation using questionnaires. One dimension was measured through several sub-dimensions, and each sub-dimension was measured through several question items in the form of a questionnaire. Each question's answer was mapped on a Likert scale. To be able to answer questionnaires correctly and accurately measure digital maturity, user understanding of the meaning of digital transformation and the business processes that occur in organizations is very important. Therefore, a management group discussion session was required to complete the DX-SAMM assessment. Responses to the questionnaires served as data inputs to calculate and represent maturity levels. The next step involved data processing by processing the values of the input results of the questionnaire answers.

$$J_{(d,a)} = \frac{\sum_{q \in Q_{da}} \frac{\sum_{r \in R} H_{(r,q)}}{|R|}}{|Q_{da}|} \quad (1)$$

$$M_{(d)} = \frac{\sum_{a \epsilon A_d} J_{(a,d)}}{|A_d|} \quad (2)$$

$$M_0 = Min(M_1, M_2, \ldots M_D) \quad (3)$$

M: Maturity; A: Average value of the attribute; Q: Question; H: The result of the value of the Likert scale; D: Dimension; R: Respondents; A: Attributes.

The calculation process was carried out according to the formulas presented in formulas 1, 2, and 3 (Eq. 1, 2, 3). From the results of these calculations [1][8][26], the maturity level was obtained in accordance with the score limit[26]. Level 0 limits the maximum score 0.2, level 1 with a maximum value of 0.8, level 2 with a maximum value of 1.6, level 3 with a maximum value of 2.4, level 4 with a maximum value of 3.2, and level 5 with a maximum value of 4.0. Generally, maturity models tend to fail when they are too complex. Therefore, the level of detail for developing this model was adjusted to the needs of various domains, as explained earlier. DX-SAMM aims to make it easy for organizations to measure their own digital maturity achievements independently. The results of data processing were then presented by the system in the form of a dashboard on the website. Representations of the overall maturity achievements and the details of each dimension are also presented. Evaluations to test the practical use of DX-SAMM are conducted with organizational case studies discussed in the next chapter[8].

5. Case-study

Case studies evaluating the use of DX-SAMM were conducted in financial sector organizations with more than 200 employees and several branches. To ensure the accuracy of the results, organizations that had undertaken digital transformation were selected. A management group session was formed to assist in the completion of the assessment. Furthermore, the system processes the input results according to the answers to each question on a Likert scale. In figure 2 (fig.2) the maturity levels of the seven dimensions are visualized.

Fig. 2. Maturity Measurement in Financial Organizations

Based on the DX-SAMM measurements, this organization is at level 3, namely, the established process with a digital maturity score of 2.37. Digital maturity in each dimension included M (organization structure) = 3.30, M(technology)= 3.80, M(strategy) = 3.23, M(employee) = 2.83, M(customer) =2.37, M (Business Process) = 3.00, and M(culture) = 3.40. The value of each subdimension is shown in Figure 3. A Customer Score of 2.37 is the lowest score of all dimensions. This is mainly because service users and customers are still not fully involved in digital services, lack experience in using services with technology, and have low customer trust in technology. This is confirmed in the management group sessions; namely, the practice of helping customers when using services is still common. Some of the reasons for this are the difficulty of customers in using the system and the hesitation of customers in processing services using technology rather than manually. The technology dimension score was 3.8, which was the highest score for all dimensions in the organization. This is because in the process of its work, the organization has utilized technology requirements for DX projects, including development, integration, business processes, and infrastructure. This technology has been used for application development, data processing, and IT security management[4][10][30]. The organization and its branches are equipped with computers, computer networks, and Internet connection services, including the use of fixed and cellular broadband or other fixed connections. Projects and activities related to digital transformation were identified, evaluated, and prioritized. Infrastructure and skill improvement programs were provided to support this transformation. Various digital transition activities have been consistently conducted. Organizations have also changed their existing business processes by digitizing technology.

In addition to providing digital maturity measurement results, the DX-SAMM also provides recommendations for improvements to the next maturity level and necessary improvements to the current level. Based on ISO/IEC Assessment-SPICE, it is recommended that the customer dimension be optimized for the maturity level. The customer dimension consists of the Customer Engagement sub-dimension, which is associated with customer engagement in digital services; Customer Experience, which is associated with customer experience in interacting with the organization; and customer trust, which is customer trust in technology services provided by the organization.

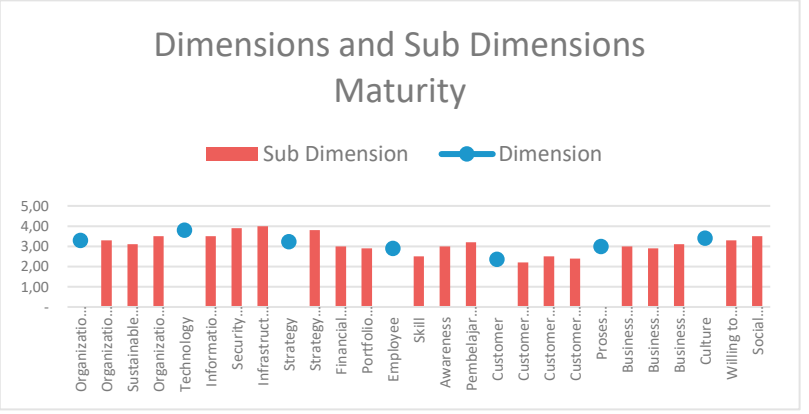

Fig. 3. Dimension and Sub Dimension Score in Case Study

These improvements relate to the DX requirements that provide space for customer engagement in interacting with the organization through an easy-to-use user interface. Customer involvement enables the creation of a customer experience. The reliability of services increases customer trust. The results of the confirmation in the organizational management session showed that customer independence in using technology-based services was minimal. Generally, customers depend on employee assistance when interacting with a service. The next improvement is that organizations need partnerships to build a digital ecosystem, digitize customer service delivery, and digitize contact. The utilization of internet (mobile) technology as an intermediary in direct access to customers is necessary to offer full transparency and the possibility of innovation in new types of services [8] [10] [11] [31][32].

6. Conclusion

In this study, a digital maturity measurement model called DX SAMM was developed. It is intended for monitoring digital maturity measurements in general to be utilized by organizations in assessing their digital maturity independently. This monitoring involves organizational management. The model in this research was developed using several approaches, including a literature review, comparative analysis, design in the development of measurement tools, and empirical validation with case studies. In this study, SPICE was adopted as a reference for maturity levels in various domains. Unlike other digital maturity models, DX-SAMM emphasizes digital maturity measurements that involve multi-dimensionality, can be used in various domains in general, and can be used independently. Digital maturity measurements can also be practically applied. Case studies show that organizations can use the results of their digital maturity assessments as a guide to formulate future strategies. This study contributes to the literature by adding references to digital maturity measurements that can be implemented in general. The main dimensions that affect the success of transformation are identified through comparative analysis, namely, seven dimensions with 21 sub-dimensions. The proposed dimensions of digital maturity reveal the overall status of Digital Transformation achievement within an organization. The Organization and Structure dimension has an impact on measuring the restructuring of the company resulting from digital transformation. Meanwhile, the Strategy dimension focuses more on the direction of the organization's vision and mission. The Technology dimension does not dominate digital maturity, which aligns with previous research findings that DX is not just about technology [33]. The success of DX lies in aligning strategy and governance [4], [10], [34], and various other dimensions.

Although the development of the DX-SAMM model has resulted in maturity measurements that can be used in various domains, the differences in characteristics between the domains are not generalizable. Therefore, dimensional and sub-dimensional depth adjustments in different domains cannot be ignored. Future research is needed to empirically test this hypothesis using more cases from various domains. Deepening the testing through a customized questionnaire that aligns with specific domain characteristics is necessary. The digital maturity measurement in this study focuses more on assessing digital maturity in a general sense that can be implemented across domains. Specific digital maturity measurements within a particular domain require adjustments tailored to the characteristics of that domain. Finally, DX-SAMM is a practical alternative for organizations to monitor the achievement of the digital transformation process independently, and the measurement results can be used as a baseline to achieve a better level of maturity.

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