Digital Transformation Capability Maturity Framework for Digital Audit Readiness in Public Sector (Case Study)

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Abstract

Digital readiness is the organizational readiness to face digitalization. The development of digital audit must be balanced with digital readiness. Organizations can use a specific capability maturity model to assess their existing position in relation to the adoption of digital audit readiness measures and receive help in advancing to the required level of implementation of relevant capabilities. This study looks at how such a model might help integrate measures linked to digital audit readiness and aid in achieving the right degree of maturity. Based on four digital transformation process categories: internal policy and governance, information and technology, digital process transformation, and human resource management, the implementation of digital audit readiness has been evaluated. Five maturity levels describe the various phases of implementing digital audit readiness measures (incomplete, performed, managed, established, predictable, and innovating). Aligning IT governance frameworks can assist implement digital audit readiness. To determine whether an organization is prepared for digital transformation, it is necessary to assess its readiness for a digital audit. The results of the digital audit readiness assessment will show problems with how digital audit transformation is being used. Sub-criteria that have a low level of maturity and high global weight can later be prioritized for increasing audit readiness.

Keywords
Digital Readiness, Capability Maturity Framework, Digital Transformation, Internal Audit

1. Introduction
Digital transformation (DX) should be implemented to improve effectiveness and efficiency. The government of Indonesia is aiming to establish "Indonesia Digital", making it no different from other countries. The four strategic sectors for digital Indonesia for 2021–2024 are digital infrastructure, digital government, digital economy, and digital society. Digital government, or e-government, has been developed recently and is also applicable to government internal audit activities. Internal auditing is a consulting and assurance activity that is objective and independent, with the goal of adding value and improving organizational performance (IIA 2022). Government audits are a crucial tool for keeping tabs on how government funds are being used, preventing corruption, and enhancing performance (Cao et al. 2021).

Along with technological advancements, digital audits are necessary. Several elements need to be taken into account, including cost, time, technology, personal data protection, cyber security, and proper user training (Lois et al. 2022). Digital auditing, which uses information technology, can shorten the time needed to conduct audits, increase productivity, reduce costs, and improve performance with quick data transmission. Internal auditors can reorganize so they can work virtually, which increases audit efficiency (Teeter et al. 2010). Internal management, audit implementation, and audit objects are the three areas of change for the digital audit. This will have an impact on the transformation of business processes, IT, and human resources (HR).

There are issues with the study in this case study, including: (a) the factors that influence organizational readiness in the digital audit transformation are unknown; (b) digital readiness has not been carried out before the digital audit will be implemented; and (c) the level of the organization's readiness to implement the new system is unknown. Designing a digital audit readiness model is the initial step in solving research problems.

1.1 Objectives
Determine the digital transformation capability maturity framework (DX-CMF) to evaluate the digital readiness of auditing.

2. Literature Review
2.1 Digital Readiness
Readiness is the developmental stage that indicates a person's attitude, desire, and ability to act, and "digital" can refer to digital technology devices and apps. Accordingly, "digital readiness" can be defined as a propensity and willingness to switch to and adopt digital technology, as well as the tendancy to create new innovations, with opportunities to use this technology to assist individuals, organizations, industries, and countries in achieving their objectives more quickly and with better results (Nasution et al. 2018). An electronic or digital readiness evaluation can integrate company readiness, human resources (HR) preparedness, information and communication technology (ICT) readiness, information readiness, and external environment readiness (Mutula and Brakel 2006). The digital readiness model is a technology roadmap that serves as a guide for implementing digital technology (Schaupp et al. 2017). A digital readiness model, which can also be utilized as a continuous evaluation of digitalization, is necessary for applying digitalization in compliance with the path of digital transformation (Soomro 2018). Digital readiness and e-readiness are synonymous with e-business readiness, e-government readiness, mobile readiness, network preparedness, and general technology readiness (Nasution et al. 2018).

2.2 Information Technology (IT) Maturity
The maturity model is a tool for evaluating a company's capabilities based on specific factors and choosing the best course of action to advance to a higher level of maturity (Soomro et al. 2020). The maturity of digital transformation in an enterprise is assessed using the IT Maturity Framework (Ikegami and Iijima 2020). Some of the IT management frameworks are the Information Technology Infrastructure Library (ITIL), Information Utilization Potential (IUP) Model, Control Objectives for Information and Related Technology (COBIT), Capability Maturity Model Integration (CMMI), Digital Transformation Capability Maturity Model (DX-CMM), IT Balanced Scorecard, Val IT, IT Capability Maturity Framework (IT-CMF), IT Assimilation Maturity (IAM), and others. They each have a different group of process categories to evaluate. Process categories in some of the IT management frameworks shown in Table 1.

Table 1. Aspect of The IT Management Framework

IT Management Framework	Aspects	References
IUP Model	Human resource readiness, enterprise readiness, ICT readiness, information readiness, external environment readiness.	(Mutula and Brakel 2006)
COBIT	Policy, Institution, Infrastructure, Applications, Plan, IT Governance, IT Strategic, IT Value, IT Risk Management, IT Performance, Information Security.	(Anza et al. 2017, Joshi et al. 2017, Schmitz et al. 2021)
IT-CMF	IT Business Value, IT Management business, IT Management Budget, IT Management Capability, IT Management Business Value. Personnel, Technology, Resource, Manufacturing.	(Ikegami and Iijima 2020, Carcary 2011, Curley and Kenneally 2011, Hu and Gao, 2019)
Val IT	Value Governance, Portfolio Management, Investment Management.	(Dewi 2019)
DX-CMM	Strategic Governance, Information and Technology, Digital Process Transformation, Workforce Management.	(Gokalp and Martinez 2021)
IAM	Business Processes, Information Architecture, IT Processes, End-Users.	(Duta et al. 2021)

2.3 Analytic Hierarchy Process (AHP)
The Analytic Hierarchy Process (AHP) is a method of measuring that employs pairwise comparisons and depends on the expert opinions to establish priority scales. The AHP method is used in practice, particularly in the context of defining and measuring criteria. (Russo and Camanho 2015). The AHP used to establish weighting methods for a set of digital audit readiness criteria and sub-criteria.

3. Methods

The research methodology consists of four phases: problem identification, framework development,validation, and weighting, as shown in Figure 1.
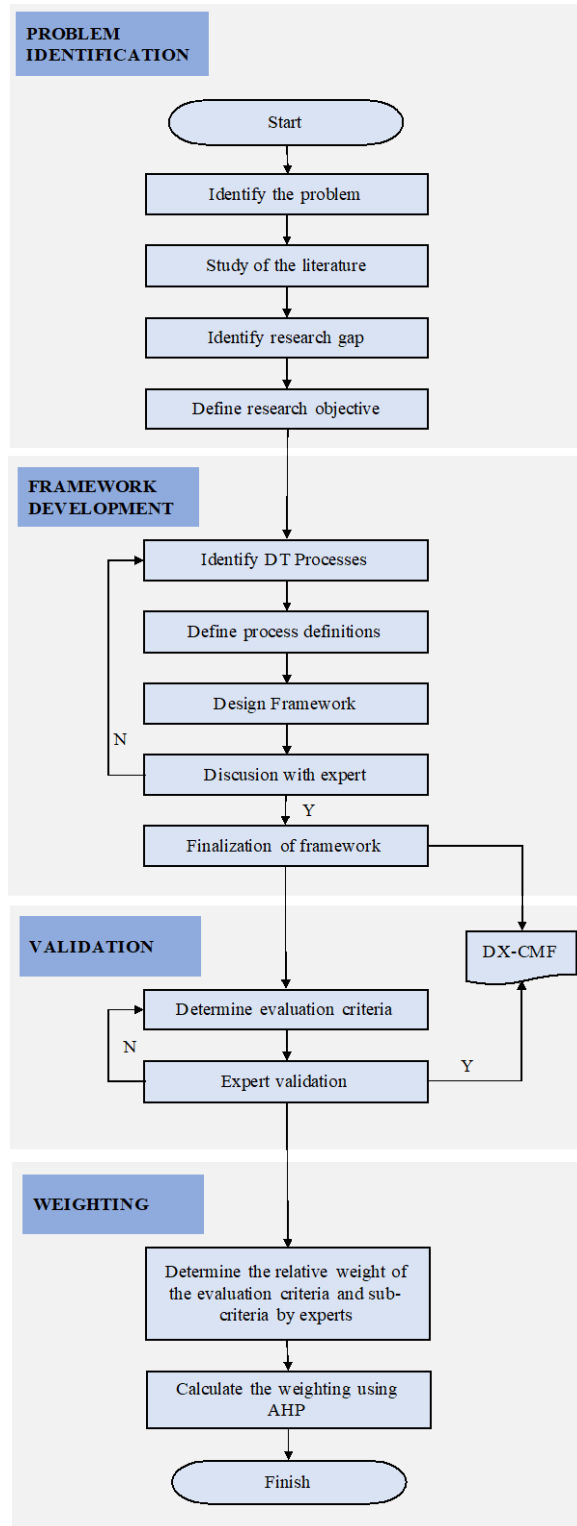

Figure 1. Methodology of research

Phase one of the research methodology is problem identification. It consists of four steps: identifying the problem, conducting a literature review, conducting a gap analysis, and defining the research objective. This phase focuses on identifying and analyzing problems, comparing them with those identified in previous research, and proposing solutions to solve the problems encountered.

The research methodology for phase two is capability maturity framework development. This phase consists of five steps. The audit transformation digital process must be identified as the first step in developing the framework. Critical processes are categorized as indicators, arranged along the same dimensions, and defined. Small adjustments to the DX-CMM from previous research were used to design the framework. Additionally, it's crucial to consider the assessment's elements in line with the applicable laws of Indonesia. DX-CMF is a combination of them that was created through discussions with experts. The DX-CMF is based on the DX-CMM model that Gokalp and Martinez (2021) studied. It adds a policy element that must be considered because it is one of the ways to determine whether the system was established in accordance with Indonesian regulations.

Phase three of the research methodology is the validation of the framework. The evaluation criteria are established at this phase. The framework is validated using reviews and advice from experts. Following validation, the framework is generalized and standardized so that it can be applied.

The research methodology for phase four is weighting of criteria and sub-criteria for evaluation. The purpose of weighting is to represent a criterion's importance on other criteria.

4. Data Collection
4.1 Determine framework based on a review of the literature.
The characteristics of the IT framework from previous studies that are shown in Table 1. will be used to define the capability maturity model as a guideline for evaluating the digital audit readiness. The capability maturity model in this study refers to the DX-CMM model and and it includes internal policy factors that are required by Indonesian regulation. The evaluation of IT maturity in Indonesian government organizations is regulated. The policy is Regulation of the Minister of State Apparatus Utilization and Bureaucratic Reform of the Republic of Indonesia Number 5 of 2018. Internal policy, governance, and service are the aspects defined by these regulations. It is a tool for assessing the maturity level of e-government. While the primary reference model, DX-CMM, has of four aspects: Strategic Governance , Information and Technology ,Digital Process Transformation , and Workforce Management. Then, the model that will be used in this study is called the Digital Transformation Capability Maturity Framework (DX-CMF). Using a comparison of the models discovered in the literature, the model is determined. The model is selected by doing a comparative analysis with five experts using FGD. Each expert has more than ten years of experience as an auditor, and three of them have degrees in information technology and information systems. In general, DX-CMF consists of four aspects, i.e., internal policy and governance (IP), information and technology (IT), digital process transformation (DP), and human resource management (HR); see Figure 2.
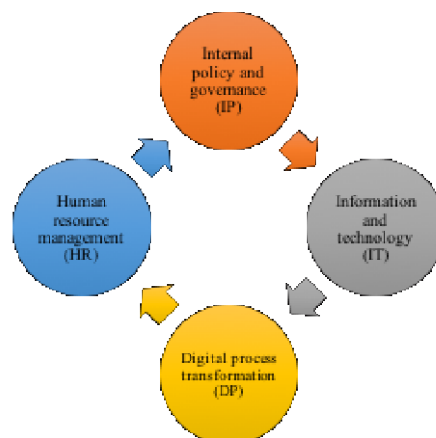

Figure 2. DX-CMF Aspects Diagram

For internal policy and governance (IP), the purpose is to determine how internal policies and governance are being used in the process of implementing digital transformation, as shown in Table 2. Therefore, four processes support the IP aspect.

Table 2. DX-CMF: Internal Policy and Governance (IP) Aspect (Gokalp and Martinez 2021, Ministry of State Apparatus Utilization and Bureaucratic Reform, 2018)

DT-CMF Aspect	Objective	Process
Internal policy and governance (IP)	To ensure the organization has internal policies and governance for the development of digital transformation.	IP1: Internal Policy of DT Governance
		IP2: DT Strategic and Planning
		IP3: Project Management
		IP4: Financial Resources

In information and technology (IT), measurement is focused on digital transformation development (see Table 3). There are eight processes that compose the IT aspect.

Table 3. DX-CMF: Information and Technology (IT) Aspect (Gokalp and Martinez 2021)

DT-CMF Aspect	Objective	Process
Information and Technology (IT)	To ensure the digital transformation development of the organization is optimally established	IT1: Requirement Definition
		IT2: Enterprise Architecture Development
		IT3: Infrastructure Management
		IT4: Data Governance
		IT5: Software Development
		IT6: Enterprise Architecture Integration
		IT7: Data Analytics
		IT8: Enterprise Architecture Maintenance

In the aspect of digital process transformation (DP), it is measured by the existing digital transformation business process. DP aspect consists of six processes as shown in Table 4.

Table 4. DX-CMF: Digital Process Transformation (DP) Aspect (Gokalp and Martinez 2021)

DT-CMF Aspect	Objective	Process
Digital process transformation (DP)	To ensure that the organization has a digital transformation business process for both its main and supporting processes.	DP1: Digitalization business process
		DP2: Vertical Integration
		DP3: Horizontal Integration
		DP4: Data-Driven Decision Management
		DP5: Quantitative Performance Management
		DP6: Integration toward life-cycle

For human resource management (HR), the purpose of measuring human resource readiness for digital transformation is as shown in Table 5. Therefore, four processes support the HR aspect.

Table 5. DX-CMF: Human Resource Management (HR) Aspect (Gokalp and Martinez 2021)

DT-CMF Aspect	Objective	Process
Human resource management (HR)	To ensure that the company has managed and prepared its human resources to support digital transformation.	HR1: I HR Skill Development
		HR2: Organizational Structure Management
		HR3: Organizational Change Management
		HR4: Sustainable Learning Management

The maturity level of DX-CMF is refers to DX-CMM maturity level and described in Table 6.

Table 6. Description of The DX-CMM Maturity Level (Gokalp and Martinez 2021)

Maturity Level	Description
Level 0: Incomplete	The DT development has not yet started.
	There is no digital transformation initiative yet.
Level 1: Performed	The DT development has been started.
	The internal policy, strategic and planning of DT is developed.
	There is a work team responsible for DT.
Level 2: Managed	The DT is managed, where the creation of the digital shadow of physical objects starts.
	Standards, guidelines, procedures are established for the enterprise architecture of process, data, application and technology.
Level 3: Established	At this stage, DT is fully established.
	Vertical integration.
	Standardized qualification of digital transformation process.
Level 4: Predictable	It is established to have horizontal integration, which is the integration of networks at the organizational level.
	Data analytics and data driven decision making are applied.
Level 5: Innovating	Innovative business process.
	Continuous adaption.
	Self-optimization.

4.1 Weighting Criteria and Sub-Criteria using AHP

This study has four main criteria and twenty-four sub-criteria. The criteria and sub-criteria were derived from a literature review. Each criteria and sub-criteria is assigned a weight indicating its relative importance. Four experts completed a questionnaire with a Likert scale ranging from 1 to 9 to determine the weighting of the criteria and sub-criteria. AHP was utilized to determine the relative importance of each criterion and sub-criteria based on the findings of an expert survey. The results of the weighting calculation for each criterion and sub-criteria are shown in the Table 9.

5. Results and Discussion

Digital readiness can be defined as the propensity and willingness to utilize and adapt digital technology as well as the ability to generate new ideas with the potential to use this technology to assist people, companies, industries, and nations achieve goals more quickly and effectively (Nasution et al. 2018). Organizational preparedness for digitization (Soomro 2018) is another definition of digital readiness. Based on the definition of digital readiness provided above, it is possible to define digital audit readiness (DAR) as the ability and willingness to transition audit activities to digital technology, as well as the ability to develop new innovations in digital audit transformation that can optimize and improve the organization's processes. With specific scope adjustments in audit activity, the digital audit readiness model will be referred to as DX-CMF. The four aspects and fourteen processes in DX-CMF that are still of a general character will be defined in the context of the internal audit's coverage.

The four DX-CMF aspects that will be connected to DAR are described as follows: The first is internal policy and governance (IP), which consists of internal policies to control the execution of DX audit operations, such as strategic planning, a DX audit work team, and financial resources for DT audits. The second aspect is information and technology (IT). For the organization's migration to the desired future environment, an IT strategy that is compatible with the DX strategy should be created. For each DX audit process, the design, integration, governance, and maintenance of IT should be defined. The third component is called digital process transformation (DP), and it can be used to define the transformation of major or supporting operations in a digital audit process. And the last aspect is human resource management (HR). Before the transformation process starts, cultural change should be implemented. Development of human resources skills, management of organizational structure, sustainable learning, and organizational transformation

are all crucial. The improvement of auditor skills must be recognized in audit activities. For the digital audit transformation to be sustainable, top management support and auditor readiness are both required.

Table 7. Definition Process of DX-CMF for Digital Audit Readiness

DAR Aspect	Indicator Process	Definition
Internal policy and governance (IP)	IP1: Internal Policy of DX Governance	Developing internal regulations to serve as a legal framework for the digital audit.
	IP2: DX Strategic and Planning	Establishing a defined strategic and plan of action for how digital audit may help the organization compete and prosper.
	IP3: Project Management	There is an organization or team that is responsible for implementing the digital audit.
	IP4: Financial Resources	The development of digital audit is supported by a budget.
Information and Technology (IT)	IT1: Requirement Definition	The information and technological requirements for digital audit are described in specifications in detail.
	IT2: Enterprise Architecture Development	Establishing an enterprise architecture (EA) or conceptual design that explains the entire digital audit process.
	IT3: Infrastructure Management	Monitoring technical and operational components, such as system, network, and storage management of digital audit.
	IT4: Data Governance	Maintaining the digital audit data's availability, usability, integrity, and security in accordance with internal data standards.
	IT5: Software Development	Designing, creating, testing, and maintaining different software applications for digital audit transformation.
	IT6: Enterprise Architecture Integration	Prepare the architecture for the integration system of the digital audit transformation.
	IT7: Data Analytics	Using data analytics to conduct a digital audit.
	IT8: Enterprise Architecture Maintenance	Prepare the architecture for the maintenance system of the digital audit transformation.
Digital process transformation (DP)	DP1: Digitalization business process	Establish a business process for auditing digitalization.
	DP2: Vertical Integration	Applying vertical integration to the system of the digital audit.
	DP3: Horizontal Integration	Applying horizontal integration to the system of the digital audit.
	DP4: Data-Driven Decision Management	Audit outcome are based on the data stored in systems.
	DP5: Quantitative Performance Management	Quantitative evaluation of audit performance is conducted, and the criteria for evaluation, reward, and punishment are all well-defined.
	DP6: Integration toward life-cycle	Establishing a sustainable audit
Human resource management (HR)	HR1: I HR Skill Development	Possible to develop auditor skills by completing the proper education and training, according to data on existing capabilities, desired skill needs, and plans.
	HR2: Organizational Structure Management	Establishing job desks and amounts auditor as well as managing the current organizational structure.
	HR3: Organizational Change Management	Ascertain that the organization is prepared to accept the changes brought about by the implementation of digital audit transformation.
	HR4: Sustainable Learning Management	Internal training programs for auditors who have not been trained by auditors who have completed certificate programs can be used to carry out continuous learning.

On the basis of discussions with experts, criteria have been established and validated for every prospective aspect that may be divided up in each process. Since there has been a start to the transformation of the digital audit in the case study, maturity level 0 (incomplete) is determined to be inappropriate for use in this evaluation. Setting criteria therefore begins at level 1, as shown in Table 8.

Table 8. Criteria for Each Aspect of Evaluation

DAR Aspects	Maturity Level	Criteria
Internal policy and governance (IP)	Level 1	Digital audit transformation strategies, work plans, and budgets are created ad hoc.
	Level 2	Digital audit transformation strategies, work plans, and budgets have been created but not yet fully implemented.
	Level 3	Digital audit transformation strategies, work plans, and budgets have been created on a regular basis and be valid to all divisions. It considered the stakeholder needs analysis.
	Level 4	Digital audit transformation strategies, work plans, and budgets have been created and evaluated.
	Level 5	Digital audit transformation strategies, work plans, and budgets have been created It considered the findings of the evaluation.
Information and Technology (IT)	Level 1	Designing, building, testing, and maintaining a digital audit transformation system has not yet been developed.
	Level 2	System for the digital audit transformation have been developed, but not yet been built, tested, and maintained.
	Level 3	System for the digital audit transformation have been developed and built, but not yet been tested and maintained.
	Level 4	System for the digital audit transformation have been developed, built and tested, but not yet been maintained.
	Level 5	System for the digital audit transformation have been developed, built, tested and maintained.
Digital Process transformation (DP)	Level 1	Business process of digital audit transformation has been created.
	Level 2	A vertical integration has been used to implement a digital audit transformation system.
	Level 3	A horizontal integration has been used to implement a digital audit transformation system.
	Level 4	Data driven decision and quantitative performance for digital audit transformation has been used.
	Level 5	Sustainable auditing practices have been developed for digital audit transformation.
Human resource management (HR)	Level 1	There is already a mapping of auditor needs and competencies to support the implementation of digital audits.
	Level 2	The mapping of needs and competencies of auditors has been used as a consideration for recruiting and training auditors.
	Level 3	An analysis of the organizational structure has been done to evaluate the implementation of digital audit is appropriate.
	Level 4	All personnel who will be affected by the implementation of the digital audit transformation have been adequately trained by the organization.
	Level 5	Sustainable learning management have been developed for digital audit transformation.

It is important to convert it in order to view the digital readiness level because the evaluation procedure uses DX-CMF, which outputs a maturity level. The digital readiness level is meant to refer to the capability level on a scale of 1-3 (performed, managed, defined). The change from capability level to digital readiness level on a scale of 1–3 (not ready, almost ready, ready).

Figure 3. illustrates the relationship between digital readiness level and maturity level. In other words, if the organization is at maturity level 1, it is not ready to conduct digital transformation. With maturity level 2, she is almost ready. And for maturity levels 3, 4, and 5, the organization is ready to transform digital auditing.
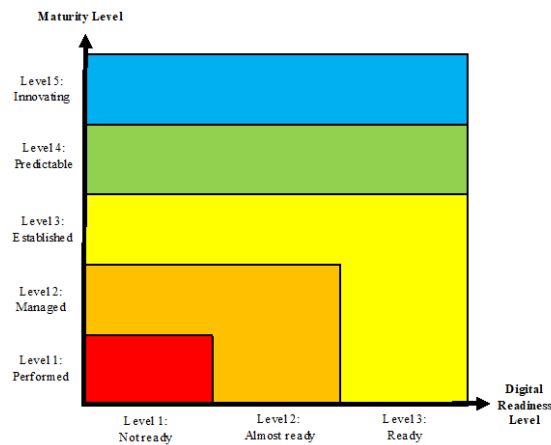

Figure 3. The relationship between maturity level and digital readiness level.

Based on the study of the literature, the evaluation framework had four main criteria and twenty-four sub-criteria. Following the calculation, five chosen experts who were in charge of choosing and evaluating the weight of the assessment criteria and sub-criteria received questionnaires to validate the criteria and sub-criteria. The results of the weighting of the criteria and sub-criteria to be used are shown in Table 9.

Table 9. Weight of crietria and sub-criteria

No	Criteria	Weight of Criteria	Sub Criteria		Weight of sub criteria	Global weight
	Goal: Determine the digital audit readiness level in public sector.					
1.	Internal policy and governance (IP)	0.301	IP1	Internal Policy of DX Governance	0.196	0.059
			IP2	DX Strategic and Planning	0.153	0.046
			IP3	Project Management	0.175	0.053
			IP4	Financial Resources	0.476	0.143
2.	Information and Technology (IT)	0.291	IT1	Requirement Definition	0.138	0.040
			IT2	Enterprise Architecture Development	0.087	0.025
			IT3	Infrastructure Management	0.131	0.038
			IT4	Data Governance	0.172	0.050
			IT5	Software Development	0.116	0.034
			IT6	Enterprise Architecture Integration	0.122	0.036
			IT7	Data Analytics	0.172	0.050
			IT8	Enterprise Architecture Maintenance	0.062	0.018
3.	Digital Process transformation (DP)	0.286	DP1	Digitalization business process	0.137	0.039
			DP2	Vertical Integration	0.091	0.026
			DP3	Horizontal Integration	0.073	0.021
			DP4	Data-Driven Decision Management	0.256	0.073
			DP5	Quantitative Performance Management	0.254	0.073
			DP6	Integration toward life-cycle	0.189	0.054
4.	Human resource management (HR)	0.122	HR1	HR Skill Development	0.301	0.037
			HR2	Organizational Structure Management	0.149	0.018
			HR3	Organizational Change Management	0.291	0.036
			HR4	Sustainable Learning Management	0.259	0.032

Based on the weighting of the criteria and sub-criteria, it was determined that internal policy and governance had the highest weight of criteria (0.301), with financial resources being the most important sub-criteria, followed by the internal policy of DX governance, project management, and DX strategic and planning. Information and technology is the second-most important criteria, with the weight of criteria is 0.291. The two most significant sub-criteria are data governance and data analytics, whereas enterprise architecture maintenance is the least important. With a weight of 0.286, digital process transformation is the third most important criteria. These criteria consist of six sub-criteria, with data-driven decision management being the most important and horizontal integration being the least significant. Human resource management is the criteria with the lowest weight, with the weight of criteria is 0.122. This criterion has four sub-criteria, the most important of which is HR Skill Development and the least important of which is Organizational Structure Management.

In table 9, the results of the criterion weighting are shown in descending order from highest to lowest. To make it easier to see the overall weight values in Figure 4, the global weight for each sub-criterion is given in descending order of importance.
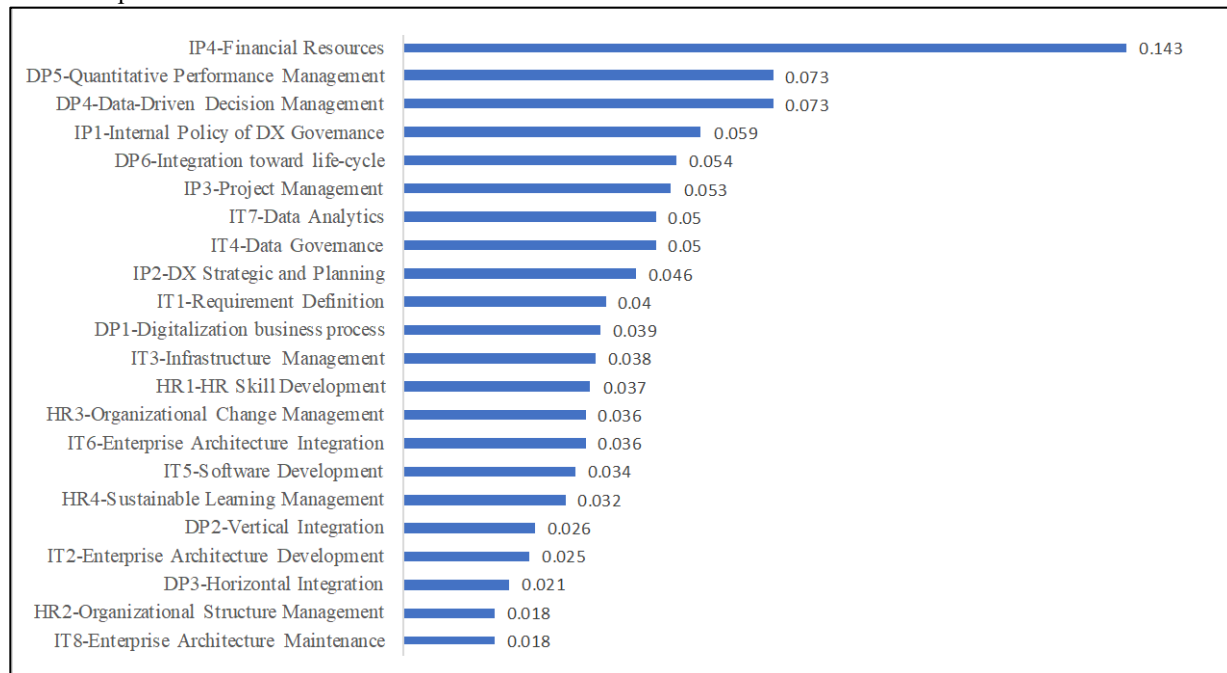

Figure 4. Global weight of sub criteria

Based on the global weight, the order of priority or level of importance that affects the assessment is: first, financial resources with a global weight of 0.143; second, quantitative performance management and data-driven decision management with a global weight of 0.073; third, internal DX governance policy with a global weight of 0.059; and the lowest global weight is in the organizational structure management and enterprise architecture maintenance sub-criteria with a global weight of 0.018.

6. Conclusion

The development of an integrated digital audit must be followed by digital readiness. In this study, capability maturity models or frameworks are used to assess digital readiness. The capability maturity frameworks combine the DX-CMM and Indonesian regulations. This model is the "digital transformation capability maturity framework" (DX-CMF), which has four aspects: internal policy and governance (IP), information and technology (IT), digital process transformation (DP), and human resource management (HR). Using established standards that have been approved by professionals, maturity is evaluated. The final outcome of the maturity assessment will be used to determine levels of digital readiness. The organization's digital readiness to adapt its auditing procedures to include digital ones can be assessed.

Based on the results of weighting using AHP, the highest criteria weight is Internal Policy and Governance (IP), followed by Information and Technology (IT), Digital Process Transformation (DP) and the lowest is Human Resource

Management (HR). Whereas the most significant weight in terms of global weight is at financial resources (IP4) and and the lowest is organizational structure management (HR2) and enterprise architecture maintenance (IT8).

For a future study to find out if digital audits are ready, a maturity level assessment will be done. The evaluation results will subsequently be used to formulate a strategy for digital audit transformation.

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