Indonesian Journal of Computer Science
ISSN 2549-7286 (*online*)
Jln. Khatib Sulaiman Dalam No. 1, Padang, Indonesia
Website: ijcs.stmikindonesia.ac.id | E-mail: ijcs@stmikindonesia.ac.id

Improvement of Data Operations Management using CMMI and DMBOK in Soekarno-Hatta Meteorology Station

Jihan Nur Ramdhani[1], Yova Rudelviani[2] , I Made Aditya Pradnyadipa[3], Irwan Shofwan[4]
jihan.nur21@ui.ac.id, yova@cs.ui.ac.id, I.made219@ui.ac.id, irwan.shofwan@ui.ac.id
[1]Univesity of Indonesia

Article Information

Submitted : 27 Feb 2024
Reviewed: 29 Feb 2024
Accepted : 1 Apr 2024

Keywords

Data Operation Management, DMBOK, CMMI, Maturity Level, BMKG

Abstract

Soekarno-Hatta Meteorology Station is a Technical Implementation Unit within Agency for Meteorology, Climatology, and Geophysics (BMKG) .It has the duties to manage, and process data for safety, regulation, and aviation navigation efficiency by distributing the processed data to their stakeholder, such as Air Traffic Service (ATS), flight operators, and pilots. Furthermore, research was also conducted in the station regarding the creation of Aerodrome Climatological Summary (ACS) annually. Loss of flight document data occurred in 2019 due to a ransomware attack, causing the cessation of the data operation process on the flight document. Unfortunately, there is no data recovery resulting in the unavailability of flight document data. This accident is very crucial because flight document data should not be lost within a 30-day timeframe as it is needed in case of any flight accident mechanism. It shows that Data Operations Management needs to be improved to support the business process. This study aims to evaluate the maturity level of data operations management in Soekarno-Hatta Meteorology Station by a conceptual model based on DAMA-DMBOK and the level of maturity is assessed using the Capability Maturity Model Integration (CMMI). The result showed that the average activity reaches level 2. Six activities are at level 1, namely obtaining externally sourced data, plan for data recovery, set database performance service levels, archive, retain, and purge data, support specialized database inventory and track data technology licenses, support data technology usage and issues. The rest of the activities will require action to improve their maturity level as given in the recommendation.

A. Introduction

The meteorological station is a Technical Implementation Unit within Badan Meteorologi, Klimatologi, dan Geofisika (BMKG), which has the main task of conducting observations, data management, and providing meteorological services[1]. The presence of a meteorological station is always associated with an airport because the operation of an airport requires meteorological services. This is a requirement set by the International Civil Aviation Organization (ICAO) and is outlined in Annex 3[2]. The Soekarno-Hatta Class I Meteorological Station, located in the Soekarno-Hatta Airport tower building in Tangerang, was established simultaneously with the operation of the first Soekarno-Hatta Airport in 1985[3].

The specific tasks of a meteorological station in data processing include:

- Conducting processing and archiving of observation data in the established format.
- Implementing data quality control for observation results.
- Processing the database and quality control of all observation results coordinated by meteorological stations in their respective regions.
- Managing data and conducting quality control of weather observation results at airports using statistical methods to create Aerodrome Climatology Summaries (ACS) for meteorological stations that provide aviation services.

With such tasks, data, and information become highly valuable assets as they are used and analyzed for various needs, including supporting aviation safety. In the business process, operational data is executed in large quantities, leading to frequent errors, especially if the operational data is not well-designed. Errors can include missing data, data redundancy, data loss, data inconsistency, and others[4]. Therefore, Soekarno-Hatta Meteorological Station is required to have good operational data management to produce accurate analysis results and minimize errors.

Data Operations Management is an important function within the Data Management Body of Knowledge (DMBOK) framework. This function is heavily influenced by the role of a Database Administrator (DBA). It is divided into two core activities: database support and data technology management[5]. In the database support activity, Soekarno Hatta Meteorological Station does not have a data recovery plan to ensure data availability. Soekarno-Hatta Meteorological Station experienced data management challenges in 2019 when the PC storing the flight document data was affected by ransomware, resulting in the loss of all data on the PC. There was no data recovery mechanism in place, including for the flight document data. However, flight document data should not be lost within a 30-day timeframe as it is needed in case of any flight accidents. This setback prompted the Soekarno-Hatta Meteorological Station to improve data operation management, to ensure the dependability and availability of database performance.

Data operations management aims to maintain and ensure the integrity of data assets, manage data availability in the data lifecycle, and optimize the performance of database transactions[6], therefore, the Soekarno-Hatta Meteorological Station needs to ensure that data operations management is carried out effectively. This is because data operations management directly

relates to the data requirements that will be used by stakeholders and relevant agencies.

Asih and Nabila conducted a study on Data Operations Management within a state-owned enterprise. They utilized DAMA-DMBOK as a reference framework and assessed the Maturity Level using Capability Maturity Model Integration (CMMI) [7]. Another similar research conducted by Brahmantara and Ruldeviyani at the National Institute of Aeronautics and Space of Indonesia used the same framework and maturity model [8].

CMMI offers several advantages over other models. It incorporates institutional features such as commitment, ability to take action, analysis and measurement, and verification of implementation. Additionally, CMMI provides a clear "road map" for further enhancement [9][10] [11][12]. As a data management framework, DMBOK has a broader focus but places more emphasis on data management aspects in terms of activities[13]

Based on these studies, the use of CMMI as a maturity model and DMBOK as a data management framework is The most suitable method for the needs of the organization in this research case study.

In this paper, the researcher provides an overview of how to measure the maturity level of data operations management and provides recommendations on how data operations management should be run at Soekarno-Hatta Meteorology Station by using Capability Maturity Model Integration (CMMI) as a maturity model and Data Management Body of Knowledge (DMBOK).

The Soekarno Hatta meteorological station has never had measurements of this operation management data.

In addition, researchers offer suggestions for increasing the maturity level of operating data management activities that are not yet by the desired conditions.

This paper consists of several chapters, which cover: Chapter 2 describes the theory that underlies this research. Chapter 3 discusses the methods used to collect data related to data operations management activities at Soekarno-Hatta Meteorology Station. Chapter 4 contains the results, discussion, and recommendations on the data collected. Finally, it closed with a conclusion in Chapter 5.

B. Literature Review

Data Management Body of Knowledge (DMBOK)

The DAMA Association International is a non-profit organization with a diverse group of global experts in data management. One of their notable achievements in the field of data management is the creation of the Data Management Body of Knowledge (DMBOK) framework. This comprehensive and universally applicable framework covers all stages of the data management lifecycle. Its detailed structure guides in developing and executing data management processes and procedures while ensuring that all requirements are met. In contrast, TOGAF and COBIT do not provide in-depth design and implementation guidance for data management. DMBOK identifies ten fundamental functions in data management, including Data Governance, Data Architecture Management, Data Development, Data Operations Management, Data

Security Management, Reference and Master Data Management, Data Warehouse and Business Intelligence Management, Document and Content Management, Meta-Data Management, and Data Quality Management[5]. The framework aims to exceed the information needs of an organization's stakeholders by providing information that is readily available, secure, and of high quality.

Data Operations Management

Data Operations Management is an important function in the Data Management Body of Knowledge (DMBOK) framework that involves the development, maintenance, and support of data structures to maximize the value of data resources for organizations. This function is heavily influenced by the role of a Database Administrator (DBA). Data Operations Management aims to safeguard and maintain the integrity of structured data assets, regulate data availability during its lifecycle, and enhance the performance of database transactions. This function is split into two core activities: database support and data technology management[5]

Database support plays a critical role in ensuring the dependability and availability of database performance. It is further divided into nine sub-activities, including implementation and supervision of databases, management of external database sources, data recovery planning, backup and recovery data activities, determining service levels for database performance, monitoring processes and performance tuning bases data, plan data retention, archive, retrieve, and purge data, and managing specific types of databases.

Data technology management, the second activity, is focused on arranging principles and bases for managing the technology used by companies. It consists of six sub-activities, which include understanding the need to use data technology, creating technology architectures to support data management, evaluating the technology used, installing and administering the technology used, monitoring technology licenses, and training to support technology use. All sub-activities are essential in compiling the principles and bases for managing the technology used by the company.

Capability Maturity Model Integration (CMMI)

The Capability Maturity Model (CMM) is a framework developed by the Software Engineering Institute (SEI) that provides a structure for organizing progressive stages of development. It consists of five Maturity Levels: Initial, Repeatable, Defined, Managed, and Optimizing, which can be used to measure an organization's process capability and prioritize improvement efforts. However, the lack of integration and standardization in CMM can cause confusion and conflict during the assessment process[14]. These shortcomings in CMM are addressed by Capability Maturity Model Integration (CMMI), which is why this research chooses to use CMMI as the framework for assessing Maturity Level. The differences in Maturity levels between CMM and CMMI can be observed in Table 1 [15].

Table 1. CMM and CMMI differences

Maturity Level	CMM	CMMI
Level 1	Initial	Iniate
Level 2	Repeatable	Managed
Level 3	Defined	Defined
Level 4	Managed	Quantitavely Managed
Level 5	Optimizing	Optimizing

Capability Maturity Model Integration (CMMI) is a framework developed by CMM to address the lack of integration and standardization. CMMI is a framework designed to enhance business processes. CMMI is implemented through two fundamental stages. The initial stage involves assessing the Maturity Level of a business process. Once the Maturity Level is determined, the subsequent step in CMMI offers a methodology to assist organizations in implementing corrective measures to elevate the Maturity Level. CMMI consists of five Maturity Levels, namely Initiate, Managed, Defined, Quantitatively Managed, and Optimizing[15]

CMMI was selected as the maturity model in this paper due to its ability to offer a comprehensive approach to process improvement across multiple disciplines. Each maturity level encompasses a range of process areas, each outlining specific activities an organization should undertake to enhance its business processes[16].

To measure the maturity level of data operations management activities, an assessment is conducted based on the activities typically performed by the organization according to the DMBOK[5]. The maturity levels in CMMI and their respective descriptions can be found in Table 2.

Table 2. Maturity Level in CMMI

Maturity Level		Description
Level 1	Initial	Processes are not well-managed or controlled, which leads to unpredictable outcomes. The approach used is ad hoc and chaotic, with no defined Key Process Areas, resulting in the lowest quality and highest risk.
Level 2	Managed	Requirements are managed, processes are planned and controlled, and projects are implemented according to documented plans.

		While risks are lower than the initial level, they still exist, and the quality is better than the initial level.
Level 3	Defined	The processes are well-defined and follow standards, procedures, and methods, resulting in medium quality and risk. The focus is on standardizing the processes.
Level 4	Quantitatively Managed	Specific goals are set for process performance and quality based on customer requirements and organizational needs. The process performance is analyzed quantitatively and higher quality processes are achieved, resulting in lower risk.
Level 5	Optimizing	Continuous improvement to achieve the highest quality of processes and the lowest risk in their performance, with both incremental and innovative improvements being made.

C. Previous Research

Based on the results of the literature review, research on data management has been conducted quite extensively by researchers but the studies on implementing models to improve data operation management were still limited

Research on Data Operations Management has been conducted by Asih and Nabila in a state-owned enterprise using DAMA-DMBOK as a reference framework and measuring the Maturity Level using Capability Maturity Model Integration (CMMI). The research resulted in recommendations to improve the Maturity Level of the company[17].

Adawiyah and Ruldeviyani conducted similar research at a financial transaction reviewing institution. This study is motivated by the occurrence of business process disruptions caused by data loss resulting from hard disk failures. The researchers provide an overview of how to measure the maturity level of data operations management and provide recommendations on how data operations management should be conducted for improving Data Operations Management at the Financial Institution [18].

Another similar research was conducted by Brahmantara and Ruldeviyani at the National Institute of Aeronautics and Space of Indonesia. The researchers provide an overview of how to measure the maturity level of data operations management and provide recommendations on how data operations management should be conducted in the organization. It is implemented by measuring the maturity level of data operations management activities using the CMMI and DMBOK frameworks. Methodology[8]

Data Operation Management evaluation in Soekarno-Hatta Meteorology Station follows a few steps starting from problem identification which is described in the Introduction section. Once the problem is identified, the process continues with literature studies to gain knowledge on DMBOK, data operations management, and how to define the maturity level of its activities based on CMMI and why CMMI is the maturity model used in this study. Finally, to be able to the recommend to achieve expected maturity level for Soekarno-Hatta Meteorology Station, Data Collection and Analysis are done to determine the current maturity level, then a recommendation can be given based on the gap each activity has.

D. Methodologhy

This chapter describes the research flow, research instruments and methods as well as research data collection.

Research Flow

Contains the steps carried out by researchers during the research process. There are 5 steps, the first is developing research instruments, the second is data collection, the third is data analysis, the fourth is maturity assessment, the last is making recommendations

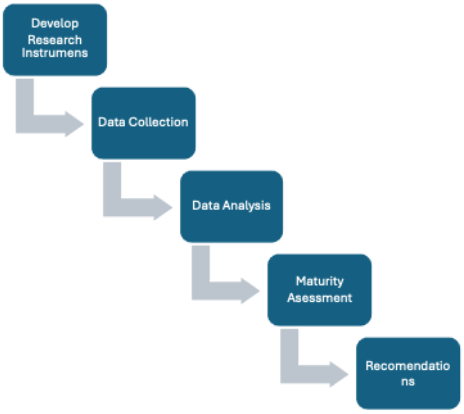

Figure1. Research Flow

1. Develop research instruments: The research instrument uses an structure interview, these set of question consisting of sixty questions based on DMBOK as our reference. We breakdown each activity to several questions starting with yes or no questions until the detail of activity that implemented in Soekarno-Hatta Meteorological Station. Interview question can be seen in table 3
2. Data Collection : To collect the data and understand the existing condition we conduct structured interview across function where the responsibility tightly couple with data and data management. The structured interview is useful for gathering demographics, understanding user knowledge, comparing results across groups on a fixed set of responses, and gathering attitude and opinion data. . Interview question can be seen in table 3
3. Develop research instruments: The research instrument uses an structure interview, these set of question consisting of sixty questions based on DMBOK as our reference. We breakdown each activity to several questions starting with yes or no questions until the detail of activity that implemented in Soekarno-Hatta Meteorological Station. Interview question can be seen in table 3
4. Data Collection : To collect the data and understand the existing condition we conduct structured interview across function where the responsibility tightly couple with data and data management. The structured interview is useful for gathering demographics, understanding user knowledge, comparing results across groups on a fixed set of responses, and gathering attitude and opinion data. . Interview question can be seen in table 3.

Table 3. List Of Interview Questions

Data Operation Management			
	Activities	**Deliverables**	**Questions**
A1	Implement and Control Database Environments (Planning)	Data availability SLA, data recovery plans	1. How has data been managed from when it was first developed to now? 2. Are there any established technical guidelines or standard protocols for the implementation of databases? 3. Has the standard operating procedure been implemented?
A2	Obtain Externally Sourced Data (Operational)	Database backups and logs, restored databases, business continuity	1. What is the mechanism if there is a need for data sourced from outside the organization? 2. Are there regulations and standards for data sources from outside the organization? 3. Has the regulation and standardization been implemented?
A3	Plan for Data Recovery (Planning)	Database performance SLAs	1. Is there a mechanism for recovering data? 2. What are the steps and how to recover data? 3. Have the stages and methods of recovering data been documented? 4. When is data recovery done? Is it scheduled? 5. Is data recovery possible at any time or does it need to wait for a specific time, such as during non-peak hours? 6. Is there a risk of performance degradation when data recovery is performed? 7. Are the recovery stages or methods always changed regularly?
A4	Backup and Recover Data (Operational)	Database performance reporting, Database performance	1. Is there a data backup mechanism? 2. What are the steps and how to do data backup? 3. Are the steps and methods of data backup documented? 4. When do data backups take place? Is it scheduled? 5. Is backup possible at any time or does it need to wait for a specific time, such as during non-peak hours?

Data Operation Management			
	Activities	**Deliverables**	**Questions**
			6. Is there a risk of performance degradation when backup is performed? 7. Is the process or method of backup regularly updated or changed?
A5	Set Database Performance Service Levels (Planning)	Database performance SLAs	1. Is there a service level agreement/reference value for service availability? 2. Is there a document that regulates this
A6	Monitor and Tune Database Performance (Control)	Database performance reporting, Database performance	1. Is there monitoring for the database? 2. How is the monitoring system currently in place? 3. Are the monitoring results analyzed? 4. Is the analysis conducted periodically? 5. Are there any follow-up activities carried out after monitoring? 6. What follow-up actions are taken, and how are they implemented?
A7	Plan for Data Retention (Planning)	Data retention plan, storage management procedures	1. Is there a data retention plan in place? 2. For how long is a data should be retain? 3. How will a data be processed after its retention time? 4. Are there any procedures or regulation regarding data retention? 5. How to check a data age?
A8	Archive, Retain, and Purge Data (Operational)	Archived data, retrieved data, purged data	1. Are there any regulations regarding data archiving, retaining, or purging ? 2. Is the requlation process have been done? 3. How the process is done?
A9	Support Specialized Databases (Operational)	Speciallized database	1. Are there any special data that being processed differently or spesifically? 2. Is that data being used together with another data in the same database?
A10	Understand Data Technology Requirements (Planning)	Data technology requirements	1. Are there any standardized Data Technology Requirements in the database implementation process? 2. Is it fullfilled the actual data processing requirement? 3. Does the data management teams understood the data

Data Operation Management			
	Activities	**Deliverables**	**Questions**
			technology requirements required by the station?
A11	Define the Data Technology Architecture (Planning)	Data technology architecture	1. Does the organization understand/aware about the framework use to plan, develop, and implement information technology to process the data? 2. Are there any documentation of the framework? 3. Is the document fullfilled the requirement of Data Technology architecture?
A12	Evaluate Data Technology (Planning)	Tool evaluation findings, tool selection decisions	1. Is the technology in data processing being evaluated periodically? 2. Is the process documented? 3. Are there any follow up action regarding the evaluation?
A13	Install and Administer Data Technology (Control)	Installed technology	1. How to install tools or software for data processing? 2. Are there any documentation regarding the instalation ? 3. Is the documentation evaluated ? 4. Is the evalution is done periodically?
A14	Inventory and Track Data Technology Licenses (Control)	License inventory	1. Are the applications/tools for data processing is premium software? 2. Are there any mechanism in storing the license of the appliactions? 3. Is the storage formally documented? 4. Who has the acces of this storage?
A15	Support Data Technology Usage and Issues (Operational)	Identified and resolved technology issues	1. Does the organization aware with the technology being used for data processing? 2. Does the organization giving feedback about issue on data processing? 3. How are the following up action related to the feedback?

3. Data analysis : In this section, we process the acquired data from Data Collection step to be assessed by qualitative analysis.Through these qualitative analysis, we aim to uncover patterns, trends, and insights that reveal the current state of maturity for each activity. By analyzing existing data operations management activities, we can find out how the activities take

place, who is responsible, whether the activities have been carried out according to procedures, whether the activities taking place have met expectations. The results are mapped with several levels, from level 1 to 4.

4. Maturity Assesment : Conduct an assessment by evaluating the current state of data operations management using the maturity model criteria, after that identify gaps and opportunities by comparing the assessment of current conditions with the desired conditions or best practices described in the maturity model. Identify gaps and areas that need improvement. Then make a visualization maturity level diagram using Microsoft Excel can be seen in Figure.2
5. Recomendation : Based on the assessment results,author create a recomendations for improving data operations management then reach higher levels of maturity.

C. Result and Discussion

The research was conducted using qualitative analysis based on data from in-depth interviews. Interviews with two sources were conducted separately to ensure the validity of each source's statements. Each source's statements will be analyzed to map them into Maturity Levels in Data Operations Management. Based on the qualitative analysis results, the Maturity Levels for Data Operations Management at Soekarno-Hatta Class I Meteorological Station can be mapped as shown in Table.4 . An illustration of the Maturity Levels for Data Operations Management can be seen in the Figure.2

Table 4. Maturity Level Result

Data Management Body of Knowledge (DMBOK) Knowledge Area: Data Operations Management		
Activities	**Response from DBA's**	**Maturity Level**
A1	This activity already has standardized, measurable, and controlled procedures with internal and external audits conducted regularly twice a year. Soekarno-Hatta Class I Meteorology Station has obtained ISO 9001:2015 certification.	Level 4 - Quantitatively Managed
A2	This activity does not yet have regulations and standardization for sourcing data from external sources.	Level 1 - Initial
A3	This activity does not have a Disaster Recovery Planning (DRP) document yet. There is no standard procedure regarding data recovery, and data are back up without any data recovery planning.	Level 2 - Managed
A4	This activity has been carried out, but it does not have an official done manually by the staff with an uncertain backup	Level 1 - Initial
A5	This activity does not yet have a Service Level Agreement (SLA) specifically related to database performance. The existing SLA only covers the	Level 1 - Initial

Data Management Body of Knowledge (DMBOK) Knowledge Area: Data Operations Management		
Activities	**Response from DBA's**	**Maturity Level**
	uptime/downtime of IT services and does not provide specific guidelines or benchmarks for measuring and ensuring database performance.	
A6	Database monitoring activities are conducted daily to check data availability, daily reports, and monthly reports. The monitoring results serve as triggers for database tuning. Database tuning is also performed annually in collaboration with Balai Besar Wilayah II and BMKG Pusat (Central BMKG). This tuning process involves holding special meetings, such as joint meetings with UPT (Unit Pelaksana Teknis), BMKG Pusat, and Balai Besar Wilayah II, to assess the database's condition and provide recommendations for improvement.	Level 3 - Defined
A7	This activity does not have clear regulations regarding Data Retention. Document observation results indicate that Soekarno-Hatta Meteorology Station only has retention guidelines for hardcopy archival documents but lacks guidelines for data retention of operational data.	Level 2 - Managed
A8	The procedures regarding data archiving, retention, and purging in this activity are not well-defined. The entire database is constantly being updated and accessed.	Level 1 - Initial
A9	This activity does not have procedures and standardization in place for the requirements of Specialized Databases.	Level 1 - Initial
A10	The Database Administrator team already has an understanding of data technology requirements. If there is a new database implementation, the requirements are adjusted to the specific needs of the database and also consider the existing conditions. The fulfillment of technology requirements is handled by Central BMKG and delegated to the relevant Technical Implementation Unit.	Level 3 - Defined
A11	Soekarno-Hatta Meteorology Station Technology is defined by BMKG head office, thus its architecture is also already facilitated and documented.	Level 3 - Defined
A12	The evaluation activity has been conducted by Central BMKG, and the Soekarno-Hatta Meteorology Station, as	Level 3 - Defined

Data Management Body of Knowledge (DMBOK) Knowledge Area: Data Operations Management		
Activities	**Response from DBA's**	**Maturity Level**
	a acts as technical implementation unit a user of the technology data facilitated by BMKG head-office.	
A13	This activity already has procedures related to installing and administering data in the form of technical instruction documents. The technical instructions are always followed when performing data installation and administration.	Level 3 - Defined
A14	Some computer devices used by the personnel still have unauthorized software or lack proper licenses.	Level 1 - Initial
A15	The organization's support regarding data technology is still minimal. Currently, the data personnel only rely on Excel for data processing and manual data backup The understanding of the technology among the personnel is not evenly distributed. There is a lack of awareness among some personnel regarding the available technology.	Level 1 - Initial

The mapping of Maturity Level for Data Operations Management indicates seven sub-activities at Maturity Level 1, two at Maturity Level 2, five at Maturity Level 3, and one at Maturity Level 4. Based on the interview results with the Coordinator of Data and Information Department at Soekarno-Hatta Class I Meteorology Station, there is a desire to improve the Maturity Level to Level 3, meaning that nine activities do not meet expectations. The gap between the current "as-is" condition and the expected condition can be seen in Figure.2

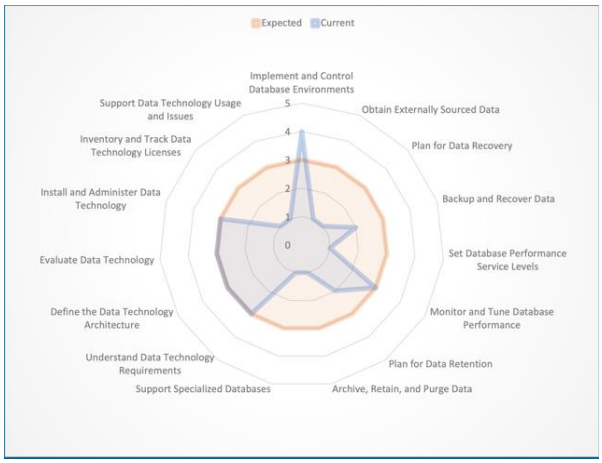

Figure 2. Gap Analysis of Maturity Level of Data Operations Management

Improvements are needed for the nine sub-activities in Data Operations Management at Soekarno-Hatta Class I Meteorology Station to achieve the expected condition. Therefore, recommendations are prepared for the

improvement of Data Operations Management to increase the Maturity Level according to the desired condition.

Table 5. Recommendation To Increase Maturity Level

Activities	Recommendation	
	Level 2	**Level 3**
A2	Define regulations and standardization for the needs of external data sources.	1. Create a system for finding and assessing potential external data sources and develop agreements with external data providers that clearly define the responsibilities of both parties. Additionally, they should implement a system for monitoring the quality of external data and manage changes to external data.
A4	-	1. Based on the observation, the data backup activity in this organization has not been carried out regularly by the Database Administrator (DBA), and there are still some meteorological data from specific equipment that do not have clear rules and standard procedures for backup 2. Establish clear backup policies, including backup frequency, types of data to be backed up, and the backup methods to be used, automate backups to ensure that the backup process is performed regularly and consistently. With automation, the risk of unintentional backup neglect can be reduced.
A3	The absence of regulations and standard procedures regarding data recovery has resulted in the organization only performing data backup without having a data recovery plan. Define regulations and standardization for data recovery	1. Set realistic Recovery Time Objectives (RTO) and Recovery Point Objectives (RPO) that align with the business needs, and develop clear and comprehensive documentation

Activities	Recommendation	
	Level 2	**Level 3**
		regarding the data recovery plan. This document should include the steps to be taken, emergency contacts, and relevant technical details, perform regular reviews of the data recovery plan and evaluate the success of recovery efforts after incidents. By doing so, improvements and adjustments can be made to enhance the effectiveness and efficiency of data recovery in the future 2. Increase awareness of the data recovery plan throughout the organization to ensure proper response when incidents requiring data recovery occur
A5	Create SLA document as part of agreement of availability database.	1. Running datatabase backup able to improve SLA Replicating data across mirror able to ensure high availability
A7	-	1. The existing data retention plan only covers meteorological data that are already in the form of reports such as METAR, TAFOR, FLIGHTDOC, but there is no specific data retention plan for individual data points like temperature, wind speed, pressure, etc., as they are considered part of data series and should not be discarded 2. Data retention plan document should be established by DBAs and the data owner, where data classifications are utilized to identify storage locations in both primary and secondary storage.

Activities	Recommendation	
	Level 2	**Level 3**
A8	Define regulation and standardrization of Archive, retain, and purge data.	1. Establish a formalized process for Archive, Retain, and Purge Data, complete with clear roles and responsibilities, along with the implementation of a well-documented procedure. Ensure that the Archive, Retain, and Purge Data process is consistently followed and adhered to, providing a reliable framework for effective data management.
A9	Define regulation and standardrization of Specialized	1. Develop procedures for the specialized database requirements in case there is a need for it in the future
A14	Define regulation and standardrization of Inventory and Track Data Technology Licenses	1. Organize yearly audit to track license and annual support cost 2. Determine total cost-of-ownership for each type technology and product that use for daily operation
A15	Define regulation and standardrization of support data technology usage and issues	1. Conducting training related to the use of relevant technology utilized by organization and technical support to understand, analyze user issues, and maximize technology utilization

D. Discussion

As shown in Figure.2 , six activities have already been at maturity level 3 (A1, A6, A10, A11, A12, A13). Activities A2, A4, A5, A8, A9, A14, A15 are at maturity level 1. Activities A3, A7 are at maturity level 2.

Currently the organization does not have a need for data from external sources (A2) , but it is possible that there will be a related need in the future. Therefore, it is necessary to stipulate regulations by the head of the BMKG. This can be an important step in research that requires additional information that is not available from internal sources. A3, A4 keeps the business running and recovers critical data needed for operational continuity. To create an effective data recovery plan, the DBA team and technicians must conduct a thorough risk evaluation, determine recovery priorities, and identify the appropriate data

backup method, because if data backup and recovery procedures are not performed, data may be lost for some reason or lost. unavailable, which could cause significant operational disruption.

This is the responsibility of the head of the BMKG database center and the team to prepare the SLA, which will later be ratified by the Head of BMKG. Later this SLA will be implemented by the Soekarno-Hatta Meteorological Station with the hope that with this SLA the DBA team will maintain the quality and availability of this data, as well as provide a clear framework for communication between service providers and data customers.

The preparation of standard operating procedures for A8 is the responsibility of the observation coordinator. To make this happen, the head of the DBA staff group holds a coordination meeting with the DBA staff to identify work items related to A8, then the head of the DBA staff group submits the SOP proposal to the coordinator, after the proposal is approved by the coordinator, the proposal is submitted to the head. meteorological station to be validated. The increase in level A8, it is hoped that DBA staff can manage operational data in a more structured and efficient manner, reducing unnecessary storage costs

To realize standardization of Inventory (A14) the steps are the same as A9, it is hoped that the inventory data managed by the organization will be consistent in format, structure and quality. This makes data easier to manage, access and use. To track Data Technology Licenses, the organization must carry out an internal audit, with coordinator of data and information as the person responsible

Technology is an important thing that supports all other activities and without a good understanding, the use of technology will not be maximized. To improve A15, the Head of the Soekarno Meteorological Station must ensure that the existing IT infrastructure supports operational data needs. This includes adequate storage capacity, network speed and appropriate hardware resources, in addition organizations must facilitate training related to renewable technologies, ensure employees have an adequate understanding of the use of technology related to operational data management and carry out ongoing evaluation of technology expectations.

To support this, of course funding is needed which can be proposed by the Head of the Meteorological Station, Soekarno Hatta, to the Head of the BMKG Planning Bureau, and ratified by the Head of BMKG through DIPA (Daftar Isian Pelaksana Anggaran) and included in the POK (Petunjuk Operasional Kegiatan) for the implementation of the Meteorological Station. Soekarno-Hatta. With this, it is hoped that DBA staff can maximize the use of the latest technology

This research helps the organization to improve the Maturity Level of Data Operations Management by providing recommendations for sub-activities that are not yet optimal. The recommendations given are based on the DMBoK framework. This research also expected to assist the organization in enhancing its data management, especially data operations management. As a non-departmental institution operating in the field of aviation meteorological data services, data is crucial for the organization to produce reliable, accurate, and trustworthy data. Additionally, this research is also expected to provide insights for other institutions on the importance of data and data management within organizations,

as effective data management can create smooth business processes within the organization.

E. Conclusion

Based on the findings, Soekarno-Hatta demonstrates a satisfactory level of maturity in six out of the assessed activities. However, nine out of fifteen activities fall below maturity level 3. Among the seven activities at maturity level 1, Obtain Externally Sourced Data, Plan for Data Recovery, Set Database Performance Service Levels, Archive, Retain, and Purge Data, Support Specialized Databases, Inventory and Track Data Technology Licenses, and Support Data Technology Usage and Issues. The remaining two activities, Backup and Recover Data, and Plan for Data Retention, are categorized as maturity level 2. The average maturity level value obtained from 15 activities is level 2. Consequently, recommendations aligned with DMBOK references have been formulated to enhance these five activities and attain maturity level 3.

It is important to note that this study focuses solely on the 15 data operation management activities outlined in the first edition of DMBOK. Subsequent research can explore additional data operation management activities and maturity model from alternative literature sources. Moreover, future research can expand through a case study conducted in other public sectors, where institutions may possess distinct data life cycles and database architecture.

F. References

[1] BMKG, "Peraturan BMKG Nomor 9 Tahun 2019 Tentang Penyediaan dan Penyebaran Peringatan Dini Iklim Ekstrim," pp. 1–21, 2019.

[2] Icao, "Meteorological Service for International Air Navigation Annex 3 to the Convention on International Civil Aviation International Civil Aviation Organization International Standards and Recommended Practices Fourteenth Edition," 2001.

[3] BMKG, "Tugas dan Fungsi BMKG," *Badan Meteorologi, Klimatiologi, dan Geofisika*. 2022.

[4] W. M. P. Van Der Aalst *et al.*, "Soundness of workflow nets: Classification, decidability, and analysis," *Formal Aspects of Computing*, vol. 23, no. 3, pp. 333–363, 2011, doi: 10.1007/s00165-010-0161-4.

[5] M. Mosley, M. Brackett, S. Earley, and D. Henderson, *The DAMA Guide to The Data Management Body of Knowledge (DAMA-DMBOK Guide) First Edition*. 2009.

[6] M. Mosley, M. Brackett, S. Earley, and D. Henderson, *The DAMA Guide to The Data Management Body of Knowledge (DAMA-DMBOK Guide) First Edition*. 2009.

[7] S. N. Asih, W. R. Fitriani, R. Nabila, A. N. Hidayanto, I. H. Ismed, and S. B. Yudhoatmojo, "Evaluation of Data Operations Management Maturity Level using CMMI in a State-Owned Enterprise; Evaluation of Data Operations Management Maturity Level using CMMI in a State-Owned Enterprise," 2019.

[8] R. P. Brahmantara, D. Y. Hutapea, and Y. Ruldeviyani, "Evaluation on Data Operations Management using CMMI and DMBOK: BDPJN Case Study," in *2021 9th International Conference on Cyber and IT Service Management, CITSM 2021*, Institute of Electrical and Electronics Engineers Inc., 2021. doi: 10.1109/CITSM52892.2021.9588888.

[9] A. Hidayati, B. Purwandari, and E. K. Budiardjo, "Global Software Development and Capability Maturity Model Integration: a Systematic Literature Review."

[10] M. Degerl, "Practical Suggestions to Successfully Adopt the CMMI V2.0 Development for Better Process, Performance, and Products," 2020.

[11] I. A. Arin, "Implementasi CMMI dalam… (Ikrar Adinata Arin) Implementasi Cmmi Dalam Sebuah Organisasi Pengembang Software Untuk Mencapai Return On Investment (ROI) Yang Diinginkan," 2012.

[12] Chanwoo Yoo *et al.*, "An Integrated Model of ISO 9001:2000 and CMMI for ISO Registered Organizations," in *11th Asia-Pacific Software Engineering Conference*, IEEE, pp. 150–157. doi: 10.1109/APSEC.2004.30.

[13] H. N. Prasetyo and M. Informatika, "Perbandingan Framework Tata Kelola Data DGI dan DAMA International Kridanto Surendro," 2013.

[14] M. C. Paulk, M. B. Chrissis, and C. V Weber, "The Capability Maturity Model for Software."

[15] Z. J. Hannum and D. Lyth, "Is CMMI® an Applicable Framework That Can be Used to Improve New Technology Venture Processes?," *National Collegiate Inventors and Innovators Alliance. Proceedings of the ... Annual Conference*, pp. 1–14, 2010, doi: 110192895.

[16] J. A. Garza-Reyes, *CMMI® Distilled: A Practical Introduction to Integrated Process Improvement, Second Edition*, no. 2. Boston, MA: Addison-Wesley Longman Publishing Co., Inc., 2003.

[17] S. N. Asih, W. R. Fitriani, R. Nabila, A. N. Hidayanto, I. H. Ismed, and S. B. Yudhoatmojo, "Evaluation of Data Operations Management Maturity Level using CMMI in a State-Owned Enterprise; Evaluation of Data Operations Management Maturity Level using CMMI in a State-Owned Enterprise," 2019.

[18] R. Al Adawiyah and Y. Ruldeviyani, "Evaluasi Maturity Level Pada Data Operations Management Menggunakan Capability Maturity Model Integration (Cmmi): Studi Kasus Lembaga Penelaah Transaksi Keuangan," *Masyarakat Telematika Dan Informasi : Jurnal Penelitian Teknologi Informasi dan Komunikasi*, vol. 11, no. 1, p. 29, Sep. 2020, doi: 10.17933/mti.v11i1.168.

[19] F. Nurdiantoro, Y. Asnar, and T. E. Widagdo, "The development of data collection tool on spreadsheet format," in *2017 International Conference on Data and Software Engineering (ICoDSE)*, IEEE, Nov. 2017, pp. 1–6. doi: 10.1109/ICODSE.2017.8285889.

[20] C. Wilson, "Structured Interviews," in *Interview Techniques for UX Practitioners*, Elsevier, 2014, pp. 1–21. doi: 10.1016/B978-0-12-410393-1.00001-6.

[21] H. Sahijwani, K. Dhole, A. Purwar, V. Vasudevan, and E. Agichtein, "Contextual Response Interpretation for Automated Structured Interviews:

A Case Study in Market Research," in *ACM Web Conference 2023 - Companion of the World Wide Web Conference, WWW 2023*, Association for Computing Machinery, Inc, Apr. 2023, pp. 886–891. doi: 10.1145/3543873.3587657.

[22] K. Williamson, L. M. Given, and P. Scifleet, "Qualitative data analysis," in *Research Methods*, Elsevier, 2018, pp. 453–476. doi: 10.1016/B978-0-08-102220-7.00019-4.