Master Data Management Planning: A Case Study of Flight Information System at PT Angkasa Pura I (Persero)

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Abstract. The flight information system used for flight data management at PT Angkasa Pura I (Persero) uses several applications that have different features. This results in inconsistent values that affect data quality due to absence of single master data source. Therefore, this study aims to provide recommendations to PT Angkasa Pura I (Persero) regarding the planning of master data management for flight information system according to its business processes. Master data management planning is carried out using the key user interview method, analyzing the database schema of each application, analyzing IT policy documents, and using the framework of the Data Management Body of Knowledge (DMBOK). The research succeeded in producing the needs of master data management at PT Angkasa Pura I (Persero) using collaborative methods and transaction hub architecture patterns. The results of this master data management plan are expected to help PT Angkasa Pura I (Persero) in managing and managing flight data so that there are no more inconsistent data between applications and can improve data quality.

1. Introduction

Master Data Management (MDM) is nothing new in the current era. With the increasing complexity of an organizational system, it is difficult for an organization to identify and maintain the consistency of the master data in the organization [1]. MDM functions to reliably describe, manage, maintain master data within the organization so that it has consistency and accuracy that will be used as a single source of truth [2] [3]. Leading business companies that have adopted MDM, utilize data as one of the success factors in decision making [4]. MDM plays an important role in implementing information management strategies in organizations by acting as providers and regulating master data for integration between systems within the organization [1]. With the MDM, reports and data in the company to be consistent where the problem of data duplication can be minimized [5] [6].

In designing MDMs can utilize some of the existing framework resources such as DAMA (2009), Dreibelbis et al. (2008), Loshin (2001), and Gartner (2008). From the analysis of the master data management framework conducted by Martin [7], it can be concluded that DMBOK is the most complete framework for creating master data management. DMBOK includes all the important factors in a master data management starting from planning, design, implementation and operation. According to Zulwelly [8] in his paper about planning MDM case studies of personnel information systems at the XYZ Institute, when compared to other frameworks, DMBOK explains in more detail the implementation stages of data management and describes the activities that need to be done in order to implement data management.

Flight information system is one of the important information for airport management companies. The system generates two main information, namely aeronautical traffic and aeronautical revenue.

These two information are used to find out One Time Performance (OTP) flights at the airport, analysis of airport development planning, improvement of airport facility services, and airport performance measurements. The flight information system consists of several applications including SIOPSKOM for recording aircraft movements along with landing, placement and storage services (PJP4U), POTS for recording the number of departing passengers and aircraft passenger services (PJP2U), and SITEC for recording the number of cargoes and billing services for cargo and aircraft services (PJKP2U) [9]. Not only reliable and consistent, the accuracy of the data is needed by top management in making decisions [10].

With the various applications that have been previously mentioned, PT Angkasa Pura I (AP1) poses problems, the problem that occurs is the existence of flight data with different formats resulting from the use of different databases. In addition the current master data flight is still managed in silo because there are no master data sources yet. This results in differences and duplication in flight data. The existence of various versions of flight data and poor data quality makes users hesitate to determine the source of the data that will be used as a reference to assist flight management activities at AP1. The purpose of this research is to provide recommendations to AP1 regarding the planning of master data management for flight information systems that are appropriate to its business processes. With the hope that centralized master data will overcome the problem of duplication and differences in flight data. In addition, the quality of data in an organization can improve because master data management is one of the most important aspects [1].

2. Literature Review

2.1. Master Data
Master data is the main data that stores important information for the organization's business [1]. A business rule of master data values is usually determined by the format and range permitted and is not limited to a predetermined domain value. The master data value is considered as golden data. According to Loshin [5] master data is specific data and has a high accuracy available about the main business entity and is used to determine factors for data transactions. Master data is the key to data transactions, reports, and analysis of a system [2].

2.2. Master Data Management
Master data management is a method for controlling primary data into an integrated source to meet business needs. Loshin said [3] to integrate master data that could use several tools that were available including: ETL, data cleansing, Operational Data Stores (ODS). According to DMBOK [2], MDM can be used to support business needs such as:

- Search for business rules that have or have not been clearly defined, commonly used information objects, and collections of valid data values in various systems in the company.
- Identify important information relating to business success that is used in various systems that will benefit from the centralization process.
- Uniforming business models in managing and integrating information.

MDM needs to be managed centrally, therefore the role of "Data steward" and "Data owner" must be owned by an organization to ensure data governance runs properly [11].

2.3. Management Activities of Master Data in DMBOK
DMBOK has set the steps that must be taken when an organization wants to implement a master data management starting from planning, control, development, and operational. This research only covers activities in the planning section. Its activities are:

- Understand master data needs. In identifying the requirements of the master data it is necessary to look for the root problems that arise from data quality.
- Identify master data source and contributors. Identify data flow from upstream to downstream to be able to find the original source and the role of individuals who created and maintained data.
- Define and maintain data integration architecture. In defining architecture it is necessary to organize master data authorization, replication processes, and data flow to ensure data

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consistency so that good data quality is obtained. So that problems regarding data redundancy and inconsistent data due to data from silo applications can be avoided.

3. Research Methodology

3.1. Data Collection
Data collection methods used in this study were interviews with key users of the Airport Operations Airside unit, Aeronautical Revenue, Cargo & Aviation Business Supports as the data owner of each application. Airport Engineer Senior Manager as a company data analyst. Business Application Senior Manager as the application manager, as well as the application development team. To ensure the reliability of the research results, triangulation is used through analysis of IT policy documents and technical development documents, field observations, and analyzing the database schema of each application.

3.2. Conceptual Framework
This research is guided by the DMBOK (2009). Not all activities in master data management are used. The researcher limited the activity to only the master data management plan for flight data at AP1 (see table 1).

Table 1. MDM Planning Activities for Flight Data

Activities	Data Collection Method	Data Generated
Understand master data needs	Interview and analyse applicable IT Policy documents	Master data requirements
Identify master data source and contributors	Interview and analyse applicable IT Policy documents	Description sources and contributors
Define and maintain data integration architecture	Based on description sources and DFD generated in the previous activity	Master data design
	Based on master data design	Data integration service design

4. Results

4.1. Understand master data needs
In identifying the needs of the master data it is necessary to pay attention to the IT policies that apply in the company. Therefore, in addition to interviews to identify them, an IT policy document study was also conducted

4.1.1. IT Policy. The role of IT in supporting operational and managerial systems in companies and business people including airport business is increasingly felt important. The dynamics of the airport industry is very different from the previous period so it requires different strategies and approaches to be more effective. For this reason, the IT Master Plan for 2017-2021 was formed as a basis for corporate planning in IT implementation and effective control tools and parameters to measure the performance and success of a company's IT implementation.

Table 2. Master Data Requirements

	Index
IT Policy	
Integration of all core service systems.	P1
Data quality is associated with organizational performance.	P2
Data Issues	
There is a duplication of master flight data in each flight information system.	P3
Changes to the master flight data are carried out in only one system which causes the value to be inconsistent. As a result, daily flights on POTS often do not appear.	P4
Frequent data input errors that cause poor data quality are explained by differences in passenger data entered in the SIOPSKOM and POTS systems.	P5
The naming of attributes and different data formats between applications. For example the flight number on SIOSPKOM is called as callsign2 character data type varying (8) with the value "AB-1234". Whereas in POTS it is called flight_no character varying (10) data type with the value "AB 1234".	P6
There is user hesitate to determine the most valid data	P7

4.1.2. Identification of Data Issues. The results of interviews with several informants explained in more detail related to issues related to data quality. Some of objectives in the 2017-2021 IT Master Plan and the data issues identified (see table 2). These problems cause inaccurate data that can result in inappropriate management planning in the future airport development. Analysis of the needs and functions of the master data management according to Loshin [5] are explained in table 3.

Table 3. Analysis of MDM Requirements and Functions

Master Data Management Functions	Master Data Requirements						
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**
Identify data that is used frequently	x						
Identify data that affects the business		x					
Create standard data integration	x	x					
Manage metadata						x	
Determine data consistency				x		x	
Create a link from the application to the master data	x						
Determine data stewardship, data management policies and procedures			x	x	x	x	x

4.2. Identification of Master Data Source and Contributor

The identification process was obtained from interviews with key users of each data owner, development team, and Business Application Senior Manager of AP1.

4.2.1. Subject Matter Expert. There are four contributors who play a role in generating and using flight data which are then appointed as Subject Matter Expert:

- Directorate General of Civil Aviation which results *"scheduled flight"*.
- Airport Operation Airside which generates *"unscheduled flight, airports, airlines, aircraft type"* and uses "*scheduled flight"*.
- Aeronautical Revenue which uses "*scheduled flight*, *unscheduled flight, airports*, *airlines*, and *aircraft type"*.
- Cargo & Aviation Business Supports which uses "*scheduled flight*, *unscheduled flight, airports*, *airlines*, and *aircraft type"*.

4.2.2. Applications List. Based on interviews with Senior Business Application Managers, there were three applications in AP1 that used flight data:

- SIOPSKOM for recording aircraft movements along with service bills for landing, placing and storing aircraft. The user is Airport Operation Airside Department.
- POTS for listing of aircraft passenger services. The user is Aeronautical Revenue Department.

- SITEC for listing of cargo and postal aircraft services. The user is Cargo & Aviation Business Support Department.

4.2.3. Data Source Matrix. Its function is to explain the origin of the data source, the user of the data source, and the format of the data. From the data source matrix can be concluded that the data source is produced by two applications, namely AOL and SIOPSKOM (see table 4). The data will be used by two other applications. Therefore, this flight data is the source of data for this application and other applications.

Table 4. Data Source Matrix

No	Data	Data Source	Application	User	Format Data
1	Scheduled Flight	DAU	AOL	DAU	Relational data
2	Unscheduled flight, airport, airplane, aircraft	Airport Operational Airside	SIOPSKOM	Airport Operational Airside	Relational data

4.2.4. Data Flow Diagram (DFD) and Data Source. Used to describe business process flight data flow between applications and the users involved. figure 1 explained that there are three business processes that use flight data, among others, for recording aircraft movements on SIOSPKOM, recording passenger services at POTS, and recording cargo services at SITEC. Scheduled flight master data is generated by the AOL application, unscheduled flight master data, airports, airlines and aircraft are generated by the SIOPSKOM application. The other two applications namely POTS and SITEC use all the master data.

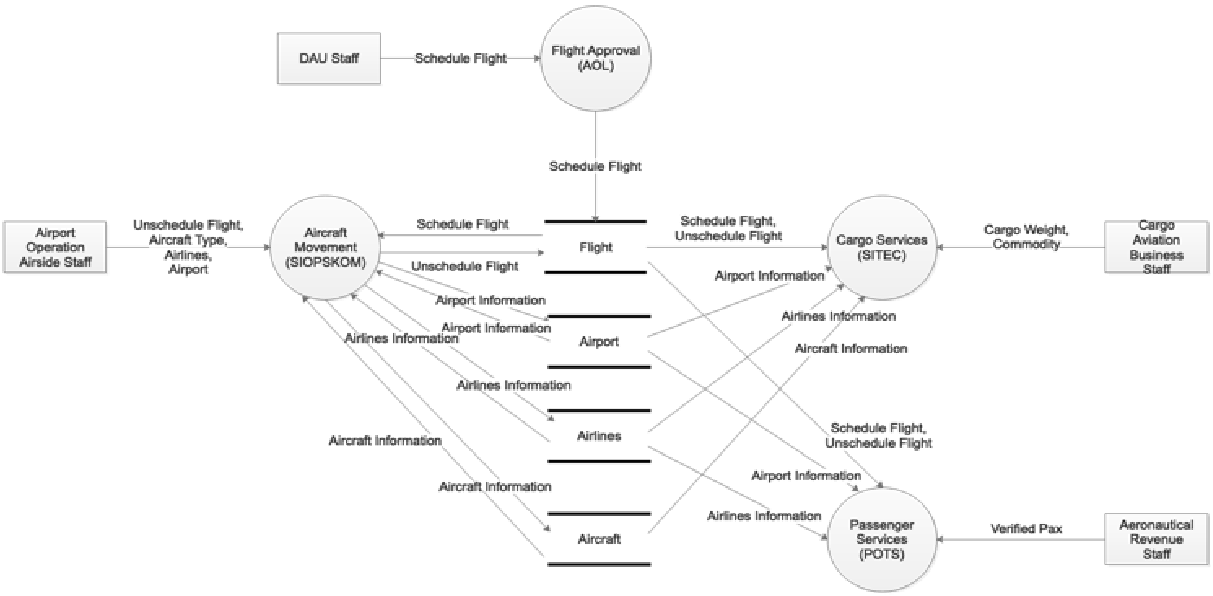

Figure 1. Data Flow Diagram

4.3. Define and Maintain Data Integration Architecture

The researcher uses three components to describe the data integration architecture, namely entity relationship diagrams for master data repository, usage methods, and architectural patterns.

4.3.1. Entity Relationship Diagram for Master Data Repository. Data Flow Diagram (DFD) that have been made previously are used as a reference to create entity relationship diagrams for master data repository. Making tables and their attributes are adjusted to the tables and data types used in each application shown figure 2.

4.3.2. Method of Use. There are three methods of use that can be used to see the role of the master in an organization, namely Collaborative, Operational, and Analytical [1].

Table 5. Mapping of Master Data Requirements and Method of Use

Method of Use	Master Data Requirements						
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**
Collaborative	x	x		x	x	x	x
Operational	x		x	x	x	x	
Analytical	x	x		x	x	x	x

Based on the results of interviews with key users and data analysts obtained the results in accordance with table 5. So it can be concluded that for the method of use that suits the needs of MDM AP1 planning is collaborative. Analytical is not used because of the intersection between Business Intelligence (BI) and Master Data Management.

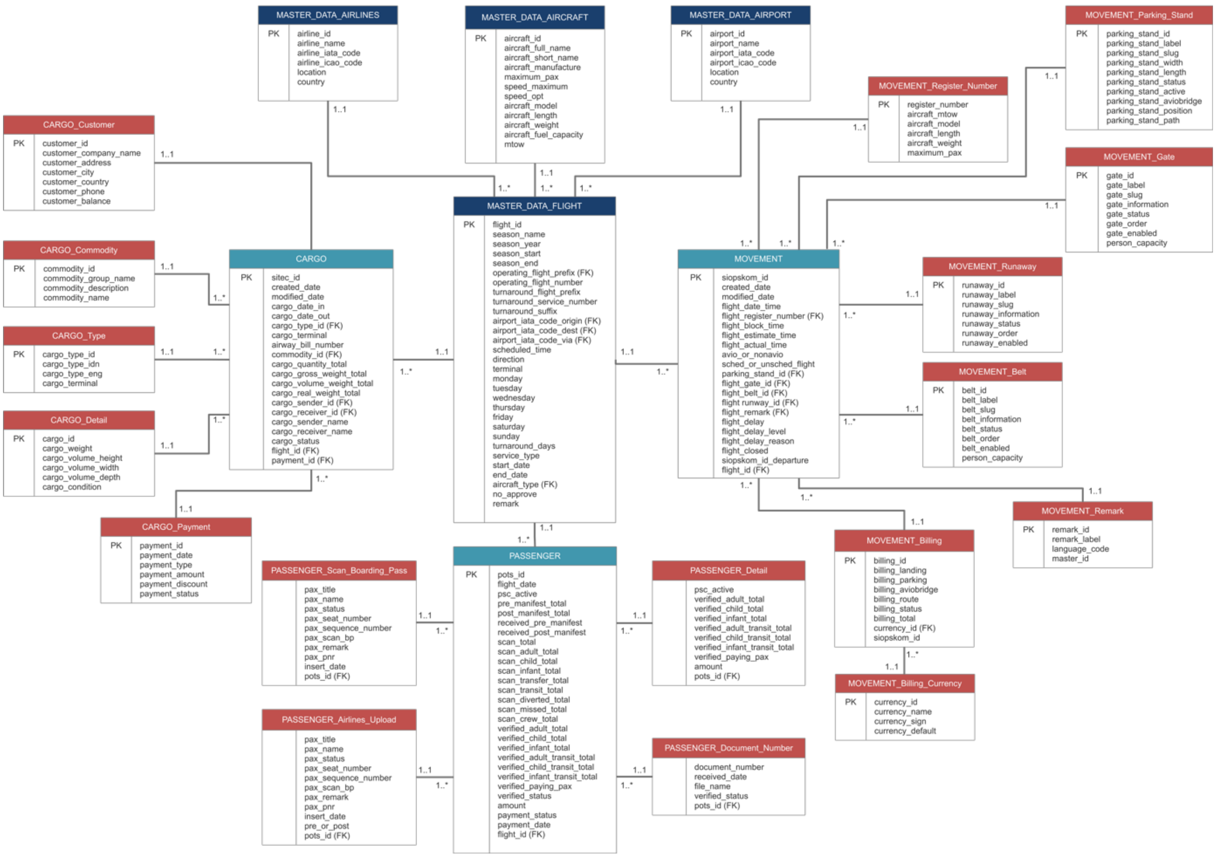

Figure 2. Entity Relationship Diagram

4.3.3. Architecture Pattern. Loshin [5] explained that in determining architectural patterns it can be seen from six. Then these aspects are mapped with four architectural patterns in MDM, namely consolidation, registry, coexistence, and transaction hub. The consolidation pattern is not used because it is more suitable for analytical use methods. It can be concluded that the most appropriate architectural pattern in MDM AP1 planning uses the Transaction Hub.

Table 6. Architecture Pattern Selection Matrix

Aspect	Registry	Coexistence	Transaction Hub
Number of master attributes			x
Consolidation		x	
Synchronization			x
Control of access			x
Service Complexity			x
Performance	x		

4.3.4. Data Integration Diagram. Describes how data flows across applications, controlling the flow of data to the system, between databases, and back to the system. Transaction hub approach uses a single centralized database where all changes occur in single database (see figure 3). After the changes are made, the system will validate to maintain data quality. The system will provide a unique identity as a record to avoid data duplication. Furthermore, changes to the data will be distributed to other systems.

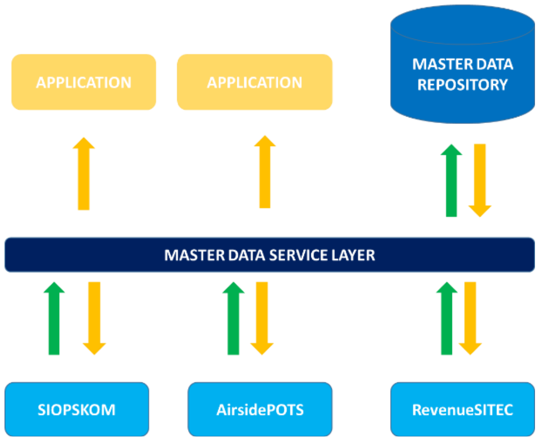

Figure 3. Data Integration Diagram

4.3.5. Data Integration Services Specification. Describes the integration of data flow from operational applications that are managed with master data sources. There are three main things that become the focus of MDM, namely involving duplicate data that occurs between data sources, reconciling cross-data sources, providing gold records, and providing access to gold records to all applications.

Reeve said [13] solutions for most data integration in real time and especially for hub and spoke architectures using Enterprise Service Bus (ESB) technology. ESB is a middleware system that functions as a bridge between applications. So researchers use ESB as a data integration tool that can be used to provide access to other applications that need to access the master data repository. Whereas ETL is used to consolidate data source applications.

5. Discussion and Conclusion

In this study, researchers planned a master data management for flight information systems at PT Angkasa Pura I (Persero). The framework uses DMBOK which has activities: understand master data needs; identify master data source and contributors; define and maintain data integration architecture; with the following conclusions: The master data repository has four entities as master data namely Flight, Airlines, Aircraft, and Airport. Has three strong entities that exist in each application, namely Cargo, Movement, and Passenger. The method used is collaborative and transaction hub architecture patterns adapted to business processes and needs at PT Angkasa Pura I (Persero).

The results of this research can be a guideline in implementing the master data management design for the flight information system at PT Angkasa Pura I (Persero) so that there are no more inconsistent data between applications and can improve data quality. Further research can be done by adding a customer data master instrument that is integrated with the ERP System

References

[1] Dreibelbis A, Milman I, van Run P, Hechler E, Oberhofer M and Wolfson D 2008 Enterprise Master Data Management: An SOA Approach to Managing Core Information
[2] The Data Management Association 2009 The Dama Guide to The Data Management Body of Knowledge (DMBOK) *DAMA International*
[3] Singh S and Sing J 2015 SSDM: An Approach of Big Data for Semantically Master Data Management *2nd International Conference on Computing for Sustainable Global Development (INDIACom)*
[4] S Thomas Ng, Frank J Xu, Yifan Yang and Mengxue Lu 2017 A Master Data Management Solution to Unlock The Value of Big Infrastructure Data of Smart, Sustainable and Resilient City Planning *Creative Construction Conference 2017 (CCC 2017)*
[5] Loshin D 2009 Master Data Management *Morgan Kaufmann OMG Press*
[6] Haneem F, Kama N, Ali R and Basri S 2017 Resolving Data Duplication, Inaccuracy and Inconsistency Issues Using Master Data Management *International Conference on Research and Innovation in Information Systems (ICRIIS)*
[7] Ofner M H, Straub K, Otto B and Oesterle H 2013 Management of The Master Data Lifecycle: A Framework for Analysis *Journal of Enterprise Information Management*
[8] Murti Z, Andarrachmi A, Yudhoatmojo S B and Hidayanto A N 2018 Master Data Management Planning: Case Study of Personnel Information System at XYZ Institute *International Conference Information Management and Technology (ICIMTech)*
[9] PT Angkasa Pura I (Persero) Rolling Plan Master Plan IT 2017-2021 *PT Angkasa Pura I (Persero)*
[10] Choughri R, Kamaleddine K, Soubjaki M and Baytieh M 2018 The Challenge of Data Accuracy in Business Analytics that Affect Managers Decision Making – Case Study of Saudi Arabia & Lebanon *IOSR Journal of Business and Management (IOSR-JBM)*
[11] Baghi E, Schlosser S, Ebner V, Otto B and Oesterle H 2014 Toward a Decision Model for Master Data Application Architecture *47th Hawaii International Conference on System Science*
[12] Fernando L K W and Haddela P S 2017 Hybrid Framework for Master Data Management *International Conference on Advances in ICT for Emerging Regions (ICTer)*
[13] Reeve A 2013 Managing Data in Motion Data Integration Best Practice Technique and Technologies *United States of America: MK Publications*

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