

Integration of Data Governance and Development of Business Intelligence Dashboard for Decision-Making in Regional Water Utility

Cindy Miswaty Marhardika Sinaga^{1*}, Gohan Willy Christoper Sihite²

^{1*,2}Information System Study Program, Telkom University, Indonesia

^{1*}cindysinaga@student.telkomuniversity.ac.id, ²gohanw@student.telkomuniversity.ac.id

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Abstract— Public service organizations need effective data management in order to deliver better services and improve decision-making. This study analyzes the implementation of Data Governance and Business Intelligence at Perumda Air Minum. Before the conduct of this study, customer complaint data were captured manually, and the formats of those inputs were disparate. This resulted in unreliable information. The study took a qualitative descriptive approach using observation, interviews, and document analysis. Data Governance was formalised by cleansing, validating, and managing data quality. Google Spreadsheet was used as a staging layer where customer complaint information was ingested through an Application Programming Interface (API) connection. The data was then visualized with a Business Intelligence dashboard using Looker Studio. Insights were offered for complaint trends, category distributions, branch-level complaint analysis, and operational monitoring tables on the dashboard. The study finds that Data Governance enhances data consistency, completeness, and reliability of reports. The Business Intelligence dashboard helped with operational monitoring and decision-making as well. Further, the combination of Data Governance and Business Intelligence enhanced reporting efficiency and organizational transparency.

Keywords: *Business Intelligence, Data Governance, data quality, Looker Studio, water utility.*

I. INTRODUCTION

In Indonesia, regional water utility organizations still encountered difficulties in organizing customer complaint in a structured and systematic process[1], [2], [3]. Perumda Air Minum is an example of a general utility

company that had no data management for handling complaints and still uses manual records[4]. Consequently, records of customer complaints were sporadic, dispersed and hard to analyse in a meaningful way[5]. And the lack of a centralized data management mechanism led to multiple operational issues like duplicate records, incomplete information, inconsistent complaint categories and delays in reporting processes[6]. In addition, the organization did not yet have an official data dictionary, standardized operational procedures for entering data, or assigned regional water utility organizations in Indonesia continued face challenges to manage customer complaints in a systematic and structured process. Perumda Air Minum (PDAM) is a two-level general utility company had no data management to process complaints and still record manually. As a result, customer complaint records were inconsistent, fragmented and very difficult to analyse. The absence of a master data management system caused operational problems including duplicate records, incomplete information, inconsistent complaint categories and delays in the reporting process. Also, they had no official data dictionary yet and sense the operational Although Data Governance and Business Intelligence solutions have been extensively applied by many private enterprises, the

application of such systems in regional public utility companies is still rather scarce [7]. It should be noted that this problem is critical for water utility companies as they rely greatly on the quality of data related to operational complaints to assess service performance and ensure customer satisfaction. Low-quality data leads to poor efficiency of operational planning and slower reactions to any service disruption events[8]. The current research aims to solve this problem by designing a Data Governance and Business Intelligence solution for Perumda Air Minum Tirta Ayu.

II. LITERATURE REVIEW

A. Data Governance

The concept of Data Governance can be defined as an organizational structure that is employed to manage the data of an organization using policies, standards, process, roles, and controls[9]. The role of Data Governance is to ensure accuracy, completeness, security, reliability, and availability of data at all stages of its lifecycle[10], [11]. The implementation of the concept of Data Governance entails several key practices that include data quality management, metadata management, data stewardship, data standardization, data integration, and data monitoring. Proper Data Governance enhances accountability and enables more accurate analytics. Public utility organizations should pay attention to this issue since the operations within such organizations rely greatly on information[12].

B. Data Quality

Data quality is defined as the condition of data used in organizations regarding completeness, accuracy, consistency, validity, and timeliness. High-quality data improves the efficiency of operations and the effectiveness of decision making. Low data quality may

cause erroneous reports, delayed operations, faulty analyses, and decrease in organizational performance[13]. Hence, the use of Data Governance is crucial for sustaining the quality of organizational data.

The current research emphasizes the importance of the following dimensions of data quality:

1. Completeness

Completeness reflects whether data fields have been filled correctly.

2. Accuracy

Accuracy reflects whether data recorded in organizations are true.

3. Consistency

Consistency relates to the standardization of data format, name of categories, and operation values.

4. Timeliness

Timeliness indicates whether the data are updated in the reporting period.

The application of Data Governance increases data quality by creating appropriate operational and validation processes.

Table 1 Data Quality Dimensions

Dimension	Description
Completeness	Availability of all required data fields
Accuracy	Correctness of operational information
Consistency	Uniformity of formats and categories
Timeliness	Availability of updated data
Reliability	Trustworthiness of organizational data

C. Business Intelligence

Business Intelligence (BI) is a collection of technologies and analytical methods used to transform raw data into meaningful information for organizational decision-

making[7]. Business Intelligence systems enable organizations to perform data integration, analytical processing, dashboard visualization, and performance monitoring activities. The implementation of Business Intelligence has become increasingly important in organizations that manage large volumes of operational data[14], [15]. BI dashboards allow management teams to monitor operational conditions in real time, identify service trends, and evaluate organizational performance more efficiently.

Several core components of Business Intelligence include:

1. Data source integration
2. Data warehouse or data staging
3. Data transformation and cleansing
4. Dashboard visualization
5. Reporting and analytical processing

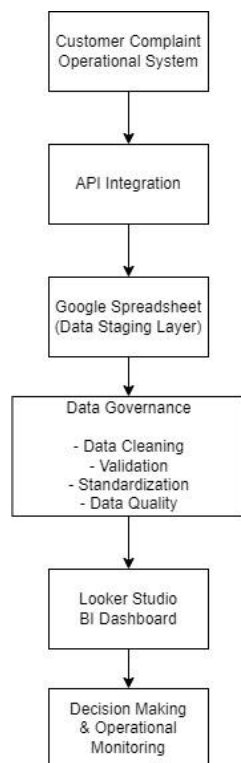


Figure 1 Business Intelligence Architecture

The Business Intelligence architecture implemented in this study consists of several integrated components. Customer complaint data originating from the operational complaint system are extracted through an Application Programming Interface (API). The extracted data are then stored in Google Spreadsheet as a staging layer for data cleansing, validation, and Data Governance processes. After completing data standardization and quality checks, the governed data are presented through Looker Studio dashboards. The dashboard serves as an analytical tool used in monitoring operations and management decision-making.

III. RESEARCH METHODOLOGY

In this study, a qualitative descriptive research design was used to investigate the implementation of Data Governance and Business Intelligence in the management of customer complaint data at Perumda Air Minum Tirta Ayu Kabupaten Tegal. Specifically, the focus of the study was to improve operational data quality by implementing Data Governance procedures and creating a Business Intelligence dashboard for the organization's decision-making process. Data Governance implementation includes several key activities: observation, interviewing, analyzing operational data, integrating data, implementing Data Governance and developing Business Intelligence dashboards. The research methodology included the following steps: collecting data, implementing Data Governance, data integration, creating a Business Intelligence dashboard and evaluating the system.

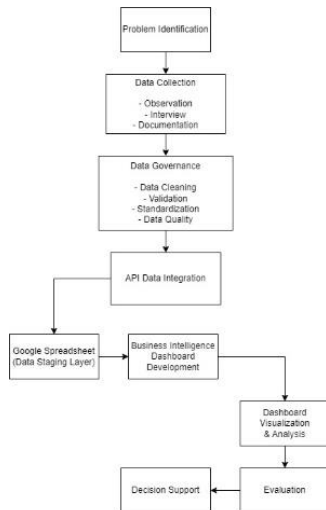


Figure 2 Research Methodology Workflow

The workflow begins with operational data collection from the customer complaint system. The collected data are then processed through Data Governance activities, including data cleaning, data validation, data standardization, and data quality assessment. After the governance process is completed, the data are integrated through an API into Google Spreadsheet and visualized using a Business Intelligence dashboard in Looker Studio. Finally, the implemented system is evaluated to measure improvements in operational monitoring and data quality.

A. Research Approach

The chosen research design in this research was qualitative descriptive. This choice was made based on the nature of the research itself, as it was dedicated to studying the process of data management within an organization and introducing Data Governance principles within the organization in question. Moreover, the qualitative approach made it possible for the researcher to analyze operational processes within the organization, pinpoint problems with data quality and evaluate the effectiveness of the dashboard developed.

B. Data Collection

Data collection procedures for the study were conducted through various ways so that information could be gathered concerning the operations and organizational activities related to customer complaints.

1. Observation

Observations were directly made within the Information Technology Planning and Development Division in order to obtain information relating to current operational problems with respect to managing customer complaints.

Observation included:

- Complaint recording procedures
- Data entry activities
- Reporting workflows
- Data validation processes
- Operational monitoring activities

The observation results showed that customer complaint records were still managed manually without standardized Data Governance procedures.

2. Interview

Semi-structured interviews were carried out with operational personnel and field managers to gather information on:

- The current complaint management process
- The issues faced with data quality
- The problems experienced during reporting
- The dashboard requirements
- Operational monitoring needs

The findings from the semi-structured interviews showed that the organization needed a well-structured Data Governance framework as well as a central Business Intelligence dashboard for operational monitoring.

3. Documentation Study

The documentation analysis was done based on previous customer complaints, organizational operation reports,

and existing spreadsheets. The documentation study revealed:

- a) Inconsistent data formats
- b) Duplicated complaint records
- c) Missing operational fields
- d) Non-standardized complaint categories

The documentation analysis also supported the formulation of Data Governance standards and data dictionaries.

C. Data Governance Implementation

Data Governance was implemented to increase the quality, consistency, and reliability of customer complaint data. A number of Data Governance activities were completed as part of this study.

1. Data Dictionary Creation

A data dictionary was created for standardized operational data fields. The data dictionary included the following information:

- a) Naming conventions for data fields
- b) Data types
- c) Classifications
- d) Valid values
- e) Data ownership

The creation of the data dictionary enhanced Data Governance consistency throughout operational divisions.

Table 2 Sample Data Dictionary

Field Name	Data Type	Description
Complaint ID	Integer	Unique for the complaint
Complaint Type	Text	Type of the customer complaint
Complaint Date	Date	Date when the complaint is submitted
Branch Area	Text	Service area where the complaint is processed
Resolution Status	Text	Status on resolving the complaint

2. Data Cleaning

Several tasks related to data cleaning were carried out including eliminating duplicate entries, removing missing values, and fixing operational inconsistencies in the data.

The following data cleaning methods were applied:

- a) Duplicate elimination
- b) Missing value removal
- c) Category normalization
- d) Typographical errors fixing

Data cleaning process greatly increased the quality of operational data.

3. Data Validation

A series of data validation activities was introduced to ensure customer complaints conformity to Data Governance policies. The following data validation techniques were used:

- a) Required fields checking
- b) Consistency in categorizing the customer complaints
- c) Date format validation
- d) Prevention of duplicates

4. Data Quality Assessment

Four types of data quality assessment were employed including:

- a) Completeness
- b) Accuracy
- c) Consistency
- d) Timeliness

D. Data Integration

Integration of customer complaints data was carried out using the Application Programming Interface (API), which is connected to Google Spreadsheet as the staging area. API integration allowed for automated data synchronization between operational and dashboard visualization systems.

Data integration included the following processes:

1. Data Extraction from the complaint system
2. API Synchronization
3. Data Transformation
4. Data Standardization
5. Data Loading to Google Spreadsheet

Data Integration using API Integration minimized manual reports and increased the efficiency of operations. The API Integration architecture allows for automated operational data synchronization as well as effective implementation of Data Governance.

E. Business Intelligence Dashboard Development

The Business Intelligence dashboard was created by utilizing Looker Studio, which helped to make visual representations of operational complaints and assist in decision-making processes.

The dashboard creation process entailed the following steps:

1. Dashboard requirement analysis
2. Integration of data sources
3. Visualization design
4. Dashboard testing
5. Dashboard implementation

A number of visualizations have been developed on the dashboard, such as the following:

- a) Complaint trends per month
- b) Distributions of complaints per category
- c) Rankings of complaints per branch
- d) Service channels analysis
- e) Detailed operational information tables

Filters for interactive analysis of data have also been added according to the following categories:

- a) Time frame
- b) Category of complaints
- c) Branch region

d) Operational zone

F. Evaluation

The deployed Data Governance and Business Intelligence system was evaluated qualitatively and quantitatively.

1. Qualitative Evaluation

Qualitative evaluation was done through operational feedback from employees and their supervisors concerning:

- a) The use of the dashboard
- b) The efficiency of reporting
- c) The availability of data
- d) The effectiveness of monitoring

2. Quantitative Evaluation

Quantitative evaluation was done by analyzing:

- a) The completeness of data
- b) The consistency of data
- c) The efficiency of reporting
- d) The effectiveness of operational monitoring

The results of the evaluation were very favorable to the organization.

G. Research Tools and Technologies

Various technologies and tools were utilized during this research, such as:

Table 3 Research Tools and Technologies

Tool	Description
Google Spreadsheet	Storage of data
API Integration	Data synchronization
Looker Studio	Visualization of data
Microsoft Excel	Preprocessing of data
Operational Complaint System	Sources of data

The combination of these technologies enabled the application of Data Governance and Business Intelligence in the organization.

IV. RESULTS AND DISCUSSION

Implementation of Data Governance in Perumda Air Minum Tirta Ayu Kabupaten Tegal greatly helped the company manage their customer complaint data effectively. Prior to implementation of the process, complaints data was still being stored manually without any standard guidelines. Various issues concerning data quality such as duplications, incomplete customer information, inconsistency in categorizing customer complaints, and unstructured operational descriptions were identified during the observation period. Implementation of Data Governance concentrated on various aspects such as data standardization, validation, data cleaning, metadata definition, and data quality monitoring. A dictionary of operations was created as a means of standardizing all the operations, complaint categories, names of branches, and status of complaints solutions. Through the implementation of standardized processes, data inconsistency among complaint records could be easily avoided. In addition, implementation of Data Governance helped increase the level of awareness in the organization about the need for proper data quality management processes. The operational staff could easily avoid inconsistencies while recording customer complaints since they had already been subjected to validation and governance guidelines.

Operational benefits of the Data Governance implementation included:

- a) Delivery of more consistent data
- b) Avoidance of duplicate records
- c) Delivery of more complete data

- d) Much faster reporting
- e) Better operational visibility
- f) More reliable analysis

B. Data Quality Improvement Analysis

Improvement in Data Quality Analysis Following the implementation of Data Governance, the quality of data in operation improved on several parameters. Before implementing the governance procedure, most of the complaints had empty entries as well as inconsistencies in category names. The key improvements have been identified in:

- 1) Completeness
- 2) Consistency
- 3) Accuracy
- 4) Timeliness

The dimension of completeness improved since mandatory data was checked for accuracy before being entered into the system. The improvements in consistency have been due to standardized categories and controlled entry processes. The improvements in accuracy have been helped by the validation process and duplication control mechanism. Meanwhile, timeliness has improved owing to the API integration and faster synchronizing operations.

Table 4 Improvements in Data Quality

Dimension of Data Quality	Before Data Governance	After Data Governance
Completeness	Low	High
Consistency	Inconsistent	Standardized
Accuracy	Moderate	Improved
Timeliness	Delayed Reporting	Real-Time Synchronization

It can be observed that Data Governance has resulted in an increase in the reliability of customer complaint data.

C. Results Integration Result using API Approach

The use of the API approach for data integration was very successful in automating the synchronization of complaint information from the operating complaint system into Google Spreadsheet. Prior to the application of API integration, manual data collection took place, which led to reporting delays and additional operational tasks. With API integration applied, the complaint data can be collected in the staging layer using automation. This resulted in fewer manual processes and more efficient operations.

Furthermore, API integration contributed to the implementation of data governance by:

- a) reducing duplicates,
- b) centralizing operational data,
- c) having consistent synchronization processes,
- d) and fast reporting processes.

Using the API integration process, it is easier for the managers to get real-time updates on their operational information through the Business Intelligence dashboards. Synchronization starts with operational complaint data collection using API services. The collected data will then be stored in Google Spreadsheet, processed via data governance processes, and presented visually using Looker Studio dashboards.

D. Business Intelligence Dashboard Results

In developing the Business Intelligence dashboard using Looker Studio, the visualization process was conducted for customer complaint data and operational monitoring data. Governed data were used in the visualization, and operational records were transformed into analytical visuals.

Various aspects of the dashboard were created during the current investigation.

1. Complaint Trend Visualization

The visualization of complaints' trend depicted the number of complaints made by customers each month throughout the year 2025. In addition, the visualization revealed the variations in the number of complaints during various operational periods. The highest number of complaints was registered during the last quarter of the year, which implies the high pressure on operations due to the increased frequency of disruptions. The visualization allowed managing the number of complaints and planning preventively.

2. Complaint Categories

During this work, the following complaint categories were identified:

- a) Water supply disruption
- b) Pipe leakage
- c) Valve repair
- d) Water quality problems
- e) Billing complaints

These findings suggest that technical reliability is an essential part of customer satisfaction.

3. Service Channel Distribution

The dashboard also provided insight into the distribution of customer complaints by service channel. Customer complaints were primarily lodged via in-person service channels, whereas digital communication channels such as the telephone and message services were relatively uncommon. This data is useful for developing future digital service innovations.

4. Branch-Level Operational Analysis

Visualization at the branch level revealed various operational branches that had considerably more complaints than other service areas. The data gathered helped management allocate resources for maintenance and operation evaluations in critical branches.

5. Interactive Dashboard Features

Various filters were incorporated into the interactive dashboard in order to enable further investigation using:

a) Trends of customer complaints



Figure 3 Trends of customer complaints

b) Complaint type distribution

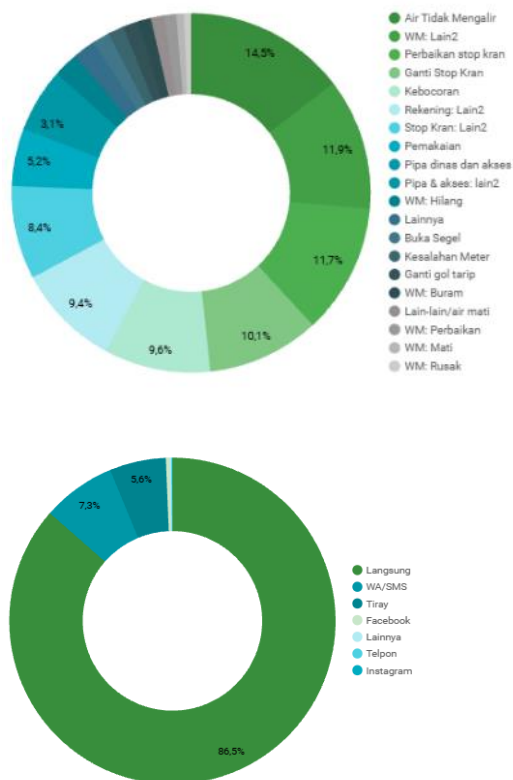


Figure 4 Complaint type distribution

c) Locate regions/branches with high levels of disruption

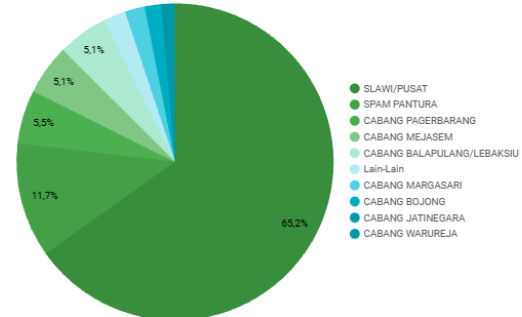


Figure 5 Locate regions/branches with high levels of disruption

• Customer complaint details table

Table 5 Customer complaint details table

no_ur	id	nomor aduan	tanggal aduan	nama pelanggan	jenis aduan	jumlah aduan	status aduan	nama staf	petugas lapangan	zona	cabang
1	null	9996	00006/30/12/2025	PDAM	Pipa	Langsung	Tuntas	null	Lain-Lain	Lain-Lain	Lain-Lain
2	301002030	5510	00007/02/12/2025	Bapak Yogi	Stop Kran: Lain2	Langsung	Tuntas	BUDI HARTONO	Lain-Lain	BRIGIF II	CABANG MEJASEM
3	1102010003	5499	00005/01/12/2025	Noti Setaji	Kebocoran	Langsung	Tuntas	ARIGA SATIRTA PAMUNGKAS	Lain-Lain	MARGASARI	CABANG MARGASARI
4	103115138	5502	00008/01/12/2025	AMNAT LN	Stop Kran: Lain2	WA/SMS	Tuntas	RAYNAL GUNTUR WISOWO	Lain-Lain	DUKUHWIN	SLAWI/PUSAT
5	107009645	5496	00002/01/12/2025	SUKEN DAR	WM: Hilang	WA/SMS	Tuntas	AKHMAAD ZULKIFLI	Lain-Lain	UJUNGGRUSI BARAT	SLAWI/PUSAT
6	103115108	5497	00003/01/12/2025	Vivis Oka Setiawan	Ganti Stop Kran	Langsung	Tuntas	AIRS MESTYANT O	Waktu Oka Setiawan	DUKUHWIN	SLAWI/PUSAT
7	106011085	5503	00009/01/12/2025	MUJI MARDI ROH	Air Tidak Mengalir	WA/SMS	Tuntas	ACHMAD ROSCH	Lain-Lain	UJUNGGRUSI BARAT	SLAWI/PUSAT
8	107022158	5504	00001/02/12/2025	-	Kebocoran	Tiray	Tuntas	AKHMAAD ZULKIFLI	Lain-Lain	UJUNGGRUSI BARAT	SLAWI/PUSAT
9	505008109	5513	00010/02/12/2025	Ibu Sri	Pemakaian	Langsung	Tuntas	ANDI SETIARWAN	Lain-Lain	KALADAWA	SPAM PANTURA
10	501032116	5500	00006/01/12/2025	BUDI PRANO TO	Ganti Stop Kran	WA/SMS	Tuntas	BUDI HARTONO	Lain-Lain	KALADAWA	SPAM PANTURA

The adoption of interactive dashboard capabilities enhanced flexibility and expedited operational analysis.

E. Discussion

The combination of Data Governance and Business Intelligence was effective in improving the analytical capacity within Perumda Air Minum Tirta Ayu Kabupaten Tegal. The former provided a framework for keeping the data accurate and consistent, whereas the latter was used to make this governed data visualizable and informative for managerial decision-making processes. This proves that Business Intelligence applications rely heavily on successful implementation of the Data Governance

practice within a company. Otherwise, a dashboard can generate inconsistent results. As a result, both practices should be implemented in an integrated manner as strategic solutions rather than separate technological ones. Implementation of this solution increased transparency within operations and efficiency in reporting. Managerial teams became more efficient in monitoring customer feedback and spotting any operational issues than when working manually.

Results prove that Data Governance is important for:

- a) organizational accountability,
- b) efficiency,
- c) analytical reliability, and
- d) digital transformation readiness.

Moreover, this research shows that regional organizations dealing with public utilities are capable of implementing Data Governance and Business Intelligence practices through relatively simple technology such as API integration, Google Spreadsheets, and Looker Studio.

V. CONCLUSION

The objective of this study was to examine the implementation of Data Governance and Business Intelligence at Perumda Air Minum Tirta Ayu Kabupaten Tegal to enhance complaint data management. Based on the findings, the successful implementation of Data Governance led to improved data quality, data standardization, validation, and data cleaning, resulting in improved consistency and completeness in the reported complaint data. Moreover, the Business Intelligence dashboard created via Looker Studio successfully presented information such as complaint trends, complaint types, and operational data across branches. This integration of Data Governance and Business Intelligence has proven to increase efficiency and organizational transparency.

In conclusion, this research was conducted only in one organization and had a descriptive nature. For further research, it would be beneficial to conduct research that includes predictive analytics and real-time monitoring systems to enhance the decision-making process in organizations. Also, it is suggested to implement Data Governance first before creating a Business Intelligence system to have accurate, standardized, and complete data for decision-making purposes.

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