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Implementation of Business Intelligence for Material Deviation Analysis Using Looker Studio (Case Study: PT Telkom Akses Bengkulu)

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Abstract*—This study is motivated by challenges in managing data for fiber optic network construction projects, which are stored in multiple separate files and are not yet integrated, making analysis and monitoring inefficient. In addition, discrepancies between planning data and actual field data affect both work volume and project costs. This research aims to integrate project data into a structured dataset, analyze deviations between planning and actual data, and present the results through interactive visualization. The study employs a descriptive analysis approach within a business intelligence framework, including data cleaning, transformation, and aggregation using Microsoft Excel, followed by visualization using Looker Studio. The dataset consists of fiber optic project data from 2024–2025, including attributes such as designators, volume, material costs, service costs, and total costs. The results indicate significant deviations between planning and actual data in both volume and cost for several work items. The interactive dashboard effectively presents these deviations, improving data clarity and facilitating monitoring and analysis. This study contributes to enhancing the efficiency of project data processing and supports data-driven decision-making through the implementation of an interactive and user-friendly dashboard.

Keywords- Business Intelligence, Data Cleaning, Looker Studio, Data Visualization, Deviation Analysis

I. INTRODUCTION

The development of fiber optic technology has increased the demand for structured and well-planned network infrastructure. In the implementation of network construction projects, planning data is used as an initial reference to determine work requirements, including material volume, number of distribution points, and cost estimates. However, real-world conditions frequently reveal discrepancies between planning data and actual field conditions. Environmental factors, existing infrastructure conditions, and additional work requirements that the initial planning stage did not identify generally cause these discrepancies.

Based on observations conducted during practical work at PT Telkom Akses Bengkulu, particularly in the construction division, it was found that differences between planning data and actual field conditions can affect the work implementation process and determine the final volume of work. These inconsistencies can also impact the billing process and influence the operational status of the network, potentially leading to delays in project completion and increased costs for stakeholders involved in fiber optic projects. Therefore, an effective data processing approach is required to align planning data with actual field conditions. In this context, the processing of planning data and work progress data is essential to produce accurate and reliable information that supports the implementation of fiber optic projects.

Based on these problems, this study proposes a solution by integrating and processing project data into a more structured system using Microsoft Excel, followed by data visualization using Looker Studio. This process involves cleaning the data to fix any inconsistencies, changing the data to make sure all formats are the same, and combining several datasets into one structured dataset. This integration makes it easier and faster to get to project information without having to open each file separately. Furthermore, the processed data is presented in the form of an interactive dashboard using Looker Studio, enabling users to monitor project progress, cost distribution, and work status more effectively. This visualization enhances monitoring efficiency and supports faster and more effective data-driven decision-making.

The application of Business Intelligence (BI) in project data processing provides a relevant solution to address the issue of unintegrated data. BI helps people make better decisions by turning scattered data into organized and useful information. However, the quality of the data used heavily influences the success of BI implementation, as poor-quality data can lead to inaccurate insights and misguided decisions. Therefore, data cleaning and data integration are critical stages to ensure that the processed data is accurate, consistent, and capable of producing reliable information [1], [2].

Based on the problems described above, the objectives of this study are to integrate previously scattered project data into a structured system, analyze work progress based on construction status, and present the results through data visualization using Looker Studio. In addition, this study aims to improve efficiency in project monitoring and support faster, data-driven decision-making. The research questions addressed in this study include how to process and integrate project data using Microsoft Excel, how to visualize the data using Looker Studio, and how the visualization results can assist stakeholders in monitoring project progress and identifying issues in the field.

A. *Data Visualization with Looker Studio*

Data visualization is the process of presenting data in the form of graphs, diagrams, or dashboards to facilitate the understanding of complex information. In the context of business intelligence, data visualization plays a crucial role in helping organizations identify patterns, trends, and operational conditions more quickly and accurately. One of the tools widely used for this purpose is Google Looker Studio, which is capable of integrating data from multiple sources and presenting it in the form of an informative and interactive dashboard[3].

The use of Looker Studio in data visualization has been shown to improve monitoring efficiency and support data-driven decision-making processes. The resulting dashboards can present information dynamically, supported by interactive features such as filters and charts that enable users to explore and analyze data more effectively. Furthermore, dashboard-based visualization helps management learn more about data conditions, enabling faster and more accurate decision-making [4].

B. *Data Analysis Methods*

The data analysis method used in this study is a descriptive analysis approach within the Business Intelligence framework, which aims to transform raw data into meaningful and easily understandable information without performing predictive analysis. The analysis process begins with data collection, followed by data preparation, which includes data cleaning and data transformation to ensure a consistent and standardized format. Subsequently, Exploratory Data Analysis (EDA) is conducted to examine the characteristics of the data, including patterns, trends, and data distribution prior to visualization[3].

In addition, the analysis process involves the Extract, Transform, Load (ETL) stage to integrate data from various sources into a single structured dataset. After processing, the data is analyzed using descriptive methods and shown on dashboards to make it easier to understand. This approach enables users to fully comprehend the overall data and supports more systematic data-driven decision-making processes [5], ultimately leading to improved business strategies and outcomes based on the insights gained from the analysis [5].

II. RESEARCH METHOD

This study employs a descriptive analysis methodology within the business intelligence framework, focusing on the conversion of data into significant and comprehensible information while eschewing predictive analysis. This approach is chosen because the study concentrates on examining current data conditions, specifically to discern discrepancies between planning data and actual field data. The descriptive method is employed to represent data conditions based on factual evidence through processes such as data collection, processing, and visualization. Data visualization in the form of dashboards has been shown to improve analytical effectiveness and enhance monitoring and decision-making processes [6], [7].

Data collection in this study was conducted through direct observation during practical work at PT Telkom Akses Bengkulu, specifically in the construction division. The dataset is made up of data from fiber optic network construction projects that took place between 2024 and 2025. It was taken from several Microsoft Excel files. The data includes attributes such as designators, job descriptions, units, planned volume, actual volume, material costs, service costs, and total costs. Initially, the data was scattered and not integrated, requiring a merging process to form a single structured dataset. This process of integrating data is in line with what other studies have found: business intelligence data usually comes from more than one source and needs to be combined before it can be analyzed. The combined dataset ensures completeness and consistency of information, which are essential factors influencing the accuracy of analysis and decision-making in business intelligence systems.

The data analysis process is carried out through several main stages, namely data cleaning, data transformation, and data integration using the Extract, Transform, Load (ETL) approach. The data cleaning stage aims to correct inconsistent data, including duplicate records, inconsistent entries, and formatting errors that may affect analysis results. The dataset was collected from 11 Microsoft Excel files. During the cleaning process, 6 duplicate records were identified and removed. In addition, each source file contained approximately six inconsistent entries represented by the "-" symbol, which were standardized and corrected before further processing. Data cleaning is a critical process in improving data quality through validation and correction, ensuring that the resulting dataset is accurate and suitable for analysis [8].

Furthermore, data transformation is performed to standardize data formats, enabling systematic processing. This is followed by the data integration stage using the ETL method, which involves extracting data from multiple sources, transforming it into a consistent format, and loading it into structured storage. This process ensures better data consistency, integration, and quality [9], [10].

Once the cleaning, transformation, and integration stages were completed, the data were visualized using Looker Studio. Looker Studio was selected as the visualization platform because it provides free access, supports seamless integration with spreadsheet-based datasets, and offers interactive dashboard capabilities suitable for project monitoring activities. Compared to other business intelligence tools such as Power BI and Tableau, Looker Studio can be implemented with lower infrastructure requirements while still providing sufficient analytical and visualization features for this study. Dashboard-based visualization has demonstrated its ability to enhance analytical effectiveness and facilitate monitoring and decision-making processes. Tools such as Looker Studio enable interactive data presentation, allowing users to explore and interpret complex information more easily. The dashboard is equipped with interactive features such as filters and charts, enabling users to analyze data independently. This approach facilitates pattern identification and provides a comprehensive understanding of project conditions. Previous studies also indicate that business intelligence dashboards enhance information clarity and support data-driven decision-making [11], [4].

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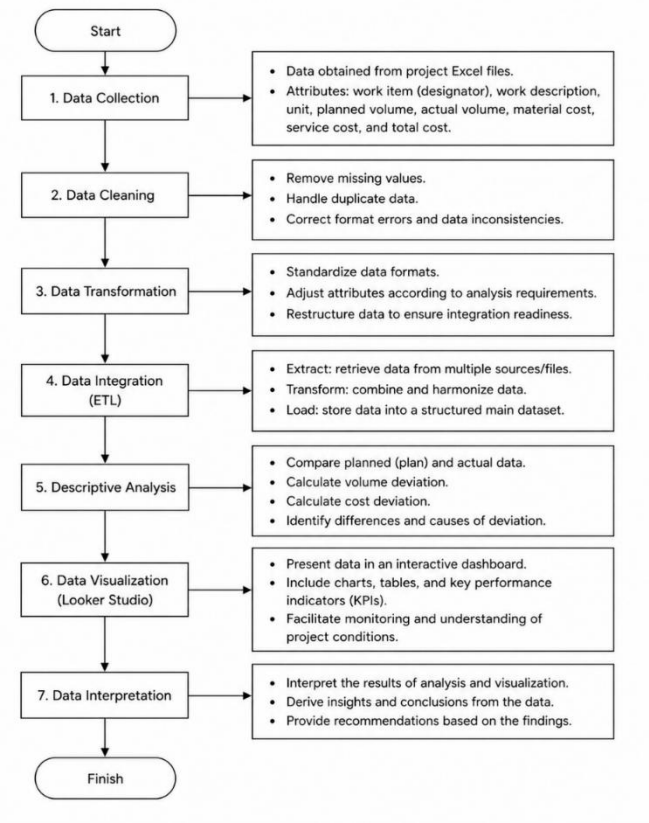


Fig 1. Research Method Flow Diagram

Figure 1 illustrates the research methodology flow used for processing data from fiber optic network projects. The process begins with the data collection stage, where data is gathered from multiple Microsoft Excel files. This is followed by the data cleaning stage, which aims to correct inconsistencies such as inconsistent entries, duplicate records, and formatting errors.

Subsequently, data transformation is performed to standardize the data structure, enabling systematic processing. The cleaned and transformed data is then integrated using the Extract, Transform, Load (ETL) approach to produce a single structured dataset.

The integrated dataset is analyzed using descriptive methods to identify deviations between planning data and actual data, both in terms of volume and cost. The results of the analysis are then presented through dashboard visualizations using Looker Studio, facilitating easier monitoring and data interpretation. Finally, the process concludes with data interpretation to generate insights and support data-driven decision-making.

III. ESULTS AND DISCUSSION

This study develops a data processing and visualization system capable of integrating planning (plan) data and actual data into a structured dataset. This section presents the research findings in accordance with the predefined objectives, including data integration, volume and cost deviation analysis, and data visualization through an interactive dashboard.

Each subsection describes the results obtained from each stage of the research, starting from data processing to the interpretation of results, with the aim of supporting project monitoring and data-driven decision-making.

A. Data Integration and Processing

In the initial stage of the study, the project data was stored separately across multiple Microsoft Excel files with non-uniform formats. The dataset contains information related to fiber optic network construction, including designators, job descriptions, units, material costs, service costs, volume, and total costs. This condition resulted in an inefficient analysis process, as users were required to manually open and compare multiple files to obtain the necessary information.

To address these issues, data integration and processing were conducted through several main stages, namely data cleaning, data transformation, and dataset merging. During the data cleaning stage, several data quality issues were identified and corrected. A total of 6 duplicate records were removed from the dataset to prevent redundant information. In addition, the 11 source files contained approximately six inconsistent entries per file represented by the "-" symbol, which were standardized before the integration process. These cleaning activities improved data consistency and ensured that the dataset was suitable for subsequent analysis. Subsequently, data transformation was performed to standardize the data format, enabling systematic processing. Finally, data from several files was combined into one structured dataset.

The results of this process indicate that previously scattered and unorganized data can be transformed into a structured and ready-to-use dataset for further analysis. With the integrated dataset, the data processing workflow becomes more efficient and facilitates the analysis of deviations between planning data and actual field conditions, allowing for more accurate assessments of project performance and resource allocation.

B. Volume and Cost Deviation Analysis

After the data has been successfully integrated and cleaned, the next stage is to analyze the deviation between planned data and actual field data. This analysis aims to evaluate the extent of differences in work volume and their impact on project costs. Deviations are calculated based on the differences between planned and actual volumes, as well as the corresponding differences in total costs.

The results of the analysis indicate that several work items exhibit deviations between planned and actual data. These deviations affect both material volume and project costs, indicating differences between initial planning assumptions and actual field conditions. The findings suggest that project requirements in the field were not always fully represented during the planning stage, resulting in variations in resource utilization and project expenditures.

Furthermore, the analysis shows that changes in material volume have a direct impact on project costs. Work items with higher actual volumes tend to generate higher costs compared to the planned estimates. This relationship highlights the importance of monitoring both volume and cost deviations to ensure effective project control and resource allocation.

Overall, the deviation analysis reveals a mismatch between planning data and actual field conditions, affecting project performance in terms of volume and cost. These findings provide valuable insights for improving planning

accuracy, budget control, and decision-making in future projects.

C. The Role of Data Visualization and Dashboard Implementation

After completing the volume and cost deviation analysis, the next stage is to present the results through data visualization using Looker Studio. This visualization aims to enable users to understand the data more quickly and interactively, without relying solely on raw tabular data.

The developed dashboard presents key information, including volume comparisons, volume differences, and cost differences for each work item. This visualization enhances the effectiveness of the project monitoring process by facilitating more efficient access to information and easier analysis.

Comparison of Actual and Plan Volumes

The comparison between actual and planned volumes is used to evaluate the level of consistency between planning data and actual field conditions.

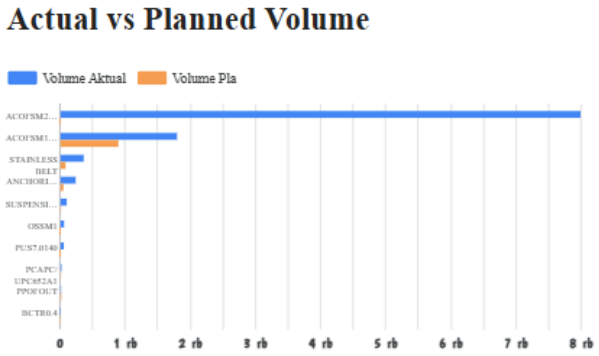


Fig 2. Comparison of Actual Volume and Planned Volume

Figure 2 presents a comparison between planned and actual material volumes for several work items. The results indicate that notable deviations occurred in a number of items, particularly ACOFSM24SC, which recorded the largest actual volume and significantly exceeded the planned value. ACOFSM12SC also showed a considerable increase in actual volume compared to the planned volume, although the deviation was smaller than that of ACOFSM24SC.

The findings suggest that actual material requirements in the field were higher than those estimated during the planning stage for several work items. These deviations may be influenced by changing project conditions, additional installation requirements, or differences between initial assumptions and field implementation. Therefore, comparing planned and actual volumes provides valuable information for evaluating project performance and improving the accuracy of future project planning.

Volume Difference (No Outlier)

Volume difference charts are used to analyze the differences between actual and planned volumes for each work item. In this analysis, outliers are excluded to obtain a more representative distribution of the data and to avoid distortion caused by extreme values.

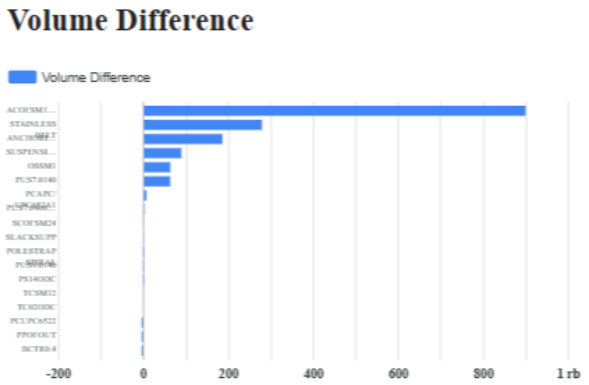


Fig 3. Volume Difference (Without Outliers)

Figure 3 presents the volume differences between planned and actual values after excluding outliers. The results indicate that ACOFSM12SC recorded the highest volume deviation among all work items, followed by STAINLESS BELT and ANCHORING. These positive deviations indicate that the actual material usage exceeded the planned volume during project implementation. The exclusion of outliers was intended to improve the visibility of general data patterns and prevent extreme values from dominating the analysis. The results demonstrate that volume deviations occurred across multiple work items rather than being limited to a single component. This finding suggests that discrepancies between planning estimates and actual field requirements were present in several parts of the project. Therefore, regular monitoring of volume deviations can provide valuable insights for improving planning accuracy, resource allocation, and project cost control in future projects.

Cost Difference

Cost difference charts are used to analyze the impact of differences between planned and actual volumes on the total project cost. This visualization presents the magnitude of cost deviations for each work item, enabling the identification of components that contribute most significantly to cost increases or reductions.

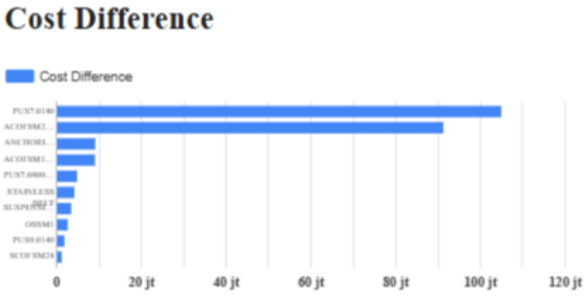


Fig 4. Cost Difference

Figure 4 presents the cost differences between planned and actual project expenditures for each work item. The results indicate that PUS7.0140 recorded the highest cost deviation among all work items, followed by ACOFSM24SC. ANCHORING and several other items also contributed to cost differences, although to a lesser extent. These findings demonstrate that cost deviations were concentrated in a limited number of work items rather than being evenly distributed across the project.

The observed cost deviations are closely associated with differences between planned and actual material volumes. As the volume of materials used in the field increases beyond the planned estimates, the corresponding project costs also increase. Therefore, monitoring both volume and cost deviations is essential for improving budget control, reducing unexpected expenditures, and enhancing the accuracy of future project planning and resource allocation.

Table of Analysis Data

In addition to graphical representations, the dashboard also presents data in tabular form, providing detailed information on planned volume, actual volume, volume differences, and cost differences for each work item.

	DESIGNATOR	Vo…	Volu…	Selisi…	Selisi…
1.	PUS7.0140	68	6.565…	64	105.046.848
2.	ACOFSM24SC	8.000	0	8.000	91.368.000
3.	ANCHORING	249	3.072…	187	9.267.720
4.	ACOFSM12SC	1.805	9.239…	900	9.188.100
5.	PUS7.0400NM	4	0	4	4.984.804
6.	STAINLESS BELT	373	1.442…	280	4.342.800
7.	SUSPENSION AYUN	113	917.470	90	3.590.100
8.	OSSM1	72	346.632	64	2.773.056
	Total keseluruhan	10.…	29.05…	9.595	234.394.318

Fig 5. Detailed Data of Dashboard Analysis Results

Figure 5 illustrates that several work items, such as ACOFSM24SC, ANCHORING, and PUS7.0140, contribute significantly to deviations in project volume and cost. The table's data backs up what the other visualizations showed. Furthermore, the table serves as a validation tool to ensure that the values displayed in the charts correspond to the actual data. Therefore, the combination of graphical and tabular visualizations provides more comprehensive, accurate, and easily interpreted information, supporting more effective project monitoring and evaluation.

Based on the results of this study, the developed system successfully integrates previously scattered project data into a structured dataset. The deviation analysis reveals differences between planning and actual data that affect both project volume and cost, highlighting areas where project management may need to adjust strategies to stay on track and within budget, such as reallocating resources or revising timelines to address these discrepancies. In addition, the implementation of data visualization through an interactive dashboard enhances the monitoring process and facilitates a more comprehensive understanding of the data. These findings are consistent with previous studies, which indicate that business intelligence dashboards improve the effectiveness of data-driven analysis and decision-making.

Despite these contributions, this study has several limitations. The data processing process is still conducted semi-manually, which requires significant time and effort. Furthermore, the system has not yet been fully integrated with real-time data sources. Therefore, future research should focus on developing more automated systems through database integration or advanced ETL processes, as well as incorporating more advanced analytical features to further enhance data-driven decision-making.

IV. CONCLUSION

The main issue addressed in this study is that project data is stored across multiple files with non-uniform formats, making it difficult to process, analyze, and monitor effectively. To solve this problem, this study suggests a solution that uses data integration and business intelligence-based visualization in the form of an interactive dashboard. This makes the information easier to understand and more organized.

The findings indicate that the research objectives have been fulfilled. The study successfully integrates project data into a structured dataset, analyzes deviations between planning and actual data, and presents the findings through an interactive dashboard. The deviation analysis reveals differences in volume and cost across several work items, which significantly affect the overall project cost. Furthermore, the dashboard-based visualization enables users to understand data conditions more quickly and supports data-driven decision-making.

However, this study has several limitations. The data cleaning process is still performed manually, requiring considerable time and effort. In addition, the system has not yet been fully integrated with real-time data sources. Therefore, future research should focus on developing more automated systems through database integration or ETL technologies, as well as incorporating advanced analytical features to further enhance data-driven decision-making.

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