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# THE DEVELOPMENT OF PERFORMANCE DASHBOARD VISUALIZATION WITH POWER BI AS PLATFORM

**Surlisa Widjaja, Tuga Mauritsius**
Information Systems Management Department, BINUS Graduate Program – Master of Information Systems Management, Bina Nusantara University, Jakarta Indonesia

**ABSTRACT**

*In the last couple years, Indomobil, one of the largest automotive companies in Indonesia, has been suffering from decline in revenue and net loss. Competition in automotive business requires the company to have innovative strategies to be able to compete with other competitors. At the same time, the company needs to find opportunities to improve the efficiency and effectiveness of business activities. Business Intelligence (BI) is a process of taking large amount of data to be analyzed and presented as a set of reports; this includes synthesizing the implied key concepts of the entire data and translating these concepts into an applicable conclusion in decision making processes to improve business performance. In this paper, we demonstrate the process of adopting the cloud-based dashboard using Power BI at the strategic management level. The development of the dashboard system is based on the Vercellis framework, consisting of four main stages which are analyzing, designing, planning, implementing and controlling. One of the finding is that the data cleansing process is the most important stage to produce the right information. The other being the involvement of the user from the analysis and design process to the result validation will greatly improve the quality of the required dashboard. Moreover, the paper aims to explore the capability of Power BI in supporting the decision making process other than by simply using the dashboard.*

**Keywords:** Business Intelligence, Decision Support Systems, Indomobil, Power BI, Performance Dashboard.

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## 1. INTRODUCTION

Within a heavily competitive automotive industry during the stagnant economic condition of the last couple years, as one of the largest automotive companies in Indonesia which the main business includes brand licensees, distributors of vehicle sales, after-sales services, automotive financing services, spare parts distributors, automobile assembly, automotive component manufacturers, vehicle rental services, and other supporting businesses [1],

companies need to have innovative strategies to be able to compete with other competitors, and at the same time find opportunities to improve the efficiency and effectiveness of business activities.

Technology development that has been increasing rapidly has also affected the existing business models in automotive industry. One of the things that is imperative for improvement is to adopt technology that focuses on strategic management, including strategic intelligence needs with the utilization of Business Inteligence (BI). With the utilization of BI, the company is expecting every department to manage the existing data and to obtain quality information in order to optimize decision making process. For enterprise management and decision makers, the implementation of BI is will bring many financial and functional benefits [2].

The majority of BI applications are currently service oriented [3], designed as a solution in handling changes in business needs. The implementation of BI application that is integrated with management applications such as ERP [4], adjacent with implementing service-oriented architecture, is one solution to overcome the limitations of management capabilities in the company. Cloud BI is an asset that can be utilized, developed and used as a tool that can help generating greater value in gathering, analyzing and disseminating information to improve and support the decisions making process better [5]. BI uses visualization [6] to for more intelligible data presentation for end users. Decision makers can browse data interfaces,analyze data, and check organizational performance in real time.

Indomobil has begun to explore and focus on building the Business Intelligence Dashboard using Power BI at the strategic management level. The main purpose of this case study is to explore the capability of Power BI in data integration, data analysis, and information visualization that enable Indomobil to build appropriate classification and measurement to support the decision making process other than by simply utilizing the dashboard.

## 2. LITERATURE REVIEW

### 2.1. Power BI

Power BI [8] is an analytical application for analyzing data and sharing knowledge in business. Power BI has a cloud integration that offers data warehouse capabilities such as data preparation, data discovery, and interactive dashboards. Microsoft releases an additional support features called Embedded Power BI on the Azure cloud platform.

Power BI also have the abilities to combine different databases, files and web services so that it can quickly make changes or fixes data and problem automatically [9]. Power BI also guarantees security in publishing reports made within the company and automatically regulates data with updates information. Power BI can also integrate all data in the company, whether cloud or on-premises, because Power BI has a gateway that allows connection to SQL Server databases, Analysis Services models, and many other data sources on the dashboard.

### 2.2. Benefits of Business Intelligence

Some benefits that can be obtained in the use of BI that can accelerate decision making [10][11]:

1. Automate and enhance information-intensive aspects of repeat business planning, performance management, analysis of variance, root cause analysis, and planning of corrective actions.

2. On time automation and acceleration of a generation of companies, as well as the unit-business dashboard and KPI to focus the company's attention on key customers and channels that drive desired results, measure performance against established KPI targets, and influence management-with exception strategies.

3. Automate the analysis of the effectiveness of trade promotions to increase sales support through consumer advertising and marketing to achieves optimal results.

4.Provide standard and comprehensive historical business information about information / facts as input for various company plans and budgets, as well as for control in a short period of time that will enable efficient planning and effective control.

5. Enable timely and cost-effective monitoring of the company's business and financial performance through standard but dynamic opinion related to profitability and performance by customers, segments, categories, brands, products, factories and networks that have a large impact on sales, costs, services, and profits.

6.Delivering business information and business analysis in simple and easy-to-use screen that allows them to specify interest variables and "as-of" dates on fast-running reports and analyzes. Business professionals can report a variety of usage preferences, including standard reports, ad hoc access to big data sets, iris and On-Line Analytical Processing (OLAP), scorecards and dashboards, and predictive analysis.

7. Change the current warehousing and reporting process mitigation or eliminate performance problems with the current environment.is designed to provide a comprehensive framework to assist companies in achieving the goals of governance and management of the company's IT.

## 2.3. Cloud BI

Cloud BI solutions are gradually gaining popularity among businesses, as many businesses are realizing the benefits of data analytics. Businesses need quality insights driven by accurate data more than ever. Cloud BI is the concept of delivering BI capabilities as a service that have the key benefits such as cost efficiency, flexibility and scalability, reliability improves through the use of multiple redundant sites, enhanced data sharing capabilities and low total cost of ownership. [12]

## 2.4. Business Analytics

At present the analytical capabilities of the information system that being built by organizations are becoming increasingly important. BI analytics platform is a software platform that provides IS capabilities in three categories: integration, information delivery, and analysis. This capability enables organizations to build appropriate classification and measurement systems to support decision making and improve performance. There are three levels of analytics (Figure. 1) as descriptive, predictive, and prescriptive[13][14]:

- Descriptive analytics (or reporting) refers to knowing what is happening in the organization and understanding some of the trends and causes underlying the event. This involves the consolidation of data sources and availability of all relevant data in a form that enables appropriate reporting and analysis. Usually, the development of this data infrastructure is part of the data warehouse. This data infrastructure can develop appropriate reports, questions, alerts, and trends using various reporting tools and techniques.
- Predictive analysis aims to determine what might happen in the future. This analysis is based on statistical techniques and other more recently developed techniques that fall under the general category of data mining.
- Prescriptive analytics aims to identify what is happening and to seek the possible estimations, and to make decisions aim at achieving the best performance. The goal is to give a decision or

recommendation for a particular action that can be a specific decision for a problem in a form of a certain amount. Decisions can be presented to decision makers in the report or can be used directly in the automatic decision rule system. Thus, these types of analytics can also be referred to as normative decisions or analytics.

BI provides a variety of services that can be applied in several examples of decision making starting from top management to the lowest line management. However, each level of management has different information needs. BI systems are mainly used to improve the quality of decisions and provide timely solutions to various problems ranging from highly structured to highly unstructured. The hope is that managerial experience will improve with BI Tools which leads to better decision.[15][16]


**Figure 1**. Three types of Analytics [7]

## 2.5. Performance Dashboard

Performance Performance dashboard is a tool that displays statistical data with a graph (chart) to cater strategic needs. The dashboard is also one part of Decision Support Systems (DSS) that can interact with users, so users can obtain layered information needed to make decision [17]. Performance dashboards are layered information delivery systems that allow business users to visually monitor business processes and enter sequential layers of information to distinguish the cause of a problem or issue. The top layer performance dashboard graphically displays exception conditions; middle layer allows users to explore or slice and dice data from various dimensions; and the lower layer allows users to check individual transactions and operational reports [18].

## 2.6. Previous Research

In 2017, research on data analysis with Power BI has been carried out in Anna University, Chennai India. It can be seen that Power BI shows a radical approach in simplifying BI and and analytic data, where individuals and organizations can easily provide data, create reports automatically, combine it on the dashboard, and share it with minimal time and effort.

Another case study from Nenad Stefanovic concluded that using cloud BI can optimizing supply chains, requires predictive analysis and data mining to make decisions for predictive inventory management that provides collaboration, flexibility, wealth, and scalability in sparepart inventory replenishment.

In 2011, the research entitled "The Impact of Adopting Business Inteligence (BI) in Organizations" has concluded that the research BI increases the company's competitive ability.

Other study of cloud BI software systems aids management and administrative personnel in developing analytical skills and therefore, improve the process of decision making. Combining both new technologies – BI and cloud computing organizations can gain synergistic effect in their integration.

In 2016, the research entitled “Big Data Visualization: Tools and Challenges” reviewed about some of the most popular various of visualization tools that one of them is Power BI which are quite promising because the tools can generate rich and interactive visualizations, also most of them tackle the huge volume of data and response in acceptable amount of time.

# 3. METHODOLOGY

## 3.1. Development Steps

The steps that is used in developing performance dashboard was adopted from Vercellis [19] that consist of 4 (four) main phases as seen in figure below :

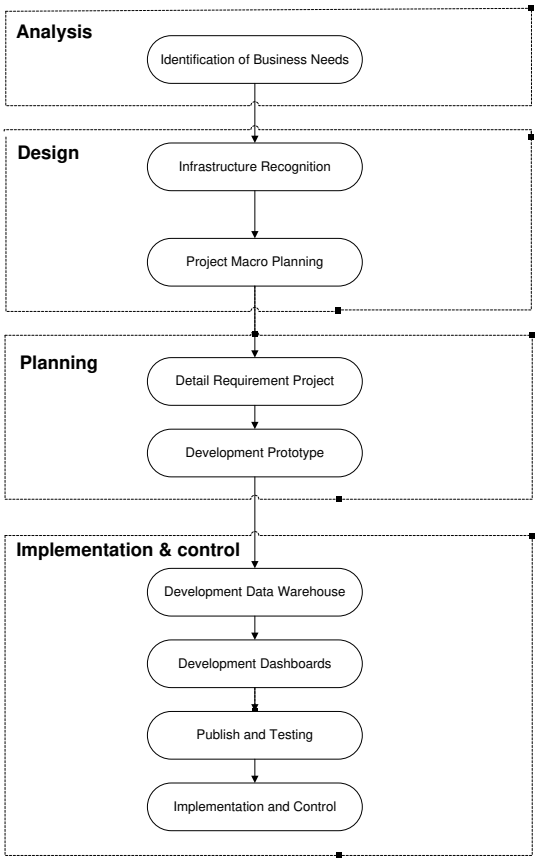


**Figure 2**. Development Steps

## 3.2. Data Analysis Method

This paper applies 3 (three) parts of data analysis method as follows :

a. Literature study is done by collecting some theories, methods or models in the field of information systems management or information technology in general, and also the business intelligence dashboard in particular.

b. Data gathering that comprises of analyzing the management report and utilizing the main data sources from the inhouse ERP transactional database, namely the Dealer Management System (DMS) that selected according to the needs that related to Sales data (Sales / Summary / Stock), After Sales (Spare Parts, Workshops) and Finance Accounting data .

c. Interviews with related parties in the company such as Board Director, CEO, Area Sales Division Head, Aftersales Managers, and Finance Accounting Depeartemen Head that managed all the Operational Supports.

# 4. RESULTS AND DISCUSSIONS

## 4.1. Business Requirement Analysis

This phase is generally carried out through a series of interviews with knowledgable workers, especially those whose job descriptions are related to the problems that have occurred and to the business strategy that will be carried out by the company. The paper will map the detail analysis of information needs, which include the analysis of the problems faced by the company and the strategies to be taken.

## 4.2. Design

The second phase is the design of the dashboard that includes two sub-phases, which are infrastructure recognition and macro projects planning. Infrastructure recognition aims to make overall planning of the architecture or infrastructure, both servers, software, hardware, networks, databases and human resources, to be used as supporting needs for the future development and transformation. On the other hand, project planning is carried out using project management and project planning methodologies to identify the development phase as a priority by taking into account the desired execution of time and costs, as well as the roles and resources needed. In this phase, the assessment of existing information needs to be done, and the decision-making process that will be supported by business intelligence must be examined first as part of the preparation in determining information needs.

## 4.3. Planning

The planning phase includes sub-phases where the functions of business intelligence is to describe the main objectives of developing the performance dashboard, the expectations desired, formal support from top level management, and milestones to be addressed. The approach used in the dashboard design process is a bottom up approach, where development dashboard performance in the initial stages will focus on the automotive business.

### *4.3.1. Detail project requirement*

Designing performance dashboard using Power BI as a platform for the company is intended to provide fast and accurate information related to company activities that can help resolve business needs and help management level in the decision making process.

### *4.3.2. Development Mockup Design Dashboard*

Designing the Power BI dashboard mockup aims to provide a visualization of users' information needs so that each user gets concise and comprehensive information. Designing the mockup clarifies that there is a match between the needs and the system planned before implementating the system; thus, the process will to become more efficient because any errors that occur due to differences in perception can be identified earlier.

### *4.3.3. Designing ETL Architecture*

Data integration is the process of integrating data from the ERP DMS database (data source) into the DMS Datawarehouse database using Microsoft SQL Server Integration Service (SSIS) software. SSIS is a tool used to extract, transform, and load processes and is classified

as a business intelligence feature. The ETL process that is passed in the formation of the data warehouse starts with the preparation of data on the database of DMS Master Customers, Companies (Branch), DateTime, Employees, Profit Centers, Regions, Vehicles and others; these processes are followed by data integration processes that combine attributes from tables which is analyzed in the DMS database to be used in fact tables and attributes in the dimension table using the snowflakes scheme structure. The data reduction process is carried out along with the data integration process by removing unnecessary attributes from the table analyzed. After that, attributes that were inconsistently written will undergo data cleansing process. The last process is retrieving data from the Transactional / OLTP database (DMS Production), which are then submitted into the DMS data warehouse database using ETL (Microsoft SSIS).

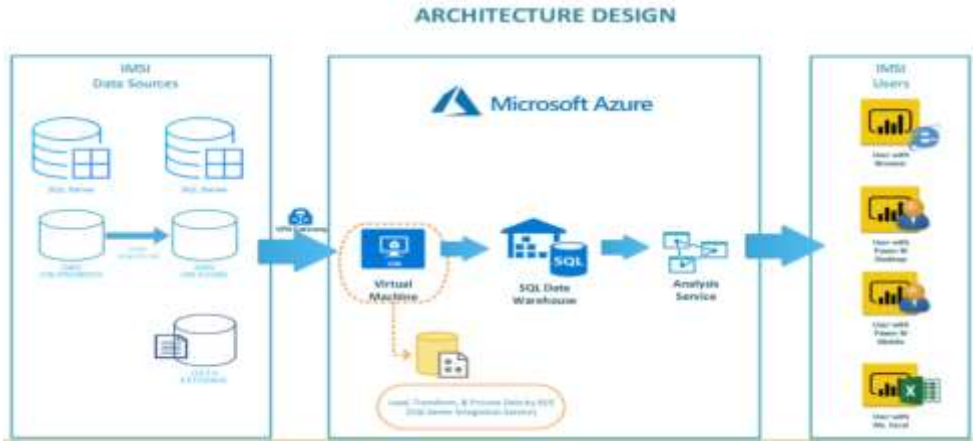


**Figure 3.** ETL Design Architecture

#### *4.3.4. Designing SSAS Architecture*

Our analysis architecture design utilizes OLAP (Online Analytical Processing) capabilities of Azure SSAS (SQL Server Analysis Service), which is a multidimensional or tabular data cube customized to enhance aggregational computation of large data with snowflake schema data warehouse. At this stage, the SSAS is built by deploying determined fact and dimension table to build a cube compatible with the predetermined schema.

#### *4.3.5. Designing Query Design*

The design of the query design displays information on the results of the formula or any calculation that will be presented in the Power BI dashboard. All formulas made in the query design stage are carried out at SSAS level so that all formulas will be updated automatically when used by all users.

### 4.4. Implementation and control

The stages in the implementation and control process are the development of the data warehouse, development of ETL, development of dashboards and also release and testing.

#### *4.4.1. Development of Data Warehouse*

Data and information used for measuring performance in the dashboard information system are accommodated in a database. Database design uses Microsoft SQL Server Integration Service (SSIS). The data that will be used as the main data source is a transactional data originating from the Dealer Management System (DMS). The company has successfully implemented DMS from 2010 to 185 dealers throughout Indonesia. DMS is an integrated application which consists of Sales Module Units, Aftersales Service Modules, Aftersales Spare Parts Modules, Logistic Modules, Cash Bank Modules, Receiveable Module Accounts,

Account Payable Modules, Tax Modules and Fixed Asset Modules which are integrated with each other.

The data quality conditions that will be used have to go through the data cleansing process every time the data is withdrawn. The data validation has been done by checking and comparing the data warehouse with the data owned by each division. After that, based on the needs that have been obtained, then prepared a logical data model to meet those needs.

Other data sources outside of DMS data that are categorized as external data are also used to analyze, but it must be identified first whether there is duplication of data, inconsistencies in the data, or whether the frequency of sending the data source is appropriate. The process of combining main data and external data requires another process that is not easy because the data must go through the stages of data cleansing and formatting adjustments according to the main data structure. Some of the external data needed include work plans (budget data), competitor brand sales data, and data on the number of employees.

### *4.4.2. Development of ETL*

The process consists of ETL stage from data source to staging data and ETL stage from staging data to data warehouse. At ETL stage from data source to staging data, data is extracted from the operational database source, Live DMS by using the SQL query command on the ISISQLCL11 server. Queries are grouped based on data source requirements according to the defining data modeling in a form of fact and dimension tables. Then, data cleaning is done first through the process of data cleansing, of which the results are entered into staging data to confirm that the data quality is accurate and valid. ETL stage from staging data to data warehouse on the ISIMSAZRDMSDB13 server is using Microsoft SQL Server Integration Services (SSIS).

Further process in designing data cube is adding computational column and measurement, which are key features that enhance the performance in processing large quantity of data in SSAS. The data control flow and the details of the stages are displayed in data flow task (Figure 4).

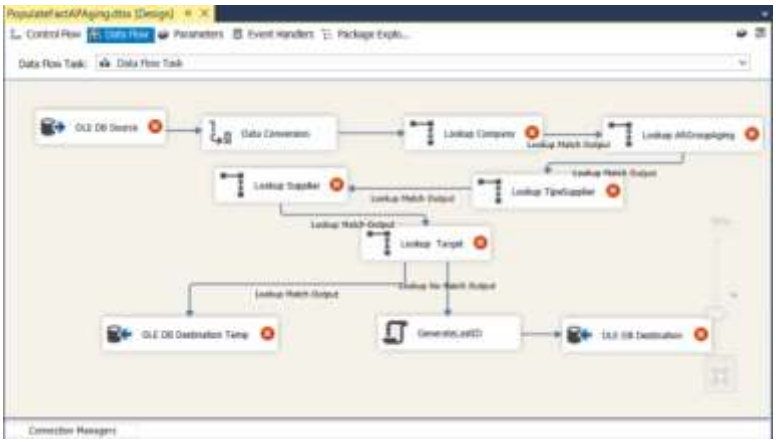

**Figure 4**. Sample Data Flow Task

The data populate process is automatically carried out periodically after the process of daily transactional data input. Detailed in table 1 is an information on frequency of data updates carried out in ETL processes in each table of dimensions and facts.

**Table1**. Sample Dimension data populate process

| Table Name | Integration |
|---|---|
| DimTime | Insert, Yearly |
| DimFiscalCalender | Insert, Yearly |
| DimRegion | Insert, Daily |
| DimBrand | Insert, Daily |
| DimVehicleType | Insert, Daily |
| DimEmployee | Insert, Daily |
| DimCompany | Insert, Daily |
| DimProvince | Insert, Daily |
| DimCity | Insert, Daily |
| DimCustomer | Insert, Daily |
| DimCustomerType | Insert, Daily |
| DimJobPosition | Insert, Daily |
| DimTransactionType | Insert, Daily |
| DimInvoiceType | Insert, Daily |
| DimVehicle | Insert, Daily |
| DimSupplier | Insert, Daily |
| DimProfitCenter | Insert, Daily |
| DimCostCenter | Insert, Daily |
| DimFinArea | Insert, Daily |
| DimItemClass | Insert, Daily |
| DimCOA | Insert, Daily |
| DimCashFlow | Insert, Daily |
| DimCashFlowGroup | Insert, Daily |
| DimCashFlowType | Insert, Daily |
| DimBalanceType | Insert, Daily |
| DimFAType | Insert, Daily |
| DimWarehouse | Insert, Daily |
| DimWarehouseGroup | Insert, Daily |
| DimItem | Insert, Daily |
| DimItemGroup | Insert, Daily |
| DimItemType | Insert, Daily |
| DimLocation | Insert, Daily |
| DimIntGroup | Insert, Daily |
| DimExtGroup | Insert, Daily |
| DimDepreGroup | Insert, Daily |

**Table 2**. Sample Fact data populate process

| Table Name | Integration |
|---|---|
| FactAR | Insert, Daily |
| FactAP | Insert, Daily |
| FactTB | Insert, Daily |
| FactBankAccount | Insert, Daily |
| FactFA | Insert, Daily |
| FactBudget | Insert,Yearly |
| FactWO | Insert, Daily |
| FactWODetail | Insert, Daily |
| FactWOOperation | Insert, Daily |
| FactTechnicianAttendance | Insert, Daily |

### *4.4.3. Development of SSAS*

The cube creation process in SSAS with multi fact constellation schema can seem daunting. But if the connection between each fact and dimension has been defined clearly in previous steps, than the actual steps left is to link each fact to the dimension, which is not automatically linked. Extra precaution is needed to ensure that the connection between fact and dimension is exactly as planned. The process of perfecting data cube by adding computational column and measurement begin in this stage. Computational column is added when there is a need for static calculation within the scope of a row. While measurements are added when there is a dynamic aggregate operation, such as total and subtotal, it can change according to the filtered dimension.

### *4.4.4. Development Visualization Dashboard*

The expected goals for data and information are structured so that it can be consolidated and arranged in a single screen, making the information accessible and can be easily explored (drilled down). In addition, the dashboard visualization is expected to be integrated and summarized into an interesting and easy-to-remember information series with clear important points instead of merely providing a medium for delivery of information to the right people. The graphics also enable analysis process that can assist in the decision making, which will improve performance. In presenting the chart, the process of analyzing the information content is carried out by examining the results of the meta-analysis of information with dashboard functionality. The mapping used to design the dashboard includes the allotment of the presentation media and the time parameters for displaying data in accordance with the priorities that have been decided.

### *4.4.5. Publish Dashboard*

Feature Publish Dashboard can be used if the report visualization has been completed.

### *Sales Executive Summary Dashboard*

The Executive Summary Sales Dashboard displays information that is used by the Sales Area Coordinator and CEO in monitoring dealer sales performance from a variety of perspectives such as revenue, market share, gross profit and marketing activity carried out by dealers for each brand. Each detail of the dashboard is displayed in the form of a visualization report so that it is easily understood by the user and can be sliced and drilled down as needed.


**Figure 5**. Sample Sales Executive Summary Dashboard

Referring to the dashboard visualization in Figure 5, the sales executive summary dashboard is divided into several graphs and charts that display the information. The information includes the size of the market share in the form of a chart that was achieved by a brand (in this case, the Nissan brand managed by Indomobil) compared to competing brands (Toyota, Daihatsu, Mazda, Honda, and other competing brands). Compared to Indomobil,

which are described using geospacial charts in the form of area deployment maps, there are influences from product variations or price fixing that are too high when compared to similar types of variants from competitors' brands or seen from the number of dealer networks owned by competitors.

Information about the most effective marketing activity is described in a donut chart; there, the information is displayed in order to collect customer prospects which are grouped based on the source of prospects: both from advertising in media, exhibition events at malls and other public places, routine activities at the showroom , customer voluntary visits directly to the showroom, or referred customers (those who are satisfied with the purchased product and recommend the product to others). With the existence of this marketing activity chart, the company can focus on the potential sources of prospects to win prospective customers so that planning activities and costs spent can be incurred more effectively. Information on sales profits derived from vehicle sales compared to the budget is displayed in line graphs that can be monitored for every milestone of company profit.

Other information that can be extracted from the data collection obtained from operational transactions is the number of prospective customer, and the number of customers who have placed order but can still be followed up for sales (closing deal) is shown in Figure 6.

**Figure 6**. Sample Dashboard Customer Prospect and Outstanding Order

### *Aftersales Executive Summary Dashboard*

The Executive Summary Aftersales dashboard displays information used for Aftersales Area Coordinator and CEO level to monitor the performance of after-sales dealer activities from various perspectives, both in terms of revenue, productivity mechanic, gross profit and customer retention. Each detail of the dashboard is displayed in a visualization report so that it is easily understood by the user and can be sliced and drilled down as needed.

The dashboard visualization in Figure 7 about the summary report of after-sales performance for each dealer is divided into several charts that show information on workshop revenue and gross profit that has been achieved in the chosen period. Information on the next bar chart displays the comparison of the vehicle units that is serviced in an official workshop to the number of units in operation. The data show that the vehicles entering the official workshops are fewer than the vehicles sold by the dealers, so they need to analyze further what causes this problem. Analysis from an external data that may be obtained is from a customer survey data about the level of satisfaction of after-sales services and a service price competition based on a comparison to unofficial workshops. In addition, the analysis of the estimated number of vehicles that will return to the workshop is visualized in the customer retention bar chart, which is the result of data processing of the number of vehicle units entry

service in one period divided by the number of vehicles in the selected period. This data, therefore, can predict the possibility of revenue (revenue) per dealer for upcoming workshop customer.


**Figure 7**. Sample Dashboard Aftersales Workshop General Performance

After-sales transaction activities in the company also come from spare parts inventory management transactions. The dashboard also displays the performance of spareparts transaction activities (Figure 8) in the form of revenue information and margin for sales and stock spare parts positions that can help the Aftersales Division to manage inventory better. Some important information in the dashboard that is displayed is the amount of inventory that is categorized based on its turn over time.

Inventories that have the longest turn over are categorized in red (Moving Code 5 or Death Stock) because the inventory group has no movement for more than 6 months. The spare parts item details and value can be drilled down to get the data details. Based on this information, the managerial level needs to take action so that the amount of inventory in that category can be reduced in the upcoming period. Moreover, further analysis needs to be carried out to find whether there is an error order from the partman, or is there a booking cancellation from the customer, and why it happens.


**Figure 8**. Sample Dashboard Aftersales Sparepart General Performance

### *4.4.6. The Control Process Phase*

After the implementation of the Power BI application runs properly, there are several things need to be done in the control phase, such as:

1. Making database maintenance procedures.

After all the BI data functions properly, the next urgent step is to back up and recover the data. This is very important because the information needed by the managerial level must always be available and well maintained , including having a back up procedures and set up recovering BI database.

2. Monitoring and tuning databases and queries.

After the process of implementing the Power BI application runs well, the BI database must always be monitored and adjusted to maintain its best performance and its most updated user needs.

3. Prepare documentation that contains information about the user access rights.

4. Ensure security in using the Power BI application.

In the use of the BI Power service, it is necessary to ensure that the data sources is used in a safe and integrated manner; that is, it can be done only when using existing credentials and source specific details to make connections to each data source. Connections to data sources that are supported and guaranteed are as follows:

- SQL Server Analysis Services (SSAS): Azure Active Directory implements existing role-based security and tiered security to limit data access. Even though users can view data with Power BI, the data remains in the location on Analysis Services cube level, with multilevel dimensions and security applications.
- Azure Services: Connecting Azure services integrated into Power BI uses Azure AD to manage the process of authorizing and controlling access in the cloud environment.
- SaaS Solution: Connect data from SaaS solutions to Power BI with existing SaaS credentials. Specific authentication methods vary based on service. After logging in, credentials are maintained to enable automatic data refresh.
- Excel and BI Power Desktop files: With Power BI Desktop or Excel, business analysts can import data from various local sources and publish it to Power BI. Business analysts need credentials to connect to local data sources. Private gateways store imported data synchronously so that reports and dashboards in Power BI are always updated.

5. Prepare guidelines and training for business users in using the Power BI application.

6. Setting up support for the implementation of the Power BI application both in terms of troubleshooting and handling the fulfillment of user needs.

### 4.5. Future Work

In this current stage, the case study only focusing on descriptive and predictive analysis as the first step of BI development. In the future, enhancement of Power BI at a higher level analytics (prescriptive) with machine learning in the future have to be implemented at the advanced development stage so that it can cover complex modeling and data combination scenarios which ultimately enable organizations to make data-based decisions in all aspects of the business.

## 5. CONCLUSION

Based on results discussion and implementation using Power BI as a platform in Indomobil, the conclusions are :

1.Development of business intelligence performance dashboards can be used as a reference in the decision making process.

2.The data cleansing process is the most important stage to produce the right information.

3.The involvement of the user from the analysis and design process to the result validation will greatly improve the quality of the required dashboard.

4.Power BI can conduct a business analysis at a higher level (predictive and prescriptive) by utilizing Azure Machine Learning Studio where users can quickly create prediction models by dragging, dropping, and connecting module data and visualizing the results of machine learning algorithms.

Based on this case study, the recommendation for further development are :

1. The previously designed data warehouse needs to be analyzed further so that it can be functioned optimally and efficiently so that it can perform well to support information needs in many businesses owned by company.

2. Development of the dashboard at the advanced stage will also be carried out for other business segments such as financing, rental, manufacturing and other businesses.

3.Using Power BI at a higher level analytics (predictive and prescriptive) with machine learning have to be implemented at the advanced development stage so that it can cover complex modeling and data combination scenarios which ultimately enable organizations to make data-based decisions in all aspects of the business.

4. User training needs to be considered so that the user understands how the data management is owned by the company and the user can feel the direct impact of the investment made in the development of Power BI.

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