Business Intelligence

by Silvia Rostianingsih

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Business Intelligence of Automotive Parts

Silvia Rostianingsih
Petra Christian University, Indonesia, silvia@petra.ac.id, https://orcid.org/0000-0002-9642-5761

Alexander Setiawan
Petra Christian University, Indonesia, alexander@petra.ac.id, https://orcid.org/0000-0002-1358-6851

Albert Bayu Sani, Alyssa Cahaya Rembulan, Calvin Christopher Kurniawan, Hans, Verick Gozali, Vito Varian Laman, William Sintan Sutanto
Petra Christian University, Indonesia

Abstract: Business Intelligence (BI) is widely used for reporting, visualization, and predictive analysis. Tools are used to turn data into useful information for making business decisions. Company of automotive parts sales is able to discover what the most favorite spare part is or which customer with the highest sales. Business intelligence helps companies study customer needs to gain deeper insight.

In this research, data is extracted from flat files and transformed into dimensional modeling. Data is taken from the part shop and workshop sales transactions from one of the automotive industries in Indonesia. After creating a dimensional model, we construct data visualization and predictive analysis. Data visualization is created for analysis of part shop and workshop sales transactions. The predictive analysis is using simple linear regression modeling to calculate the number of days to fulfill the order goal.

Business Intelligence helps the company find data insight such as there is an anomaly in the transaction. The visualization is using data from 2016-2020. Within five years, August is always the highest sales for the part shop sales. Whereas in average, January was the highest month for workshop sales. Although there was a new part that is launched in 2020, it became the second-highest sales. However, that part is a substitute item from another part that hold the highest sales in the previous years. During the pandemic, some large distributors are experiencing a decline in sales, while the small to middle distributors still have stable sales. This research also helps predict the number of days to fulfill the order goal.

Keywords: automotive parts, business intelligence, predictive analysis

Introduction

Business Intelligence (BI) is widely used for reporting, visualization, and predictive analysis. Tools are used to turn data into useful information for making business decisions. Company of automotive parts sales is able to

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discover what the most favorite spare part is or which customer with the highest sales. Business intelligence helps companies study customer needs to gain deeper insight. The information generated from BI affects many departments. The manufacturing department could schedule and plan their production, such as how much material they need or when to produce the spare parts. The workshop department could create service reminders to remind when the customer needs to replace its spare parts.

Stefanovic carries out business intelligence modeling to create the predictive analysis of automotive industry management. Predictive analysis with a clustering model is useful for making decisions regarding spare part inventory planning to increase sales, reduce costs, and increase customer satisfaction. The resulting model has an accuracy rate of 98.68% in the first week and 92.46% in the second week in terms of predicting the amount of stock that runs out (Stefanovic, 2015).

The importance of creating dashboards (reporting and visualization) was also expressed by Damyanov and Tsankov because of its ease of creating, retrieving data, maintaining, and quickly making changes to the information at the right place and time, as well as costs low in making decisions (Damyanov, 2019).

The research conducted by Wibowo creates a dashboard for visualizing Dengue Hemorrhagic Fever and creates mitigation recommendations based on epidemiological investigation (PE) data and patient increment status variables (Wibowo, 2020).

This research proposes a business intelligence system that can assist automotive parts industry companies in analyzing their business processes related to the sale and distribution of spare parts. In this study, a business intelligence model is made to visualize the sales and distribution of vehicle spare parts in collaboration with one of the biggest automotive dealers in Indonesia. The business intelligence is expected to provide insight in the form of the number of spare parts needed in a certain period of time. It also provides insight into customer behavior based on the type of vehicle and the required spare parts. This system not only produces reporting and visualization from past data but can also perform predictive analysis which predicts the number of days to fulfill the sales goal.

Literature Review

Business Intelligence

Business Intelligence (BI) is a collection of techniques and tools for transforming raw data into useful information for business analysis purposes (Bentley, 2017). The primary goal of BI is to gain actionable insights that lead to smarter decisions and better business results. There are three types of data analysis (descriptive, predictive, and prescriptive) that can help users achieve this goal (Lachev, 2016). Power BI offers easy configuration and integration with existing information technology, so Power BI is often referred to as self-service BI (Bansal, 2017). Power BI can be used to analyze data at a higher level (prescriptive or predictive analysis) using Azure Machine Learning Studio where users can easily perform predictive modeling by drag, drop, and the relationship between modules, and perform visualizations based on the results of machine learning algorithms (Surlisa, 2019).

Predictive Analysis

Predictive analytics include a variety of statistical techniques from predictive models, machine learning, and data mining that analyzes past data into a prediction in the future. The model will look for patterns that exist in past data that can be implemented on many systems such as analysis of the failure of a credit system related to past data of a customer, application loans, and more (Bentley, 2017). Another example related to the health system is analyzing the relationship between fertility, number of female population, public expenditure related to health, sanitation facilities, and level of birth. The behavior between countries also differs, depending on geographical aspects, characteristics labor market, and their welfare state model (Ivan, 2016).

Method

Data is extracted from flat files and transformed into dimensional modeling. Data visualization is created for analysis of workshop and part shop. Workshop transaction means sales transaction for other branches. Part shop transaction means sales transaction for any store that cooperates with this company. The system also predicts the number of days to fulfill the goal of order. The framework of business intelligence can be seen in Figure 1.

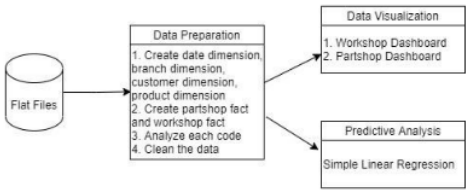


Figure 1. The famework of business intelligence

Data Preparation

Data preparation is the process of extract, load, and transform. First, data is extracted from the transaction in 2016-2020. The number of transaction can be seen in Table 1. Flat files are generated from the sales application. Sales data is obtained from part sales and workshop sales. Part shop sales are data from direct selling to a distributor. While workshop sales are data from the workshop department. Second, load is the process of loading data from flat files into Business Intelligence software. Third, we must prepare the data by cleaning the data and creating dimensional modeling. Cleaning data is the process of replacing data and deleting unnecessary or redundancy data. One of the findings is that the data cleansing process is the most important stage to produce the right information (Surlisa, 2019).

Table 1. Number of transaction

Year	Part Sales	Workshop Sales
2016	54.403	37.188

2017	59.656	31.562
2018	61.670	39.121
2019	55.818	42.473
2020	41.248	31.562

Dimensional modeling consists of dimension tables and fact tables. Dimension tables consist of date dimension, product dimension, branch dimension, and customer dimension. Fact tables consist of workshop sales transactions and part shop sales transactions. The dimensional modeling of business intelligence can be seen in Figure 2. The dimensional modeling is built based on the existing data, so each model is unique. For example, Warestika was using data from the inventory cards (stock in and stock out) for the fact tables (Warestika, 2021). Research by Lubis classiffied as a part of transactions, finances, testimonials, visits, and business performance for BackIn (backpacker reservation system) (Lubis, 2020).

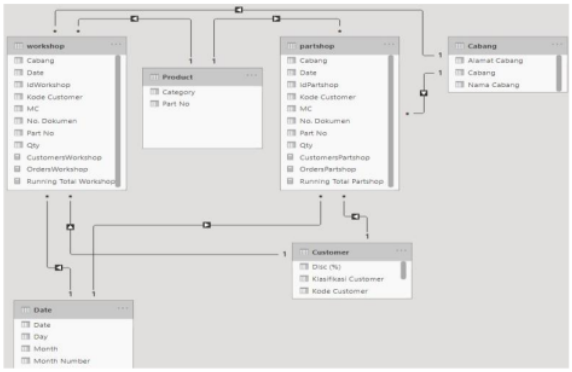
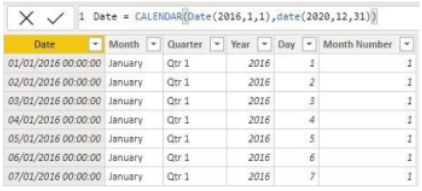


Figure 2. Dimensional modeling



Date	Month	Quarter	Year	Day	Month Number
01/01/2016 00:00:00	January	Qtr 1	2016	1	1
02/01/2016 00:00:00	January	Qtr 1	2016	2	1
03/01/2016 00:00:00	January	Qtr 1	2016	3	1
04/01/2016 00:00:00	January	Qtr 1	2016	4	1
05/01/2016 00:00:00	January	Qtr 1	2016	5	1
06/01/2016 00:00:00	January	Qtr 1	2016	6	1
07/01/2016 00:00:00	January	Qtr 1	2016	7	1

Figure 3. Date dimension

This dimension is generated from data of part shop and workshop. Date dimension is created by generating calender from 1 January 2016 until 31 December 2020 (Figure 3). Product dimension (Figure 4) contains category and part number. The part number is obtained from the parts shop and workshop table, while the category column contains the initial five characters of the part number. The name of part is hidden for confidential reason. Customer dimension (Figure 5) contains customer name, discount, and customer name. The name of customer is hidden for a confidential reason. Branch dimension (Figure 6) contains branch code, branch name, and branch address.

Part No	Category
990H0-990AB-012	990H0
990H0-990AB-016	990H0
990H0-990AE-025	990H0

Figure 4. Product dimension

Customer Code	Disc (%)	Customer Name
60146	20	Nama Customer
111288	25	Nama Customer
60410	20	Nama Customer
171154	20	Nama Customer
60496	22	Nama Customer
119492	20	Nama Customer
60363	23	Nama Customer

Figure 5. Customer dimension

Branch Code	Branch Name	Branch Address
609340100	nama cabang	Alamat cabang

Figure 6. Branch dimension

Whereas fact tables consist of workshop facts (Figure 7) and part shop facts (Figure 8). These facts contain branch number, document number, date, customer code, part number, quantity, and moving code (MC). Moving code 1 means every month the item is sold. Moving code 2 means for the past 12 months there has been 1 month of no sales. Moving code 3 means for the past 12 months there have been 3 months of no sales. Moving code 4 means for the past 12 months there have only been 3 months of sales. Moving code 5 means for the past 12 months there have been no sales for this product.

Branch	Document No	Date	Customer Code	Part No	Qty	MC
609340100	BPS/19/002357	25 March 2019	609340124	09209M09L02-000	1	1
609340100	BPS/19/002661	04 April 2019	609340124	09209M09L02-000	1	1
609340100	BPS/19/000246	09 January 2019	609340124	09471-12210-000	1	1
609340100	BPS/19/004172	24 May 2019	609340124	09471-12210-000	1	1
609340100	BPS/19/000246	09 January 2019	609340124	09471-12216-000	1	1

Figure 7. Workshop fact

Branch	Document Number	Date	Customer Code	Part No	Qty	MC
609340100	FPJ/19/005176	12 June 2019	60363	09283-98002-000	1	1
609340100	FPJ/19/005149	12 June 2019	60363	09352B70L04N190	1	1
609340100	FPJ/19/005260	15 June 2019	60363	09471B12182N000	1	1
609340100	FPJ/19/005260	15 June 2019	60363	11141-61J10-000	1	1
609340100	FPJ/19/002131	28 February 2019	60363	11141-71C00-000	1	1

Figure 8. Part shop dimension

Data Visualization

Reporting and visualization is used to analyze data in the past. There are three dashboards which are analyzed workshop transaction, part shop transaction, and customer. The workshop dashboard (Figure

9) and part shop dashboard (Figure 10) are identical. The dashboard is filtered with the transaction from 1 January 2019 until 30 June 2019. In the first visualization section (top left) there is a card that informs how many workshop orders occurred in a certain period (based on the filter date on the right). This measure contains a distinct count from the column number of documents in the workshop or part shop fact table. The second card informs the number of parts that have been sold during a certain period (based on the filter date on the right). This measure contains a summarization of the quantity of parts that are sold. The third card shows how many customers have ordered part of the workshop to the company during a certain period (based on the filter date on the right).

Figure 9. Workshop dashboard

Figure 10. Part shop dashboard

The first visual (middle left) is a clustered column chart to compare the number of orders per month. January is the month with the highest number of sales, while June is the quietest month for workshops. The second visual is the line chart for forecasting workshop orders for two months forward. The forecast parameters are forecast length, confidence length, and seasonality (Figure 11). The forecast length sets the period time for forecasting, for example, two months. Ignore last is used for ignoring a few last months of the data, while the confidence interval is useful for determining the confidence level for the forecast to be made. The last one is seasonality which is defined as the

number of time steps needed for a full data cycle, for example, the forecast length is two months with data per day. Therefore the seasonality is set to 2 x 30 which is 60. The third visual is a clustered bar chart for the top five best seller products. The fourth visual uses a clustered column chart where information on the quantity sold each month will be obtained. The next visual aims to describe the comparison of product sales from each MC each month. This visual will use a clustered bar chart type. The last visual is a donut chart that provides information on the top five customers with the most frequent purchases.

Figure 12 visualizes the customer dashboard. The first visualization (top left) is clustered bar chart which is useful for visualizing ten customers with the highest number of part shop orders and displaying the discounts they get. The second visualization (bottom left) is a donut chart to display the percentage distribution of the number of customers who are classified as High / Medium / Low (High = have bought more than 25000 items, Medium = have bought more than 5000 items, Low = have bought less than 5000 items). The third visualization (bottom right) is displaying complete customer data in the form of customer code, customer name, quantity, discount (%), order quantity, and customer classification.

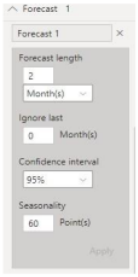


Figure 11. Forecast parameter

Figure 12. Customer dashboard

Predictive Analysis

The predictive analysis is using a simple linear regression model. The simple linear regression model is used to make predictions number of days to fulfill the order goal. The Workshop predictive analysis (Figure 13) and part shop predictive analysis (Figure 14) are identical.

The first card is the number of workshop (or part shop) orders during a certain period (according to the filter date range). The second card aims to display the goal order to be achieved by the company based on the input. The third card shows the difference between the goal. The fourth card shows the average order per day. The fifth card shows how many days it will take to reach the goal. The graph shows a comparison between two lines, namely the running order line and the linear regression line.

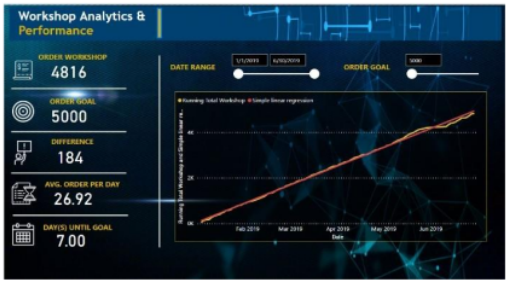


Figure 13. Workshop predictive analysis using simple linear regression

Figure 14. Part shop predictive analysis using simple linear regression

Results

The business intelligence is using data from 2016-2020. Figure 15 shows the total part shop and workshop sales numbers for each month. Within four years (20162019), August is always the highest sales for the part shop sales. Whereas in average, January is the highest month for workshop sales. In the year 2016, June is the highest month for workshop sales and in the year 2018, May is the highest month for workshop sales.

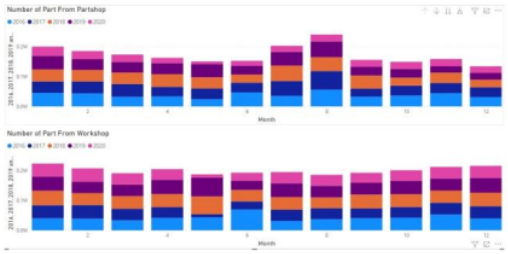


Figure 15. Total sales of part shop and workshop for 2016-2020

Figure 16 shows the total sales number for each part per year. Part number 990H021040-004 is the new part that is sold in 2020 and surprisingly it becomes the second-highest of the total sales. However, when we look closer, the part number 16510-61A31-000 and 990H0-21040-004 had the same category. Thus when we summarize these two parts, it is apparent that part number 990H0-21040-004 is just a substitute item. The sales in the year 2020 are falling apart because a pandemic is spread worldwide and forcing people to reduce their mobile activity.

Figure 17 shows the total sales number for each customer per year. In the last two years (2019-2020), customer number 60146 had decreased sales. While customer number 60411 and 60139 still experiencing stable sales. It shows that some large distributors are experiencing a decline in sales, while the small to middle distributors still have stable sales.

Part No	2016	2017	2018	2019	2020
16510-61J00-000	24,196	20,794	21,053	21,215	14,918
990H0-21040-004					9,438
09305-13002L000	18,284	18,695	15,868	14,116	8,232
99000B10W40N040	8,278	16,777	20,402	25,347	7,775
99000B99010N010	11,842	12,528	11,256	12,360	4,920
99000B10W40N010	7,224	13,128	13,416	14,426	4,753
16510-73060L000	11,966	6,940	7,532	6,566	4,498
09482B00L10N000	6,854	6,363	5,598	6,170	4,393
99000B99208N208	15,600	11,232	10,400	10,192	4,160
09289-07007-000	11,960	10,077	7,332	5,732	4,073
33140-74010-000	7,039	7,050	6,894	5,838	3,806
09409M07L01-000	2,784	3,671	4,011	6,516	3,591
41331-62020L000	5,673	6,394	5,929	5,077	3,360
99000B10W40N208	3,328	4,784	5,824	4,576	3,328
55200B77502N000	9,023	8,467	7,563	4,409	3,274
99000B00W20N208	1,664	3,536	5,616	6,032	2,912
09289B05013N000	5,842	5,171	4,796	4,382	2,834
990H0-21040-001					2,664
99000B00W20N001	1,732	3,243	4,494	6,034	2,595
17521-86550L000	3,701	4,069	3,938	3,237	2,492
990H0-21030-208					2,288
Total	**461,287**	**459,363**	**454,014**	**427,005**	**264,670**

Figure 16. Total sales by part for part shop

Kode Customer	2016	2017	2018	2019	2020
60411	78,609	65,108	64,511	60,398	45,406
60139	14,368	30,896	36,826	44,652	27,807
60146	129,079	121,181	116,069	65,357	20,150
60181	24,256	23,269	24,599	29,955	17,789
60363	21,239	24,887	23,563	19,719	15,225
60438		14,080	18,012	17,918	10,068
60136	6,996	9,059	10,490	11,945	9,731
60445	8,065	7,150	8,123	7,183	7,448
111288		2,238	10,349	7,792	6,839
60123	9,071	6,502	7,008	6,181	6,703
230431					6,640
60558		3,736	4,825	6,456	6,026
60203	5,978	5,770	6,590	6,725	5,474
60410	4,578	6,590	8,436	7,888	5,321
60496	5,143	1,073	1,270	4,454	4,880
60262	5,983	6,636	6,749	5,109	4,871
60414	5,288	3,747	2,869	3,757	4,482
196659			13,146	15,207	4,332
Total	**461,287**	**459,363**	**454,014**	**427,005**	**264,670**

Figure 17. Total sales by customer for part shop

Conclusion

Dimensional modeling consists of date dimension, product dimension, branch dimension, and customer dimension, workshop sales transactions and part shop sales transactions. Business Intelligence helps the company find data insight such as there is an anomaly in the transaction. Within five years (2016-2020), August is always the highest sales for the part shop sales. Whereas in average, January was the highest month for workshop sales. Although there was a new part that is launched in 2020, it became the second-highest sales. However, that part is a substitute item from another part that hold the highest sales in the previous years. During the pandemic, some large distributors are experiencing a decline in sales, while the small to middle distributors still have stable sales. This research also helps predict the number of days to fulfill the order goal.

Acknowledgments or Notes

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