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Design of the Business Intelligence Dashboard for Sales Decision Making

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***Abstract*---**Business intelligence is a system that can help an executive or a decision-maker to analyze a fact that can become a value from a profit or sales from a different dimension. Business intelligence provides a data visualization usually in a form of graphics or charts that can help the decision-maker to make a decision. It can also help to do trend analysis and help make an indicator when the business is off the track. It can help the decision making a process like for item positioning and customer segmentation. The creation of a business intelligence dashboard can help PT. Inisiatif Mitra Mandiri to do the extensive analysis in order to make a decision such as sales performance monitoring, item positioning, and monitoring, and customer segmentation dashboard. Sales performance monitoring means that they can monitor the sales performance of a company and helping the executive to realize when their sales performance is off the track and need to be fixed. It gives a trend analysis about the sales and can help the executive to detect the losses. While item monitoring can be used to monitor the item in each site that is having high demand and can be used to plan for a placing and stocking the items on that site. For instance, executives can manage to make planning for item stocking on each site by looking to the previous years on which items are getting high demand. For customer segmentation, it can be used to determine a profitable customer that needs to be retained and it needs customer data from various dimensions that can help them to do the customer segmentation.

Keywords— *Design, Business Intelligence, Dashboard, Decision Making, Star Scheme*

I. INTRODUCTION

In this globalization era, the process of making the right decision has become harder. A business application that can only generate an operational report sometimes is not enough to do extensive analysis and executive required to do more depth analysis to make a good decision (Budiawan, 2018). It is because an operational report is not designed for analysis purposes and executives need something to do extensive analysis to have more information needed to create a decision. In order to solve this problem, we need to develop a kind of system that can help to generate a report that can help the executive to make an analysis.

Business intelligence is a system that can help an executive or a decision-maker to analyze a fact that can become a value from a profit or sales from a different dimension. Business intelligence provides a data visualization usually in a form of graphics or charts that can help the decision-maker to make a decision. It can also help to do trend analysis and help make an indicator when the business is off the track. It can help the decision making a process like for item positioning and customer segmentation.

PT. Inisiatif Mitra Mandiri is one of the companies that engaged in the field of information technology. They realize that to extend their product capability and helping their clients in doing the decision making they need to create business intelligence. By learning from existing research, the creation of business intelligence can help their client to do extensive analysis in order to make a decision with PT. Inisiatif Mitra Mandiri business intelligence

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dashboard such as sales performance monitoring, item positioning, and monitoring, and customer segmentation dashboard.

Sales performance monitoring means that they can monitor the sales performance of a company and helping the executive to realize when their sales performance is off the track and need to be fixed. It gives a trend analysis about the sales and can help the executive to detect the losses. While item monitoring can be used to monitor the item in each site that is having high demand and can be used to plan for a placing and stocking the items on that site. For instance, executives can manage to make planning for item stocking on each site by looking to the previous years on which items are getting high demand. For customer segmentation, it can be used to determine a profitable customer that needs to be retained and it needs customer data from various dimensions that can help them to do the customer segmentation.

A. Scope

The scope of this research is as follows:

a. Sales performance

Including sales data that can be seen through by grouping the measure of the total sales by site and time dimension.

b. Item positioning and monitoring

Including sales data that can be seen through by grouping the measure of the total sales by site, item and time dimension.

c. Customer segmentation

Including sales data that can be seen through by grouping the measure of the total sales by customer, item and time dimension.

B. Methodology

In making this research, needs to be supported by data and references. Implementation of the methodology is in accordance with the standards of research. Several methods are used, among other things:

1) Data Collection

Method of data collection is done in three ways, namely:

a. Interview

Collecting data by interviewing the relevant parties such as the owner of the company and staff involved in the project.

b. Observation

Observation by looking at the current application and the current reports.

c. Literature Study

In this method data and information, the collection is done by reading books and scientific paper or journal that related to business intelligence and it can be used as a reference in this research.

2) Methods of Analysis

Before starting the construction of business intelligence, business intelligence needed opportunity analysis to identify and prioritize the needs of business information which will bring maximum benefits for the company (Williams & Williams, 2006). Business intelligence opportunity analysis consists of:

a. Identify existing business drivers.

At this stage, the internal and external factors affecting the company's business processes are identified.

b. Identify the business strategy, goals and objectives.

At this stage of the company's strategy and objectives are translated, so it can be prioritized where more information is needed in order to increase corporate profits.

c. Identify the business design.

At this stage of the business process that runs are elaborated. This stage is further divided into two, namely:

1. Recognize the value disciplines.

At this stage, the company described the advantages compared to similar companies engaged in the same plane.

2. Recognizing the need for core business value aided the process with business intelligence.

At this stage management or operational processes that need to be assisted with the business intelligence process will be outlined.

d. Identify the business value that will be obtained when applied to business intelligence.

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At the last stage described the benefits obtained from business intelligence that will be applied to the organization.

3) Design Method

There are four steps in designing a business intelligence application as a whole. The steps consist of analysis, design, planning, and implementation and control (Vercellis, 2009). The four steps are as follows:

a. Analysis

The first step in business intelligence development is analysis steps that are identifying what are the objective, priorities, and the benefit of doing the business intelligence project.

b. Design

At this stage, it is necessary to make an assessment of the existing information infrastructures. Moreover, the main decision-making processes that are to be supported by the business intelligence system should be examined, in order to adequately determine the information requirements.

c. Planning

The planning stage includes a sub-phase where the functions of the business intelligence system are defined and described in greater detail. This stage identified the sources of the needed data to be inserted into the data warehouse.

d. Implementation and Control

The last phase consists of five main sub-phases.

- *Development of data warehouses and data marts*. These represent the information infrastructures that will feed the business intelligence system.
- *Development of ETL tools*. Procedure to extract and transform the data existing in the primary sources, loading them into the data warehouse and the data marts
- *Development of metadata*. These explain the meaning of the data contained in the data warehouse and the transformations applied in advance to the primary data.
- *Development of applications*. Developing the core business intelligence applications that allow the planned analyses to be carried out.
- *Release and testing*. The system is released for test and usage

First, the data warehouse is developed. These represent the information infrastructures that will feed the business intelligence system. In order to explain the meaning of the data contained in the data warehouse and the transformations applied in advance to the primary data, a metadata archive should be created. Moreover, ETL procedures are set out to extract and transform the data existing in the primary sources, loading them into the data warehouse and the data marts. The next step is aimed at developing the core business intelligence applications that allow the planned analyses to be carried out.

II. LITERATURE REVIEW

A. Database

The database is a single, possibly large repository of data that can be used simultaneously by many departments and users. Instead of disconnected files with redundant data, all data items are integrated with a minimum amount of duplication. The database is no longer owned by one department but is a shared corporate resource. The database holds not only the organization's operational data, but also a description of this data. For this reason, a database is also defined as a self-describing collection of integrated records. The description of the data is known as the system catalog (or data dictionary or metadata—the "data about data"). It is the self-describing nature of a database that provides program–data independence (Connolly & Begg, 2015).

The approach taken with database systems, where the definition of data is separated from the application programs, is similar to the approach taken in modern software development, where an internal definition of an object and a separate external definition are provided. The users of an object see only the external definition and are unaware of how the object is defined and how it functions. One advantage of this approach, known as data abstraction, is that we can change the internal definition of an object without affecting the users of the object, provided that the external definition remains the same. In the same way, the database approach separates the structure of the data from the application programs and stores it in the database. If new data structures are added or existing structures are modified, then the application programs are unaffected, provided that they do not directly depend upon what has been modified. For example, if we add a new field to a record or create a new file, existing applications are unaffected. However, if we remove a field from a file that an application program uses, then that application program is affected by this change and must be modified accordingly (Connolly & Begg, 2015).

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B. Data Warehouse

The data warehouse is a subject-oriented, integrated, nonvolatile, and time-variant collection of data in support of management's decisions. The data warehouse is the heart of the architected environment and is the foundation of all DSS processing (Vercellis, 2009).

A data warehouse is a foremost repository for the data available for developing business intelligence architectures and decision support systems (Vercellis, 2009).

Based on the definitions above, it can be concluded that the data warehouse is the primary repository where it is subject-oriented, integrated, nonvolatile, and time-variant for developing business intelligence architectures.

4) Main Categories of Data Feeding

It is possible to identify three main categories of data feeding into a data warehouse: internal data, external data and personal data.

a) Internal Data

Internal data are stored for the most part in the databases, referred to as transactional systems or operational systems that are the backbone of an enterprise information system. Internal data are gathered through transactional applications that routinely preside over the operations of a company, such as administration, accounting, production, and logistics (Vercellis, 2009).

These data usually come from different components of the information system:

1. Back-office systems that collect basic transactional records such as orders, invoices, inventories, production and logistics data.
2. Front-office systems, that contain data originating from call-center activities, customer assistance, and execution of marketing campaigns.
3. Web-based systems that gather sales transactions on e-commerce websites, visits to websites, data available on forms filled out by existing and prospective customers.
4.

b) External Data

There are several sources of external data that may be used to extend the wealth of information stored in the internal databases (Vercellis, 2009).

To be concluded, the differences between internal data and external data is, if internal data is retrieving data from the database, then the external data is retrieved data that does not exist in the database.

c) Personal Data

In most cases, decision-makers performing a business intelligence analysis also rely on information and personal assessments stored inside worksheets or local databases located in their computers. The retrieval of such information and its integration with structured data from internal and external sources is one of the objectives of knowledge management systems (Vercellis, 2009).

5) Characteristics of Data Warehouse

There are four main characteristics of the data warehouse(Inmon, 2005), divided into:

a) Subject oriented

Subject oriented means a data warehouse is based on the main subject in the corporate environment and not process-oriented or application functions. Subject areas include the usual customer, product and transaction. Each subject area is physically implemented as a set of related tables in the data warehouse.

b) Integrated

Of all the aspects of a data warehouse, integration is the most important. Data is fed from multiple, disparate sources into the data warehouse. As the data is fed, it is converted, reformatted, resequenced, summarized, and so forth. The result is that data once it resides in the data warehouse has a single physical corporate image.

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c) Non-volatile

Data warehouse's data is loaded (usually, but not always, en masse) and access, but it is not updated (in the general sense). Instead, when data in the data warehouse is loaded, it is loaded in a snapshot, static format. When subsequent changes occur, a new snapshot record is written. In doing so, a historical record of data is kept in the data warehouse.

d) Time-variant

The time-variant implies that every unit of data in the data warehouse is accurate as of some moment in time. In some cases, a record is time-stamped. In other cases, a record has a date of a transaction. But in every case, there is some form of time marking to show the moment in time during which the record is accurate.

Based on the descriptions above, characteristic the data warehouse is subject-oriented because the data is organized based on the main subject. The second characteristic of the data warehouse that it is integrated because once the data residing in a data warehouse, it has a single physical corporate image even though it came from different sources. Non-volatile because of data warehouse ability to keep a historical record of data and it can't be updated. The last salient characteristic is time-variant, which implies every unit of data in the data warehouse is accurate as of some moment in time.

6) ETL (Extract, Transform, Load) Tools

a) Extract

During the first phase, data are extracted from the available internal and external sources. A logical distinction can be made between the initial extraction, where the available data relative to all past periods are fed into the empty data warehouse and the subsequent incremental extractions that update the data warehouse using new data that become available over time. The selection of data to be imported is based upon the data warehouse design, which in turn depends on the information needed by business intelligence analyses and decision support systems operating in a specific application domain (Vercellis, 2009).

b) Transform

The goal of the cleaning and transformation phase is to improve the quality of the data extracted from the different sources, through the correction of inconsistencies, inaccuracies and missing values (Vercellis, 2009). Some of the major shortcomings that are removed during the data cleansing stage are:

a. inconsistencies between values recorded in different attributes having the same meaning;
b. data duplication;
c. missing data;
d. existence of inadmissible values

During the cleaning phase, preset automatic rules are applied to correct most recurrent mistakes. In many instances, dictionaries with valid terms are used to substitute the supposedly incorrect terms, based upon the level of similarity. Moreover, during the transformation phase, additional data conversions occur in order to guarantee homogeneity and integration with respect to the different data sources. Furthermore, data aggregation and consolidation are performed in order to obtain the summaries that will reduce the response time required by subsequent queries and analyses for which the data warehouse is intended (Vercellis, 2009).

c) Load

Finally, after being extracted and transformed, data are loaded into the tables of the data warehouse to make them available to analysts and decision support applications (Vercellis, 2009).

7) Dimensionality Modeling

Dimensionality modeling is a logical design technique that aims to present the data in a standard, the intuitive form that allows for high-performance access. Dimensionality modeling uses the concepts of Entity-Relationship (ER) modeling with some important restrictions. Every dimensional model (DM) is composed of one table with a composite primary key, called the fact table, and a set of smaller tables called dimension tables (Connolly & Begg, 2015).

There are three basic types of dimensional models, one of them is star schema. Star schemas have one fact table and several dimension tables (Ballard, Farrell, Gupta, Mazuela, & Vohnik, 2006).

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Star schema is a logical structure that has a fact table containing factual data in the center, surrounded by dimension tables containing reference data (which can be denormalized). The representation of multidimensional star schema contains two types of data tables: dimension tables and fact tables (Vercellis, 2009).

Based on the statements above, it can be concluded that star schema is the logical structure of the data that enables two types of tables, they are dimension tables and fact tables. Dimension tables contain data that is compatible with the needs of business and the facts surrounding the table to obtain the information.

The multi-dimensional representation is based on a star schema that contains two types of data tables: dimension tables and fact tables. A fact table is a table that generally contains something that can be measured and historical, and a collection of a foreign key from the primary key contained in each dimension table (Vercellis, 2009). Fact tables usually refer to transactions and contain two types of data:

a. Links to dimension tables, that are required to properly reference the information contained in each fact table.

b. Numerical values of the attributes that characterize the corresponding transactions and that represent the actual target of the subsequent OLAP analyses.

Therefore, the fact table contains derived data and connects one or more dimension tables. The dimension table is a table that contains categories with summary details of which can be in the form of reports. In general, dimensions are associated with the entities around which the processes of an organization revolve.

8) Metadata

In order to document the meaning of the data contained in a data warehouse, it is recommended to set up a specific information structure, known as metadata, i.e. data describing data. The metadata indicate for each attribute of a data warehouse the original source of the data, their meaning and the transformations to which they have been subjected. The documentation provided by metadata should be constantly kept up to date, in order to reflect any modification in the data warehouse structure. The documentation should be directly accessible to the data warehouse users, ideally through a web browser, according to the access rights pertaining to the roles of each analyst (Connolly & Begg, 2015).

9) Staging Area

The staging area is the place where the extracted and transformed data is placed in preparation for being loaded into the data warehouse. The purpose of the staging area is for handling data extracted from the source system. There can be data transformations at this point and/or as the data is loaded into the data warehouse. The structure of the staging area depends on the approach and tool used for the extract, transform, and load (ETL) processes (Ballard, Farrell, Gupta, Mazuela, & Vohnik, 2006).

Based on the statements above, it can be concluded that the staging area is the place where the ETL process runs for consumption by the business users.

10) Dimension Table

Dimension tables contain attributes that describe fact records in the fact table. Some of these attributes provide descriptive information; others are used to specify how fact table data should be summarized to provide useful information to the business analyst. Dimension tables contain hierarchies of attributes that aid in summarization (Ballard, Farrell, Gupta, Mazuela, & Vohnik, 2006).

The dimension table contains relevant, yet separate, information (such as the corporate calendar, the corporate pricing tables, the locations of stores, the means of shipment for an order, and so forth). The dimension table defines important, yet ancillary, information that relates to the fact table (Inmon, 2005).

11) Fact Table

The fact table is a structure that contains many occurrences of data. The fact table and the dimension table are related to the existence of a common unit of data (Inmon, 2005).

Fact tables usually refer to transactions and contain two types of data:

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a. Links to dimension tables, that are required to properly reference the information contained in each fact table.

b. Numerical values of the attributes that characterize the corresponding transactions and that represent the actual target of the subsequent OLAP analyses.

Based on the statements above, it can be concluded that a fact table is the primary table in a dimensional model and related to the dimension table by the existence of a common unit of data.

C. Dashboard

Today's dashboards are direct descendants of the old EIS and DSS systems with greatly improved functionality and appearance. That's because they are linked to today's powerful data systems and utilize a tightly focused Key Performance Indicator.

Three types of the dashboard(Scheps, 2018) are:

12) Tactical Dashboards

Measure short-term productivity and effectiveness. Their output is often used by an individual contributor. As an example, a network engineer might have a tactical dashboard that actively monitors real-time IT infrastructure statistics and trends. And it can help to tip-off when something is wrong immediately.

13) Operational Dashboards

Quantity the short and medium-term effectiveness of a specific business function (or family of business functions) at the team of the business-unit level. This level of the dashboard could potentially be deployed for an individual knowledge worker or a local team manager. The trends and metrics displayed will have an impact on short-term decisions.

14) Strategic Dashboards

Built for the policy-setting levels of the organization (such as the chief-level executives or business-unit directors). These dashboards display metrics that represent corporate strategy and direction.

D. Business Intelligence

15) Definition of Business Intelligence

Business information and business analyses within the context of key business processes that lead to decisions and actions and that result in improved business performance (Williams & Williams, 2006).

Business intelligence can be defined as the processes, technologies, and tools needed to turn data into information, information into knowledge, and knowledge into plans that drive profitable business action. Business intelligence encompasses data warehousing, business analytical tools, and content/knowledge management.

Business intelligence may be defined as a set of mathematical models and analysis methodologies that exploit the available data to generate information and knowledge useful for complex decision-making processes (Vercellis, 2009).

16) Purpose of Business Intelligence

The main purpose of business intelligence systems is to provide knowledge workers with tools and methodologies that allow them to make effective and timely decisions (Vercellis, 2009).

a) Effective decisions

The application of rigorous analytical methods allows decision-makers to rely on information and knowledge that are more dependable. As a result, they are able to make better decisions and devise action plans that allow their objectives to be reached in a more effective way.

b) Timely decision

Enterprises operate in economic environments characterized by growing levels of competition and high dynamism. As a consequence, the ability to rapidly react to the actions of competitors and to new market conditions is a critical factor in the success or even the survival of a company.

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17) Business Intelligence Architecture

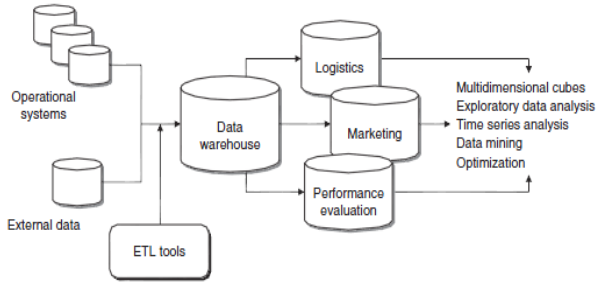

Figure 1:*Typically Business Intelligence Architecture*

Business intelligence architectures contain three major components (Vercellis, 2009), they are:

a) Data sources

In the first stage, it is necessary to gather and integrate the data stored in the various primary and secondary sources, which are heterogeneous in origin and type. The sources consist for the most part of data belonging to operational systems but may also include unstructured documents, such as emails and data received from external providers.

b) Data warehouses and data marts

Using extraction and transformation tools known as extract, transform, load (ETL), the data originating from the different sources are stored in databases intended to support business intelligence analyses.

c) Business intelligence methodologies

Data are finally extracted and used to feed mathematical models and analysis methodologies intended to support decision-makers. In a business intelligence system, several decision support applications may be implemented. And that is included decision support application:

1. Multidimensional cube analysis
2. Exploratory data analysis
3. Time series analysis
4. Inductive learning models for data mining
5. Optimization models

18) Business Intelligence Opportunity Analysis Overview

The principal methods of BI opportunity analysis are to identify and prioritize opportunities to use business information, business analyses, and structured decisions. The principal objectives are to increase revenue and/or reduce costs, thereby increasing profits and creating business value(Williams & Williams, 2006). To accomplish those objectives, a structured approach that aligns two key factors with each other is needed:

a. Business drivers, business strategies, goals and objectives, and the core business processes that drive provided.

b. BI applications that will improve the effectiveness of those core business processes.

19) Development of a Business Intelligence

There are 4 main steps in the development of business intelligence(Vercellis, 2009), there are:

a.Analysis

During this phase, the needs of the organization relative to the development of a business intelligence system should be carefully identified. This preliminary phase is generally conducted through a series of interviews of knowledge workers performing different roles and activities within the organization. It is necessary to clearly describe the general objectives and priorities of the project, as well as to set out the costs and benefits deriving from the development of the business intelligence system.

b. Design

The second phase includes two sub-phases and is aimed at deriving a provisional plan of the overall architecture, taking into account any development in the near future and the evolution of the system in the mid-term. First, it is necessary to make an assessment of the existing information infrastructures. Moreover, the main decision-making processes that are to be supported by the business intelligence system should be examined, in order to adequately determine the information requirements. Later on, using classical project management methodologies, the project plan will be laid down, identifying development phases, priorities, expected execution times and costs, together with the required roles and resources.

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c.Planning

The planning stage includes a sub-phase where the functions of the business intelligence system are defined and described in greater detail. Subsequently, existing data, as well as other data that might be retrieved externally, are assessed. This allows the information structures of the business intelligence architecture, which consists of a central data warehouse and possibly some satellite data marts, to be designed. Simultaneously with the recognition of the available data, the mathematical models to be adopted should be defined, ensuring the availability of the data required to feed each model and verifying that the efficiency of the algorithms to be utilized will be adequate for the magnitude of the resulting problems. Finally, it is appropriate to create a system prototype, at low cost and with limited capabilities, in order to uncover beforehand any discrepancy between actual needs and project specifications.

d. Implementation and control

Implementation and control are the last phases and consist of five main sub-phases. First, the data warehouse and each specific data mart are developed. These represent the information infrastructures that will feed the business intelligence system. In order to explain the meaning of the data contained in the data warehouse and the transformations applied in advance to the primary data, a metadata archive should be created. ETL procedures are set out to extract and transform the data existing in the primary sources, loading them into the data warehouse and the data marts. The next step is aimed at developing the core business intelligence applications that allow the planned analyses to be carried out. Finally, the system is released for test and usage.

III. PROPOSE DESIGN

A. Identification of Data Warehouse

20) Star Schema

The figure below is a star schema that consists of dimensiSiteFix, dimensiItemFix, dimensiTimeFix, dimensiCustomerFix dimension that connected to the fact table.

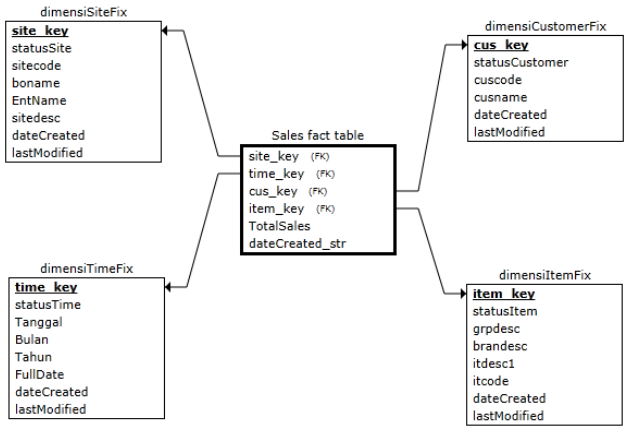

Figure 2:*Star Schema*

Combination of TotalSales with dimensiSiteFix, dimensiTimeFix, dimensiItemFix, dimensiCustomeFix to create Business Intelligence dashboard. For customer segmentation that can be created from dimensiCustomerFix, dimensiItemFix, and dimensiTimeFix. We can know which information about the customer frequency of doing business with a company from a time view. The company can know the total of customer purchases and also knowing each customer that buying what kind of every product group from the company.

For item positioning that can be created from dimensiItemFix, dimensiTimeFix, dimensiSiteFix to create Business Intelligence dashboard. We can know information about item sales for each site. We also can visualize the total of each item sales.

Sales monitoring can be done by looking at total sales measure and with the help of a mathematical model, it can be used to visualize sales performance that can be group by dimensiSiteFix and dimensiTimeFix. And also

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by having historical data stored in the data warehouse, we can visualize sales forecasts that can be group by dimensiSiteFix and dimensiTimeFix.

21) Metadata Design

There are five metadata that are created in this case, they are:

1. Site Dimension Metadata

Table name: dimensiSiteFix

Description: Metadata table of site dimension. This dimension can be used to group measure of total sales by site description, branch office name and entity name.

Table 1: *Site Dimension Metadata*

Field Name	Data Type	Size	Desc	Table Source	Field Source	Transformation
site_key	int	-	Surrogate key of site dimmension	-	-	Create
statusSite	varchar	255	Status of site data	-	-	Create
sitecode	varchar	255	Code of site	mmmsite	Sitecode	Copy
boname	varchar	255	Branch Name	bsmbo	Boname	Copy
EntName	varchar	255	Entity Name	sysenti	EntName	Copy
sitedesc	varchar	255	Site Name	mmmsite	Sitedesc	Copy
lastModified	varchar	30	Last update date of site data	-	-	Create
dateCreated	varchar	30	Entry date when site data is entered	-	-	Create

2. Customer Dimension Metadata

Table name: dimensiCustomerFix

Description: Metadata table of the customer dimension. This dimension can be used to group a measure of total sales by customer name.

Table 2:*Customer Dimension Metadata*

Field Name	Data Type	Size	Description	Table Source	Field Source	Transformation
cus_key	Int	-	Surrogate key of customer dimension	-	-	Create
statusCustomer	Varchar	255	Status of customer data	-	-	Create
cuscode	Varchar	255	Code of customer	somcust	cuscode	Copy
cusname	Varchar	255	Customer Name	somcust	cusname	Copy
lastModified	varchar	30	Last update date of customer data	-	-	Create
dateCreated	varchar	30	Entry date when customer data is entered	-	-	Create

3. Item Dimension Metadata

Table name: dimensiItemFix

Description: Metadata table of item dimension. This dimension can be used to group a measure of total sales by a group of item descriptions, brand descriptions, and item descriptions.

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Table 3:*Item Dimension Metadata*

Field Name	Data Type	Size	Description	Table Source	Field Source	Transformation
item_key	int	-	Surrogate key of item dimension	-	-	Create
statusItem	varchar	255	Status of item data	-	-	Create
grpdesc	varchar	255	Item Group description	mmmitgrp	grpdesc	Copy
branddesc	varchar	255	Item Brand description	mmmbrand	branddesc	Copy
itdesc1	varchar	255	Item description	mmmitem	itdesc1	Copy
itcode	varchar	255	Item code	mmmitem	itcode	Copy
lastModified	varchar	30	Last update date of item data	-	-	Create
dateCreated	varchar	30	Entry date when item data is entered	-	-	Create

4. Time Dimension Metadata
Table name: dimensiTimeFix
Description: Metadata table of item dimension. This dimension can be used to group measure of total sales by day, month and year.

Table 4: *Time Dimension Metadata*

Field Name	Data Type	Size	Description	Table Source	Field Source	Transformation
time_key	int	-	Surrogate key of time dimension	-	-	Create
statusTime	varchar	255	Status of time data	-	-	Create
Tanggal	varchar	255	Day of transaction	arminvo	arinvoicedate	Transform
Bulan	varchar	255	Month of transaction	arminvo	arinvoicedate	Transform
Tahun	varchar	255	Year of transaction	arminvo	arinvoicedate	Transform
FullDate	datetime	-	Date of transaction	arminvo	arinvoicedate	Copy
lastModified	varchar	30	Last update date of date data	-	-	Create
dateCreated	varchar	30	Entry date when date data is entered	-	-	Create

5. Sales Fact Metadata
Table name: FactTableSales
Description: Metadata table of fact table.

Table 5:*Sales Fact Metadata*

Field Name	Data Type	Size	Description	Table Source	Field Source	Transformation
time_key	int	-	Foreign Key from time dimmension.	dimensiTimeFix	Time_key	Copy
cus_key	int	-	Foreign Key from customer	dimensiCustomerFix	Cus_key	Copy

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			dimmension .			
site_key	int	-	Foreign Key from site dimmension .	dimensiSiteFix	Site_key	Copy
Item_key	Int	-	Foreign Key from item dimmension .	dimensiItemFix	Item_key	Copy
TotalSales	float	-	Total Sales	ardinvo	SUM(arquantityinvoice *arsalesprice)	Calculate
dateCreated_str	varchar	30	Entry date when sales data is entered	-	-	Create

B. Definition of a mathematical model

In this stage, the mathematical model that is going to be used for graphs with calculation (trend line and forecasting) has been defined. There are 2 formulas that are going to be used in drawing the trend line and forecasting for the business intelligence dashboard, they are:

1. Polynomial Degree 2 Model

(Month of FullDate^2 + Month of FullDate + intercept)

Notes: Intercept are a distancefrom the origin tothe point where line, curveorsurfacecuttingthe coordinateaxes.

2. Exponential Smoothing

$F_{t+1} = \alpha Y_t + (1 - \alpha)F_t$

F_{t+1} = forecast of the time series for period t+1.

Y_t = actual value of the time series in period t.

F_t = forecast of the time series for period t.

α = smoothing constant.

C. Development of Prototype

Based on the project requirements that have been defined before, there will be a development of four Business Intelligence dashboards, which will helps in fulfilling executives' needs. The four dashboards are:

1. Customer Segmentation Dashboard

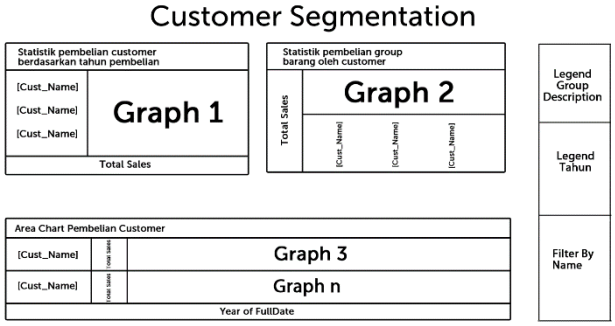

Figure 2:*Customer Segmentation Dashboard Design*

This dashboard is designed because the company is having problem in determining which customer is the most profitable and the user can see from the dashboard which customer are having the highest sales. From that the user can do a segmentation and determine if the customer are need to retain and take action.

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Graph 1 showing a statistic in horizontal bar about customer with their sales data and this graph is depict by combining data from time dimension, customer dimension, and total sales fact. The time dimension year attribute are used to show user about how many sales transaction the customer do with the company on each year. Each year had different color to differentiate each year.

Graph 2 showing a statistic in stacked bar about customer with their sales data and this graph is depict by combining data from item dimension, customer dimension, and total sales fact. The item dimension are using grpdesc attribute to show how much item and what kind of item in item group does the customer usually buy. Each item group had different color to differentiate each item group.

Graph 3 and n are using an area chart which can be use to see the frequency of customer transaction in an area chart. User can see if the customer is increasing their buying frequency to the company if the line is increasing or vice versa, if the customer are lowering their buying frequency than the line will decreasing.

The customer dimension in this dashboard are used to depict the customer name in the dashboard and this dashboard are going to be use to determine which customer can have a more special treatment to keep them loyal and also ensuring them to keep or increasing their buying frequency.

2. Item Positioning Dashboard

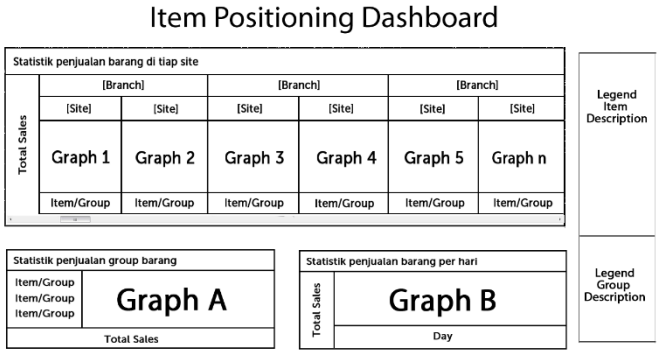

Figure 3:*Item Positioning Dashboard Design*

This dashboard are use to solve problem regarding to positioning an item to each site. To give solution and answer the demand of company to know which a is having the highest demand and on which site. And the item positiong dashboard also show which item is the most favourite and had the highest demand. Also user can know on what day is the most active sales regarding to an item.

Graph 1,2,3,4,5 and n are showing a statistic about the item sales in stacked bar. This graph are the combination of item dimension, site dimension and total sales fact. The item dimension provide item name and item group name attribute. And the site dimension provide site name, branch name and entity name attribute. The sales data are divided into sales of item on each site and also what kind of item that having the highest demand are sorted from highest to lowest.

Graph A showing a statistic about the item sales overall in horizontal bar. This graph are combination of item dimension and total sales fact. The graph showing item group total sales on the company and already sorted from highest to lowest rank in term of sales. From this we know the overall sales of the company item that are having good sales or bad sales.

Graph B showing a statistic about the item sales on each day in stacked bar. This graph is combination of time dimension, item dimension and total sales fact. The graph showing an item sales on each day. This graph can be use to analyze on what day that the company having best sales and to know the best item sales of the day.

3. Sales Performance Monitoring Dashboard

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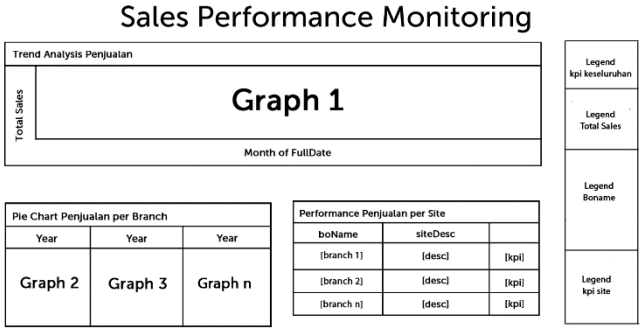

Figure 4:*Sales Performance Dashboard Design*

This dashboard are use to solve problem regarding to analyze the trend of sales. In this dashboard we can see the trend of the company sales wether they currently having good sales trend or not. To make it easier to determine wether the trend is good or not, the dashboard are design with the KPI color that can be set in the calculation field. The pie chart are depict the branch with their sales data to see each brand sales performance and also showing which site give the biggest contribution. The KPI not only set on the trend line graph but also on the text table to show the current performance of each site.

Graph 1 showing a sales trend line with the help of the Tableau tools to show the trend line. The KPI color on the trend line are divided into three color which is green, yellow and red. Green color are depict a good sales, yellow are depict an average sales and red are depict an underperformance sales. The KPI rules can be set according to the company request how they want to be measure. This graph are combination of time dimension and total sales fact. The measure of the trend line are divided into each month.

Graph 2,3 and n are showing a sales performance in a pie chart. Each year a company sales performance are measure in a pie chart and each pie chart are showing a sales performance of each branch. Each branch are differentiate by different color. This graph are combination of site dimension, time dimension and total sales fact. The pie chart are also showing each branch contribution in term of sales from overall view and compared to all other sites.

On the text table next to the pie chart graph the company sites performances are shown. A KPI symbol is set to see each site current performance. The setting for the performance indicator symbol can be change according to the company request. Three symbols are used in this table. The green circle to depict a good performance, yellow triangle to depict average performance and red cross to depict underperform sales. This text table are combination of site dimension and total sales fact.

4. Sales Forecast Dashboard

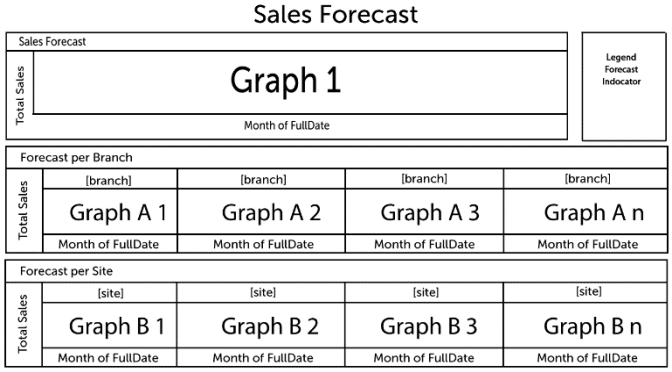

Figure 5:*Sales Forcat Dashboard Design*

This dashboard are designed to do a sales forecast. A sales forecast can be done if the database store a historical data. The forecast are created with the help of previous sales data. The sales forecast are divided into three which is

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the overall sales for a whole company, the forecast of each branch and the forecast for each site. With the help of tableau the forecast is can be done to calculate the forecast.

Graph 1 is showing a forecast of overall company. The actual sales and the estimate sales for the future are differentiated with different color. This graph is a combination of total sales fact and time dimension. The forecast are calculate 1 year ahead. The time measurement for this graph is month.

Graph A2-An is showing a forecast for company's branches. The purpose of forecasting for each branch is to analyze wether the future of a branch is can be consider good or not. This graph is combination of time dimension, site dimension and total sales fact. The time measurement for this graph is month. Not only showing the forecasting, the graph also showing the trend of actual sales of the branch which the sales performance monitoring dashboard only show the trend of overall company sales.

Graph B1-Bn is showing a forecast for company's sites. The purpose of forecasting for each site is to analyze wether the future of a site is can be consider good or not. This graph is combination of time dimension, site dimension and total sales fact. The time measurement for this graph is month. Not only showing the forecasting, the graph also showing the trend of actual sales of the site which the sales performance monitoring dashboard only show the trend of overall company sales.

IV. CONCLUSION

By working on this research, a star schema that includes four dimensions, such as customer, site, item and time with a sales fact table that have measurement of total sales is created for the data warehouse design. Based on those star schema several dashboards are produced such as Customer Segmentation Dashboard, Item Positioning Dashboard, Sales Performance Monitoring Dashboard and Sales Forecast Dashboard in order to support executives in decision making process. From all processes that have been done in developing the application of Business Intelligence, we can conclude that:

1. Business Intelligence supports depth analysis because it provide report that can be view from various dimension and more suitable for analysis rather than operational report. The depth analysis report example is for sales performance monitoring, customer segmentation and item positioning.
2. Business Intelligence provides sales performance indicator that can help to overcome losses due to poor sales.
3. Business Intelligence provides a report that can distribute measure from site and item dimension, so that executives may know which item has the highest demand on each site and can handle more precise item positioning.
4. Business Intelligence helps to determine customer segmentation through analysis of customer data, time dimension and item dimension which we can see through their frequency of doing business with company.
5. Business Intelligence provides graph about comparison of sales with statistical graphic to see if the graph is decreased or increased.
6. Business Intelligence helps to depict the sales forecast based on the data stored from previous year and visualize the sales forecast in a form of graphic.

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