DEVELOPMENT OF BUSINESS INTELLIGENCE FOR THE INTEGRATION OF FINANCIAL REPORTING SYSTEMS AT PT XYZ

JAROT S SUROSO[1] and DEA CARISSA[2]

[1, 2] Universitas Bina Nusantara, Jakarta, Indonesia. Email: [1]jsembodo@binus.edu, [2]dea.carissa@binus.ac.id

Abstract

The purpose of this study was to design a BI system. The methodology used in this study uses the BI roadmap approach (Moss and Atre 2003). The BI roadmap approach is used because it is agile and adaptive with changes in building BI products and is fully aimed at supporting BI development. In BI technology, there is a data integration process: Extract, Transform, and Load (ETL) which can help the process of converting the Online Transaction Processing (OLTP) system into Online Analytical Processing (OLAP). The results of the study obtained that the transaction data warehouse designed using PDI (Pentaho Data Integration), is very helpful in collecting transaction data from the original transaction data that already has a database and only as OLTP (Online Transactional Processing) data so that it can be used as OLAP (Online Analysis Processing) data so that it is analyzed using OLAP.
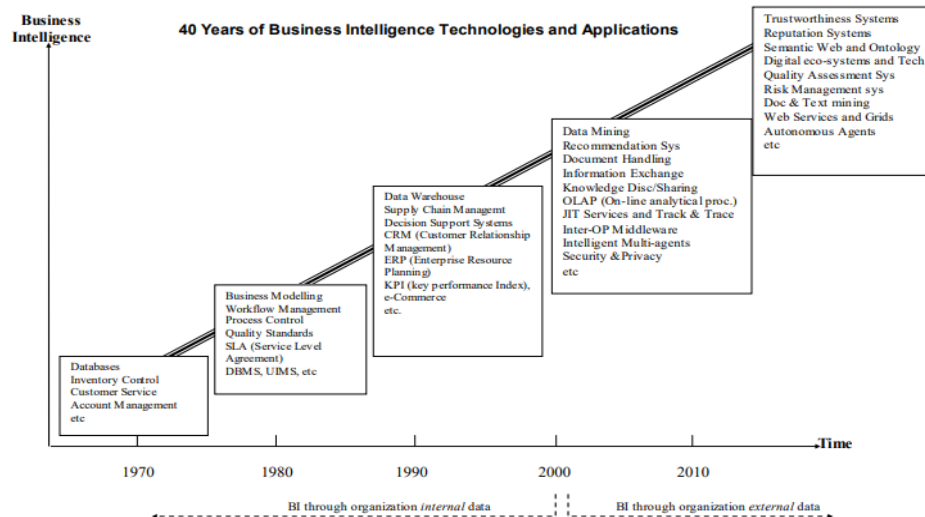
Keywords: business intelligence; system integration; financial reporting.

Introduction

Business Intelligence is a new technology for understanding the past and predicting the future. The technology intended here is one that is capable of collecting, storing, accessing and analyzing data to help decision makers make better decisions. Business Intelligence is a data-driven decision-making support system. Various advantages in the application of Business Intelligence, namely to collect, store, analyze and provide access to data to help users make decisions accurately by carrying out various activities including, decision support systems, queries, reporting, On-line Analytical Processing (OLAP), statistical analysis, forecasting, and data mining for data analysis. Figure 1.1 below shows that the idea of Business Intelligence has evolved over the past forty years and will continue. It can be seen that Business Intelligence focuses on data mining and knowledge discovery. This is an important aspect of Business Intelligence (Siswono 2013).

Present at the beginning of 2019, PT XYZ, which is a subsidiary of XXX group, introduced PT XYZ as a technology-based express delivery company that is ready to be the first choice for consumers in meeting the needs of sending goods. Realizing its existence in the digital era, PT XYZ implements the latest technological development in every service offered. Not only that, determined as a trusted and reliable partner to connect the entire Indonesian market, PT XYZ implements an integrated logistics system supported by integrated transportation infrastructure.

Figure 1. 1 Development of BI Technology and its applications (Chang et al., 2006)

To support the company's business processes, PT XYZ uses NETSUITE as an Enterprise Resource Planning (ERP) application to record company costs and revenues and an E-bill application to manage transactions related to company revenue. In the case of PT. XYZ, currently to process transaction data and visualize that data to become a report is still done manually using the Microsoft Excel application. Currently, the data entered by ERP is only in the form of transaction data reports containing all company transactions in a certain period. PT XYZ requires transaction data reports to assist in planning and cost control, determining cost of goods shipped and making management decisions. Based on the results of an interview with the management of PT XYZ, there are several problems related to the process, including?
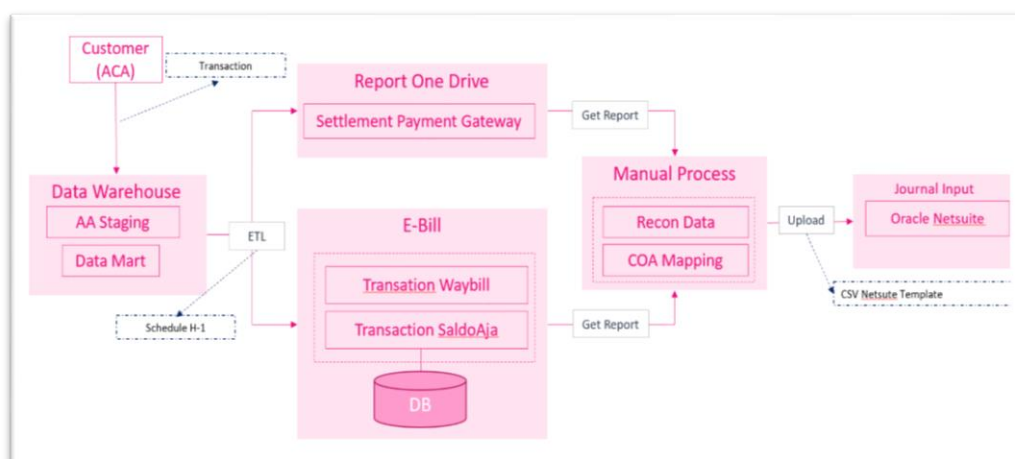
The data obtained from the output of the E-bill application mentioned earlier is still raw data and takes 1-2 weeks for the process of processing data into information because it is done manually. Limited technology uses Microsoft Office as a tool to process data while the company has many large data sources. The speed and accuracy of processing data has not been maximized because the data has not been fully integrated between departments. Decision making is less accurate and fast because it is still not supported by a tool that supports decision making.

PT XYZ requires a BI application that provides monitoring information related to total order reports and revenue estimates to improve management effectiveness and efficiency in strategic decision making.

Table 1.1 Processes Running Now in PT XYZ1

Steps	Required Time	Constraints
Downloading Transaction Data from E-Bill	3-5 days	The more subscribers and the more transactions, the longer it takes to download data
Transaction Data aggregated	3-5 days	The more files you download, the more time it takes to put all your files together in 1 (one) large file
Processing Transaction Data using Microsoft Excel formulas	2-3 days	files sometimes not responding or even force close by themselves
Uploading transaction data that has been processed into NETSUITE	1-2 days	Upload data one by one
Presenting transaction data that has been processed in the form of a graph	1-2 days	files sometimes not responding or even force close by themselves

Figure 1.2 Processes Running Now at PT XYZ2

Therefore, the development of BI applications can be a solution to assist companies in monitoring business processes, especially related to the company's financial performance. Development includes the design and implementation of BI solutions ranging from architecture, data warehouse, ETL processes and visualizations in the form of dashboards. The reason for using BI as a solution is that it can be used by many organizations to compile ERP information, and other data repositories for quick and effective decision making (LUFTY ABDILLAH 2020). And also because the purpose of BI is to provide information about the business at that time to managers and allow them to take decisions that can address a problem or take an opportunity.

Researchers tried to assist the company in solving its problems by creating a study entitled: Business Intelligence Development for The Integration of Financial Reporting Systems in PT XYZ.

Research Methods

The methodology used in this study uses the BI roadmap approach (Moss and Atre 2003). The BI roadmap approach is used because it is agile and adaptive with changes in building BI products and is fully aimed at supporting BI development. In BI technology, there is a data integration process: Extract, Transform, and Load (ETL) which can help the process of converting the Online Transaction Processing (OLTP) system into Online Analytical Processing (OLAP).

PT XYZ has the need to develop Business Intelligence for the integration of reporting systems. With the integration of the reporting system, it can help PT XYZ managers in determining the cost of goods and services, controlling costs and supporting decision making. Below is the frame of mind in this study. The thinking framework contains a research flow starting from determining the background of the problem, problem formulation, planning stage, design to implementation and control. Through this research, it is hoped that it can provide the best solution for PT XYZ according to its needs.

The data sources that will be used by the author in this thesis are:

1. Primary data, data obtained through:

   a. Survey of the current system.

   b. Identify user needs by conducting structured interviews with users and management levels. Structured interviews (Williams 2016) are essentially business conversations and brainstorming sessions about business strategies, functional strategies, core business processes, and the use of business information and business analysis to improve business performance. The general logic for conversations follows the opportunity for top-down BI analysis. Interviews allow for a deeper digging into what are core business processes, key business or functional challenges, and information gaps for analysis and decision-making as well as gaps that hinder the ability to drive business outcomes.

2. Secondary data, data obtained by literature studies conducted by looking for relevant journal references related to the material analyzed using journal databases such as Google Scholar, Emerald insight, Elsevier and other databases using the keywords Business Intelligence, Data Warehouse.

Results and Discussion

Analysis

1.1 Identification of Business Needs

For the purposes of identifying business needs, primary data derived from primary data is needed through surveys of the systems used and identification of user needs by conducting structured interviews with users and management levels, while for the data obtained by literature studies conducted by looking for relevant journal references. :

1. Primary data, data obtained through:

a. Survey of the current system.

Survey the system used and makes observations to find out the system that is currently running at PT XYZ so that it can be a basis for determining the application that is being developed for the purposes of the reporting integration system on the management. Meanwhile, observation is carried out by studying and analyzing the existing data used today.

The result is that users and management levels have difficulty:

    i. Pulling data: the system is running now; users have to download gradually because the limitations of Microsoft Excel are not proportional to the amount of data required

    ii. Monitoring the amount of transaction data in a certain period: the results of downloading need to be made into one file so that monitoring can be made in the form of graphs so that users and management levels only know how the total movement of transaction data is

    iii. Monitoring the amount of transaction data that can be billed in a certain period: the results of downloading need to be made into one file so that monitoring can be made in the form of a graph so that users and new management levels know how much total transaction data can be billed so that they know the estimated amount of income that will then be input into the ERP system, NETSUITE.

    iv. Monitoring the amount of transaction data that can be billed and the billing has been paid off in a certain period: the results of downloading need to be made into one file so that monitoring can be made in the form of graphs so that users and management levels only know how much total transaction data can be billed and the billing has been paid off so as to know the estimated amount of income that will then be input to the ERP system, NETSUITE.

b. Identify user needs by conducting structured interviews with leaders. Interviews were conducted with PT XYZ leaders to find out the problems they were facing. Interviews conducted in connection with the systems and business processes applicable at PT XYZ, the information needs required by the company to design Data Warehouse reports according to reporting needs and design reports for internal purposes.

The result of the interview is that users and level management need a dashboard to monitor regularly in real time so that users and level management can make decisions immediately if needed.

2. Secondary data, data obtained by literature studies carried out by looking for relevant journal references related to the material analyzed using a journal database using the keyword Business Intelligence, Data Warehouse.

1.1.1 Mock-up Dashboard

A dashboard mockup created based on getting requirements is translated in the form of a mockup view. Here's a mockup view of the Harmony dashboard.
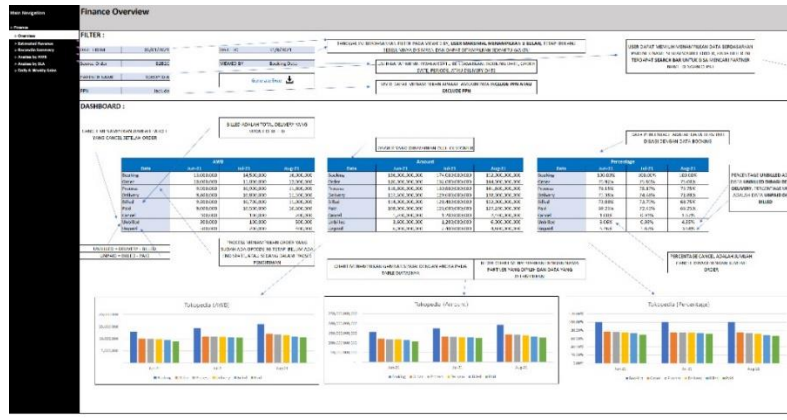

Figure 4. 1 Harmony Dashboard Mockup

1.1.2 Mock-up Report

Mockup reports are created based on getting requirements that are translated in the form of mockup views. Here's a mockup view of the Harmony dashboard.

Figure 4. 2 Mockup Report

1.2 Design

1.2.1 Infrastructure recognition

The scope of PT XYZ's IT has so far used staging data on E-Bills, where the data is still not well distributed in accordance with current reporting needs, so there is a need for mapping needed in reporting that adjusts reporting metadata. In order to facilitate mapping, it is necessary to establish a Data Warehouse in accordance with the Integration mapping, where data mapping will be used for reporting in management. The parts involved in this project are as follows:

a. Dad

This division handles data source (data staging) in Core PT XYZ, which can then be utilized by other divisions

b.IT Product & Technology

This division processes data that can be used for the purposes of other divisions in making reports or other needs, which requires mapping data from data sources (DAD) And in this division also manages server integration for data operational needs, and as IT data security so that unwanted things do not happen, and make server failover backups.

c. VP Finance and team

This division regulates all financial flow processes such as assets and liabilities, the results of which are reported for reporting needs, so that the VP Finance division and the team can be said to be the exit for managing PT XYZ's financial data.

d. IT Developer (ITDV)

This division builds IT needs at PT XYZ, such as building data warehouse needs, which are needed by users to facilitate data management, as well as building BI applications.

1.2.2 Project Macro Planning

Broadly speaking, the scope of the transaction data system development project at PT XYZ consists of estimated income (Unearned Revenue), accounts receivable, (Account Receivables), revenue (Revenue) in the Income Statement. This development process or timing refers to the timeline that has been made earlier in Table 3.1 adjusted by PT XYZ before going live reporting.

1.3 Planning

1.3.1 Detailed Project Requirements

At the planning stage, data mapping from the report to be used is needed, so that it is known what sources are needed, after which an analysis of the data source is carried out so that it can be built according to the needs of the data marts used in the data warehouse

a) The first process is the report inventory process, before mapping data, first do an inventory of reports to find out which reports will be discussed in this study, the inventory of this report will later affect the next mapping.

b) The second process is mapping the report, a report here focuses on the sources needed on the report. So that the source can be grouped and more structured such as in the Post of Financial Position Report, Office Liabilities, Other Liabilities, Office Assets, Other Assets.

1.3.1.1 Inventory Report

At this stage, an investigation is carried out which is a mandatory research report to meet the requirements for the formation of a data warehouse, the process of inventorying the report is the first step at the data warehouse stage following the Vercellis method. The report that will be discussed here is a report related to the reporting process to the management level, namely the Profit and Loss Statement, especially transaction data revenue (Revenue).

1.3.1.2 Mapping Reports

After an inventory of the report is carried out, the next stage is mapping the data on the report. Mapping reports are closely related to business requirements where in business requirements mapping data from the report to be used is needed, so that it is known what sources are needed. Here is the mapping data needed:

Report on the amount of transaction data (Unearned Revenue)

1) "cmdm_code", "booking_dt", "order_dt", "delivery_dt", COUNT("awb"), SUM("delivery_fee") FROM "ps_shipment_ar" GROUP BY ("cmdm_code", "booking _dt")

2) Report on the amount of transaction data per service (Unearned Revenue per Service)

   "cmdm_code", "booking_dt", "order_dt", "delivery_dt", "service", COUNT("awb"), SUM("delivery_fee") FROM "ps_shipment_ar" GROUP BY ("cmdm_code", "booking _dt", "service")

3) Report on the amount of billable transaction data (Revenue)

   "cmdm_code", "booking_dt", "order_dt", "delivery_dt", "invoice_dt", COUNT("awb"), SUM("delivery_fee") FROM "ps_shipment_ar" GROUP BY ("cmdm_code", "invoice _dt")

4) Report on the amount of transaction data that can be billed and the billing has been paid off

   "cmdm_code", "booking_dt", "order_dt", "delivery_dt", "paid_dt", COUNT("awb"), SUM("delivery_fee") FROM "ps_shipment_ar" GROUP BY ("cmdm_code", "paid _dt")

1.3.2 Definition of the Mathematical Models Needed

In this case, the influencing factor in the choice of model is the evaluation criteria. Appropriate measurable performance indicators should be defined to establish criteria for the evaluation and comparison of alternative decisions.

These indicators may assume various forms in each different application, and may include the following factors:

    a) effectiveness and level of service;

    b) quality of products and services;

    c) flexibility of operating conditions;

    d) Reliability in achieving goals.

1.3.3 Identification of the Data Definition of Data Warehouses and Data Marts

1.3.3.1 Business Process

The first process is a business process, there are two categories in the stages of business processes, namely Data Warehouse business processes and application business processes. Data Warehouse business processes focus on mapping reports that refer to the sources needed in the report. Meanwhile, there are three instruments of application business processes, namely Data Warehouse business processes, IT development business processes, BI application business processes.

1.3.3.1.1.1 Harmony Database Business Process

Figure 4. 3 Business Process

Explanation:

The Order Management System (OMS) will send transaction data that already has a sent status to Harmony Database. Harmony Dispatcher will deliver the pro-forma to the customer. The content of the pro-forma, namely transaction data, refers to transaction data that has been sent from OMS. Customers will do pro-forma-related feedback and from Harmony Dispatcher will send invoices and tax invoices. The invoice contains information about payment methods (via Gopay, OVO, Shopeepay, QRIS, or Virtual Account). When the customer will make a payment, the customer will be connected to Bayaraja which then through the API, the customer will make a payment. When the payment is successful, Bayaraja will receive a notification that there is a customer who has made a payment through one of the existing payment channels and

the notification will be sent to Harmony Database. Meanwhile, Gopay, OVO, Shopeepay, QRIS, or Virtual Account will send pro-forma via email or dashboard. The pro-forma will be retrieved using RPA, API, FTP or email listener. The pro-forma data will then be entered into the Harmony Collection Engine which will later be stored in the Harmony Database. Invoices that have been successfully created until invoices that have been successfully paid will be processed in Harmony Posted then will be posted according to the Chart of Account and General Legder to ERP (Netsuite).

1.3.3.1.1.2 Harmony Business Process Reporting

Figure 4. 4 Harmony Reporting Business Process

Explanation:

The user reports to management by accessing the Harmony application, a report that will be reported obtaining data from the Data Warehouse on the database server. The user makes manual adjustments to the harmony application after obtaining data from the Data Warehouse, then the user generates a report with a management reporting format, then the user sends a report to Harmony. Management may at one time submit updates on changes to the reporting structure, validation, and other reporting format needs, which will be applied to the Harmony application.

1.3.3.2 Identification Data Marts

The second process is the identification of data marts, where data marts constitute a subset of the Data Warehouse, usually consisting of a single subject area. Then it can be analyzed grouping by data mart, according to the user and the needs of the reporting report as needed.

Table 4. 1 Identification Data Marts

Data Mart	Characteristics	Source Data Mart
Data Mart 1	Transactional Data	ps_shipment_ar
Data Mart 2	Invoicing Data	tx_payment_invoice
Data Mart 3	Settlement Transaction from External	tx_payment_fsi
Data Mart 4	Reconciliation of Internal and External Settlement Data	ps_collection

1.3.3.3 Functional Requirement

The third process is Functional Requirement, which is a requirement that describes the activities or processes that must be owned and carried out by the system to be built. There are several stages that are carried out, namely:

1. Database Staging Creation

The Staging Database stores data from a separate PT XYZ source system into a consistent format and integrated with each other. The staging database contains data that will be used in the process of making reports and analyzing data.

On staging occurs the process:

a) Data selection

   The data from the selection will be used for the Data Mining process.

b) Pre-processing/Cleaning

   Before the Data Mining process is carried out, the cleaning and enrichment process of the data is first carried out to remove data duplication and special & unidentified characters, check for inconsistent data, S correct errors in the data due to delimiter errors and others.

2. Formation of reports according to Management reports

a) Data Processing

   Data processing is the process of processing data staging to form reports according to the format requested by management.

b) Data Warehouse

   Data Warehouse is a place to store the results of data processing, with data that can be processed into data reporting needs.

c) Validation

   The validation rules used must match the metadata version.

d) Report Submission

   The reporter can make a partial submission by sending part of the data that passed validation first, after which the reporter corrects the data so that the report can be fully sent.

e) Recall Previous Master Information Data (MID)

MID is a database that stores complete data to pass reporting. MID also functions as a sending history data, so that users can access it when needed.

3. Web view creation (user interface) for User reports

a) Data Review

Users can see the summary data in the review section such as the date of the report, branch, amount of data, percentage of errors and others.

b) Manual Adjustment

Users can see account level report data (detailed) and information level (summary). At each level, the application must be able to accommodate user needs in conducting adjusment in the form of:

    i. Data input

    ii. Data correction

    iii. Upload data

c) Manual Upload

Especially for reports that are processed manually by users, the system provides a data upload feature from excel format to facilitate submission to the reporting portal.

d) Insert Master Information Data (MID)

After the data is reported, the data will be generated in MID, which is historical data delivery.

4. Creation of a web view (user interface) for Administrators

a) Metadata Management

Through the Harmony portal, PT XYZ can download the metadata structure and validation. The application can read that metadata and validation to process data validation on the web application.

b) Management Parameters

Parameters can be automated directly by the reporter and can be used by multiple reports. There are several types of parameters, including:

    i. Report Parameters

    ii. Validation Alert Configuration

    iii. Secure Access Configuration

    iv. User Group & Workflow Management

    v. User Access Management

c) Data Designer

The application can provide live notifications of the impact of changes made based on validation rules. The menu contained in the data designer is:

    i. Data Source Management

    ii. Report Designer

    iii. Sand Box

    iv. Formulas / Functions

    v. Global Parameters

    vi. Scheduler and Monitor

d) Rollback Management

The Rollback Management page is used to facilitate the process of replenishing retaging data if needed. Administrators can perform rollbacks for specific dates, source systems and tables as needed. After the rollback process is complete, the system will automatically reprocess data processing of related reports.

5. Dashboard

The dashboard is a page that provides comprehensive information related to:

    a) Total Order
    b) Total Sales
    c) Total Discount

1.3.3.4 Non-Functional Requirement

The fourth process is Non-Functional Requirement, where this process is more about the security, performance, availability and maintenance of the system that has been created. The things that form the basis of security include User Group Creation, Access Rights Settings, and Audit Trail. Performance Recalculation of related reports after manual adjustment can be completed in under 10 minutes for each reporting. Availability System can process BI data on schedule, BI data is available and can be accessed by users no later than 08:00 am. Maintenance in the form of BI data dackup needs to be done periodically properly.

1. Security

The things on which security is based are:

a) User Group Creation

Each reporting division is divided into different user groups. There is a division of role makers and checkers as well as a division of access rights in user group configurations

b) Permissions Settings

Harmony data can only be accessed by the competent authorities. Access to the data can be verified with a user id and password that has been registered in the Secure Access system.

Users can only log into harmony application if they have access rights and obligations to report to the Vice President. And the one who can view and edit the data inside this application is the owner report.

c) Audit Trail

The application has an audit log feature for access, process and error logs for each user activity.

2. Performance

Recalculation of related reports after manual adjustment can be completed in under 10 minutes for each reporting

3. Availability

a) The system can process Harmony data on a schedule

b) Hamony's data is available and can be accessed by users no later than 08:30 am

4. Maintenance Backup of Harmony data needs to be done periodically properly.

1.3.3.5 User Requirement

The fifth process is User Requirement, BI reporting applications must have access control and user roles. The function of the user role is to be able to manage all functions in the application, can manage reports such as recalling the data needed such as create update delete, can check the results of reports made by user makers and send reports to management.

Harmony reporting apps must have access control and a user role. Here it is divided into three parts, namely:

Table 4. 2 User Requirements

Action	User Role		
	Admin	Maker	Approver
Create User Group	X		
Create User	X		
Create Parameter	X	X	
Approver Parameters	X		X
Create Data	X	X	
Adjustment Data	X	X	
Report Approver	X		X
Send Report	X		X

The functions of the user role are:

1) Admin: Can manage all functions on the app.

2) Maker: Can manage reports, such as pulling back the data needed, such as create update delete.

3) Approver: Can check the results of reports made by user makers and send reports to the Authority.

1.3.3.6 System Requirement

The sixth process is System Requirement, which are specifications that define the functions that must be possessed by the information system to be built such as infrastructure specifications. The system used is a cloud database with the following details.

Server Database

CPU	: 8 Core
RAM	: 32 GB
SSD Storage	: 1.66TB
DB Engine	: Postgresql 13

Server Development

CPU	: 8 Core
RAM	: 8 GB
SSD Storage	: 8 GB
DB Engine	: Postgresql

Server Aplikasi

CPU	: 8 Core
RAM	: 8 GB
SSD Storage	: 1.5 GB
Aplikasi	: Java dan Angular

Figure 4. 5 System Requirements

1.3.3.7 System Design

The seventh process is System Design, this stage is a stage of system development that defines functional needs, preparation for implementation design, describes how a system is formed which can be in the form of depiction, planning and sketching or arrangement of several separate elements into a whole and functioning whole, including configuring the components software and hardware of a system. There are five stages that are carried out based on system design drawings, namely:

1) Data Source

   At this stage the data sources used are Database on PostgreSQL Server, Database PT XYZ (SQL Server) and Excel User

2) Data Preparation

   At this stage, preparing the data to be pulled from the source, then loaded into DWH, this is included in the ETL (Extract Transform Load) process. The BI tool used at this stage is SSIS.

3) Data Storage

At this stage, prepare a Data Warehouse that is stored in a cloud database and filled with data extracted from the data source and mapped according to the results of the analysis.

4) Data Analysis

At this stage is a very important stage, because at this stage the researcher makes a cube which later this cube can analyze, calculate and link data. The BI tools used at this stage are SSAS (SQL Server Analysis Services).

5) Data Access

This stage is the finalization stage where the data that has been processed from stage 1 to stage 4 will be presented in the form of reports and applications. The tool used is SSMS (SQL Server Management Studio), namely Harmony.

1.3.4 Development of a Prototype

Prototype is one of the system life cycle methods that are based on the concept of a working model. The goal is to develop the model into a final system. The stages of the Prototyping Method include:

1) Needs analysis

At this stage the developer identifies the software and all the needs of the system to be created.

2) Building prototyping

Build prototyping by creating temporary designs that focus on presenting to users (e.g., by creating inputs and output formats).

Figure 4. 6 Prototype Intelligence Dashboard

The intelligence dashboard consists of a bar graph and a table. The bar graph depicts the number of numbers according to the table that is above it.

3) Evaluation of prototyping

This evaluation is carried out to find out whether the prototyping is in accordance with the user's expectations.

4) Coding the system

At this stage the already approved prototyping will be converted into a programming language.

5) Test the system

At this stage, it is carried out to test the software system that has been tested by creating SIT (System Integration Test) documentation

6) System Evaluation

Ready-made software will be evaluated by the user to find out whether the system is as expected by creating UAT (User Acceptance Test) documentation

7) Using the system

The software that has been tested and approved by the customer is ready to use.

1.4 Implementation and Control

1.4.1 Development of Data Warehouses and Data Marts

After the data mart is formed, then determine the process of developing a data warehouse according to the needs of the data mart, then here will determine the dimensions with facts related to the formation of the data warehouse in accordance with the data mart.

1. Dimensional Modeling

Dimensional modeling is the process of forming dimensions and facts and star schemas, where the formation of this star schema is in accordance with the Vercellis method. At this stage, it is the stage of determining the dimensions related to the fact that has been adjusted by the needs of the data mart according to business requirements, so that there is no redundancy of data on the dimensions.

Figure 4. 7 Entity Relationship Diagram

2. Physical design.

This physical design consists of 2 categories, namely the physical design dimension and the design dimension fact, which is the process of forming metadata in the database, by detailing all the attributes of each dimension and fact that have been designed in the previous stage. And also determine the database used for data integration on related dimensions and facts, so that it is necessary to adapt the data to the database to be used, namely by pulling staging data, after doing data staging is to analyze the data into dimensions and facts. After analyzing the Fact and Dimensions for the database, the query process is carried out during the Data Warehouse processing process in the SQL Server Integration Services application and the formation query for each Staging and Data Warehouse packages according to needs.

3. Architectural Systems

The system of architecture emphasized at this stage is the emphasis of conceptual models that define the structure, behavior, and views of more than a system. A system architecture can consist of system components, the visible external properties of component components, relationships (e.g., behavior) between them. It can provide a plan from which the product can be obtained, and the developed system, which will work together to implement the system as a whole. In the architectural system, there are 4 stages of the system that will run and will be integrated with each other. The first is that the source system stage consists of several parts including DAD and EXCEL Parameters. The second stage of entering the data source is entered in the database. The third stage is the Extract Transform Load (ETL) process and the fourth stage is the formation of a data warehouse

System The architecture of forming a data warehouse is to take from several sources to form the required data warehouse, it can be described as follows:

1) In the first stage, the data source used from several sources, namely:

    a) Order Management System (MySQL Server),

    b) SGS (MySQL Server),

    c) FVP (MySQL Server),

    d) EXCEL Parameter (Excel) Data from payment gateway

    e) EXCEL Parameter (Excel) Data from uploaded user

2) In the second stage, the data source is entered into a database staging on a server that is different from the source with the MySQL Server engine that holds all the data sources originally.

3) In the third stage, the staging data is carried out the Extract Transform Load (ETL) process to avoid dirty data, namely duplicate data, redundancy so that data cleansing is necessary.

4) At the fourth stage is the formation of a data warehouse.

1.4.2 Development of ETL Tools

The main focus of this phase is to develop procedures for validating the data that has been extracted and moving the data in the form of a Data Warehouse. The development of ETL tools here uses the SSIS (SQL Server Integration Services) application, a function of SSIS is a tool used to perform extract, transform, and load (ETL) processes and is classified as a feature of Business Intelligence. In relation to Business Intelligence, SSIS is a feature used to pull data from an ERP, relational database, or file for the results to be stored into a Data Warehouse. While ETL is a process to collect data from various sources (Extract), clean it (Transform), to then save it into another system (Load). The development of this system as a whole is the actual implementation of the analysis and design carried out. In this phase of the project, researchers designed data warehouses (fact tables and dimensions) and ETL. In addition to the SSIS application at this stage, it also uses the SSAS application (SQL Server Analysis Service) which is one of the Business Intelligence tools. Analysis Services is a technology for OLAP (Online Analytical Processing) and Data Mining. OLAP administration procedures are carried out in SQL Server Management Studio including viewing data and creating multidimensional expressions.

The OLAP used is Drill down and Pivot (rotate). Drill down represents data in more detail while pivot visualizes operations that propagate data axes as an alternative in data presentation.

1.4.3 Development of Metadata

Metadata describes the content, quality, conditions, and other characteristics of a data written in a standard format. In this case, the standard reporting metadata format used by PT XYZ refers to the metadata standard provided by the management. Metadata itself has several functions including identifying data, grouping similar data, distinguishing data according to certain criteria and providing important information related to data.

1.4.4 Development of Applications

The method to verify data in the Data Warehouse is to prepare reports in Analysis Services SQL Server Management Studio or use a BI application and compare it with reporting data managed by users which will be reported to management.

At this stage, the scheduler process for withdrawing data warehouses along with the schedule is carried out to generate data in the application sourced from the data warehouse every day at 00.30.

Process Flow is a step or stage in submitting a report from the beginning to the end.

Figure 4. 8 Process Flow Data Reporting (DINA IKRAMINA SETIANI 2020)

There are five stages in the data reporting flow process, namely:

1) DataMart

At the data mart stage, where the data displayed is a data source display that has been generated by the scheduler according to the date period selected.

2) Manual Adjustment

In the manual adjustment stage, it is the process of displaying and processing data sources that have been adjusted according to the date period. In the manual adjustment there are Create, Edit, Delete and Import features.

3) Validation

In the validation stage, it is the process of displaying and processing data according to reports and periods for validation. In validation there are create, edit, delete, import (import data from excel), Validate (used to validate data), Rollback (to multiply data to the initial stage), Reterive (used to replace data according to the columns selected from the previous data).

4) Approval

At the approval stage, display the data according to the report and the period for the approval process. In approval there is an Approve feature (to approve data will be processed to the next stage), Reject (to reject data in the process to the next stage), Rollback (return the data back to the initial stage).

5) Submission

At the Submission stage, display data in accordance with the report and data period that has been approved for processing and is ready to be presented to management. In the

submission there is a Submit feature (to process data into CSV form), Download (to display the list that has been created), Rollback (return the data back to the initial stage).

To access the features above, there is a role (access rights) for each user. This means that each user level has different access rights, depending on the user's authority given. Here are the role permissions to the available users:

Table 4. 3 Role Process Flow

Feature	Role (Access Rights)
Datamart	Maker
Manual Adjustment	Maker
Validation	Maker
Approval	Approver
Submission	Approver

1.4.5 Release and Testing

The main purpose of system testing is to ensure that the resulting system is in accordance with previously determined requirements. Testing this system is very important, therefore a process documentation is made to record all activities that have been carried out during the Business Intelligence application development process including the integration of reporting systems. This documentation can be in the form of User Manual Book, Business Requirement Definition (BRD), Functional Specification Document (FSD), System Integration Testing (SIT), and User Acceptance Testing (UAT). Later this documentation can be used as a guide for users and teams involved in this project and those who are not involved in this project. After making the documentation, a validation process is carried out involving related users in this reporting project for inspection and provision of the purpose that the information system has been implemented correctly and in accordance with the user's needs and intended use.

The following is an example of a report that has been tailored to the user's needs:

Figure 4. 9 Reports that have been adjusted to the needs of the user

Discussion

From the discussion above, it can be obtained about the efficiency and effectiveness of reporting from the previous process where for internal parties PT XYZ downloaded data in several files then combined it into a file. Then the file is processed in order to get the necessary information. This process runs 1-2 weeks. With the Harmony application, the report process at PT XYZ becomes shorter and simpler. The data displayed in Harmony in real time, there is no need to process data, so the input process to NETSUITE is more effective and efficient and the management level can monitor regularly because it has implemented Business Intelligence development.

With the Harmony application, the reporting process conveyed by PT XYZ to the management level already uses one portal that is integrated with metadata. Harmony is one of the reporting features that are integrated directly to the management level, so information can be received faster and will make the reporting process faster and more accurate.

Conclusion

1) The conclusion of the results of this study is that the transaction data warehouse designed using PDI (Pentaho Data Integration), is very helpful in collecting transaction data from the original transaction data that already has a database and only as OLTP (Online Transactional Processing) data so that it can be used as OLAP (Online Analysis Processing) data so that it is analyzed using OLAP.

2) In addition, in this study for reporting transaction data designed using PRD (Pentaho report Designer), it is very helpful in making transaction reports and can be adjusted to needs, so that problems that often occur in terms of dependence in obtaining reports are expected not to occur again.

3) The transaction dashboard, designed using Pentaho CDE (Community Dashboard Editor), is very helpful for leaders in analyzing data to study the trends of transactions carried out in XYZ companies, and can be used to support decision making and can also be a measure of company performance.

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