Implementation of Business Intelligence to Determine Evaluation of Activities (Case Study Indonesia Stock Exchange)

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Received: 11 April 2020; Accepted: 01 November 2020; Published: 08 December 2020

Abstract: This study aims to examine how to evaluate the activities undertaken in IDX. By building the system “business intelligence implementation to determine the evaluation of activities”. Where in this study also used the algorithm Naive Bayes in the process of data classification activities that have been done. The approach to the development of this software is through the study of libraries, data collection, system design, system implementation, Test systems and analysis. The tools used in the development of this software are Pentaho, Postgresql (as a data processing tool), Microsoft Excel (as a tool for creating training data), XAMPP (as a Web server tool) and the encoding used in this software development is the PHP CodeIgniter framework (as the backend), Highcharts (as Dashboard views) and DataTables (as table views). In this study, authors build software that is expected to help the Directorate of Development (RPE) in conducting evaluation activities in IDX. The analysis of the study uses variables from budget-realization data and activity categories as comparators to figure out the activity status. The study also used IDX activity data in 2018 to implement a built-in system. The results of this study show that the realization of the budget and category of this activity strongly affects the activities that will be evaluated or not evaluated. Activities in each of the IDX representative offices are also potentially to be evaluated, depending on the value of the budget specified in the training data set.

Index Terms: Business intelligence, data warehouse, etl, classification, naive bayes classifier, activities evaluation

1. Introduction

Indonesia Stock Exchange (IDX) is the party that organizes and provides a system that also provides for bringing together the sale and purchase offers of other parties for the purpose of trading securities between them. One of the socialization and education activities undertaken by the Directorate of Development (RPE) [1-3], through the Investor development and education strategy Unit is to support socialization and education activities that have been implemented well in the Office Representatives throughout Indonesia or the Jakarta area[2,4-8]. To be able to help the effectiveness of activities needed tools consist of reporting system activities that can generate information against several divisions, namely between PIV with PWI [6,9], KEU [10,11], KOM [12,13] and RDP [14]. Activities as part of a program implemented by one or more working units as part of a measured target celebrity on a programme [15]. The organizers of the activities themselves can be agencies, agencies, Governments, organizations, private people, institutions, etc. Similarly, the activities undertaken or carried out by Indonesia Stock Exchange (IDX), which is essentially the activity of Indonesia Stock Exchange (IDX) is occurring in all representative offices which is divided into 34 units based on provinces in Indonesia. The number of activities carried out in the week or per month in a representative office, the reason to be able to apply business intelligence to get an evaluation related to the implementation of an activity the activities of the Indonesia Stock Exchange. Business Intelligence (BI) is defined as the method of converting data into information and subsequently to knowledge [11]. Business Intelligence (BI) has been a top priority of IT executives for several years [23]. The types of knowledge obtained are about the customer requirements and decisions, organizational performance in the industry and the global trends [12]. Another definition of BI, particularly the BI systems is, BI systems put together the gathering and storage of data and knowledge management with analytical tools to present a ready-for-action and complicated information to the planners and decision makers [12]. Business intelligence (BI) refers
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to a managerial philosophy and a tool used to help organizations manage and refine business information with the objective of making more effective business decisions [14]. Business intelligence (BI) has been proliferated due to its increasing contribution to such as business performance determination, data integration from disparate sources, data warehousing, planning, forecasting, budgeting, and the decision making that guides business operation toward desired performance [24]. In determining the evaluation of the activity, it takes a classification of data to be taken a decision whether the activity has been conducted in the evaluation or not. Evaluation is a process of collecting useful information to make decisions and as a benchmark to the extent that objectives can be achieved [13]. From the explanation of the paragraph above, the problems that exist in this study include how to help determine the evaluation of activities in IDX the solution is to build a business intelligence system to determine the evaluation of IDX activities, how to evaluate IDX activities as expected by the solution is to design a business intelligence system that can determine the evaluation of IDX activities, and how the results of the evaluation activity that has been done by determining the evaluation status of activities that have been done by classifying using Naive Bayes algorithm.

As for problem limits in this research include this system is made with the scope of IDX, this system is also made to get decisions about the evaluation status or not of the activities that have been conducted. So in this study will be predicted regarding data analysis to determine the evaluation of the activities with the reference of the determined budget data. Information from business Intelligence will display a graph in the form of a pie or bar showing the activity on each type evaluated by what amount, in each province evaluated how many, at each representative office evaluated how many, this is expected to assist the relevant party, namely IDX to be able to determine the evaluation of the activities that have occurred to be taken a decision that can later affect the activities of conducted by such related representative office. The Following is a stage of research methodology, loaded in Fig. 1.

Fig. 1. Research Methodology

- **Literature Review**, The literature review aims to learn about the basics and methods of the Naive Bayes algorithm, and how to implement it with BI, which is obtained through journals, internet browsing and related readings with good topics Textbook or paper.
- **Data Collection**, The type of data used for this research is primary data. The primary data itself is data obtained that is collected and processed by itself from the research object. In this research data used is the activity data in 2018 from IDX.
- **Design System**, The design of this system aims to be able to design the stages of the development of business intelligence to obtain a status of activities.
- **Implementation System**, Implementation System is the stage of software creation, the continuation of the system design activities. This stage is a stage where the system is ready to operate, consisting of explanations about the implementation environment, and implementation of the program.
- **Test and Analysis System**, Testing and analysis of systems that have been created with predefined parameters.

2. Literature Review and Materials

This literature review is about the previous research related to BI, here are some literature reviews that writers have summarized. BI is a neat and systematic process where every organization can acquire, analyse, and disseminate information from significant internal or external sources of information to business activities and for decision making [25]. BI can present business information in a timely and easy-to-consume manner, also providing the ability to reason and understand the meaning behind business information through discovery, analysis, and ad hoc queries [26]. The characteristic of the BI is characterized by a framework that collects, transforms and exhibits organized information.
from various sources. BI is a system and answer that helps decision makers to understand the situation of the company's economy [27]. BI is a framework that converts information into data, then learns. Thus improving the company's basic decision making process [28]. And the following are supporting materials for the research to be built:

A. Business Intelligence

Business Intelligence is a series of activities to understand the business situation by conducting various types of analysis on data owned by the organization and external data from third parties to help determine the strategy, decision Business that is tactical, and operational and takes the necessary actions to improve business performance [1].

B. Data Warehouse

Data Warehouse is a concept and combination of technologies that facilitate organizations to manage and maintain historical data obtained from operational systems or applications. The use of Data Warehouse technology is almost required by all organizations, libraries are no exception. Data Warehouse allows the integration of various types of data from a wide range of applications or systems. This guarantees the mechanism of "one door for management to obtain information, and analyze it for decision making" [2].

C. ETL

ETL (Extract, Transform Load) three database functions that are combined into one tool that automates the process to pull data out of one database and place it into another database. The database functions are described following [3]:

1. Extract

   Extract is the process of reading data from a specified source database and extracting a desired subset of data.

2. Transform

   Transform is the process of converting the extracted/ acquired data from its previous form into the form it needs to be in so that it can be placed into another database. Transformation occurs by using rules or lookup tables or by combining with other data.

3. Load

   Load is the process of writing the data into the target database

D. Highcharts

Highcharts could satisfy our needs. It is based entirely on JavaScript. This tool has a relatively low resource overhead, and a faster response speed. Users do not need to install any plug completely, truly cross-platform. Developers are not limited by browser compatibility and development languages [4].

Highcharts written by pure JavaScript. Highcharts is simple and convenient to add interactive charts in the web site or web application. Highcharts interface is aesthetic. HighCharts had a good compatibility. It will be able to support most of the current browsers [5].

E. DataTables

DataTables works to produce dynamic data tables, where data can be directly sorted by column, besides that with DataTables also provides a search form which directly searches data from all the columns that appear without the need to query from database first [6].

F. Classification

The model in the classification has the same meaning as the black box, where there is a model that accepts input, then able to do the thought of the input and give the answer as an output of the results of his thinking [7].

1. Models that are already built during training can then be used to predict new class labels that are not yet known. In the construction of models during the training process required an algorithm.

2. The classification prediction is the processing to find a model (or function) that describes and characterizes the concept or class of data, for a particular benefit, that can use modeling to predict which object class the label does not Known.

Classification is a process of finding a model or function that describes or distinguishes the concept or class of data, with the intention of being able to estimate the class of an object whose label is not known. In achieving these objectives, the classification process forms a model capable of distinguishing data into different classes based on specific rules or functions. The Model itself can be a "if-then" rule, a decision tree, or a mathematical formula [8].
G. Bayes Classifier

Bayes is a simple, probabilistic-based predictive technique based on the implementation of the Bayes theorem (or Bayes rule) assuming strong (naïve) independence (independence). In other words, Naive Bayes, the model used is the “independent feature module” [9]. In Bayes (especially Naive Bayes), the intent of a strong independence on the feature is that a different feature in the same data. The Bayes prediction is based on the Bayes theorem with the following general (1):

\[
P(H|E) = \frac{P(E|H) \cdot P(H)}{P(E)}
\]

Here is a description of the above formula loaded in Table 1.

Table 1. Naive Bayes Classifier

| Parameter | Description |
|-----------|-------------|
| P(H|E)     | Conditional end probability (conditional probability) An H hypothesis occurs if the evidence is given by E |
| P(E|H)     | The probability of an E proof occurs affects the H hypothesis. |
| P(H)      | The initial probability (priori) hypothesis H occurs without regard to any evidence |
| P(E)      | Initial probability (priori) proof E occurs regardless of hypotheses/evidence of others |

The classification with Naive Bayes works on a probability theory that looks out the hallmark of the data as evidence in probability. This gives the characteristics of Naive Bayes as follows [10]:

1. The Naive Bayes method works firmly (robust) against isolated data which is usually a data with different characteristics (outliner). Naive Bayes can also handle wrong attribute values by ignoring the training data during model building process and predictions.
2. Tough facing irrelevant attributes.
3. Attributes that have correlation can degrade the performance of Naive Bayes classification because the independent assumption of the attribute is no longer present.

3. Designing of Research

The following is an overview of the system to be built, as shown in Fig. 2.

Fig. 2. Overview of Systems built
In the first phase, collecting transactional data, i.e. the activity data from that already done. Such data include activities data, activity type data, activity category data, representative office data, city data, provincial data and budget realization data. The second stage, perform ETL (Extract Transform Load) on the source data. This ETL process is the data from the source system and presents data in various forms for the transformation process. In this process it is done converting the data into a form of useful format for the transformation process by selecting which attribute to use. Third stage, then the result of ETL goes into the Data warehouse. Fourth stage, after that of data Warehouse then done classification using the Naive Bayes algorithm to determine evaluation of the activities already done, which is displayed in the form of dashboard.

A. Software Requirement

Software used to implement the system are as follows:

1. The operating system used Windows 10.
2. The programming language used is PHP Codeigniter.
3. The database used is MySQL.
4. Visual Studio Code (Tools for coding).

B. Profil Company

Indonesia Stock Exchange (Indonesian: Bursa Efek Indonesia) is a stock exchange based in Jakarta, Indonesia. It was previously known as the Jakarta Stock Exchange (JSX) before its name changed in 2007 after merging with the Surabaya Stock Exchange (SSX). As of October 2019, the Indonesia Stock Exchange had 656 listed companies. In December 2017, based on Single Identification Number there were 628,346 domestic investors, of which 51.33% were foreign investors and 48.67% domestic investors. Whereas in December 2019, the total stock investors are 1.1 million and increase 30 percent from previous year. Originally opened in 1912 as Vereniging Voor Effectenhandel In Batavia under the Dutch colonial government acting as a branch of Amsterdamse Effectenbeurs, it was re-opened in 1977 after several closures during World War I and World War II. After being reopened in 1977, the exchange was under the management of the newly created Capital Market Supervisory Agency (Badan Pengawas Pasar Modal, or Bapepam), which answered to the Ministry of Finance. Trading activity and market capitalisation grew alongside the development of Indonesia's financial markets and private sector - highlighted by a major bull run in 1990. On 13 July 1992, the exchange was privatised under the ownership of Jakarta Exchange Inc. As a result, the functions of Bapepam changed to become the Capital Market Supervisory Agency. On 22 March 1995 JSX launched the Jakarta Automated Trading System (JATS). In September 2007, Jakarta Stock Exchange and Surabaya Stock Exchange merged and named Indonesian Stock Exchange by Indonesian Minister of Finance. The current location of the Indonesian Stock Exchange is located in the IDX building in the Sudirman Central Business District, South Jakarta, near the current site of the Pacific Place Jakarta.

C. Database

Databases are the general data management that is computing on software [17]. This IDX database is named Idis database. The table of this Idis data, loading a table from the existing database that has been created where the data in this table, will be taken the table dimensions as needed when designing the table dimensions. Here is a table of Idis databases loaded in Table 2.

### Table 2. List Table of Database Idis

| Table Name    | Table Component   |
|---------------|-------------------|
| BudgetActivity| Id                |
|               | Anggaran          |
|               | AuditTrailId      |
|               | DataId            |
|               | DepartmentId      |
|               | Description       |
|               | JenisKegiatanId   |
|               | KantorPerwakilanId|
|               | Name              |
|               | PeriodeAnggaran   |
|               | State             |
| WorkArea      | Id                |
|               | AuditTrailId      |
|               | DataId            |
|               | DepartmentId      |
|               | Description       |
|               | Name              |
|               | State             |
### TypeActivity

| Id | AuditTrailId | DepartmentId | Description | Name | State | KategoriKegiatanId | MataAnggaranId | Singkatan |
|----|--------------|--------------|-------------|------|-------|--------------------|----------------|-----------|

### RepresentativeOffice

| Id | AuditTrailId | DataId | DepartmentId | Description | KodeKP | Name | State | AreaKerjald | AdminKpId | Kanitld |
|----|--------------|--------|--------------|-------------|--------|------|-------|------------|-----------|---------|

### CategoryActivity

| Id | AuditTrailId | DataId | DepartmentId | Description | Name | State | Order |
|----|--------------|--------|--------------|-------------|------|-------|-------|

### BudgetComponent

| Id | AuditTrailId | DataId | DepartmentId | Description | Name | State |
|----|--------------|--------|--------------|-------------|------|-------|

### City

| Id | AuditTrailId | DataId | DepartmentId | Description | Name | ProvincesId | State |
|----|--------------|--------|--------------|-------------|------|-------------|-------|

### Province

| Id | AuditTrailId | DataId | DepartmentId | Description | Name | State |
|----|--------------|--------|--------------|-------------|------|-------|

### BudgetRealization

| Id | AuditTrailId | DataId | DepartmentId | Description | KegiatanId | KomponenAnggaranId | Name | Nilai | State | Quantity | Keterangan |
|----|--------------|--------|--------------|-------------|------------|---------------------|------|-------|-------|----------|------------|
D. Designing Data Warehouse

Data Warehouse obtains the data from a number of operational database systems which can be based on RDBMS/ERP Package, etc. The data from these sources are converted into a form suitable for data warehouse [16]. The process of warehousing data is a process used as a basic data for Business intelligence solutions. Therefore, it is necessary to design a data warehouse. Designing the Data warehouse itself is done by forming a new database as a formation data to be processed for the implementation of BI. Data used to get the results to be analyzed is adjusted.

Problems with this research. The table used is a table associated with the implementation of PT IDX activities. The table used is derived from the initial database of Idis databases, namely TrxActivity, TypeActivity, CategoryActivity, Province, City, Budget Realization. From this table, Not all attributes on the original data are used for the Data warehouse. From the attribute Processed into a data warehouse model, which is a 6 dimensional table

\[\text{TrxActivity} \_\text{Dim}, \text{TypeActivity} \_\text{Dim}, \text{CategoryActivity} \_\text{Dim}, \text{Province} \_\text{Dim}, \text{City} \_\text{Dim}, \text{BudgetRealization} \_\text{Dim}\]

as well as 1 fact table Idis\_fact as shown in Fig. 3.

Fig. 3 above shows the fact table of the Idis database that has been designed. The Data will be used for Extract Transform Load (ETL) process. From the design of the data warehouse indicates that there are 6 dimensions that will process: \[\text{TrxActivity} \_\text{Dim}, \text{TypeActivity} \_\text{Dim}, \text{CategoryActivity} \_\text{Dim}, \text{Province} \_\text{Dim}, \text{City} \_\text{Dim}, \text{BudgetRealization} \_\text{Dim} \]
4. Result and Discussion

A. Implementation Dimension Table

Dimension tables are strongly denormalized and are used to select the facts of interest based on the user queries. The fact table stores fact attributes its key is defined by importing the keys of the dimension tables [18]. The following are implementations of the created dimensions, where the dimension implementation of this table is sorted by design that has been created on designing the Data warehouse. Here is a preview of the Created dimension table loaded in Fig. 4.

Here are the details of each dimension table that has been created:

1. Fig. 5 will showing implementation the first dimension, namely *TrxActivity_Dim*
Following is the result data of dimension *TrxActivity_Dim* in Fig. 6.

2. Fig. 7 will showing implementation the dimension, namely *TypeActivity_Dim*

Following is the result data of dimension *TypeActivity_Dim* in Fig. 8.
Fig. 8. Result Data of TypeActivity_Dim

3. Fig. 9. will showing implementation the dimension, namely CategoryActivity_Dim

Fig. 9. CategoryActivity_Dim

Following is the result data of dimension CategoryActivity_Dim in Fig. 10.

Fig. 10. Result Data of CategoryActivity_Dim

4. Fig. 11. will showing implementation the dimension, namely Province_Dim

Fig. 11. Province_Dim
Following is the result data of dimension `Province_Dim` in Fig. 12.

![Fig. 12. Result Data of Province_Dim](image)

5. Fig. 13 will showing implementation the dimension, namely `City_Dim`

![Fig. 13. City_Dim](image)

Following is the result data of dimension `City_Dim` in Fig 14.

![Fig. 14. Result Data of City_Dim](image)

6. Fig 15. will showing implementation the dimension, namely `BudgetRealization_Dim`
Fig. 15 BudgetRealization_Dim

Following is the result data of dimension BudgetRealization_Dim in Fig. 16.

Fig. 16. Result Data of BudgetRealization_Dim

B. Implementation ETL

ETL processes take up to 80% of the effort in BI projects [19]. A high performance is thereby vital to be able to process large amounts of data and to have a up-to-date database [20]. On the implementation of ETL (Extract Transform load) load the dimension table created in the previous step. Here is an implementation of the built-in etl loaded on Fig. 17 Implementation ETL:

Fig. 17. Implementation ETL
From the picture above, it can be seen that in the process of implementing ETL is done merging of the created dimension table, then obtained the output according to the design of the fact table that has been created.

C. Implementation Naive Bayes

Naive Bayes is among the simplest probabilistic classifiers. It often shows amazingly well in many real-world applications, in the face of the strong assumption that all features are provisionally independent given the class [21]. In this Naive Bayes implementation there are several steps to do. Here is an implementation of the built-in naive bayes classifier:

1. Define the training data, which contains predefined training data that is in the form of spreadsheet files. Loaded on Fig. 18.

2. Upload your spreadsheet file training data into the system. Loaded on Fig. 19.

3. Specifying data testing, extracted from data already displayed on the original dashboard. Loaded on Fig. 20.
4. Comparing data between training data and later data testing, the results will be noticeable where activities should be evaluated and activities that should not be evaluated. Loaded on on Fig. 21

![Fig. 21. Result Compare Data Training & Data Testing](image)

D. Implementation Intelligence Dashboard

Intelligence Dashboard can be used for data analysis and decision making [22]. On the implementation of this dashboard intelligence, there are 2 dashboards displayed. Here is an implementation of the built-in intelligence dashboard:

1. **Dashboard Original**

Dashboard Original this is dashboard that displays the original data of activities or data activities that have not been applied classification activity evaluation. Loaded on Fig. 22.

![Fig. 22. Implementation Intelligence Dashboard Activity Original](image)
2. **Dashboard Evaluation**

Dashboard Evaluation this dashboard that displays activity data that has been evaluated and activity data that does not include evaluation. Loaded on on Fig. 23.

![Dashboard Evaluation](image)

**Fig. 23. Implementation Intelligence Dashboard Activity Evaluation**
E. Testing Result

Based on the results of the tests, the system can run and operate properly as expected. From data testing and training that has been compared to produce the expected output. Based on the desired usage scenario. Releasing functions that have been designed, can run well with enough good performance.

5. Conclusion

In this study, business intelligence system is expected to assist IDX in conducting evaluation activities. From the analysis of data that has been done can be concluded that the activities in each IDX representative office could potentially be evaluated. The realization of budgets and activity categories becomes the key to whether or not the activity is potentially evaluated. From this system can be redeveloped by adding a report feature that can be created in the form of a spreadsheet file or an image for example, so the output can be made easier in printing from the results of a built business intelligence.

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How to cite this paper: Ali Fajri, Ardiles Sinaga, ”Implementation of Business Intelligence to Determine Evaluation of Activities (Case Study Indonesia Stock Exchange)”, International Journal of Information Engineering and Electronic Business(IJIEEB), Vol.12, No.6, pp. 51-67, 2020. DOI: 10.5815/ijieeb.2020.06.05