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FUNDRAISING DECISION SUPPORT SYSTEM ON INDONESIA'S OIL PALM PUBLIC SERVICE AGENCY USING KIMBALL-ROSS FOUR-STEP DIMENSIONAL PROCESS AND METABASE DASHBOARD

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ABSTRACT

Oil Palm Public Service Agency as an Indonesian local authority for supporting Oil Palm Plantation Fund Management, and directly responsible to the Ministry of Finance of Indonesia by the policies established by the steering committee concerning government programs. The organization, in this case, is required to make financial reports that aim to provide helpful information for decision making and demonstrate the accountability of the reporting entity for the resources entrusted to it. For five years, the organization relies on its data manually gathered from multiple sources of information systems and external parties, which consume a considerable amount of time and are prone to human errors. This study explains how an organization can use a Business Intelligence Dashboard to provide a quick and robust decision support system by doing automated data gathering and visualization for fast and better decision accuracy at Oil Palm Public Service Agency. This article shows that designing visually informative dashboards can help related parties understand the current situation and history.

Keywords: *Public Service Agency, Business Intelligence, Dashboard, Oil Palm, Information System*

1. INTRODUCTION

In carrying out its activities, Indonesian Oil Palm Public Service Agency has three main processes as the following[1]. (1) Fundraising; by imposing a levy on the export of plantation products and their derivatives as well as the rate of contribution from plantation business actors; (2) Fund Management; by managing some of the funds collected to be developed and the results used for operational financing of Oil Palm Public Service Agency; and (3) Distribution of Funds; which contains sustainable plantation product development programs, as illustrated in Figure 1.

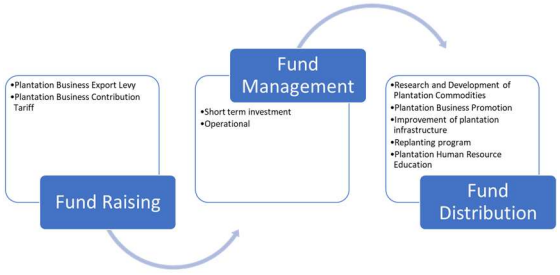

Figure 1. Public Service Agency Main Activities

In helping the Agency, this study present the case study of the implementation of a Decision Support System with Business Intelligence (BI) to answer these three basic questions[2][3], (1) "What has happened?", descriptive analytics using data aggregation and data mining to provide insight into the past; (2) "What could happen?", predictive analytics using statistical models and forecasting techniques to understand the future; and (3) "What should we do?", prescriptive analytics using optimization and simulation algorithms to advise possible outcomes.

A valid Business Intelligence Dashboard is expected to have (1) Intuitive Design) characteristics to allow new users to familiarize themselves with the controls quickly. Patterns of action follow a natural, expected flow. Clear menus are a big part of this design. Obvious significant keys in austere locations, such as an exit program 'x' in the top right-hand corner, are critical for ease of use. (2) Wide scope of searchable data allows users to determine how thorough reports are how well they can handle shifts towards new data set types. A user would need to run the number of reports to gather actionable information. (3) Search Customization, to allow users receive actionable information which requires a great

degree of data that examines a single issue from multiple perspectives.

Several previous study has been presented related to the case study of the implementation of business intelligence in government. Gottfried et. al. [4] conducted research on the use of open government data (OGD) as a source of information. This study explores how OGD can be used to generate business intelligence for the identification of market opportunities and strategy formulation. This study uses Latent Dirichlet Allocation (LDA) modeling to extract emerging topics in these two industries from the OGD, and data visualization tool (pyLDAVis) to visualize topics. Another research in [5] conducted on an e-government system to create a form of interoperability relationship between different services at different levels: national, state or district government levels. This study proposes a hybrid approach to e-government interoperability and data integration using a combination of Datawarehouse and EDA-based approaches. A research in [6] conducted research that examines how to evaluate the activities carried out on the IDX. By building a system of "implementation of business intelligence to determine the evaluation of activities". Where in this study also used the Naive Bayes algorithm in the process of classification activities. Other researchers has conducted research on the implementation of e-government in Moroccan government organizations [7]. They were presenting the development of BI environment for an e-Gov system, using open source technologies. This study proposes an architecture that evolves into a more hybrid BI solution for E-Government based on large-scale data, using Data Warehouses, to ensure interoperability in E-Government systems. Meanwhile, Yulianeu et al [8] conducting research on the application of BI at the Indonesian State Civil Service Agency (BKN). BKN has started using business intelligence by creating an Executive Information System (EIS) dashboard from the civil servant database according to the needs of Indonesian citizens. The proposed EIS assist the Indonesian government in analysing the annual PNS budget and in predicting the needs of new civil servants candidates.

This study presents a case study of an implementation of a business intelligence in the Indonesia Oil Palm Public Service Agency for Funding Management. The research question in this study is the following. (1) Can the Business Intelligence Dashboard can help the agency in the policy making? (2) Is the Kimball-Ross four-step dimensional process and metabase dashboard suitable for building a Business Intelligence Dashboard for BLU? This study contributes on the following topics: (1) providing case study of the implementation of business intelligence to provide overview of the advantages of consolidating scattered and independent data into a set of datasets that are easy to analyze for various types of information needs in the Oil Palm Public Service Agency. (2) provide case study of a more targeted framework in designing the Business Intelligence Dashboard in the Oil Palm Public Service Agency (3) providing case study of presenting more comprehensive information on the policy-making process in the Oil Palm Public Service Agency.

2. LITERATURE REVIEW

3.1 Business Intelligence

Business intelligence (BI), commonly referred to as a suite of applications and technologies for collecting, storing, analyzing, and providing access to data, is used to assist management executives in decision-making [9]. BI performs data processing and analysis to be more orderly and faster with the help of tools, making it easier to find data that can be useful both for agencies and the community[10].

Data collection and analysis have been the core of business intelligence (BI) for many years. Still, traditional BI must be adapted to cope with large volumes of data generated by Industry 4.0 (I4.0) technologies.

These technologies generate significant amounts of data processed and used in decision-making to generate value for the companies. Integrating value generation of I4.0 through data analysis into strategic and operational activities is still a new research topic. Results show that most studies focus on real-time applications and voluminous and unstructured data integration. More business research is needed on business model transformation, methodologies to manage the technological implementation, and frameworks to guide human resources training [10].

Business intelligence (BI), up until the present day, is still used as the umbrella term for large-scale decision support systems (DSS). BI is the largest area of IT investment in organizations and has been rated as the top technology priority by CIOs worldwide for many years. The most critical use patterns in decision support are concerned with the type of decision to be supported and the type of manager that makes the decision. The seminal Gorry and Scott Morton MIS/DSS framework remains the most popular framework to describe the use of patterns [9].

Business intelligence (BI) technologies have attracted much attention from academics and practitioners, and the emerging field of business analytics (BA) is beginning to generate much academic research. While interesting, the impact of BI and the relative importance of BA on corporate

performance management (CPM) have not yet been investigated. A CPM framework modelled based on the Integrative model of IT business value and information processing theory to address this gap by collecting data from a global survey of senior managers in 337 companies. Their findings suggest that the more effective the BI implementation, the more influential the CPM-related planning and analytic practices [11].

Since 2001, practitioners have applied Agile methodologies to many delivery disciplines and explored the application of Agile methods and principles to business intelligence delivery and how Agile has changed with the evolution of business intelligence. A significant amount of data generated through the internet and smart devices has grown exponentially, evolving Business intelligence and altering how organizations and individuals use the information [12].

Extant studies suggest that implementing a business intelligence (BI) system is costly, resource-intensive, and complex. Literature draws attention to the critical success factors (CSFs) for implementing BI systems. Leveraging case studies of seven large organizations and blending them with Yeoh and Koronios's BI CSFs framework, the empirical research supports this notion of CSFs. It provides a better contextual understanding of the CSFs in the BI implementation domain [13].

3.2 Public Service Agency

Public sector institutions are part of the government and are designed to conduct legal management to distinguish them from other private companies or non-profit organizations[14]. Public sectors usually consist of both public services and public enterprises. Private and public organizations can be defined by the level of government or market influence on ownership and control [15]. Public Service Agency is placed in the upper left region of the quadrant because the government controls it with non-profit intention by providing public services.

Research on information technology (IT) governance often adopts the classic agency theory view in the private sector. It focuses on the controlling role of the board of directors in limiting potential opportunistic managers/agents. However, the board of directors does not exist in the public sector. There may be less need to pay attention to the control aspects of governance and more attention to the politically challenging national resource allocation [16]. Public organizations lack the autonomy necessary to operate as independent organizational actors, and it is not complete as their private sectors counterparts.

3.3 Four-Step Dimensional Design Process

The four critical decisions made during the design of a dimensional model, include:

a. Select the business process.

Business processes typically are operational activities performed by an organization. Selecting the correct process is crucial to define a specific design target, which will declare the suitable grain, dimensions, and facts. Translating this business process into a fact table will be the next step because most fact tables focus on the outcome of a single business process. Each business process corresponds to a single row in the bus matrix of the enterprise data warehouse.

b. Declare the grain.

The granularity of the Four-step Dimensional Design Process determines how detailed the fact table must be. The most detailed factual information is that a row of data represents a single transaction made. The lower the level of granularity of a data warehouse, the more precise and more comprehensive the data provided. Consequently, data processing will be slower and take longer.

c. Identify the dimensions.

Dimension provides the context surrounding a business process event. It gives who, what, and where of a fact in simple terms. For example, in the Sales business process, for the fact of quarterly sales number, the dimensions would be Customer Names (Who), Location (Where) and Product Name (What). In other words, a dimension is a window to view the information in the facts.

d. Identify the facts.

Facts are the measurements/metrics or facts from a business process. A typical measurement for a Sales business process would be quarterly sales number.

We can answer these questions by considering the business's needs and the realities of the underlying source data during the collaborative modeling sessions. Following the business process, grain, dimension, and fact declarations, the design team determines the table and column names, sample domain values, and business rules. Business data governance representatives must participate in this detailed design activity to ensure business buy-in [17]. This combination of dimensions and fact

models will form a star-schemas because they resemble a star-like structure.

3.4 Metabase Dashboard

The dashboard design is made using modern Business Intelligence tools with the name 'Metabase', which can pull and process data from various sources to be displayed as meaningful data. This tool allows the creation of interactive visualizations and has the option to display them as web-based dashboards or embed them inside other applications.

As of 2021, Metabase has five different Editions that can be used, which are: Open Source (free of cost under AGPL), Enterprise (advanced enterprise features such as sandboxing and auditing tools, with a subscription cost), Cloud (Hosted Service, no need to invest on hardware, also with a subscription cost), and Embedding (for embedding/integrating Metabase as a part of other application, with a paid premium account).[18]

3. METHODOLOGY

3.1 Data Understanding

In this study, dataset of fundraising is collected for five year period, starting from 2017 and up to 2021. This period is selected based on the foundation where the public service agency established its information system. The dataset is presented as Header, Detail and Payment Data.

The Header Data explains the export activities carried by the exporter which each row of data in this Header represents one export activity as described in Table 1.

Table 1. Header Data

No.	Field	Type	Description
1	BillingCode	Text	Billing ID
2	Exporter	Text	Name of Exporter
3	Port Origin	Text	Name of Origin Port
4	Port Destination	Text	Name of Destination Port
5	Country Destination	Text	Country of Destination Port
6	Request Date	Datetime	Date of request
7	Shipping Date	Datetime	Date of shipping

The Detail Data explains the exported items based on each row of export activity represented in Header Data. The Detail Data also includes every item shipped in metric tonnes. The Detail Data Structure is described in Table 2.

Table 2: Detail Data

No.	Field	Type	Description
1	BillingCode	Text	Billing ID
2	Goods Type	Text	Type of goods exported
3	Quantity	Double	Quantity of shipped goods

The Payment Data holds the exporter's levy before the authorities release the goods. These levies are calculated from the tariff put to each item type being exported times the quantity of the goods times the effective exchange rate. The formula is explained in Equation (1).

$$L = (t \times q \times e) \quad (1)$$

L: $Levy$

t: $tariff$

q: $quantity\ (in\ Metric\ Tonnes)$

e: $exchange\ rate\ (USD\ to\ IDR)$

This exchange rate value is vital since the tariff is US Dollars. The amount to be billed to the exporter is in Indonesian Rupiah, so we need to make sure that this exchange rate information is available on every transaction or fact.

Table 3: Payment Data

No.	Field	Type	Description
1	BillingCode	Number	Billing ID
2	Payment Amount	Double	The amount of levy paid based on goods type
3	Bank	Text	Bank used to pay the levy
4	Payment Date	Datetime	Date of levy paid
5	Exchange Rate	Double	Effective Exchange Rate

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These datasets have been imported to local repositories using standard import tools such as Dbeaver or PHPMyadmin with minor adjustments to replacing all null values with default.

3.2 Data Preprocessing

Dataset mentioned earlier can easily be transformed into the desired model using Metabase Native Query Tools.

The dataset was converted using Header Data joined with Detail Data and later left joined with Payment Data using BillingCode as the key to achieving good data quality. This procedure meets the project's data requirements, as presented in Table 4 below.

Table 4: Data Requirement

No.	Field	Type	Description
1	Exporter	Text	Exporter Name
2	Location	Text	Exporter Location
3	Port Origin	Text	Name of Origin Port
4	Port Destination	Text	Name of Destination Port
5	Country Destination	Text	Country of Destination Port
6	Goods Type	Text	Type of goods exported
7	Quantity	Double	Quantity of shipped goods
8	Payment Amount	Double	The amount of levy paid based on goods type
9	Request Date	Datetime	Date of the export request
10	Shipping Date	Datetime	Date of goods shipped
11	Payment Date	Datetime	Date of levy paid

This dataset transformation must understand the following questions as presented in Table 5.

Table 5: Business Questions

No	Questions	Type
1	How much levy has been accumulated?	What
2	How many different commodities that has been shipped?	What
3	Who is the biggest exporter in terms of shipment?	Who
4	Who is the biggest exporter in terms of levy payment?	Who
5	Which area/province is the largest shipper?	What
6	Which country is the most popular export destination?	What
7	What are the most common commodities sold?	What

The questions above are categorized as Descriptive Analytics, which is used to describe the examination of data or content, usually manually performed, to answer the question "What happened?" (or What is happening?). Descriptive Analytics is typically characterized by traditional business intelligence (BI) and visualizations such as pie charts, bar charts, line graphs, tables, or generated narratives.[19]

3.3 Modeling

For Descriptive Analytics used in this project, we will be using Metabase Question Editor to generate statistics and correlations between attributes like Figure 2. This editor, designed with SQL (Structured Query Language) in mind, defines data or tables to be queried. If necessary, other data will be joined using certain criteria or summarized by specific values. Data sorting and row limit are also available as a feature. It can be customized to represent better user expectations about what kind of answer they want.

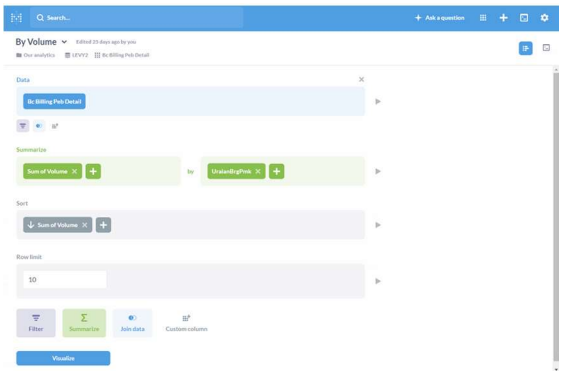

Figure 2. Question Editor

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4. FINDING AND DISCUSSION

3.1 Evaluation Progress

After we carefully model and analyze the result, the success criteria on this project are based on whether the model can answer all the questions in the Data Understanding section.

Figure 3 below answers the first question of Table 5, how levy has accumulated throughout history until the present day. This data is gathered by summing up all the payment values in Table 3. It shows us that the total levy accumulated in the five years of 2017-2021 is approximately 137.3 trillion Rupiah.

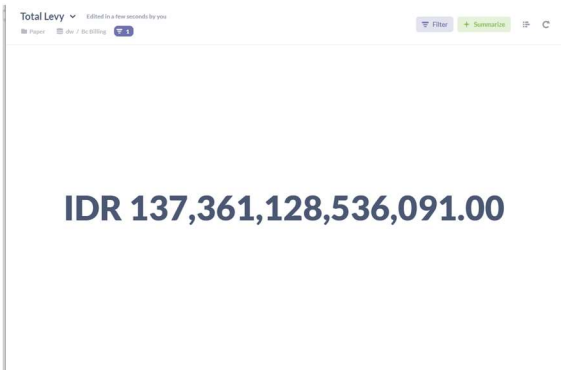

Figure 3. Total levy accumulated for period 2017-2021

Figure 4 below answer the second question of Table 5 on how many specific commodities has been sold as export goods. We can achieve this by grouping all the goods type values in Table 2. It shows us that commodities that have become export goods until the end of 2021 consist of 22 different types.

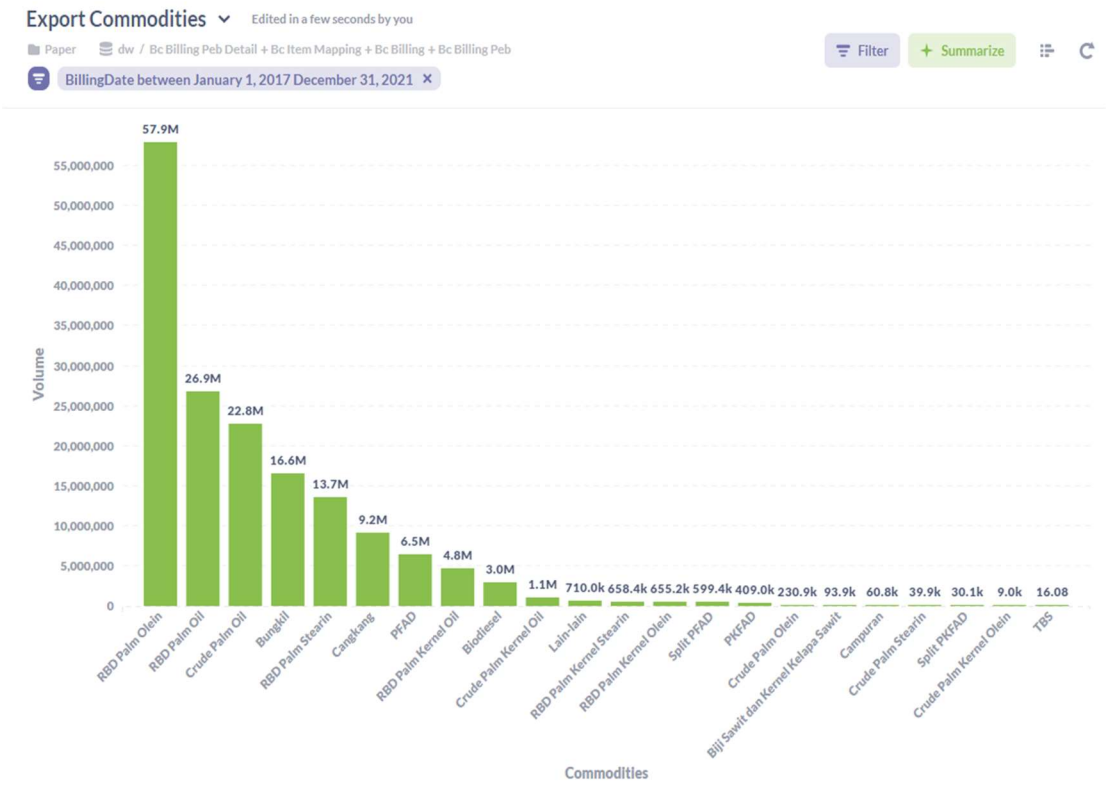

Figure 4. Numbers of distinct commodities

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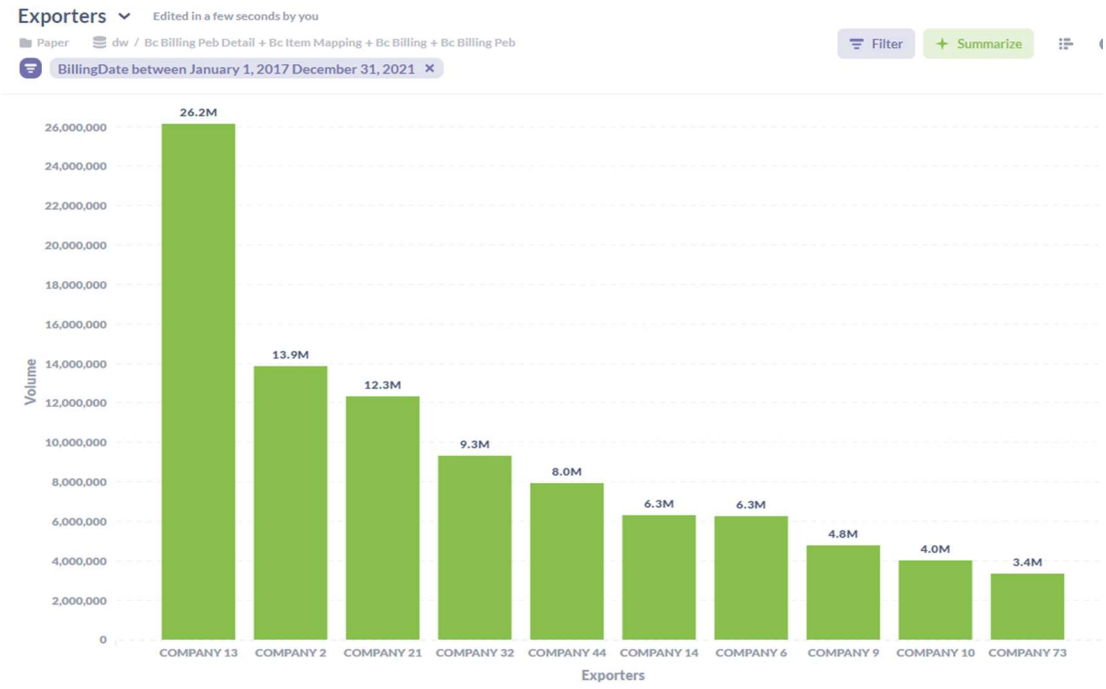

Figure 5. The volume of shipment grouped by exporters

Figure 6. Levy payment by exporters

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Figure 7 below answers the fifth question of Table 5, which province is the most significant origin of the export goods. We try to comprehend the knowledge of the most resourceful region for this type of export activity. We can achieve this by grouping all the Port Origin values in Table 1 and counting all the rows for that specific Port Origin. It shows us that the most significant province comes from Riau; by looking at the color legend, with value, it represents around 127 million metric tons. Darker color means the highest value, and lighter color represents the lower value.

Figure 8 below answers the sixth question of Table 5, which country is the most frequent export destination. We try to comprehend the knowledge of the most promising country to market Indonesia's palm oil commodities. We can achieve this by grouping all the Country Destination values in Table 1 and counting all the rows for that specific Country Destination. It shows us that the most frequent destination country is India, with 42.2 million metric tons. The darker green color represents the value on the map.

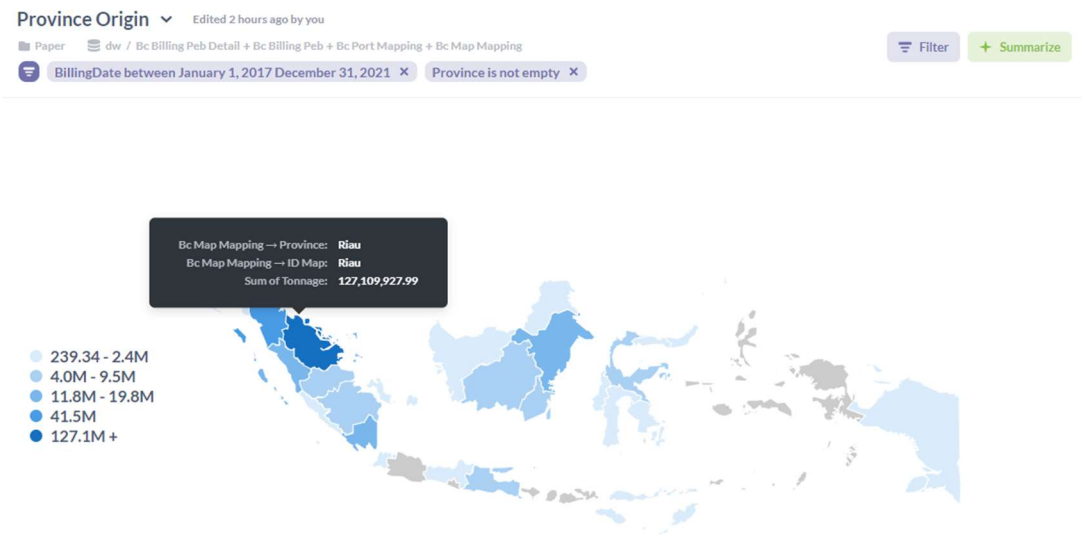

Figure 7. The volume of shipment by provinces

Furthermore, we can reuse the previous graph to answer the 7th question by changing the visual graph from Figure 5 to Pie Chart in Figure 9 below. We can explain which commodity type is mainly sold as export goods, "RBD PALM OLEIN" on approximately 57.9 million Metric Tons or 34.88% of total shipment.

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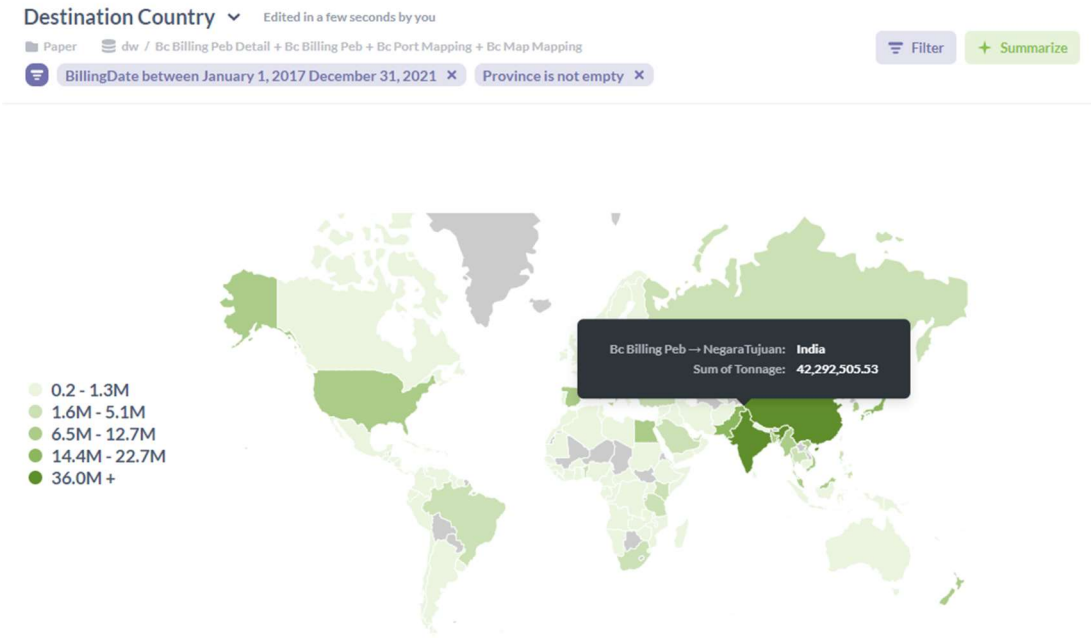

Figure 8. The volume of shipment by the destination country

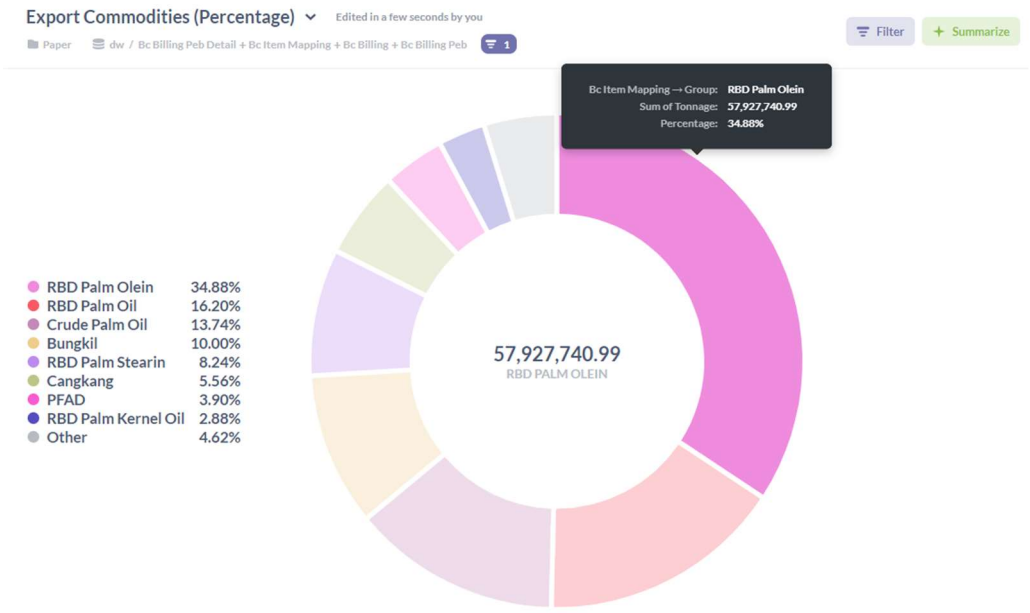

Figure 9. Shipment volumes shares by commodities

The complete list of commodities traded, as displayed in Table 6, is obtained by changing the Metabase's Visualisation type from a graph into a table.

Table 6: Export Commodities

Commodity Types	Metric Tons
RBD Palm Olein	57,927,741
RBD Palm Oil	26,902,118
Crude Palm Oil	22,812,154
Bungkil	16,608,065
RBD Palm Stearin	13,681,273
Cangkang	9,227,668
PFAD	6,468,677
RBD Palm Kernel Oil	4,774,641
Biodiesel	3,018,473
Crude Palm Kernel Oil	1,148,957
Lain-lain	710,019
RBD Palm Kernel Stearin	658,395
RBD Palm Kernel Olein	655,220
Split PFAD	599,385
PKFAD	409,011
Crude Palm Olein	230,869
Biji Sawit dan Kernel Kelapa Sawit	93,947
Campuran	60,810
Crude Palm Stearin	39,943
Split PKFAD	30,129
Crude Palm Kernel Olein	9,021
TBS	16

We can conclude from each graph above that the Business Intelligence Dashboard can answer all the questions from Table 5. The answers are summarized in Table 7 below.

Table 7. Answered Business Questions

No	Questions	Type	Value	Addressed?
1	How much levy has been accumulated?	What	137.3 trillion Rupiah	Yes
2	How many different commodities that has been shipped?	What	22 unique commodities	Yes
3	Who is the biggest exporter in terms of shipment?	Who	Company 13 (26.2 million metric tons)	Yes
4	Who is the biggest exporter in terms of levy payment?	Who	Company 2 (15 trillion rupiah)	Yes
5	Which area/province is the largest shipper?	What	Riau (approx 127 million metric tons)	Yes
6	Which country is the most popular export destination?	What	India (42.3 million metric tons)	Yes
7	What are the most common commodities sold?	What	RBD Palm Olein (57.9 million metric tons)	Yes

For further improvement, we can advance this article to other methods such as Predictive Analytics, which will address questions: (1) Which country will most likely be a potential buyer? (2) What commodities will be popular next year? (3) How much will the business grow next year? Etc, or using Prescriptive Analytics to address questions such as: (1) What should we do to increase demand? (2) What can we do to overcome the bottleneck on the export mechanism? And so on.

5. CONCLUSION & FUTURE RESEARCH

This paper provides an overview of a systematic approach in determining a suitable decision support system model for public service agencies. The initial section of this paper describes the challenges faced by public service agencies understanding the questions raised by management and what data they already have to answer them. This paper also explains

how Metabase dan Data Warehousing can answer the needs of the Oil Palm Public Service Agency by creating a graphics visualization. This approach may not be equally applicable between various public service agencies, depending on the organization's nature. However, in the end, the successful implementation of the Business Intelligence Dashboard at the Oil Palm Public Service Agency will add to a series of successes and an excellent example for delivering decisions and policy for government institutions, especially Public Service Agencies.

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