The Use of CGM Web System as Cost of Goods Manufactured Monitoring in the Industrial Revolution 4.0 Era

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Abstract. The implementation of the Internet of Things (IoT) concept can support the implementation of the Business Intelligence information system in a company. The advancement in information technology, especially in wireless networks, must be utilized as optimally as possible to improve a company's operations. PT Petrokimia Gresik (PG) has developed cost of goods manufactured monitoring software that can be accessed both online via a web browser, desktop, and mobile applications (android and ios), as well as offline (with desktop applications). The application functions as a cost of goods manufactured diagnostic tools for all products produced by PG. The evaluation includes variable and fixed costs which can be detailed down to the activity causing it. The development of IoT-based software is expected to optimize the evaluation of cost of goods manufactured comprehensively and support the company's business decisions to meet company targets and compete in an increasingly competitive business environment.

Keywords: Internet of things · Business intelligence · Cost of goods manufactured

1 Introduction

PT Pupuk Indonesia (PI) is a State-Owned Enterprise (BUMN) which oversees a number of fertilizer companies including PT Pupuk Sriwidjaja (PUSRI) located in Palembang, PT Pupuk Kalimantan Timur (PKT) located in Bontang, PT Petrokimia Gresik (PG) located in Gresik, PT Pupuk Kujang Cikampek (PKC) located in Cikampek, and Pupuk Iskandar Muda (PIM) located in Lhoksumawe. With the inauguration of PI as a holding company, it is hoped that in the future, there will be a commitment from the Board of Directors of the Holding Group to synergize fertilizer companies under PI so that the Ministry of SOEs' primary goals in the continuity of fertilizer supply for national food security can be achieved which will save costs through the use of more economical and efficient facilities and infrastructure (Fig. 1).

The business development of PI and its subsidiaries requires a system capable of processing data in ERP and other external data and presenting it as management consideration in making decisions to seize opportunities and win the competition, one of

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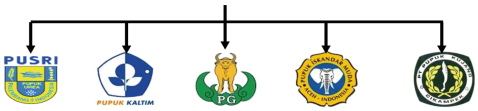

Fig. 1. Subsidiaries of PT Pupuk Indonesia Holding Company.

which is a business intelligence system. Business Intelligence is the process of extracting operational data of an organization or company and then collecting it into a data warehouse; then, the data in the data warehouse is processed using statistical analysis and data mining processes so that various trends in patterns are obtained from the data.

Business Intelligence (BI) is an analytical tool used to integrate data, analyze, store and access many data to assist in decision makings, such as for database queries and reporting, tools for multidimensional data analysis, and data mining [1]. BI can be optimized in several digital components, including data warehousing, online analytical processing, extract transform load, data mining, and multidimensionality [2]. BI generally converts data from various sources, for example, from Customer Relationship Management (CRM), Supply Chain Management (SCM), Enterprise Resource Planning (ERP), and others. Keys in the BI definition are components (elements), the relationships between elements, and externally visible properties. These properties include services, performance characteristics, and resource sharing. BI can be optimized in evaluating operations and supporting management decisions. In PG, BI is used in monitoring production costs. The development of the business world makes PG must be able to monitor its operations on an ongoing basis so that it can continue to compete with its competitors. BI that is realized through CGM Web can help PG monitor production costs in detail in evaluation and business decision-making by management to meet company targets and compete in an increasingly competitive business environment.

Some definitions of Business Intelligence, according to some experts, are as follows: 1. Ephraim Turban and Carroll Pollard. According to Efraim Turban and Carroll Pollard [2], business intelligence refers to "A conceptual framework to support business, combining database architecture, analysis tools and applications". 2. Mohammad Shariat and Roscoe Hightower Jr. According to Mohammad Shariat and Roscoe Hightower Jr. [3], business intelligence is defined as "Analysis tools that can be used to integrate data, analyze, store and access data to assist in decision making".

According to Vercellis [3], the business intelligence concept consists of 6 (six) modules: a. Data Source, sources of data from internal and external companies. The process of collecting and integrating data from various existing sources. b. Data Warehouse, the database to support the Business Intelligence process consists of the extraction and transformation tool stages known as ETL (Extract, Transform, Load). c. Data Exploration, data exploration to support Business Intelligence needs. The processes used in this stage include queries, reporting systems, and statistical methods. c. Data Mining, the process of exploring in-depth information and knowledge regarding the patterns and characteristics of the data collected. d. Optimization, stages to produce some of the best possible solutions as a basis for decision making for management. e. Decisions, the stage when the final decision is made for management based on a series of previous stages of the process.

BI usually converts data from various sources, for example, from Supply Chain Management (SCM), Enterprise Resource Planning (ERP), and others. The key in the definition of BI architecture is the components (elements), the relationship between the elements, and externally visible properties. These properties include services, performance characteristics, and resource sharing.

In BI, OLAP is an approach method to quickly provide answers to requests for dimensional analysis processes in applications and technologies that can collect, store, and manipulate data into multidimensional data for analysis purposes. OLAP is the key to business intelligence in analyzing data and information for further use as the basis for a company's decision-making.

2 Research Methods

This study was conducted by searching for literature and sources of information in scientific journals related to the CGM Web application as a concrete step in implementing BI in monitoring PT Petrokimia Gresik's production costs. a. Collecting data and information in scientific journal articles relevant to this study's topic. b. Reading and understanding articles in scientific journals. c. Identifying data and information in scientific journal articles relevant to this study's topic. d. Summarizing essential data and information from each literature. e. Writing and compiling the obtained data and information in a structured and systematic manner according to this paper topic (Fig. 2).

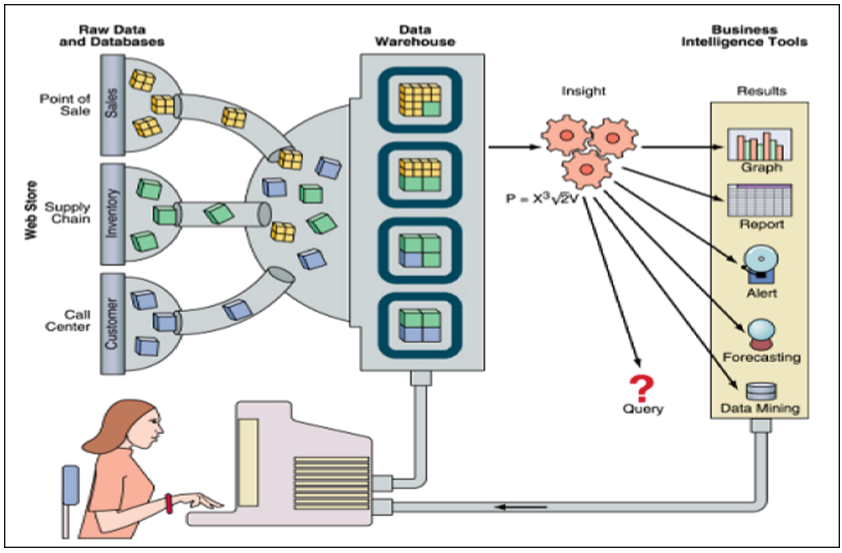

Fig. 2. Basic understanding of business intelligence.

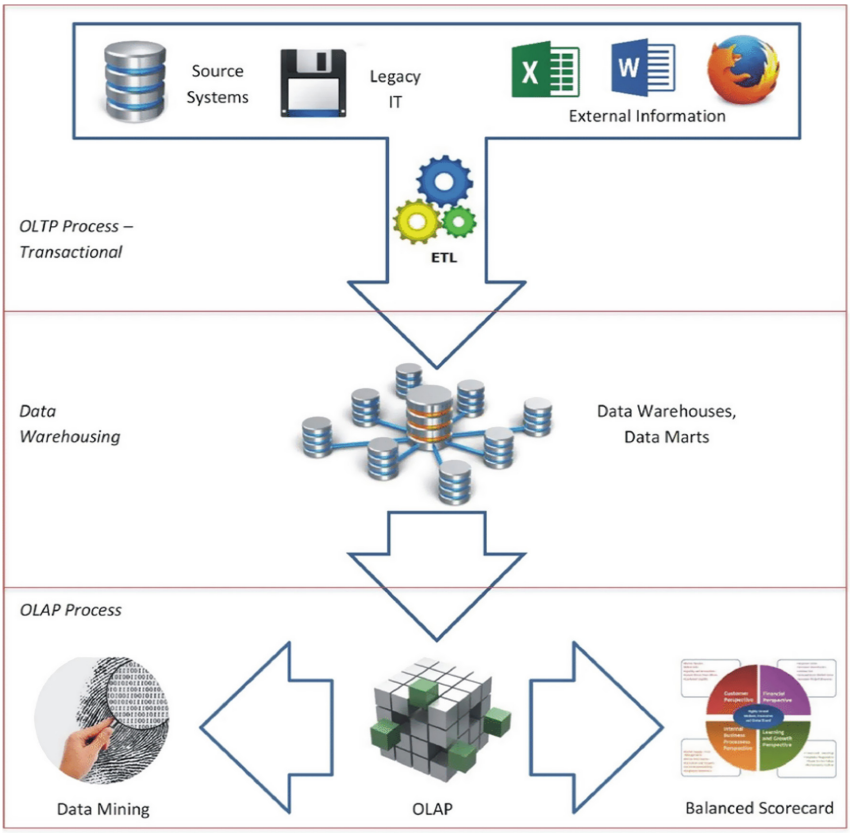

Fig. 3. Business intelligence concept chart

3 Results and Discussion

Business Intelligence (BI) is an information system concept that performs the process of extracting operational data, collecting the data into a data warehouse, and then subjected to statistical calculations and data mining to obtain the patterns and characteristics of the data set. According to Turban's research [5], business intelligence consists of 5 (five) types: 1. Enterprise reporting that aims to produce regular reports to management. Operating reports and dashboards are included in this type of report. 2. Ad Hoc Query and Analysis aim to provide access to users to run the query process in the database. 3. Cube analysis aims to process multidimensional OLTP analysis used by management in a limited environment. 4. Statistical analysis and data mining that serve to predict and/or analyze correlations between variables. 5. Delivery report and alert that aim to make a comprehensive report. The business intelligence framework can be described in Fig. 3

The advancement in information technology, especially in networking services to support wireless services, also supports the implementation of BI in the Industrial Revolution 4.0 era. Optimal utilization of the Internet of Things (IoT) will help organizations to obtain data and information from the field as needed. Literally, IoT is a concept that

connects all devices to the internet network and allows IoT devices to communicate and share data between one device and another via the internet from Zanella [6]. It is estimated that 2 billion devices worldwide are connected to the internet network. This is a huge potential and business opportunity for telecommunications service providers. The application of IoT makes it possible to connect the physical world into a computer-based digital world.

The interconnection of multiple devices will result in automation in almost all areas of life. According to Gubbi and Buyya [7], the main benefits of IoT are: 1. Improving customer engagement, high competition in marketing products and services, consumers experience disruption because of the advancement in information technology. IoT can provide an experience for consumers with the convenience of making transactions or other forms of after-sales. 2. Technical optimization, the role of IoT directly increases the benefits of technology to make it better. 3. Reducing waste, with easy access to the internet network; everyone can find data and information in digital form in real-time to accelerate the decision-making process and effectiveness in resource management. The success of IoT cannot be separated from the basic elements, namely: cloud computing, small devices and active engagement.

Cloud computing is a platform that makes wireless networks a center for data processing and applications. According to Armbrust [8], there are 3 (three) forms of delivery in cloud computing: 1. Software as a Service (SaaS) is a facility provided by a platform manager service provider as an infrastructure for application users. 2. Platform as a Service (PaaS) is a facility that application developers can utilize without performing a platform maintenance process. 3. Infrastructure as a Service (IaaS) is a facility explicitly provided to maximize infrastructure (Fig. 4).

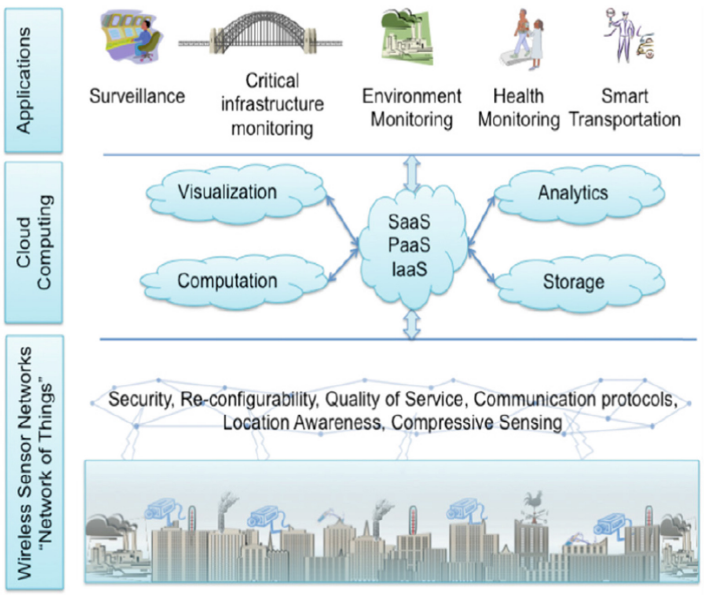

Fig. 4. IoT framework with cloud computing.

While there are 4 (four) models of cloud computing: 1. Public cloud is a server that can be used by many users, and its utilization is the same as shared posting. 2. Private cloud is a server that can only be used by one user. 3. Hybrid cloud is a server that can be used by the public. 4. Community cloud is a server that can be used by several organizations with the same needs. The use of cloud computing can overcome problems and challenges in implementing IoT, such as the high cost of server investment and disaster risk mitigation (disaster recovery). However, things to consider for an organization when using cloud computing are: 1. Availability and speed of internet access. 2. Service level agreement (Service level agreement). 3. Vendor commitment and experience. 4. Security, privacy, and data backup. 5. Cost (Figs. 5 and 6).

CGM Web is an example of implementing an information system at the operating level at PT Petrokimia Gresik. The web was developed by utilizing Power BI to process production cost data into production cost reports useful in monitoring production costs. The development of CGM Web utilized the Internet of Things (IoT) concept because of the ease of access to the internet network. The web was developed to facilitate employees

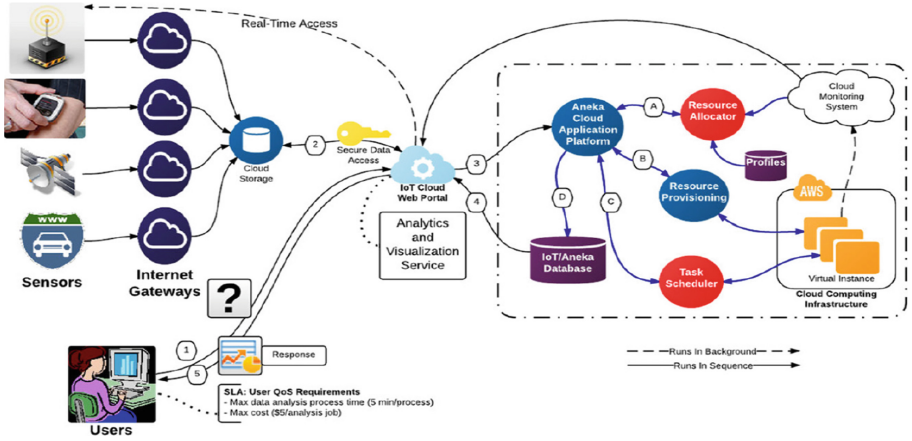

Fig. 5. End-to-end interaction model for the implementation of cloud-centric Internet of Things.

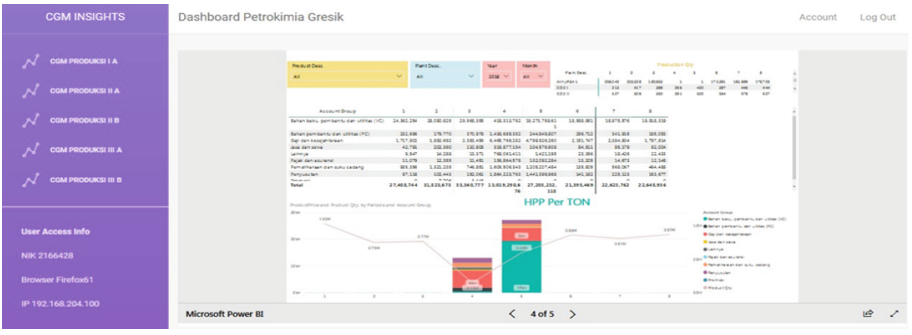

Fig. 6. CGM Web Application interface.

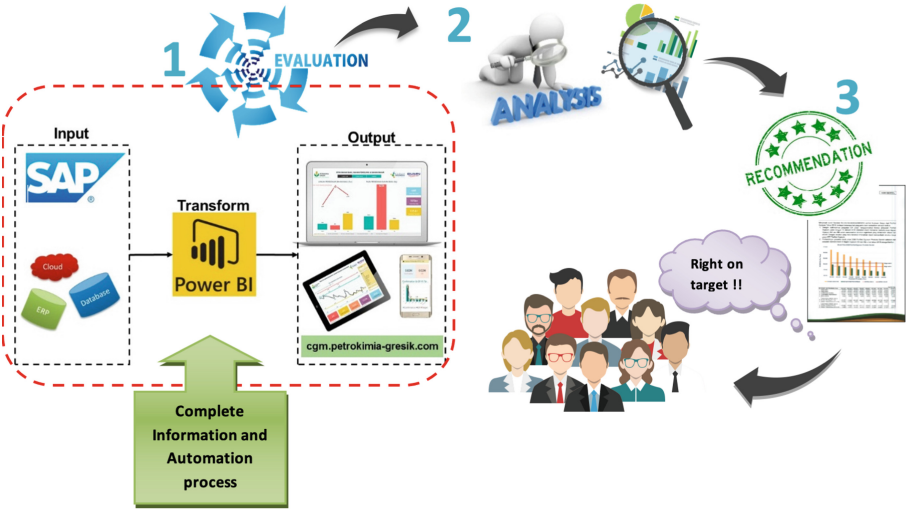

Fig. 7. CGM Web data and information flowchart.

in monitoring production costs. Employees can evaluate the realization of production costs for the products produced and these production costs can be one of the bases in determining the selling price of the product. The CGM Web features that employees can use in monitoring production costs are as follows: 1. Cost of Goods Manufactured (CGM) per ton. This feature serves to see the realization of the quantity number of production of a product and see trends in the realization of COGS per ton of a product, including the breakdown of the value per cost component forming the CGM. 2. Fixed cost. This feature is used to see the monthly fixed cost realization in a production unit, see the details of transactions forming fixed costs, and determine whether these costs are direct or allocation costs. 3. Variable cost. This feature serves to see the realization of cost per ton of bag production of variable cost components, namely raw and auxiliary materials (which have a material code). 4. Variable cost consumption rate. This feature serves to see the trend of consumption rate realization on the variable cost components, namely raw and auxiliary materials (which have a material code). 5. Variable cost unit price raw material. This feature is used to see the trend of used prices for the variable cost components, namely raw and auxiliary materials (which have material codes).

The results of data processing from the CGM Web can find trends from time to time regarding the realization of production costs for products produced by the company and can find out details of variable and fixed costs so as to facilitate monitoring and evaluation of Petrokimia Gresik products (Fig. 7).

4 Conclusion

The utilization of the Internet of Things (IoT) has an essential role in supporting Business Intelligence information systems in a corporate organization. In the industrial revolution 4.0 era, the speed of data and information flow is needed to accelerate the decision-making process by management. Data digitization is something that all industries must

fulfill to increase the effectiveness of company operating activities and the efficiency in cost aspects. The optimization of information technology is expected to become a unified company's operating strategy that must be prepared from the start so that business processes can be integrated into a company value chain and produce outcomes in the form of data and information used to improve the company performance. In implementing this CGM Web, Petrokimia Gresik can take advantage of detailed production cost information on an ongoing basis. Production cost data in the CGM Web can continue to support production cost monitoring and become one of the management's business decision-making bases.

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