Reusability Metric on Procurement of Goods and Services

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***Abstract*—Reusability is generally used to determine the level of integration a program, one of them the procurement of goods and services. The objective of this paper to analyze the reusability of components at the business process of the procurement of goods and services using metrics. This component we're analyzed by calculating of frequency and percentages by involving components of the registration of document, the completeness of document, procurement procedures, tender, selection of suppliers, delivery time, the total of goods or services, quality, payment, as well as taxes and inspection. The analysis showed that 7 components that can reusability (more than 50%) are the registration of documents, tender, selection of suppliers, the total of goods or services, quality, payment, as well as taxes and inspection. The highest percentage from of all component is the registration of document (100%).**

Keywords—Reusability; Item; Service; Metric

I. INTRODUCTION

Today humans are indulged by several facilities included in the procurement of goods and services. All the activities can be determined using event logs through a process known as process mining. Process mining is commonly used because it has good accuracy and comprehensibility so that it will facilitate extract data in the event log. To know the trend of using the menus, we can use reusability [1]. Reusability is the ability of a method that can be used to determine the integration of the use of the website program, for example on business processes.

The use of reusability general will facilitate the development level of a program by saving resources and time, as well as capable of monitoring the weaknesses of the program. Reusability efficiency of a program can be calculated by using the metric [2]. Application of reusability metrics will facilitate the analysis of business processes that describe developments in the procurement of goods and services. This paper is made with the aim of analyzing the use of component reusability in the process of procuring goods and services. The results are expected to be used as a reference for the development of components for an institution or a company engaged in the procurement of goods and services.

II. LITERATURE REVIEW

When the manager modifies business rules to achieve effectiveness and a larger composition, the software must keep working to show the significant progress. The process of creation of large computer-based system means to modify and or build an existing application in a distributed system environment so that it becomes competence to meet business needs in the future [19]. Reuse of old methods in to the new program, either on the side of the module or the module collectivity on the new program adapted to the existing needs [3]. In the development of the program can be used multiple existing modules to be implemented on a new program that will be applied, such as the business process of procurement of goods and services. The procurement of goods and services means an activity that involves goods and services by an agency or a particular company from the planning stage until completion of all activities to obtain goods and services [11]. To simplify the process, and to detect problems or frauds that occur using the model [20].

A business process model consists of a series of activities and constraint models among the models activity. Business Process Modeling Notation (BPMN) is a method developed by the Business Process Modeling Initiative (BPMI) in the manufacturing business process model [4]. The purpose of method usage of BPMN is to provide a notation that is easily understood by all business users as well as ensuring that the XML language that is designed for the execution of business processes can be expressed visually by the notation [5]. Unlike other types of business process diagrams, on BPMN it has been added specific notation to describe the event-based messages that can be used as a medium of communication between the organization and the businessman.

Fig. 1, shows symbols of BPMN. Business process as in Business-to-Business (B2B) often adds some more complex notations as notation message (message), time (timer), a link (link), and any error conditions (error condition). BPMN process involves a mechanism called a flow object includes the start, intermediate, or end. Mechanism illustrated with a circular shape and angle system. Angle presented the activity which should be done Fig. 2. Gateway is represented with a rhombus and demonstrate different choices. Gateway also explains the branching and merging of the path. Connecting objects has a sequence flow represented in the form of straight lines with arrows covered and explains the sequence of activities to be carried out. Message flow shows the business

process is going on. The process is represented by the dotted lines and opened arrows. Association associates an artifact, data and flow object represented by dashed lines. Pool is represented with a large square which contains flow objects, connecting objects, and artifact. Lane is a more detailed section than the pool. On the artifacts is has object data to describe the required data or result from an activity. A group is represented in the square with a circular angle and the dotted line outside. Group used is to do the activity grouping [9].

Measurement of reusability components is used to determine the value of components to reuse effectively, because reusability is an effective way to increase productivity. Required to calculate the reusability of components Fig. 3. Component's black-box nature the source code of the components is not available for the users [17]. The entire record of the business process that contains the implementation of the system in the form of an audit trail for understanding of system activity and diagnosing the problem, and can be done in the process discovery of event log [21, 22]. An event log is a basic "log book" that is analyzed and monitored and can capture many different types of information. For example, it can capture all logon sessions to a system. It can also record different types of application events, such as application errors, closures or other related events. Event log is often used by a tool called security information and event management. Analysis of the contents of an event log to help system administrators determine what is going on within a system. This is particularly important in the highly complex but with little activity. It is also used for the entry log files from various sources [12]. Petri nets were studied in the 1960s by C.A. Petri. Petri net is one of the tools to model events and condition system expressed by transitions and places [13].

Place can serve as an input or output for a transition that it can be use fulfilled to take place. Place stating the condition is the output of the transition. Petri nets expressed in the 4-tuple (PS, TS, AS, ws) and PS is the set of place (PS1, PS2, PS3, ..., PSn), T is the set of transition (TS1, TS2, TS3, ……, TSm), A is the set of arc (AS ⊆ (PS * TS) ∪ (TS * PS), and ws indicate weighting function (ws: AS → 1, 2, 3, ……, etc.). Petri nets can be described as a directed graph, nodes of the graph form taken place on the set of place P or transition are taken from the set of transition graph T.

In petri nets the graph is allowed to use some of the arc to connect two nodes or equivalent by giving weight to each arc that states the amount of arc this. Structure is known as the structure Multi graph. In the form of graphs, petri nets can be expressed in the form of notations IS (tsj) and OS (tsj) which each show that the input and output place to transition tsj. Mathematically definition can be written into the following equation [6].

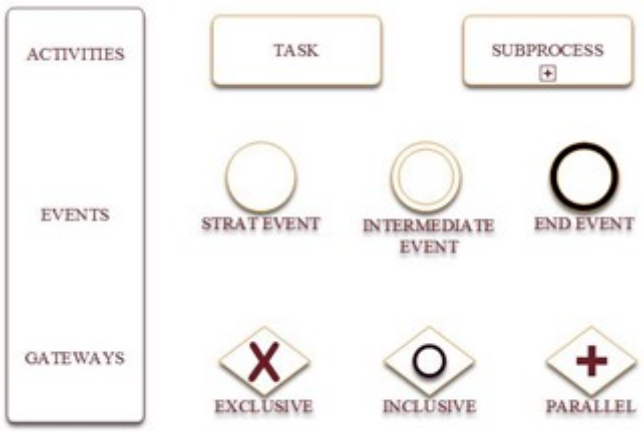

Fig. 1. Business Process Modelling Notation.

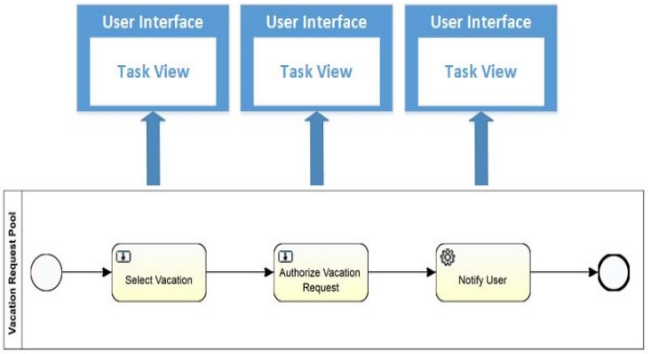

Fig. 2. Example BPMN

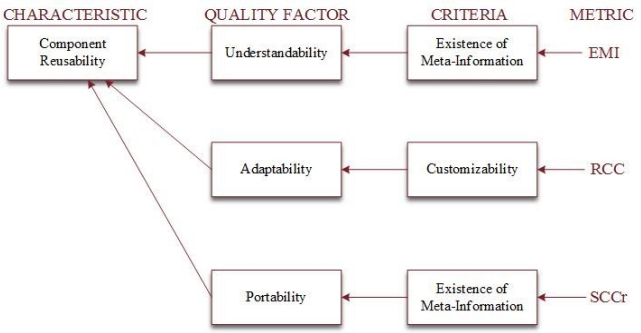

Fig. 3. Component reusability model [17]

$$IS(tj) = \{psi : (psi,tsj) \in AS\} \quad (1)$$

$$OS(tj) = \{psi : (tsj,psi) \in AS\} \quad (2)$$

Petri nets graph consists of two types of nodes, namely circles and lines Fig. 4, and Fig 5. Circle stated place while the line states transition. Arc is symbolized by the arrows connecting the place and transition. Arc connecting place psi to transition tsj denoted by psi∈ IS (tsj). If the weight of the arc from place psi to transition (tsj) is expressed by ws (psi, tsj) = k.

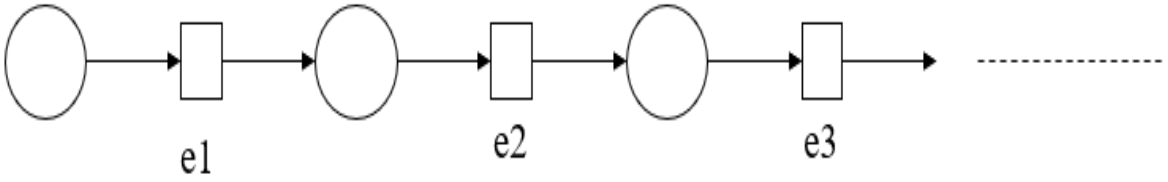

Fig. 4. Model Sequence Petri Net

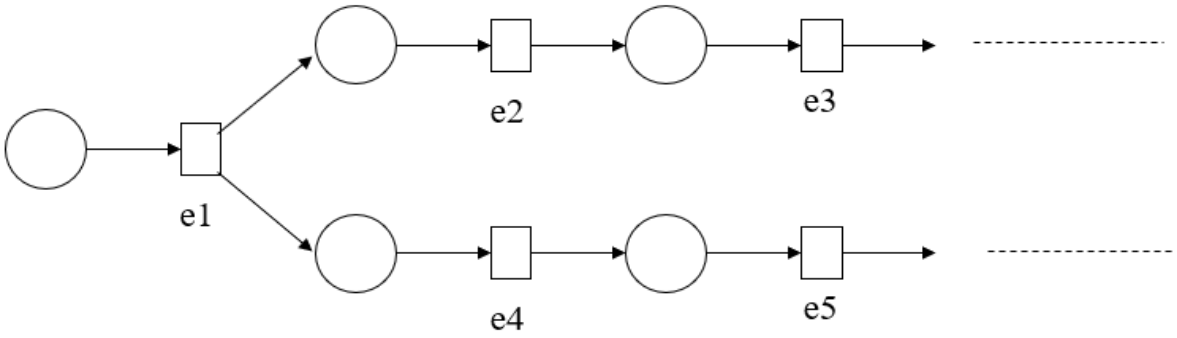

Fig. 5. Model Concurrency Petri Net

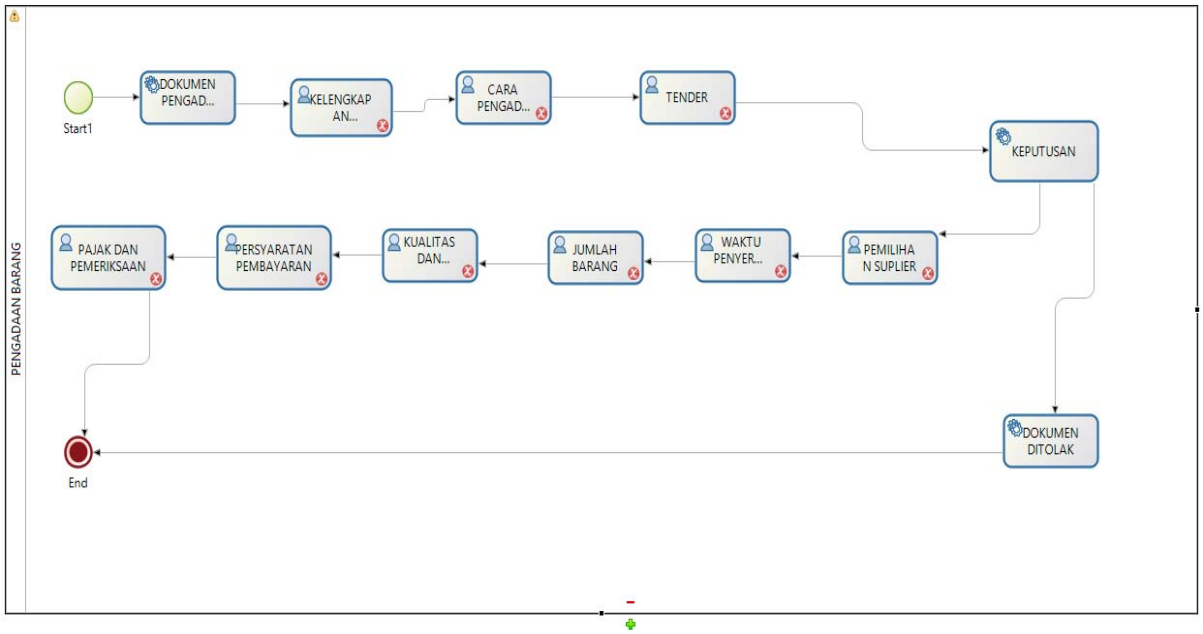

Fig. 6. Process Procurement of Goods and Service

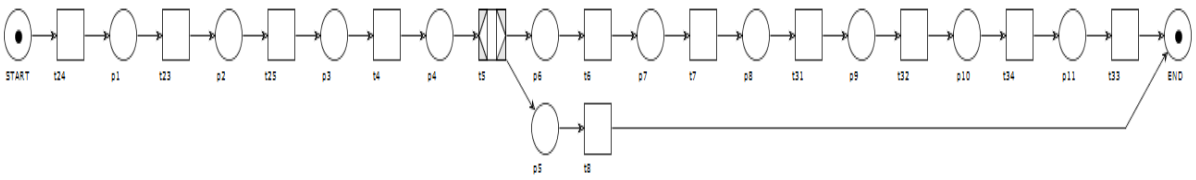

Fig. 7. Petri Nets Process Procurement of Goods and Services

Petri net used graphic language and mathematical modeling and analysis of discrete systems, where the price variable sing, the system only in two states such as on or off as well as active or inactive. Graphic representative of Petri net to make Petri net is widely used in various fields such as process control, computer networks, queuing systems, and others. Arc is expressed by consecutive couple. The first and the second element state the origin stating the purpose. Dynamic behavior shown on the token stream and followed by the net change in the marking place. This flow occurs due to the transition process triggering token move from one place to the other. Implementation Petri net is done with the amount and distribution of tokens in Petri nets. Petri net is executed with detonation transition (firing transition). Detonation transition process on Petri net to follow the rules. Transitions in Petri net and place stated event represents an event that may occur.

Necessary mechanisms indicate whether the conditions have been met. Token is something that is put in place that states whether a condition is met. In the graph token it is described by a point and placed in the place. Event logs show the set of activities and the use of models in the process of procurement of goods and services. Event logs are used quite effectively for comparative purposes whether the company business processes have been applied properly and with the state of its implementation in the field [15]. Continuous business processes needs to adapt the changes in the environment, in accordance with the business strategy, government policies and regulations must also be ensured. Compliance aspects in BPM is very important for government. meta model contains. The model has detailed information and is stored in the repository [16]. to create a new business process model and general use. Trends in the use of a model can be identified by reusability metric. Matteo et al. in 2011, has applied reusability at the library to see the aspect of storage, control, distribution, and management. The study also examines the reusability in a library. Reusability is used to design the library with the complex and dynamic components to develop a searchable principle, friendly, and useful reuse. Making the libraries architecture was able to improve productivity and quality in the use of reusability. Metric, commonly used to define the percentage of successful use reusability. It is used to assess and evaluate the use of a software oriented to specific objects [7]. The coupling and cohesion measurement can use a matrix to determine reusability [8]. In addition, the use of metric enabled in order for a software quality can be recognized and used optimally (Sonia, 2010).

Reuse can be done by integrating the business processes contained in the software. The presence of a detailed repository facilitates component search and retrieval that matches the system's requirements for reuse in business processes. Reuse can be used in different ways to integrate business processes. The process of analog reuse is done for the selection of management based on the ongoing business process and has a repository and adaptation [1]. In the process of adaptation, it can be an adjustment and refinement of business processes. The process can be done automatically through the same model transformation as business process SOP [13].

III. Methodology

In the business process of procurement of goods and services, there are some content files such as checking documents, tender procurement, and delivery of goods or services. Fig. 6, shows that the BPMN business process of procurement of goods and services, is how the flow of the process of procurement of goods and services is done. Conversion from Fig. 6 in the form of Petri nets can be Fig. 7, while the event log of the images shown in Table I.

Event logs obtained from the business processes that are running on the procurement of goods and services, case number that is used to analyze the flexible business processes [15]. Content procurement of goods and services can be reused if it meets the frequency reuse and reuse percentage. Measurements using a functional component event log procurement of goods and services direct not known as frequency reuse. Functional components are frequently used system (qualification) which is classified by system components. Reuse frequency can be measured by using the following formula.

$$Reuse\ Frequency = \frac{n(C)}{\frac{1}{n}\sum_{i=1}^{n} n(Si)} \quad (3)$$

n(C) = Number of reference component
n(Si) = Number of reference standard

Reuse percentage is used to calculate the percentage of the amount of the component that is qualified to be identified and reused. The following formula is used to calculate the percentage reuse.

$$Reuse\ Percentage = \frac{n(Q)}{n(Q)+n(NQ)} x100\% \quad (4)$$

n(Q) = Number of components qualified
n(NQ) = Number of components not qualified

IV. Results and Discussion

Table 2 is the result of the event log of the business process of procurement of goods and services to determine reusability metric. There are 10 components used such as the receiving documents, documenting, procurement procedures, tenders, selecting suppliers, time of delivery, quantity or quality of goods, quality, tax payments and checks.

TABLE I. CODE PROCUREMENT OF GOODS AND SERVICES

Number Case	Log Traces
A	Registration of Document
B	Complete of Document
C	Procurement Procedures
D	Tender
E	Selection of Suppliers
F	Delivery time
G	The Total of Goods or Services
H	Quality
I	Payment
J	Taxes and Inspection

TABLE II. EVENT LOGS DATA PROCUREMENT OF GOODS AND SERVICES

Number Case	Log Traces
1	ABCDEFGHIJ
1	ABCDEFHIJ
2	ABCEFGHIJ
2	ABCDEFGHJ
3	ABCDEFGHIJ
3	ABCDEFGIJ

TABLE III. REUSE FREQUENCY AND REUSE PERCENTAGE

Node Case	Reuse Frequency	Reuse Percentage
A	1.45	100%
B	0.47	30%
C	0.34	22%
D	1.36	87%
E	1.44	92%
F	0.39	25%
G	1.20	77%
H	1.28	82%
I	1.44	92%
J	1.34	85%

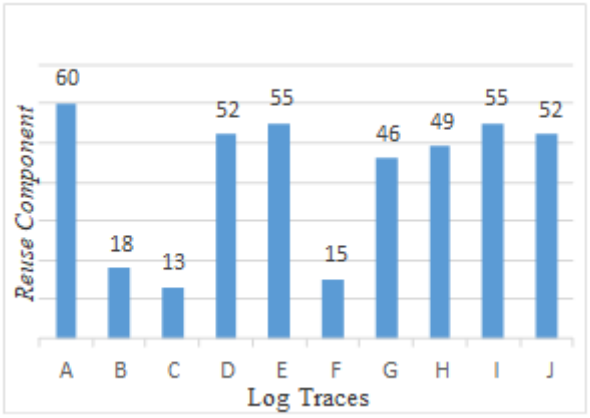

Fig. 8. Reuse component dataset procurement of goods and services.

In this case, reusability metric is used to analyze component and qualification of a component that can be reused in business processes of procurement of goods and services. The value of frequency reuse otherwise qualified and can be reused if it reaches 100% [14]. Reusability is an important factor for engineering processes affecting the quality of business processes by reducing time and effort [1]. From the study it can be concluded that the use of reusability in the procurement of goods and services shows some of the components in the reusable business processes. registration of document is a component that has a reuse percentage of 100% compared with the other components. Registration of documents into business processes running should be done at the first time.

The ability reusability in designing program or system models residing in business processes has different reuse rates according to the number of the components. It used all or greater of the same system model and design. SOP is used in system creation and at the time of development so that existing components are not well documented. System of development and modification is often done based on the needs of running business processes [18]. Reusability metrics are calculated based on the event log of the business processes that occurs in the procurement of goods and services. Counters are used to determine the reuse of the components used. Table III shows the value of frequency reuse and reuse percentage of event logs of procurement of goods and services that determine which component is eligible to be reused, while reusability metric can be seen in Fig. 8.

The results of data analysis showed that the total components in the business process of procurement of goods and services reach the 100% of reuse. Optimizing node of Table 3 shows the business processes that often appear in the event logs. Optimal Node = A → E → I → D → A → H → G → B → C → F. Table III shows there are 7 components suggested to be reused in business processes of procurement of goods and services, namely component A, E, I, D, J, H, and G. Based on Fig. 8 it shows the ideal node occurs in A and a leased value in C, these values represent the value of reuse component. the maximum value of frequency reuse is

declared when it is more than 50% and a minimum value is less than 50% [18]. maximum and minimum values can be reuse in accordance with business processes.

V. CONCLUSION

In this paper, it can be fan that there are 7 components that can be reused such as are the registration of documents, tender, selection of suppliers, the total of goods or services, quality, payment, as well as taxes and inspection. The components within the business process of procurement of goods and services can be reused are the component that has reusability percentage more than 50%.

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