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Optimation economic order quantity method for a support system reorder point stock

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ABSTRACT

The success of a company is measured by the ability to provide goods and services at the right time and place. Besides, one of the factors of the company's progress is also supported by inventory management which functions to control the company's inventory by neither hoarding lots of products nor running out of products. The development of technology requires a company's inventory management that is fast, precise and accurate to support its' performance. In fact, some companies have difficulty in determining the stock of their goods production so that it impedes the fulfillment of consumer needs in the event of high market demand. This study is to determine the reorder point stock of a company that determines the number of purchases and sales of the company's products, therefore the amount of expenses and income can be presented to the board of directors to be followed up quickly and accurately. The method used is a statistical approach to the economic quantity model where safety stock analysis is first performed. This method is used to put the company's products to the inventory so that there are no excess or even shortages of products. System development method used is a user centered design, which is the most suitable to the study. The output of the activity is information in the form of advice to the company leaders in making decisions about production planning, controlling stock inventory, detailing market demand quickly, precisely and accurately and developing a decision support system that is made by taking into account the details of user needs.

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1. INTRODUCTION

Competition in the global market leads companies to look for opportunities by minimizing production costs but increasing investment without reducing product quality. Data accuracy becomes an important source of a company to determine sales predictions in accordance with market demand. One of the company's strategies to increase benefits is to manage all of its assets. The company's inventory management should provide accurate information about detail inventory of goods and services, especially large companies with many high valuable goods. The information accuracy about ordering or releasing goods also affects the company's performance. Risks taken by the company if the data presented does not match the field data on the procurement and release of goods, which can cause companies to lose money.

In this regard, this study aims to analyze and create a system that can be used by companies to provide decisions related to the procurement of goods. A system will be developed to help companies determine the amount of goods ordered by optimizing the method that will be used, namely economic order quantity (EOQ) [1]. By optimizing the EOQ method, company can determine the number of orders related to how much raw materials requested to suppliers and reorder points related to the time of procurement of goods, as well as reporting on raw material inventory [2]. The EOQ method is also used to figure out the remaining raw material inventory as a preventife measure for the company in managing raw materials, in order to minimize the cost of purchasing raw materials to suppliers based on data on the number of company production orders [3].

The EOQ method is recommended in purchasing goods to suppliers as well as for self-produced goods [4]. However there is a slight difference, goods that are self-produced are using economic lot size [5]. A significant difference is in the economic lot size which requires ordering costs, including the order preparation cost and machine preparation cost which is used to produce goods. In the other hand, economic order quantity is mostly used to find out the quality of orders with minimum storage costs and inverse cost ordering [6, 7].

Decision making is used to solve problems faced by taking into account the criteria used [8, 9]. In this study the decision support concept is used to figure out the amount of inventory that must be provided by the company by noticing market demand and supply of raw materials. The need of raw materials based on the market demand will be determined with the help of a support system reorder point stock. System requirements are defined according to user necessity, because the analysis and design of the system is oriented towards user input [10, 11]. Reorder point stock is found based on the number of raw materials purchases in accordance with market demand, therefore the company's revenue figures can be known quickly, precisely and accurately.

2. RESEARCH METHOD AND LITERATURE REVIEW

2.1. Research method

The first thing the author does is gathering all information related to the functional needs of the system and non-functional systems to be built. The system will be built using the user centered design (UCD) system development model. UCD model is often used because the model can accommodate all the needs and wishes of the user in each process [12]. Users are always involved in every step that is carried out in detail and in a structured manner [13]. In this model the user can also provide input after the system is built and the input is used by the developer to improve the system, because the system is actually created by defining all the wishes of the user [14].

The first stage carried out in this study is to determine and collect data. By combining the concept of UCD system development, namely figuring out user context, determining and collecting data can be made into one concept or one step. However there are two stages passed, namely determining both the background of the developing system user, collecting the data and then preparing all the necessary equipment during the system development process.

The next step is the literature study, which is to study everything related to economic order quantity, and its application to decision support systems. Then the author enter the user centered design stage, such as planning the UCD process, defining the background of the system user, explaining the user's needs and the data used. The next step is making a design of the created system development and the concept of decision support using the economic order quantity method. After all the processes are carried out, the next is the design evaluation that has been implemented in the system development process and waiting for the input from the user about the system design that is being implemented -whether it still need improvement or is it in accordance with the needs and wishes of the user. If the design needs an improvement / input from the user, then the process is repeated in stages based on the evaluation of the user whether it starts from the stage of defining user context, from the stage of defining user needs, or perhaps from the stage of designing the system. After all the stages in the user centered design method are carried out, the process continues to the stages of drawing conclusions from the whole process. User testimonials become an important part of how many percentages of user needs are poured into the system; the greater the percentage means the system has successfully accommodated and implemented the user's needs and wishes. Figure 1 show each stage carried out in the system development process using the UCD model [15].

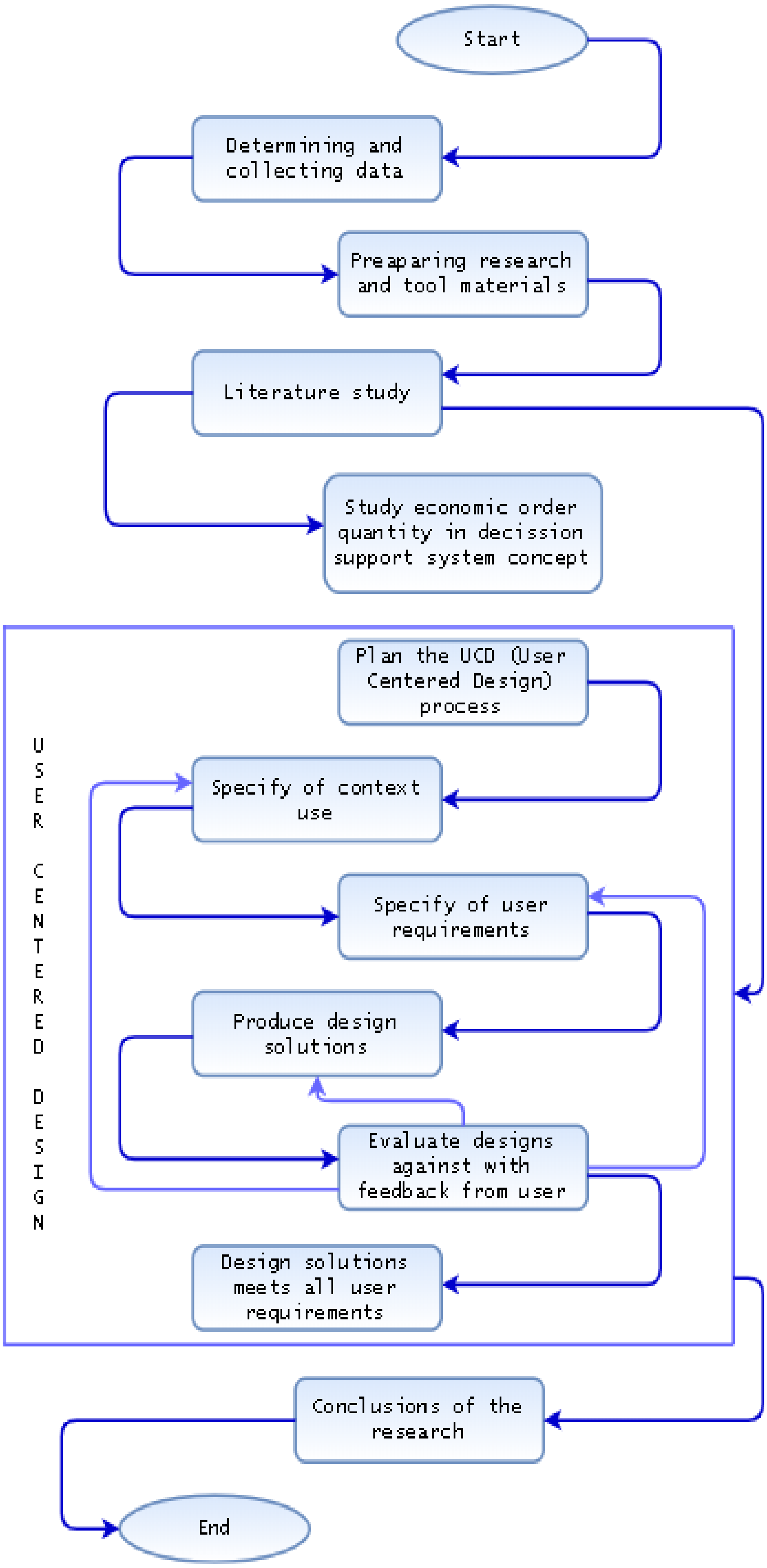

Figure 1. Research method with fase of user centered design

2.2. Literature review
2.2.1. Decission support system

Decision support system (DSS) is a system that provides recommendations for solving a problem by accommodating the criteria used [16, 17]. DSS is a computerized information system for supports decision making activities by organizing criteria/information by calculating the weight of each alternative involved [18, 19]. In other words, the output of the computer-based decision support system and the results of the decision can be used as a recommendation to solve the problems faced [20-22]. The stages in making a decision [23], consist of:

- The first stage is the intelligence stage, which is looking for information on the criteria used to produce decisions and determine the weight of preferences for each of the criteria.
- The second stage is the design stage by making the stages of the decision process made, developing the stages of each decision making process, and analyzing the decisions that will be taken.
- The third stage is the choice stage, which is choosing the available decisions based on the weighted value for each recommended decision to solve a problem. The decision with the highest weight is the one to be implemented.
- The fourth or final stage is the implementation stage, where the recommended decision with the highest weight is applied / taken to solve the problem.

The intelligence, design and choice stage are the initial steps in decision making, and it is ended with a decision recommendation [23, 24]. These recommendations will be used at the implementation stage where the recommended decision is implemented and used to solve a problem [25, 26]. To determine the weight value for each criterion which is used as alternative solution is by figuring out the highest weighted alternative as a recommended decision based on the highest weight value [27]. Some methods are often used in decision support concepts such as AHP (analytical hierarchy process) in research that has been conducted by [28-30], TOPSIS methods in the following studies [31-33], as well as EOQ (economic order quantity) in this study [34, 35].

2.2.2. Economic order quantity

Economic order quantity (EOQ) method is used to make the volume or number of orders best suited to the needs that are implemented at each time of purchase. By minimizing the cost of ordering goods during the purchasing time, the costs can be reduced as economically as possible [35]. The EOQ method can also be used to streamline raw materials in a production process compared to the one without using the method. The use of economic order quantity can be maximized if the order time and order quantity are known [36]. The time of the message (lead time), namely the time when the order is made and the time when the order is received [37]. The lead time is known and is constant or steady every time an order is made [38]. Whereas the number of economic orders that might be suited to this method can be calculated by the formula [39]:

$$\text{EOQ Method} = \sqrt{\frac{2\text{DS}}{\text{H}}} \quad (1)$$

with :

EOQ : number of items in each order
D : annual demand for raw material inventory
S : costs required per order
H : the fee required for storage per unit annually

2.2.3. Reorder point stock

Reorder point stock can be interpreted as an appropriate time to reorder [40]. In other words ROP is a period in which orders must be re-made. ROP is also related to lead time and safety stock [41]. Because to make the ROP required the right lead time is when the safety stock has thinned or is almost gone [6]. To calculate this reorder point stock the formula used is [42]:

$$ROP = (\, d * L \,) + SS \quad (2)$$

with:

ROP : orders must be re-done
d : the number of daily needs
L : lead time/waiting time for the order to be returned
SS : safety stock/sufficient amount of stock at one time

2.2.4. Safety stock

The safety inventory serves to protect the company against a condition where the company experiences a shortage of raw materials, delays in the supply of ordered raw materials that hinder production activities or a surge in demand that is not predicted, so the company must increase production to meet market needs [43]. In general, company management must find out how much raw materials are still obtained related to storage or storage costs, so the company must also determine the tolerance limits [44].

To calculate the value of safety stock, the first thing to know is that the amount of raw material that has been used in the previous period and the estimated amount of raw material that will be used in that period is calculated per year. Then the value is analyzed using the statistical formula as follows [5]:

$$Standard\ deviation: \sqrt{\frac{\sum(X-Y)^2}{n}} \tag{3}$$

with :
X : the actual amount of raw material usage
Y : the estimated amount of raw materials usage
N : the amount of data

3. RESULTS AND ANALYSIS

Figure 2 explains the framework of the system being created, where the center of the cycle is in the design of systems that relate to all processes, from the analysis stage to the determination of both functional and non-functional requirements of the system. The decision of using the economic order quantity as a method for calculating the decision support system is to figure out the number of orders that must be requested by the company, to determine the lead time and safety stock therefore the company can make preventive actions when the stock has thinned and the user centered design method as system development method, since the system is tailored to all the needs of users. In this study, the company is the Mackarel Company. The design cycle also gets feedback from the user during the process of design evaluation. It is to improve the system that has been corrected by the user. Users can request improvements to system modules that are not suitable to the needs.

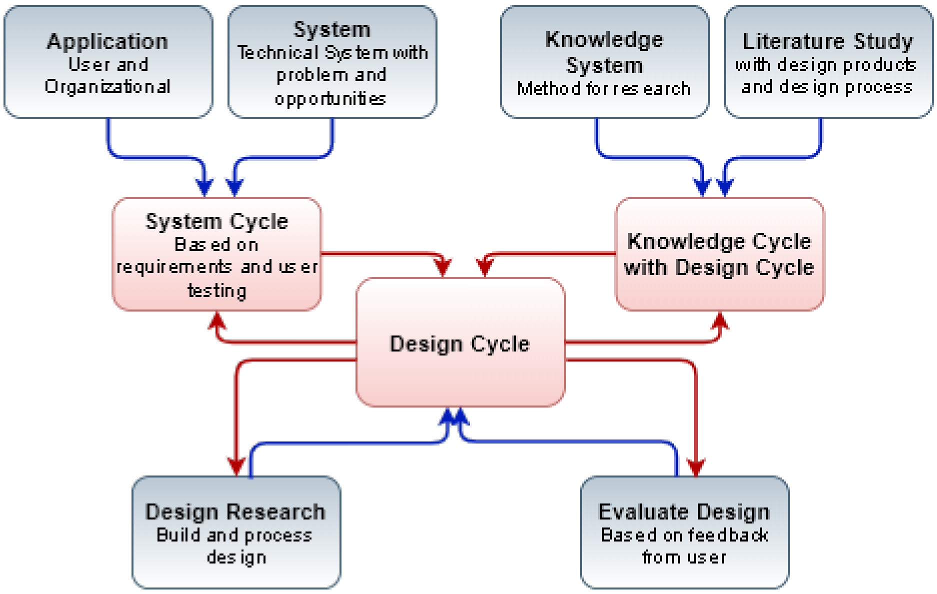

Figure 2. The framework of information system research

In this research, a storage fee of IDR 60,000 per year is used with a booking fee of IDR 105,000, or an average of IDR 8,750.00 monthly, and an average order of 5 to 6 times a message per month. The average amount of raw material purchases per month reaches 290 kg. The average monthly cost of purchasing raw materials that must be incurred by the company is IDR 10,141,000.00. These costs will be used to calculate the average raw material needed in a period of 1 month and to calculate the safety requirements, namely the stock of safe raw materials in supplies per month and the need for raw materials in the waiting period. By using the formula that was explained in the previous chapter, this chapter will look for the values of these needs one by one.

Starting by calculating the value of order quantity company using the EOQ method with (1), the result is:

$$Order\ Quantity\ Value: \sqrt{\frac{2 * 8750 * 5.83 * 290}{5000}} : 76.91 \quad (4)$$

After knowing the value of the order quantity, then the value is used to find the reorder point value using (2), but the average raw material requirements per month must be known in advance, as well as the value of safety requirements and the needs during the waiting time for ordering raw materials before it come. After the calculation, it is found that the average value of needs per month is 141.01 kg, the value of safety requirements calculated by (3) with a tolerance limit of 10% is 360 kg and the raw materials needed during waiting time resulted in reorder values point is 69.26 kg.

Figure 3 explains the relationship between EOQ, re order point and safety stock in a diagram with the values obtained in previous calculations. From the analysis, it can be concluded that the company will reorder when the amount of raw material is only 69.26 kg left. Orders made by the company amounted to 76.91 kg to increase raw material inventory. While the safety stock value is 360 kg, in this case the safety stock value is large because it is used to maintain the stability of the company's supply as a preventive measure in the event of a surge in market demand or a shortage of raw material supply due to various factors.

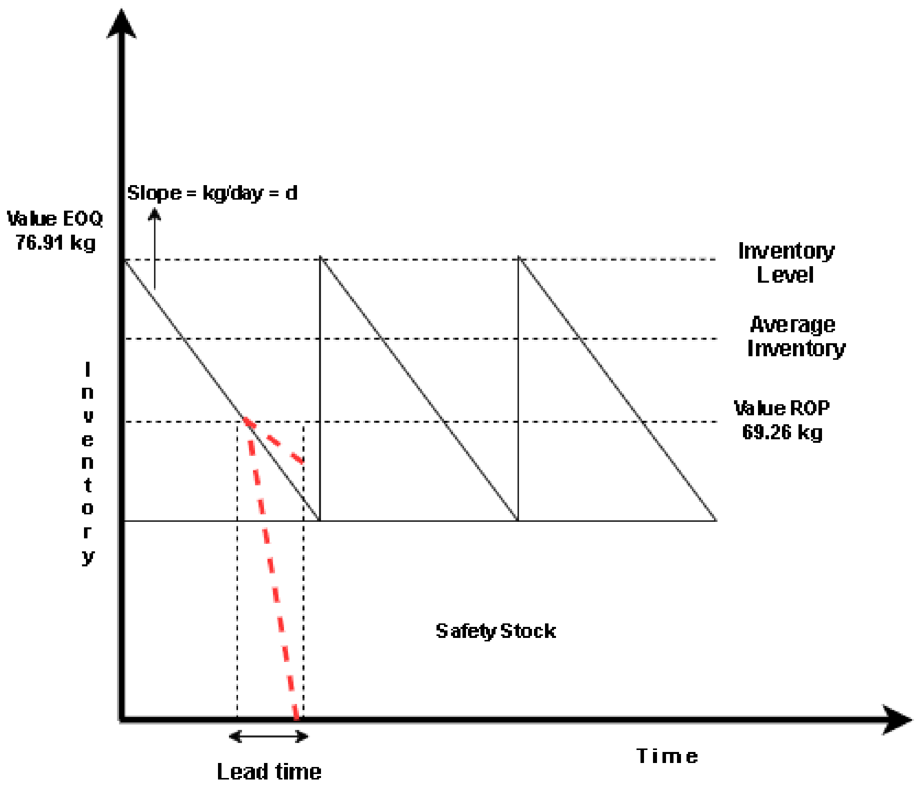

Figure 3. The relathionship between of EOQ, re order point, and safety stock

4. CONCLUSION

Based on the results of the analysis that has been done and explained in the previous discussion, the conclusion that can be drawn from this study is that the economic order quantity, reorder point value and safety stock value are the most optimal to support the company in solving problems regarding the procurement of raw materials for inventory and production by considering and estimating market demand and waiting times. Raw materials are used by the company for the production process. Reorder point value is 69 kg, EOQ is 77 kg and safety stock is 35 kg. From the calculations performed, the most economical total cost of inventory has been obtained. This study aims to optimize the EOQ method and to figure out the optimum reorder point, safety stock and EOQ values by applying it to the decision support system. Suggestions for further research is to develop decision making to determine safety stock, reorder points and economic order quantity using other methods so the results can be compared.

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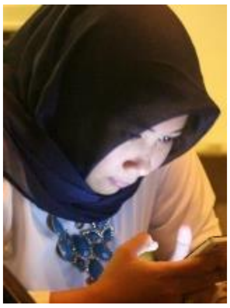

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