DEVELOPMENT OF SUPPLY CHAIN MANAGEMENT IN CV. NK TEKNIK

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ABSTRACT

CV. NK Teknik is a company which engaged in electricity production tool namely, electric switch. In their production, the company often encounter difficulty in deciding the amount of materials to be provided for the supplier. When product demand meets an increase then a deficiency in materials and products in warehouse would happen and vice versa. In distributing their products, company would send the products to distributor who have paid in full first, but the company do not have yet the schedule to distribute the products. From the existing problem, CV. NK Teknik then would need an application that could help in managing their supply chain.

Supply Chain Management. The strategy that is being used is Push Supply Chain because the company is using Make-to-stock strategy. In this research, the method that is being used in determining the amount of materials by using forecast method, Single Moving Average and to calculate stock assurance using Safety Stock method. The analysis result from research states that the forecast method, Single Moving Average was utilized well in information system.

The functional test result, UAT (User Acceptance Test) and end-user test have resulted a conclusion that the system was able to help the head of procurement division in determining material amount and also deciding distribution schedule.

Keywords: supply chain management, push supply chain, make-to-stock, single moving average, safety stock.

1. INTRODUCTION

CV. NK Teknik is a company which engaged in electricity production tool namely, electric switch. The manufactured products are made of materials such as brass plate, pertinax, arde rod (grounding rod), copper round bar, brass, aluminum, etc. Interview result that have conducted with Endang Komara who is the chairman of CV. NK Teknik company state that the activity which occurred currently in company's upstream part is providing materials to supplier, receiving materials and production process. Mass product conducted by company to make stock of the product as a request anticipation from distributor. While the activity in the company's downstream part is performing products distribution to distributor.

Interview result which is conducted with Asep Nurohman who is the Head of Procurement Division stated that the activity which occurred in company's upstream part is providing materials from procurement division to the supplier every month. The procurement division often miscalculate the amount of required materials because of uncertainty from the distributor side. For example, on March 2017 CV. NK Teknik have provided cable ties as much as 2505 meters while the demand is 3630 pieces of product, there was a deficiency in materials as much as 1125 meters. The result of interview with Rizal Ahmad who is the company's Head of Production Division stated that CV. NK Teknik could process materials into products as much as 8000 pieces with 10 kinds of electric switch product in one month. If the company experience a decrease in product demand, then what would happen is an excess on product stock and materials in company's warehouse. On May 2017, CV. NK Teknik had product stock in the warehouse for 4245 pieces while the demand is only 3312 pieces, CV. NK Teknik encountered a product spillover for 933 pieces. If this event kept occurring the company must pay additional cost for maintenance and stock safekeeping in warehouse.

The interview result with Deden Candra who is the Head of Distribution Division stated that currently, the company in sending products to distributor would prioritize a distributor's demand which have paid in full, yet the company presently do not have proper scheduling in managing products distribution to the distributor.

According to presented problems previously, CV. NK Teknik company would need an information system that could manage their supply chain. That is why, Supply Chain

Management (SCM) is a good choice to handle the company's problem.

The research objective is as follow:

1. Supporting Head of Procurement Division in determining amount of materials demand to supplier.
2. Assisting Head of Distribution Division in making a schedule for products distribution.

2. RESEARCH CONTENT

2.1 Theoretical Foundation

The theoretical foundation in this research would explain about theories related with information system building by using supply chain management approach in CV. NK Teknik.

2.1.1. Information System

According to McLeod, information system is a data that is processed into a more useful form and meaningful for its receiver. While Sutarbi states that information system is a data which have clarified or processed or interpreted to be used in decision-making process. Therefore, the definition of information is a batch of components that connect each other and cooperating to collect, process, save, and distributing information related to support decision-making process, coordination, and controls that is inside. [1]

2.1.2. Supply Chain

Pursuant to Pujawan, supply chain is companies' network that work together to create and deliver a product to the hand of end-user. Where in supply chain there are 3 kinds of flow that should be managed. First example is a material that was sent from supplier to the factory. After the product is produced, they are delivered to the distributor, then to the retailer, then to the end-user. The second is money flow or the like which flows from downstream to upstream. The third is information flow that could be occurred from upstream to downstream or vice versa. [2]

2.1.3. Supply Chain Management (SCM)

Supply Chain Management (SCM) is an integrative method or approach to manage the flow of product, information, and money in integrated manner which involves parties starting from upstream to downstream that consist of supplier, factory, distribution network as well as logistics services. [2]

SCM firstly proposed by Oliver & Weber in 1982. SCM is a method or total approach system to coordinates every supply chain element from the supplier to retailer, then reach further level which is an advantage that is not available traditional logistics system. [3]

Hence, supply chain management is not only oriented to company's internal affair but also external affair which involves relation with partner's company. Because the companies that reside in a supply chain ultimately want to satisfy the same end consumers.

2.1.4. Supply Chain Management Strategy

In supply chain there are three kinds of strategies namely, Push strategy, Pull strategy, and Push-pull strategy. The following are explanation of each strategy in supply chain management [2]:

1. Push-based supply chain
   In push-based supply chain strategy, production decision and delivery are based on long-term forecast.
2. Pull-based supply chain
   In pull-based supply chain, production and product delivery occurred with coordination from forecast based on consumer's demand.
3. Push-pull supply chain
   In push-pull supply chain strategy, there are few steps in its application and among those steps are push-based and further with pull-based system strategy.

2.1.5. Decoupling Point Supply Chain

Decoupling point is a meeting point until where an activity could perform based on forecast (without waiting the customer's demand) and from where the activity should be postponed until there was a certain demand. The following are common process in decoupling point. [2]

1. Make to Stock (MTS)
   Make to stock is a system where decoupling point located in the last process that is delivery to customer. Final product produced according to forecast. Hence, only delivery activity which is conducted after there was a demand from the customer.
2. Assembly to Order (ATO)
   Assembly to order is a system where only assembling activity that awaits a demand from customer, while component fabrication activity is conducted according to forecast basis.
3. Make to Order (MTO)
   In a system that follows Make to order, component fabrication activity cannot be worked without awaiting demand from customer because every demand may require different kinds of component.

4. Engineer to Order (ETO)
   Engineer to order have decoupling point in the beginning of product designing process. Means that, new product designed after there was a demand from customer. This model usually suitable if every customer needs a product with specific design.

2.1.6. Supply Chain Management Components

Supply Chain Management have three main components as supporter in an ongoing business process that are as follow [2]:

1. Upstream Supply Chain
   Upstream supply chain is a whole company manufacturing activity along with distribution or distributor relation could be expanded into a few degrees. Main activity in upstream supply chain is product procurement
2. Internal Supply Chain
   Internal supply chain is a process of product delivery to warehouse. The main activity in internal supply chain is production management, fabrication and stock control.
3. Downstream Supply Chain
   Downstream supply chain is an activity which involves delivery process to end consumers. The main activity in downstream supply chain is product distribution, warehouse and transportation.

2.1.7. Procurement

Procurement management is one of main components in supply chain management. The duty of procurement management is to provide input such as product or service that is required in production activity as well as other activities in the company.

2.1.8. Stock

Stock along the supply chain have big implication towards financial performance of a company. Inventory as a main element of working capital is an activity which constantly in rotation state and consistently changing.

2.1.9. Safety Stock Technique

According to stock classification that have explained previously, writer uses safety stock technique to accommodate demand uncertainty which affecting stocks.

Safety stock have a function to protect against miscalculation in forecasting demand during lead time. Lead time itself is a time needed between materials that is being ordered until arrived at the company. The value of safety stock depends on the uncertainty of stock as well as demand. The following is the formula to determine safety stock which could be seen on equation 2.1. and 2.2.

$$\text{Safety Stock} = Z \times Sdl \quad (2.1)$$

Information:
Z = Service Level
S_{dl} = Uncertainty of demand and lead time
Reorder point is when stock reach a point where it is required to carry out reorder point. The following is a formula in determining reorder point as seen on equation 2.2.

$$Sdl = \sqrt{(d^2 \times sl^2 + l \times sd^2)} \quad (2.2)$$

Information:
d = Average usage
sl = Lead Time Deviation Standard
l = Lead Time
sd = Average usage deviation standard

2.1.10. Forecasting

Forecasting is a prediction for what would happen in the future. While plan is a decision which would conducted in the future. Automatically, there is an obvious difference between forecast and planning. Forecast is a prediction towards what might happen, but not necessarily conducted by the company. Forecasting aims to obtain prediction that could minimalize miscalculation in forecasting which usually measured by mean square error and mean absolute error. [4]

2.1.11. Kinds of Forecasting

There are a few kinds of forecasting which is commonly used. Forecasting type that is used are as follow [4]:

1. Time Series Model
2. Casual Model
3. Judgmental Model

2.1.12. Time Series Model

Time series model is based on set of data in sequence which is the same distance (for example: weekly, monthly, yearly). This batch of data which is a batch of observation of various variable based on time, usually tabulated and portrayed in form of graphic which shows subject's behavior. Time series is suitable to use to forecast a patterned demand in the past that consistent for a long time, so that the pattern would still continue. The following are time series model forecast methods:

1. Single Exponential Smoothing Forecast Method
   Single exponential smoothing method is used in a condition where data weight on a period

differ from data on previous period and forming exponential function.

2. Single Moving Average Forecast Method
   Single moving average method uses a number of new actual demand data to arouse forecast value for future demand.
3. Weighted Moving Average Forecast Method
   Weighted moving average method gives equal scale for every observation, even though the data on the last is more important and need consideration in making forecast.

2.1.13. Forecast Error Measurement

Forecast error measurement could use Mean absolute error, Mean absolute deviation, Mean square error, Mean absolute percentage error.

1. Mean Absolute Error (MAE)
   MAE is an average value of absolute error from forecasting error (positive and negative value are overlooked) could be seen on equation 2.11.
   $$\text{MAE} = \frac{\sum |x_t - F_t|}{n} \quad (2.11)$$
2. Mean Absolute Deviation (MAD)
   MAD measures forecast precision by calculating average of forecast error (absolute value of each error). MAD is useful when measuring forecast error in a unit that is same with the original row. MAD value could be seen on equation 2.12.
   $$\text{MAD} = \frac{\sum(\text{Absolut from Forecast Error})}{n} \quad (2.12)$$
3. Mean Squares Error (MSE)
   MSE is an average of squared forecasting error and could be seen on 2.13. equation
   $$\text{MSE} = \frac{\sum(X_t - F_t)}{n} \quad (2.13)$$
   Information:
   X_t= Actual data during t period
   F_t= Forecast data obtained from same t period
   n = Many data from forecast result
4. Mean Absolute Precentage Error (MAPE)
   MAPE is a relative error measurement. MAPE often more important than MAD because MAPE states mistake percentage from forecast result toward actual demand during a certain period which would give information of error percentage too high or too low. Mathematically, MAPE could be seen on equation 2.14.
   $$\text{MAPE} = \frac{100}{n} \sum \left| A_t \frac{F_t}{A} \right| \quad (2.14)$$
5. Tracking Signal
   Tracking signal is a measurement of how good a forecast in predicting actual values. Mathematically, tracking signal could be seen on equation 2.15.
   $$\text{Traking Signal} = \frac{\text{RSFE}}{\text{MAD}} \quad (2.15)$$

Information:
RSFE = Cumulative error
MAD = Mean Absolute Deviation

2.1.14. PHP (Hypertext Processor)

PHP is a programming language script which combined with HTML and run on server side. PHP usually used for programming. Dynamic website, alhough not considered to be used on another use. One advantage of PHP programming language is that it could be obtained freely but its ability is powerful [6]

2.1.15. MySQL

SQL (Structured Query Language) is a programming language that is used to access date in a relational database This language in de facto manner is a standard language which used in relational database management. Nowadays, almost every existing database server support this language to perform its data management. [7]

2.1.16. Entity Relationship Diagram (ERD)

ERD is a first model of database which is used mostly. ERD developed based on assemblage of mathematics theories. ERD used for relational database storage so that if database storage use OODBMS then database design would not use ERD. [8]

2.1.17. Data Flow Diagram

DFD often used for depicting a system which have existed or new system that would be developed logically without considering physical environment where the data is flowing. DFD is a tool which used in structured system development methodology and able to expand data flow clearly and structured inside the system. [9]

2.1.18. Website

Website is a number of web pages which show various information such as text, data, pictures, sounds, videos and even a combination of all those statically as well as dynamically which then form a concatenation of building that connected to each other with page network or hyperlink. [10]

2.2. Problem Analysis

Problem analysis is an assumption of the problem which would be elaborated in data processing procedures on information system

building program using supply chain management in CV. NK Teknik. Problem analysis of the system which is currently running are :

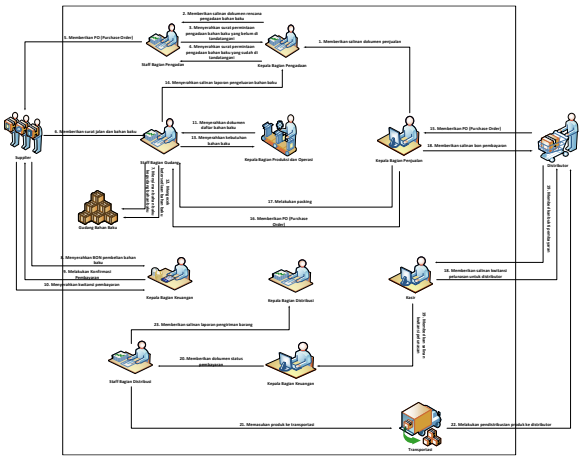
1. The head of procurement division faced a difficulty in determining the amount of materials to be provided for supplier because of the uncertainty in product demand committed by distributor. When the demand is high then a deficiency in materials would happen. In other way around, when the demand is low then an excess in materials and products happen in warehouse.
2. The head of distribution division encountered a difficulty in making a product distribution schedule for distributor, if the problem happens constantly then the disadvantaged party is the distributor and customer that would resulting negative effect toward the company in the end.

2.3. Supply Chain Management Analysis

Supply chain management analysis is being used for applying supply chain management approach toward a system that would be built.

2.3.1. Supply Chain Management Model in CV. NK Teknik

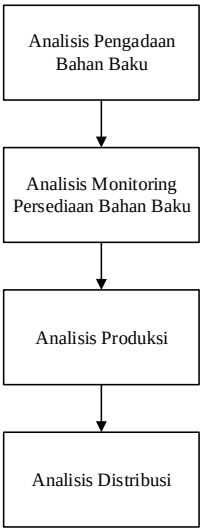
According to the SCM analysis that have explained on previous part, as for the supply chain which lies in CV. NK Teknik could be seen on Picture 1.



Picture 1 Supply Chain Management Model in CV. NK Teknik

2.3.2. Supply Chain Analysis in CV. NK Teknik

Supply chain analysis is conducted to portray the process of supply chain management that would be built in CV. NK Teknik based on supply chain model in Picture 2.

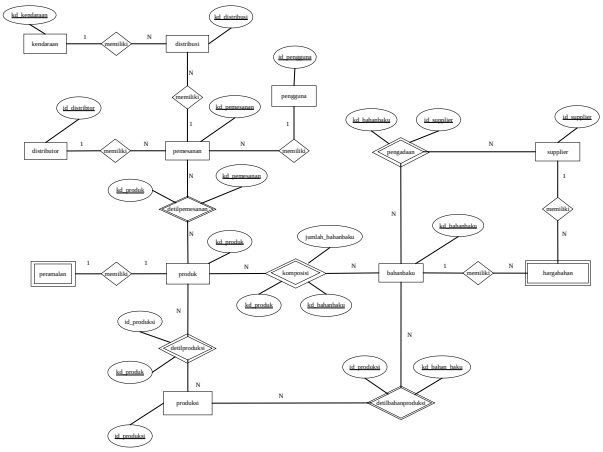


Picture 2 Supply Chain Management Analysis in CV. NK Teknik

1. **Materials Procurement Analysis**
   Materials procurement analysis is conducted by procurement division based on document of materials procurement plan.
2. **Materials Stock Monitoring Analysis**
   Materials stock monitoring analysis to determine safety and unsafe limit that must available in warehouse which intend to anticipate materials gap or deficiency by using safety stock method.
3. **Production Analysis**
   Production analysis carried out by production division to specify the amount of product that should be produced daily. The amount of production is calculated based on forecasted data result then divided with amount of work in one month.
4. **Distribution Analysis**
   Distribution analysis is committed by distribution division to make product delivery schedule for distributor.

2.4. Databse Analysis

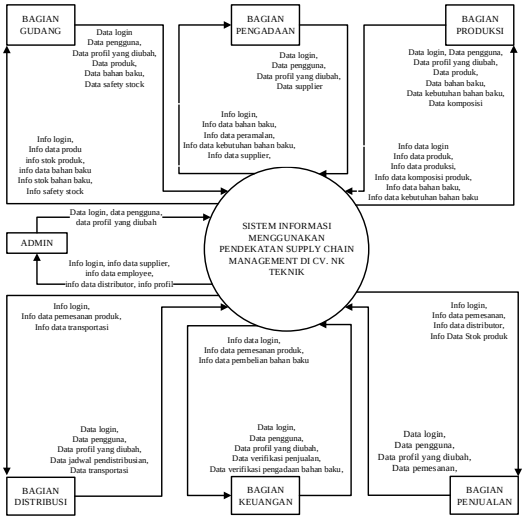
Database analysis on information system using supply chain management approach in CV. NK Teknik would be built using Entity Relationship Management (ERD). As for ERD itself is depicted on Picture 3.



Picture 3 Entitiy Relationship Diagram of SCM Information System in CV. NK Teknik

2.5. Context Diagram

Context diagram defines how the data is being used and transformed for process in form of data flow to inside and outside of the information system using supply chain management in CV. NK Teknik globally. Context diagram in system could be seen on Picture 4.

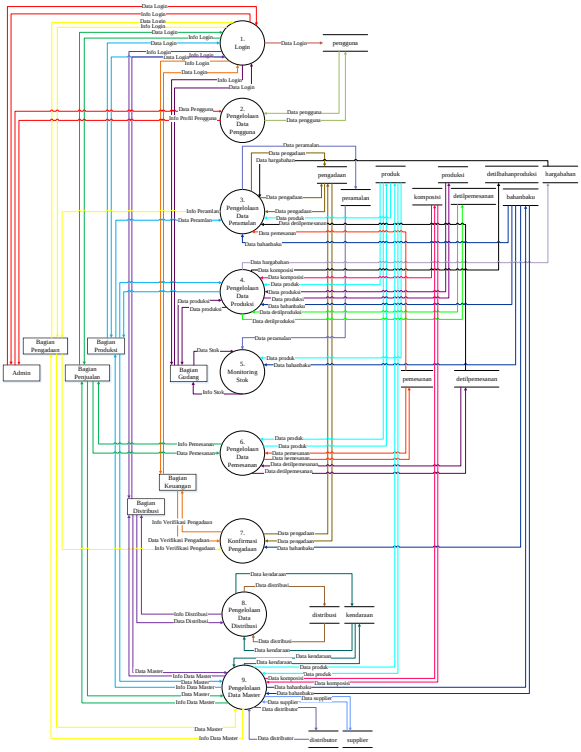


Picture 4 SCM Information System Context Diagram in CV. NK Teknik

2.6. Data Flow Diagram

Data Flow Diagram (DFD) shows how a flow of data elaborate process that is happening in the system until a more detailed process. Based on context diagram in picture 3.16 then it could be elaborated into a few DFD.

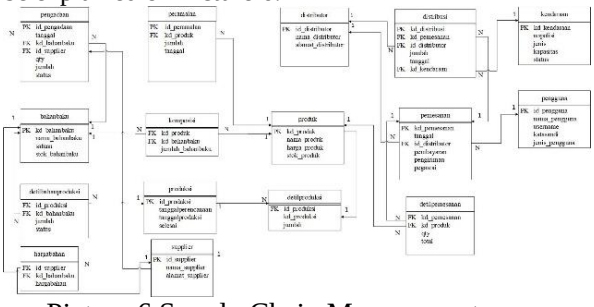
Level 1 information system supply chain management DFD in CV. NK Teknik could be seen in Picture 5 that describe about existing process in the system generally.



Picture 5 Level 1 information system supply chain management DFD in CV. NK Teknik

2.7. Relation Scheme

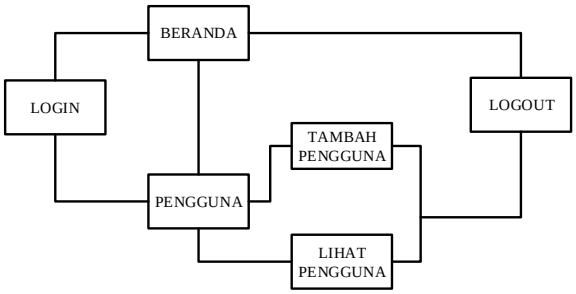
Relation table portrays a relation between data, the meaning of data and its limit. Relation process between attribute is a combination between attribute which have the main key that connected by the key field. Relation table would be explained on Picture 6.



Picture 6 Supply Chain Management Information System Relation Scheme in CV. NK Teknik

2.8. Menu Structure Design

Menu structure design is used for depicting any menu available which could be accessed in the system. Administrator menu structure is a menu structure that designed according to admin-level user. Administrator menu structure design could be seen on Picture 7.

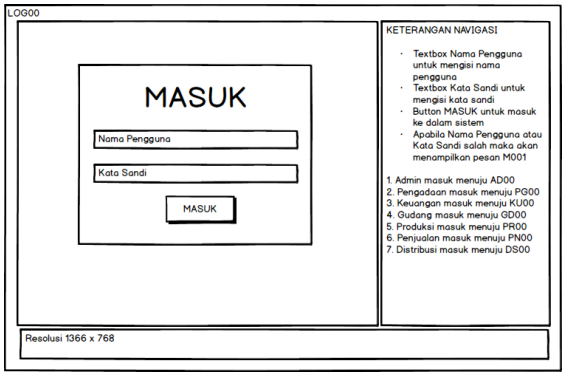


Picture 7 Administrator Menu Structure Design

2.9. Interface Design

Interface design is created to depicts the visual of information system which would be used by user to interact with system that would be built. Design is based on interface of both input and output which would be resulted in implemented system.

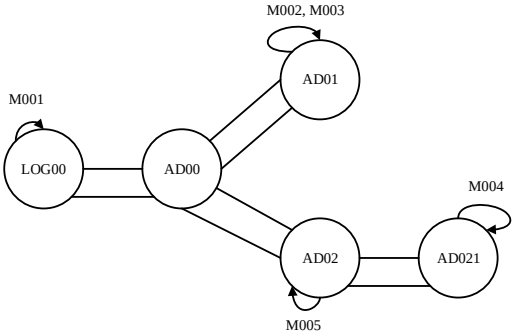
Interface design on the supply chain management information system in CV. NK Teknik could be seen in Picture 8.



Picture 8 Login Interface Design

2.10. Semantics Network Design

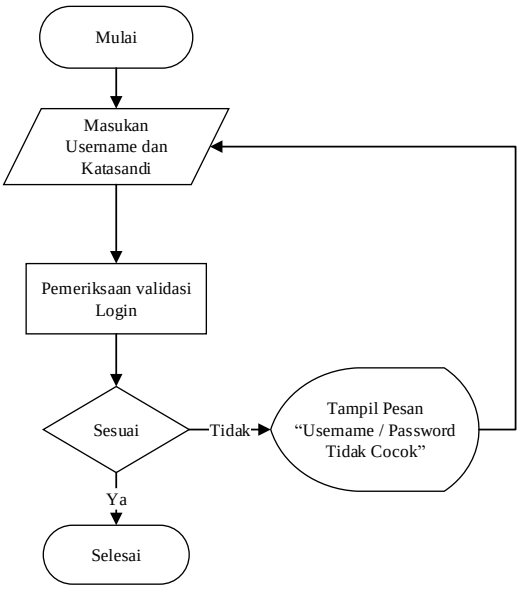
Semantics network design is a representation of interface design which shows where each interface connected to each other. The following is a semantics network design for admin user could be seen on Picture 9.



Picture 9 Admin Semantics Network

2.11. Procedural Design

Procedural design transforms structural elements from program's architecture into a procedural description from software components. Login process is executed when user is about to enter the system. Procedural design of login process could be seen on Picture 10.



Picture 10 Login Procedural Design

2.12. System Testing

System testing is the most important thing which intends to find errors or drawbacks in the system that is being tested. The testing is intended to find out if the created supply chain management information system have fulfilled performance according with the design's purpose.

Testing that is being used to test the system is a black box testing method. Black box testing focuses on functional requirement test of information system.

Testing plan which is conducted by testing black box built system and beta. Supply chain management information system build testing in CV. NK Teknik uses test data that have given.

2.2.12.1. Functional Testing

Black box testing is focused to functional requirement of built software. Testing is conducted only by committing test of each process to find out possible errors that might happen. The result of testing on sample case test which have conducted shows a result that the process is in order. Error filtering process in form of direction of message box visual is maximal enough. Functionally, the system could produce desired output.

2.2.12.2. User Acceptance Test (UAT)

The purpose of user acceptance test is to confirm that the system in testing could fulfill business needs to give assurance that tested system is working correctly and could be used before given officially to end user.

UAT result in sampe case test that have conducted, concludes that every process is working well. The system could functionally produce the desired output.

2.2.12.3. Beta Testing

Beta testing is a test that conducted directly in the actual environment. User performs evaluation toward the software through interview method. From the interview result, it could be inferred if the built software has meet its purpose or not.

Based on the conducted beta testing, the conclusions are:

1. This system could assist admin, procurement division, production division, financial division, warehouse division, sales division and distribution division in carrying out each other's task.
2. The built system is easy to use.
3. This system needs a guide in its usage.
4. The System is having a good and interesting interface.
5. The system is using a language that is easy to understand.

3. CONCLUSIONS AND SUGGESTIONS

This part explains about conclusions which contain results gained from after conducting analysis, design and implementation of built software and development along with suggestions which would give important notes and possible revision that needs to be done to improve the previous software.

3.1. Conclusions

The results gained in writing this research are concluded as follow:

1. This supply chain management information system could ease the procurement division in determining the amount of materials for procurement.
2. This supply chain management information system could also ease the distribution division in making a schedule for distributing product to distributor.

3.2. Suggestions

The result from system testing, it received a few suggestions that could be considered. Those suggestions are as follow:

1. Information system needs a development in the aspect of interface design so that the system would look more interesting.
2. A user data management addition would be better if there is a specific system that could manages employee data.

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