DEVELOPMENT OF SUPPLY CHAIN MANAGEMENT INFORMATION SYSTEM PT. RECLAYS PURNAMA CIPTA

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ABSTRACT

PT. Reclays Purnama Cipta is a company that was established in 2007. This company is a company engaged in clothing and has 3 branch outlets. This company has problems in determining the amount of raw materials to be ordered to suppliers for the following month. The next problem is that the Head of Distribution has difficulty in determining the quantity of products to be sent to each branch outlet. The objective of this study is to assist the Head of Storage in determining the amount of raw materials to be ordered to suppliers and help the Head of Distribution in determining the amount of each product to be sent to each outlet. The method used to determine the amount of raw materials to suppliers and to determine the number of products to be sent to each outlet is the Holt-Winters Method. The Safety Stock method is used for securing the stock of raw materials and products in the warehouse. Calculation results for Tees Graphic products using the Holt-Winters Method for January 2019 obtained the number of 1034 pcs with the smallest MSE which is 107570.9. Based on the results of the blackbox and UAT test it can be concluded that this information system can assist the head of Storage in determining the amount of raw material to be ordered to suppliers and can help the head of the Distribuion section in determining the number of products to be sent to each branch outlet.

Keyword : Information System, Supply Chain Management, Holt Winters Method, Safety Stock, Mean Square Error.

1. PRELIMINARY

PT. Reclays Purnama Cipta is one of the companies engaged in clothing which is located on Jalan Srimahi Dalam No. 1, the city of Bandung, West Java province. PT. Reclays Purnama Cipta was established in 2007. PT. Reclays Purnama Cipta has 3 outlets located in the city of Bandung, DKI Jakarta, and in the city of Makassar. PT. Reclays Purnama Cipta has many consumers spread across West Java, DKI Jakarta, and Makassar City. This company sells goods in the field of clothing such as hats, clothes, jackets, sweaters, pants, wallets, sandals, shoes, bags and belts. Self-produced products are t-shirts and sweaters while products such as jackets, pants, hats, wallets, belts, sandals, shoes and bags are made by vendors. The series of work systems in the upstream part carried out by PT. Purnama Cipta reclays for suppliers and vendors, namely procuring raw materials from suppliers, receiving raw materials from suppliers, processing raw materials into finished products, procuring products from vendors and receiving products from vendors. The raw materials needed to produce t-shirts and sweaters are 30's combed cotton fabric, 20's combed cotton fabric, cotton fleech fabric, yarn, woven label, hang tag, and plastic. PT. Reclays Purnama Cipta carries out activities downstream by distributing products to consumers and to outlets in the City of Bandung, DKI Jakarta and Makassar City.

Based on the results of interviews conducted with the head of Storage stated that determining the amount of raw materials still uses estimates from the previous month's sales report. PT. Reclays Purnama Cipta procures raw materials to suppliers before the 5th of every month. Based on attachments E-1 to E-12 product sales and attachments E-15 raw material inventory, PT. Reclays Purnama Cipta has a number of sales from January 2017 to December 2018 as many as 37,610 products with the most sales are t-shirt products reaching 21,259 Pcs. Based on the facts obtained in that time period, the head of the Storage section had difficulty in determining the amount of raw material to be ordered to the supplier for the following month. This becomes a problem if product sales increase and there is a shortage of raw materials in the warehouse, such as in December 2018 the inventory of fabric raw materials is 462 kg while the raw materials needed in December 2018 are 590.25 kg, which results in the production process not running smoothly because the material the standard available for the production process is deficient.

Based on the results of interviews conducted with the head of the Distribution section stated the difficulty in determining the amount of each product to be sent to each branch outlet. Delivery to each branch outlet is done at the beginning of each month. If the product is delivered in short supply, there will be a shortage of stock at each branch outlet and requires each outlet to make product requests to the warehouse located in the city of Bandung based on

attachment E-17 shipping data in March 2017 delivery to the Makassar Reclays outlet is done five times as many as 931 shipments pcs on March 6, 2017, 280 pcs on March 10, 2017, 290 pcs on March 11 2017, 537 pcs on March 17 2017, and 251 pcs on March 22 2017. As a result, the time required for delivery becomes longer.

Supply Chain Management (SCM) is a complete cycle chain management from suppliers, operational activities in the company, continues to distribution to consumers, so that the above problems can be overcome by using the Supply Chain Management system, where PT. Reclays Purnama Cipta can work with business partners because the function of Supply Chain Management itself is to integrate business processes from suppliers to consumers.

Based on the existing problems at PT. Reclays Purnama Cipta, so we need to build a supply chain management information system so that the management of the flow of raw materials or products and the flow of information in the company from ordering raw materials, processing raw materials and product delivery processes to consumers and branch outlets can create synchronization and consistency.

The purpose of this research is as follows:
1. Assist the Head of Storage in determining the amount of raw materials to be ordered to suppliers to meet the needs of the production process so that there is no shortage of raw materials.
2. Assist the Head of Distribution in determining the amount of each product to be sent to each outlet.

2. RESEARCH CONTENTS
2.1 Theoretical basis
Theoretical Platform aims to provide explanations from various sources and theoretical studies relating to the development of Supply Chain Management Information Systems at PT. Purnama Cipta Reclays.

2.1.1 Information System Concept
Information system is a set of interconnected components that work together to collect, process, store and distribute related information to support the decision making, coordination and control processes that are contained therein [1].

2.1.2 Supply Chain Management Concept
Supply Chain is a system where an organization distributes production goods and services to its customers. This chain is also a network or network of various interconnected organizations that have the same goal, which is as good as possible carrying out the procurement or distribution of the goods [2].

2.1.3 Supply Chain Management Components
In Supply Chain Management there are three main components that support the running of a business process as follows [3]:

1. Upstream Supply Chain
Upstream Supply Chain is the overall activity of manufacturing companies with their distribution or relationship between manufacturers, distributor relations can be extended to several levels, all channels from the origin of raw materials / materials. The main activity in the upstream supply chain is product procurement.
2. Internal Supply Chain
Internal Supply Chain is the whole process of sending the product to the warehouse which will then be used for the business process transformation of the input of raw materials from the distributor into the company's outputs. Main activity : production management, manufacturing, inventory control.
3. Downstream Supply Chain
Downstream Supply Chain is an overall activity that involves shipping to the end customer. Main activity : Distribution, warehouse, transportation and sales services.

2.1.4 Type of Forecasting
There are several types of forecasting that are used. The type of forecasting used is as follows [4]:
1. Time Series Model.
The time series method is a quantitative method of forecasting using time as the basis for forecasting.
2. Casual Model.
Forecasting methods that use a causal relationship as an assumption, namely that what happened in the past will be repeated at this time.
3. Judgemental Model.
If time series and causal models are based on quantitative, judgment involves including quantitative/subjective factors in forecasting methods. It is especially useful when the expected subjective factors become very important when accurate quantitative data have been obtained.

2.1.5 Push and Pull Supply Chain
Pull supply chain is a "make-to-order" production strategy whose main benefit is avoiding inventory waste or a company strategy, especially manufacturing companies where new production is always carried out after market sales and actually carried out on orders from consumers [5].

Push Supply Chain is a Make-to-Stock production strategy. The push system is basically a system of planning and controlling production. The push strategy is more popular than the pull system because the production system is based on forecasting or forecasting and produces large amounts of output which will later enter the inventory before being distributed to customers.

2.1.6 Purchasing Raw Materials
Purchasing raw materials is an activity carried out primarily by companies manufacturing in the production process to obtain raw materials, equipment or equipment. The main goal is to obtain

raw materials by minimizing costs as low as possible in accordance with the quality standards that have been determined [6].

2.1.7 Holt Winters Method

Holt Winters forecasting method is a combination of the Holt method and Winters method, used for forecasting if the data has trend and seasonal components. The Holt Winters method is based on three refinement equations, namely the overall refinement equation, trend refinement, and the seasonal refinement equation [7]. Here is the formula for the Holt Winters Method [8]:

- Determine the initial value of the level
$$S = \frac{y_{t+3}}{I_t} \tag{1}$$
- Determine the initial value of the trend
$$b = \frac{S_{t+3} - y_{t+3}}{I_{t+2}} \tag{2}$$
- Determine the initial value of the Seasonal
$$I = \frac{y_t}{y_t + y_{t+1} + y_{t+2}} \Big/ t \tag{3}$$
- Overall smoothing
$$S_t = \alpha \frac{y_t}{I_{t-L}} + (1 - \alpha)(S_{t-1} + b_{t-1}) \tag{4}$$
- Trend smoothing
$$b_t = \beta(S_t - S_{t-1}) + (1 - \beta)b_{t-1} \tag{5}$$
- Seasonal smoothing
$$I_t = \gamma \frac{y_t}{S_t} + (1 - \gamma)I_{t-L} \tag{6}$$
- Forecasting
$$F_{t+m} = (S_t + mb_t)I_{t-L+m} \tag{7}$$

Explanation:
S : overall adjustment factor
b : trend adjustment factor
α : refinement parameters for data $(0 < \alpha < 1)$
γ : fineness parameters for seasonal $(0 < \gamma < 1)$
β : refinement parameters for the trend $(0 < \beta < 1)$
I : seasonal adjustment factor
L : season length
$Ft+m$: the forecast for the next m period from t.

2.1.8 Mean Squares Error (MSE)

MSE is the average of the difference between the squares of the predicted value and the observed one [9]. MSE is used to produce an error that shows how much difference the estimated results with the destination. This makes it different because of randomness in the data or because it does not contain more accurate estimates. Here is the formula for Mean Squares Error [10]:
$$MSE = (A_{t-1} - F_{t-1})^2 \tag{8}$$
Explanation:
F_{t-1} = Forecasting the previous period
A_{t-1} = Actual sales of the previous period

2.2 Problem analysis

Problem analysis is an assumption of the problem that will be described in several data processing

procedures in the Supply Chain Management Information System at PT. Purnama Cipta Reclays.

1. The Storage Section has difficulty in determining the amount of raw materials to purchase raw materials from suppliers. If determining the amount of raw material does not match the quantity to be ordered, production will be hampered due to lack of raw material.
2. Distribution Division has difficulty in determining the amount of each product that will be sent to each branch outlet in the City of Bandung, Makassar City, and DKI Jakarta. If the product is delivered less then there will be a shortage of stock and outlets will make product requests to the warehouse and cost more shipping.

2.3 Supply Chain Management Model

The following is a mapping of supply chain management models which can be seen in Figure 1.
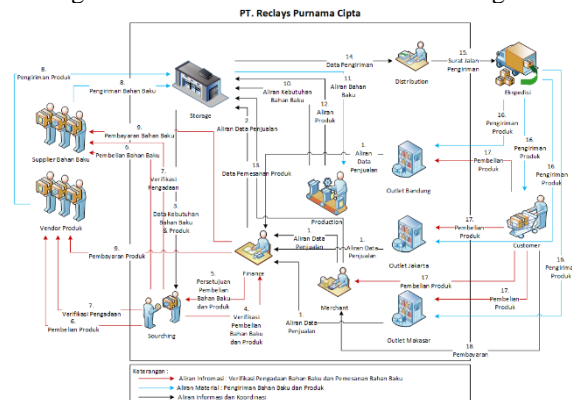

Figure 1. Supply Chain Management Model

2.4 Supply Chain Management Analysis

Analysis of Supply Chain Management at PT Reclays Purnama Cipta consists of several stages which can be seen in Figure 2.
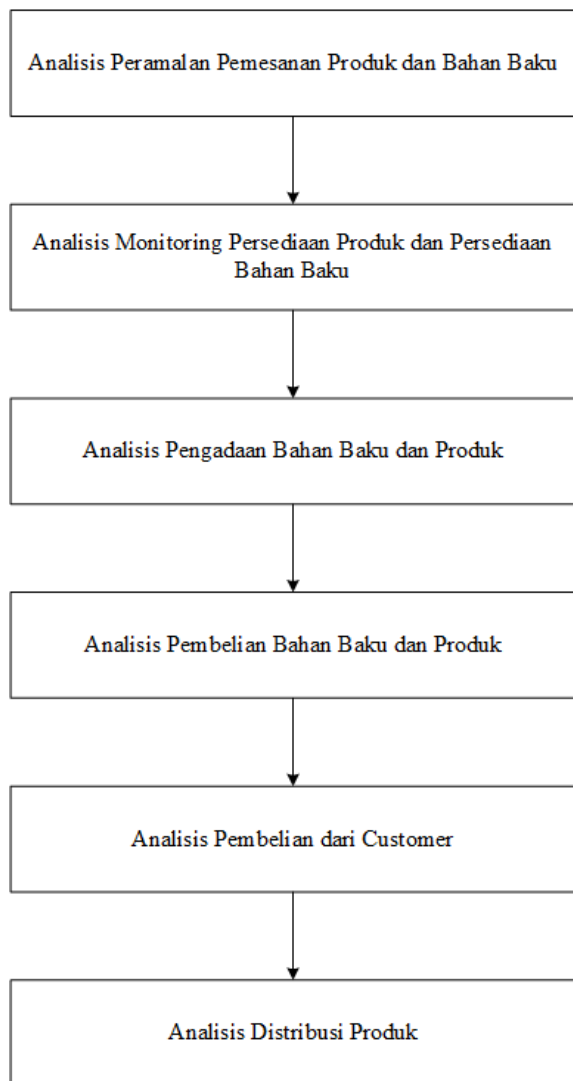
Figure 2. Supply Chain Management Analysis

Analisis Peramalan Pemesanan Produk dan Bahan Baku	
Analisis Monitoring Persediaan Produk dan Persediaan Bahan Baku	
Analisis Pengadaan Bahan Baku dan Produk	
Analisis Pembelian Bahan Baku dan Produk	
Analisis Pembelian dari Customer	
Analisis Distribusi Produk	

1. Product Sale

The following are product sales data for January 2017 to December 2018.

Table 1. Product Sale

No.	Period 2017 - 2018	Graphic Tees Product Sales Data	Unit
1	January	111	Pcs
2	February	137	Pcs
3	March	161	Pcs
4	April	227	Pcs
5	May	245	Pcs
6	Juny	1200	Pcs
7	July	90	Pcs
8	August	242	Pcs
9	September	199	Pcs
10	October	176	Pcs
11	November	205	Pcs
12	December	632	Pcs
13	January	327	Pcs
14	February	237	Pcs
15	March	369	Pcs

No.	Period 2017 - 2018	Graphic Tees Product Sales Data	Unit
16	April	589	Pcs
17	May	839	Pcs
18	Juny	255	Pcs
19	July	655	Pcs
20	August	691	Pcs
21	September	839	Pcs
22	October	940	Pcs
23	November	944	Pcs
24	December	1298	Pcs

2. Calculation of Forecasting by the Holt Winters Method

This stage is the calculation of forecast sales using the Holt Winters method. For example, in forecasting from actual Graphic Tees product sales data with units of Pcs to predict sales in January 2018, the data used to predict it uses data from the previous month, namely January 2017 to December 2018, then as an example calculation for January 2019 as following:

- Determine the initial value of the Seasonal

$$I = \frac{y_t}{y_t + y_{t+1} + y_{t+2}/t}$$

$$I_1 = \frac{111}{111 + 137 + 161/3} \quad I = 0.81$$

$$I_2 = \frac{137}{137 + 161 + 227/3} \quad I = 0.78$$

$$I_3 = \frac{161}{161 + 227 + 245/3} \quad I = 0.76$$

Explanation:
- $Y_t/ Y_{Januari}, Y_{t+1}/ Y_{Februari}, \ldots, Y_{t+n}$: Actual value of sales data for the t-period

- Determine the initial value of the level

$$S_t = \frac{y_{t+3}}{I_t}$$

$$S_t = \frac{227}{0.81} \quad S_t = 278.807$$

Explanation:
- $Y_t/ Y_{Januari}, Y_{t+1}/ Y_{Februari}, \ldots, Y_{t+n}$: Actual value of sales data for the t-period
- I_t : Initial seasonal value

- Determine the initial trend value

$$b = \frac{S_{t+3} - y_{t+3}}{I_{t+2}}$$

$$b = \frac{278.807 - 227}{0.76}$$

$$b = -18.689$$

Explanation:
- $Y_t/ Y_{Januari}, Y_{t+1}/ Y_{Februari}, \ldots, Y_{t+n}$: Actual value of sales data for the t-period
- I_t : Initial seasonal value
- S_t : Initial level value

- Overall smoothing

$$S_t = \alpha \frac{y_t}{I_{t-L}} + (1 - \alpha)(S_{t-1} + b_{t-1})$$

$$S_t = 0.1 * \frac{245}{0.78} + (1 - 0.1) * (278.807 + (-18.689))$$
$$S_t = 265.402$$

Explanation:
- Y_t/ $Y_{Januari}$, Y_{t+1}/ $Y_{Februari}$, ... , Y_{t+n} : Actual value of sales data for the t-period
- I_t : Initial seasonal value
- S_t : Initial level value
- b_t : Initial trend value
- Trend smoothing
$$b_t = \beta(S_t - S_{t-1}) + (1 - \beta)b_{t-1}$$
$$b_t = 0.1 * (265.402 - 278.808) + (1 - 0.1) * -18.689$$
$$b_t = 18.161$$

Explanation:
- S_t : Initial level value
- b_t : Initial trend value
- Seasonal smoothing
$$I_t = \gamma\frac{y_t}{S_t} + (1 - \gamma)I_{t-L}$$
$$I_t = 0.1 * \frac{245}{265.402} + (1 - 0.1) * 0.78$$
$$I_t = 0.80$$

Explanation:
- I_t : Initial seasonal value
- S_t : Initial level value
- Forecasting
$$F_{t+m} = (S_t + mb_t)I_{t-L+m}$$
$$F_{januari} = (1009.43 + (65.53)) * 0.94$$
$$F_{januari} = 1034.903$$

3. Calculation of Error Value with Mean Squares Error

From the forecasting table above we must calculate the error value or error using Mean Squared Error (MSE) to find out which approximates the accuracy level of ordering Tees Graphic products in units of Pcs which is the most accurate used as forecasting forecast in January 2019.

The example of MSE calculation is as follows:
$$MSE = (X_{Mei} - F_{Mei})^2$$
$$MSE = (245 - 203)^2$$
$$MSE = 1764$$

Explanation:
Xmei : Actual data for May 2017
Fmei : Forecasting data for May 2017

Calculate MSE:
$$MSE$$
$$= \frac{(X_{Mei} - F_{Mei})^2 + \cdots + (X_{Desember} - F_{Desember})^2}{n}$$
$$MSE = \frac{131349.9}{20} = 6567.495$$

4. Bill of Material

To find out the amount of raw materials to be ordered, BOM (Bill of Material) data is needed for one Pcs Graphic Tees product. Presentation of raw materials for one product can be seen in Table 2.

Table 2. Bill of Material Tees Graphic

No.	Raw Material	Qty	Unit
1.	Combed 30s fabric	0.25	Kg
2.	Obras Thread	0.1	Cone
3.	Woven Label	1	Pcs
4.	Hang Tag	1	Pcs
5.	Plastic	1	Pcs

5. Monitoring of Inventories of Raw Materials and Products

The following is a monitoring table that the product received:

Table 3. Product Inventory Monitoring

Product Name	Product Stock	Safety Stock	Status
Tees Graphic	196 Pcs	205 Pcs	**Tidak Aman**
Basic Tees	65 Pcs	73 Pcs	**Tidak Aman**

Following is the monitoring table of raw material inventory:

Table 4. Raw Material Inventory Monitoring

Name of Raw Material	Amount of Material Required	Remaining Stocks	Safety Stock	Status
Kain Combed 30s	433.25 Kg	78 Kg	86.03 Kg	**Tidak Aman**
Kain Cotton Fleece	58.45 Kg	10 Kg	11.55 Kg	**Tidak Aman**

6. Procurement of Raw Materials

Based on monitoring the inventory of raw materials in table 5. Then the raw materials are held as follows.

Table 5. Procurement of Raw Materials

Name of Raw Material	Amount of Material Required	Amount of Raw Materials that Must Be Booked
Kain Combed 30s	433.25 Kg	552.28 Kg
Kain Cotton Fleece	58.45 Kg	60 Kg

7. Forecasting Product Delivery to Outlets

In predicting the number of product shipments, there are several steps that must be carried out, which are as follows:

a. Prepare outlet sales data from the previous period to be processed as input data.
b. Calculate the forecast value in sales data using the Holt Winters Method.
c. Looking for MSE values from the three forecasting techniques above to find out the smallest error results.

8. Makassar Reclays Outlet Product Sales

The following is the data of Makassar Reclays Outlet product sales from January 2017 to December 2018.

Table 6. Makassar Reclays Outlet Product Sales

No.	Period 2017 - 2018	Graphic Tees Product Sales Data	Unit
1	January	28	Pcs
2	February	34	Pcs
3	March	40	Pcs
4	April	57	Pcs
5	May	61	Pcs
6	Juny	300	Pcs
7	July	23	Pcs
8	August	61	Pcs
9	September	50	Pcs
10	October	44	Pcs
11	November	51	Pcs
12	December	158	Pcs
13	January	82	Pcs
14	February	68	Pcs
15	March	92	Pcs
16	April	147	Pcs
17	May	210	Pcs
18	Juny	64	Pcs
19	July	164	Pcs
20	August	173	Pcs
21	September	210	Pcs
22	October	235	Pcs
23	November	236	Pcs
24	December	325	Pcs

9. Distribution of Products to Outlets

The process of distributing products to each outlet is done every month or if there is a request from the outlet. The following is a table of the number of products that must be sent to Makassar Reclays Outlets:

Table 7. Distribution of Products to Outlets

Date	Outlet Name	Product	Shipping Amount
15/01/2019	Reclays Makasar	Tees basic	123 Pcs
		Tees graphic	258 Pcs
		Tees typhography	176 Pcs

10. Product Distribution to Customers

The process of distributing the product to the customer is done if there is an order from the customer. Product distribution to customers is usually done on the same day if the payment is made at 08.00 WIB - 16.00 WIB or the same as the company's working time, if payment is made outside the company's working hours, the product will be sent the next day on the working day.

2.5 Entity Relationship Diagram (ERD)

Entity Relationship Diagram (ERD) is a data model that illustrates several designs conceptually in an entity context. The following is an Entity Relationship Diagram (ERD) which can be seen in Figure 3.
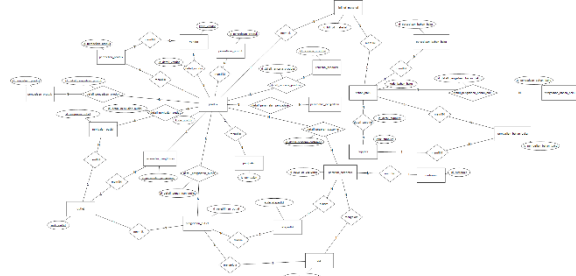

Figure 3. Entity Relationship Diagram

2.6 Data Flow Diagram

Data Flow Diagrams (DFD) explain that users of information systems built can access the available systems based on their access rights. Here is a Data Flow Diagram (DFD).
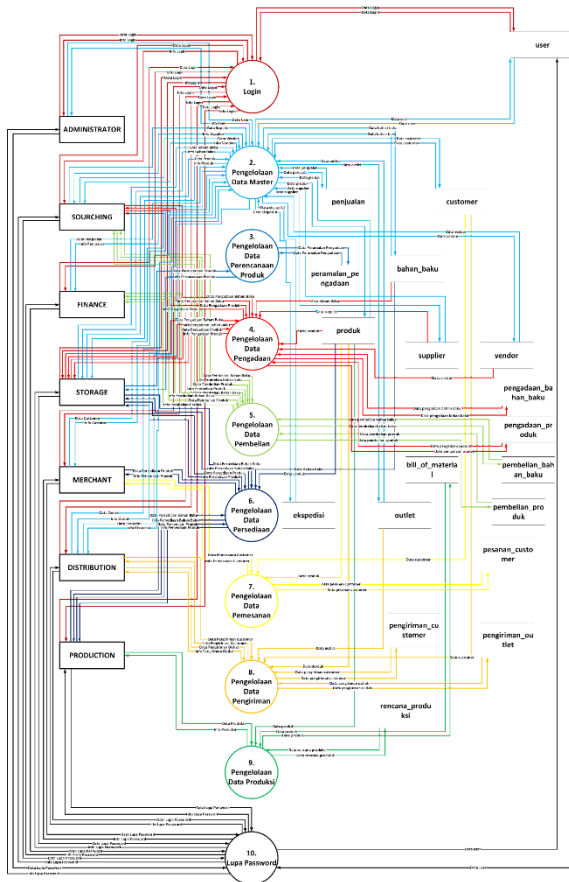
Figure 4. Data Flow Diagram

2.7 System Testing Conclusions
2.7.1 Blackbox Testing Conclusions

Based on the results of BlackBox testing that has been carried out on PT. Reclays Purnama Cipta, it can be concluded that each process contained in the system is in accordance with the initial design but still allows errors in syntax, this system also functionally meets the system requirements as expected.

2.7.2 Conclusion Testing User Acceptance Test (UAT)

Based on the results of testing of user acceptance test testing of PT supply chain management information systems. Purnama Cipta reclays that have been done, can be concluded:

1. The procedures contained in the system for each process are in accordance with what is expected by prospective users in the work environment of PT. Purnama Cipta Reclays.
2. The display response of each menu on the system that has been tested is in accordance with the results expected by potential users in the work environment of PT. Purnama Cipta Reclays.

The completeness of the menu on the system that has been tested is in accordance with the needs of users in the work environment of PT. Purnama Cipta Reclays.

3. FINAL
3.1 Conclusion

After analyzing, designing, and testing. Then a conclusion can be drawn to the Supply Chain Management Information System at PT. Reclays Purnama Cipta as follows:

1. Supply Chain Management Information System at PT. Reclays Purnama Cipta can help the Head of Storage in determining the amount of raw materials to be ordered from suppliers to meet the needs of the production process.
2. Supply Chain Management Information System at PT. Purnama Cipta Reclays can help the Head of Distribution to determine the number of product shipments to each outlet.

3.2 Suggestion

Supply Chain Management Information System at PT. Purnama Cipta Reclays can still be developed further with higher system specifications and better performance.

The following are some suggestions that can be used for the development of this research :

1. Added graphical facilities to see the increase and decrease in sales each period.
2. Added profile facility for each user.
3. There is a need for better development and maintenance of the system that has been built, so that the system can be used in accordance with future needs.

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