DEVELOPMENT OF INFORMATION SYSTEMS USING SUPPLY CHAIN MANAGEMENT APPROACH AT CV. NIRMALLA GRAHA

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ABSTRACT

CV. Nirmala Graha is a company engaged in the production and sale of various gypsum profiles for household, office and other construction purposes. The problem that often occurs is the way the company determines the number of raw material orders that are only estimated from product sales in the previous period. So that in terms of monitoring the availability of raw materials can not show accurate information because the monitoring of raw material stocks has not run well so that often there are shortages or excess raw material stock. The advantages of casting raw materials stored in the warehouse will harden if the storage area is moist, so the raw material for casting is always ordered to a minimum when ordering raw materials. This research is intended to plan inventory and order raw materials that are not well planned. Forecasting methods used are fuzzy time series algorithms and determine the amount of safety stock so as not to occur out-of-stock. The results of the study were tested using the calculation of AFER (Average Forecasting Error Rate) errors with a 1% result, so the forecasting accuracy was very good to be used for this study. Based on the problems contained in the CV. Nirmalla Graha, we need a supply chain management information system. The development objective of this system is to facilitate the production and purchase of raw materials needed for production to avoid shortages or excess stocks.

Keywords: ordering, raw materials, fuzzy time series, safety stock, out-of-stock, Average Forecasting Error Rate, supply chain management.

1. INTRODUCTION

CV. Nirmala Graha is a company engaged in the production and sale of various gypsum profiles for household construction, offices and others that relate to the ornamentation of a building with a variety of shapes and sizes. CV. Nirmala Graha uses Make-to-stock strategy where the production process continues without waiting for orders from customers. CV. Nirmala Graha has several suppliers of raw materials in the form of casting and white cement, the raw material is the main ingredient in the production process.

In the process of procuring raw materials, CV. Nirmala Graha usually orders suppliers who usually supply raw materials. There are 7 suppliers who usually supply raw materials to CV. Nirmalla Graha. CV. Nirmala Graha conducts production according to the available raw materials in the warehouse, so the warehousing department must always observe the raw material supply. Production activities start from the process of ordering raw materials to suppliers, when the supply of raw materials is almost gone. Often there is an error in determining the order of raw material quantities that are not calculated and estimated. Because in terms of monitoring the availability of raw materials can not show accurate information because the recording of warehousing has not run well so that often there are shortages or excess stock of raw materials. Excess raw materials such as casting stored in the warehouse will harden if the storage is damp, so the raw material for casting is always ordered to a minimum when ordering raw materials. In July 2017 (in the F-3 attachment), casting raw materials experienced a buildup of 25kg, so that some of the casting raw materials were utilized for production and some were discarded because they could not be used for production raw materials.

Based on the results of an interview with Mr. Aep Saefudin as the delivery staff stated that the delivery of products to customers will be carried out

if the customer has paid the payment. Determination of delivery schedules for customers based on customers who have paid in advance. Frequent errors occur in calculations that result in the product load being sent experiencing a mismatch with the vehicle's load which results in multiple shipments to customers, resulting in losses due to loss of sales potential and customer trust.

Based on the description of the problems contained in the CV. Nirmalla Graha, the company needs a system that can monitor the availability of raw materials, conduct production planning, and facilitate the scheduling of product delivery to customers. Nirmalla Graha. The application of the Supply Chain Management approach method can be an alternative to help companies deal with these problems because the function of Supply Chain Management (SCM) itself is to integrate business processes ranging from raw material procurement to end users.

Identification of the problem, namely:

1. The process of procuring raw materials often results in shortages and excesses of raw material stocks, causing uncertainty in determining the amount of raw material purchases to suppliers.
2. The product distribution system to customers is not in accordance with the delivery schedule.

The objectives to be achieved are:

1. Facilitate the production section to meet the production requirements for the next period.
2. Facilitate shipping in determining delivery schedules.

2. CONTENT OF RESEARCH

The foundation of this thesis writing theory explains the theories related to the development of information systems using the Supply Chain Management approach at CV. Nirmalla Graha to be built.

2.1.1 System Information

According to Tafri D.Muhyuzir (2001,8) information system is data collected, grouped and processed in such a way that it becomes valuable information for those who receive it.

The conclusion of the author is that the information system is a set of data that is processed in such a way that it can be easily made a system that collects and displays data information so that it is called an information system.

2.1.2 Supply Chain

According to Simchi-Levi et. Al "Supply Chain (SC) is a network of independent and interconnected organizations that work cooperatively and mutually beneficial in controlling and improving material flow and information from suppliers to users." (Simchi-Levi, Kaminsky, Simchi-levi , & Bishop, 2003)

From the explanation according to the experts above it can be concluded that Supply Chain is a network of organizations or companies that can work together to be able to benefit each other and can improve the flow of material and product information to the end user.

2.1.3 Supply Chain Management

According to Indrajit Richardus Eko Djokopranoto "Supply Chain Management is the information manager, goods and services ranging from the earliest suppliers to the last consumers by using an integrated system approach with the same goal." (Indrajit Richardus Eko Djokopranoto, 2002)

According to I Nyoman Pujawan, there are three entities that must be managed well, including material, information and finance.

1. first is the flow of goods flowing krom upstream (downstream).
2. Second is the flow of money and the Ike flowing from downstream to upstream.
3. Third is the flow of information that can occur from upstream to downstream or vice versa.

Following is the supply chain model and 3 types of managed flows can be seen in Figure 1.

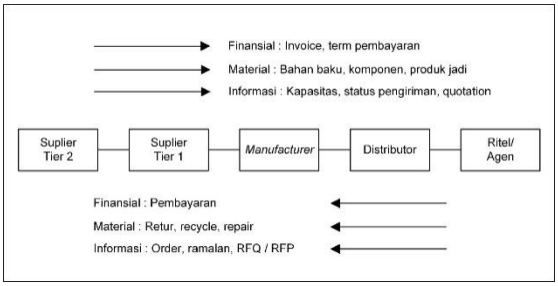


Figure 1. Three flow of Supply Chain Management

2.1.4 Safety Stock

Inventory security or Safety Stock has a function to secure or protect errors in predicting orders during Lead Time. Lead Time is the time taken between the raw materials ordered until received by the company. The following is the formula for determining the Safety Stock.

Equation 1

$$SS = \text{Average usage of the previous period} \times LT \quad (1)$$

Where:
SS = Safety Stock
LT =Lead Time

Reorder points or re-order points when the inventory reaches the point where it must re-order. The following is the equation for determining the reorder point.

$$\text{Reorder Point} = (LD \times AU) + SS \quad (2)$$

LD = Lead Time
AU = Average usage
SS = Safety Stock

2.1.5 Forecasting Method Fuzzy Time Series

Forecasting the number of requests for C7T gypsum profiles using the first Chen Fuzzy Time Series Algorithm data collection obtained from the sale of C7T gypsum profile products from February 2017 to January 2018. Sales data for C7T gypsum profile products can be seen in the following table:

Table 1 Sales of C7T Gypsum Profile Products

Periods	Number of Requests (bars)
Feb-17	457
Mar-17	434
Apr-17	428
May-17	462
Jun-17	437
Jul-17	455
Aug-17	453
Sep-17	448
Oct-17	457
Nov-17	489
Dec-17	464
Jan-18	442

After the data is collected, the next step is to analyze using the fuzzy time series Chen method which consists of several steps, namely:

a. Defining the set of universes U and the interval as an illustration of the rules.
In Table 1, the product demand for C7T gypsum profile is minimal (Dmin = 428) and the maximum product demand for C7T gypsum profile (Dmax = 489). Acquisition of the initial value and the final value for the set of universes ∪ is ∪ = [428-4, 489 + 1] = [424, 490] The division of the length of the interval in this case is the length of interval 6, so that ∪ is divided into 11 intervals.

b. Defining the fuzzy Ai set in the universe ∪.
The value of 11 fuzzy sets is assumed to be a fuzzy value derived from the linguistic variable data on the number of requests for C7T gypsum profile products, namely:

Table 2 linguistic variable

Variabel	Information
A_1	Demand for production greatly decreases level III.
A_2	Demand for production greatly decreases level II.
A_3	Demand for production greatly decreases level I.
A_4	Production demand has declined considerably.
A_5	Declining production demand
A_6	Fixed production demand.
A_7	Production demand increases.
A_8	Production demand is increasing.
A_9	Production demand greatly increased level I.
A_{10}	Production demand greatly increased level II.
A_{11}	Production demand greatly increased level III.

c. Color definition
Based on table 2 linguistic variables obtained color tables to show the lowest to highest level. The following color table in table 3:

Table 3 color variable

Variable	information	colors
A_1	red	
A_2	Pink	
A_3	Orange	
A_4	Orange -Yellow	
A_5	Yellow	
A_6	Green	
A_7	Blue Green	
A_8	Light blue	
A_9	Light blue	
A_{10}	Blue	
A_{11}	Dark blue	

d. Process Fuzzification.

The results of the fuzzification request for C7T gypsum profile products can be seen in Table 4 below:

$$\hat{Y}_{13} = \frac{m4}{k} = \frac{464+442}{2} = 453$$

Table 4 Process fuzzification

Periods	Number of Requests (bars) (A_i)	U_i	fuzzification
Feb-17	457	U_6 =[454,460]	A_6
Mar-17	434	U_2 =[430,436]	A_2
Apr-17	428	U_1 =[424,430]	A_1
May-17	462	U_7 =[460,466]	A_7
Jun-17	437	U_3 =[436,442]	A_3
Jul-17	455	U_6 =[454,460]	A_6
Aug-17	453	U_5 = [448,454]	A_5
Sep-17	448	U_5 = [448,454]	A_5
Oct-17	457	U_6 =[454,460]	A_6
Nov-17	489	U_{11} =[484,490]	A_{11}
Dec-17	464	U_7 =[460,466]	A_7
Jan-18	442	U_4 =[442,448]	A_4

Based on Table 4, obtained fuzzification results for example fuzzification on January 2018, namely A4, with a demand of 442 stems at intervals of interval4. The same thing was done for the data fuzzification results the following month.

e. Determination of Fuzzy Logic Relationship (FLR).

Tabel 5 Fuzzy Logic Relationship

Fuzzy Logic Relationship			
$A_6 \rightarrow A_2$	$A_7 \rightarrow A_3$	$A_5 \rightarrow A_5$	$A_{11} \rightarrow A_7$
$A_2 \rightarrow A_1$	$A_3 \rightarrow A_6$	$A_5 \rightarrow A_6$	$A_7 \rightarrow A_4$
$A_1 \rightarrow A_7$	$A_6 \rightarrow A_5$	$A_6 \rightarrow A_{11}$	

f. Grouping of fuzzy relations in a group.
Fuzzy logic relations are seen in Table 6 below:

Tabel 6 Grup Relasi Logika Fuzzy

Groups	Group Relasi		
Group 1	$A_1 \rightarrow A_7$		
Group 2	$A_2 \rightarrow A_1$		
Group 3	$A_3 \rightarrow A_6$		
Group 4	$A_5 \rightarrow A_5$	$A_5 \rightarrow A_6$	
Group 5	$A_6 \rightarrow A_2$	$A_6 \rightarrow A_5$	$A_6 \rightarrow A_{11}$
Group 6	$A_7 \rightarrow A_3$	$A_7 \rightarrow A_4$	
Group 7	$A_{11} \rightarrow A_7$		

Table 6 shows the fuzzy logic relation groups formed from fuzzy relations.

g. Defuzzy calculation.
The following is a breakdown of the results of forecasting demand calculated using the equation. Suppose that February 2018 (t = 2), then F (2-1) = A6. In Table 6 the A6 fuzzy logic relation group is A2, A5 and A11. Fuzzy time series t = 2 that is F (1) = A2, A5, A11 and the defuzzy value for t = 2 is the mean of the middle value obtained.

Table 7 defuzzyfication results

Periods	Number of Requests (bars) (A_i)	Forecasting (rod) (Fi)	$\lvert F_i - A_i \rvert$
Feb-17	457	-	-
Mar-17	434	457	23
Apr-17	428	433	5
May-17	462	427	-35
Jun-17	437	442	5
Jul-17	455	439	-16
Aug-17	453	457	4
Sep-17	448	477	29
Oct-17	457	477	20
Nov-17	489	457	-32
Dec-17	464	463	-1
Jan-18	442	442	0
Feb-18	-	453	-

In Table 7, the results of forecasting (Fi) of C7T product demand in February 2018 are 453, this value is obtained based on C7T product demand (Ai) in the previous month, namely January

2018 with the value at the interval U4 = [464,442] and yield fuzzification is A4. Determination of forecasting results for each month is based on the results of the previous month's fuzzification.

2.1.6 Average Forecasting Error Rate (AFER)

AFER calculation with equation (2-11) as follows:

$$AFER = \frac{\sum_{i=1}^{n} |Ai - Fi| / Ai}{n} \times 100\%$$

$$AFER = \left(\frac{\frac{23}{434} + \frac{5}{428} + \frac{-35}{462} + \cdots + \frac{0}{442}}{11} \right) \times 100\% \quad ()$$

$$AFER = 0.0149278672361319 \times 100\%$$

$$AFER = 1\%$$

Based on the AFER calculation, a percentage of 1% obtained shows that the value of errors in predicting the number of C7T product requests is between the range of 1% to 10%, then the accuracy of forecasting C7T product demand using Chen Fuzzy Time Series algorithm is **Very Good**.

2.2 Problem analysis

Problem analysis is an assumption of the problem that will be described in data processing procedures in the CV System. Nirmalla Graha uses the Supply Chain Management approach.

Analysis of problems from the current system is:

1. The process of procuring raw materials often results in shortages or excesses of raw material stock, causing uncertainty in determining the amount of raw material purchases to b.
2. The product distribution system to customers is not in accordance with the delivery schedule.

2.3 Supply Chain Management (SCM) Analisys

Analisis supply chain management akan digunakan untuk mengimplementasikan pendekatan supply chain management pada sistem yang akan dibangun.

2.3.1 Supply Chain Management (SCM) Model at CV. Nirmalla Graha

Based on the Supply Chain Management analysis found in the previous section, the following is the supply chain management model contained in the CV. Nirmalla Graha can be seen in Figure 2.

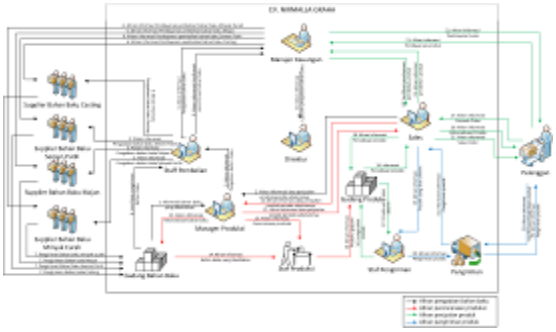


Figure 2. Supply Chain Management (SCM) Model CV. Nirmalla Graha

2.3.2 Supply Chain Analisys at CV. Nirmalla Graha

Supply chain analysis is carried out to find out the supply chain management process that will be built on the CV. Nirmalla Graha based on the supply chain management model in figure 2. Supply chain management analysis can be seen in Figure 3.



Gambar 3. Supply Chain Management Analisys at CV. Nirmalla Graha

1. **Analysis of production planning**

Production planning analysis is carried out to be able to determine the amount of production to be carried out in the coming period. Production planning is carried out using forecasting techniques with Fuzzy Time Series algorithms.

2. **Analysis of monitoring of raw materials & Products**

After the forecasting phase, the next step is to monitor the raw material inventory and determine the safe limit of raw materials that must be in the warehouse of raw materials which aims to avoid the

occurrence of shortages or vacancies of raw materials using the safety stock method.

3. Analysis of raw material procurement

In this raw material procurement analysis CV. Nirmalla Graha procures raw materials with the amount ordered in accordance with the results of product forecasting plus safety stock minus the stock in the warehouse.

4. Analysis of product orders from customers

In this customer product ordering analysis is to calculate the number of orders ordered by the customer to determine the transportation to be used when shipping. Shipment will be made when the number of orders reaches the maximum capacity of the entire vehicle.

5. Analysis of product distributif

Based on the ordering data, the company determines the product distribution schedule to customers who have made payment transactions. Determination of the vehicle to be used is seen from the number of orders to be sent.

2.4 Database Analysis

Database analysis on supply chain management information systems at CV. Nirmalla Graha will be built using Entity Relationship Diagram (ERD). Here is a picture for database analysis can be seen in Figure 4.



Figure 4. Entity Relationship Diagram of supply chain management information system at CV. Nirmalla Graha

2.5 Context Diagram

Di a context program describes how data is used and transformed to process in the form of data flow into or out of the supply chain managemenet information system in the CV. Nirmalla Graha as a whole. Context diagram can be seen in Figure 5.



Figure 5. Context Diagram of supply chain management information system at CV. Nirmalla Graha

2.6 Data Flow Diagram (DFD)

Data Flow Diagram illustrates the flow of data and describes the processes that occur in the system until the process is more detailed. In the context of the context contained in Figure 5. can be described again into the form of DFD.

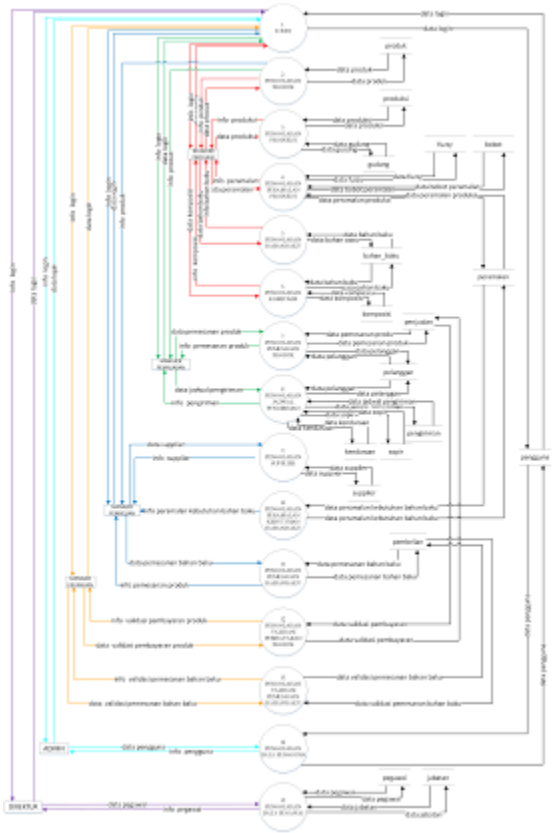


Figure 6. DFD Level 1 Supply Chain Management information system at CV. Nirmalla Graha

2.7 Relationship Scheme

The relation scheme explains the relationship of data - data, the meaning of data and its limitations. The relation process between attributes that have the same primary key, so that the attribute becomes a single entity, the attribute is connected by the key filed. The relation table can be seen in the picture 7.

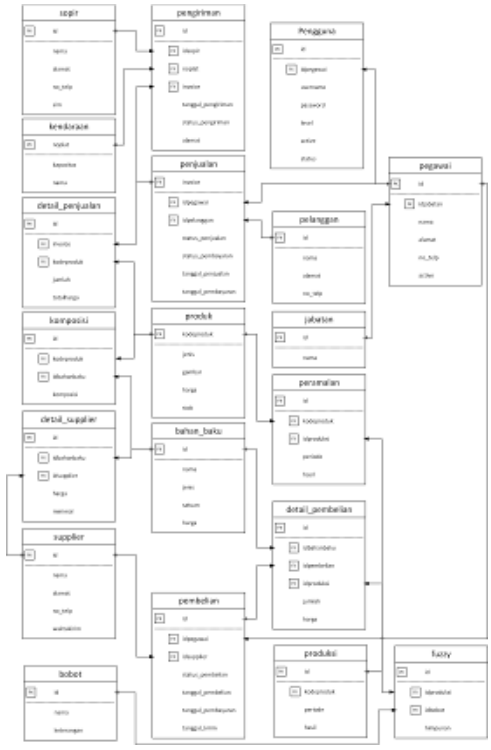


Figure 7. supply chain management relation scheme at CV. Nirmalla Graha

2.8 System Testing

System testing is the most important thing because it aims to find out the errors or deficiencies contained in the system being tested. The purpose of this test is to find out the supply chain management information system at CV. Nirmalla Graha that has been made has met the needs that are in accordance with the design goals.

The tests used to test this system are black box testing methods, User Accpetance Test (UAT), and beta.

1. Black Box Testing

PengUIjan black box prioritizes the functional requirements of the system that has been built.

Test each process to find out what errors might occur.

Based on the results of the tests that have been carried out it can be concluded that the system built is correct. Functionally, the system built has produced the expected information.

2. UAT Testing

Pengujian UAT bertujuan untuk mengonfirmasi bahwa the system that is currently being tested can meet business needs to provide confidence that the system being tested works correctly and can be used before being officially given to the end user. End user testing is carried out by one or more user representatives with help from the testing team.

After testing the UAT to each user, it can be concluded that all processes are functioning properly. Functionally the system can produce the expected output.

3. Beta Testing

This beta test is done by testing directly at the research site by using interview techniques for each user.

Based on the beta testing that has been done, it can be concluded that:

1. The system built can help the purchasing manager in determining the amount of raw material to be purchased.
2. The system built can recommend the amount of production to assist the production manager in determining the amount of production to be carried out.
3. The system built can help marketing managers in scheduling and determining vehicles to deliver products to customers.

4. CLOSING

This concluding section explains the conclusions of the results produced after analyzing, designing, and implementing the system design that was built and developed.

3.1 Conclusion

Based on the results obtained in this final assignment, the following conclusions can be drawn:

1. This Supply Chain Management information system can help the process of procuring raw materials, making it easier for production managers to determine the amount of production in calculating the raw material needs that must be purchased to meet the production needs of the next period.

2. This Supply Chain Management information system can facilitate the marketing manager in determining the distribution schedule so that there is no more buildup of orders.

1.2 Suggestions

Supply chain management information system at CV. Nirmalla Graha can still be further developed with better system specifications and maximum performance. Suggestions for the development of Supply Chain Management information systems are some suggestions that can be done, among others:

1. Based on the results of the interview, the system view still needs to be improved to make it more attractive.

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