e-SCM based on Material Inventory Management uses the Material Requirements Planning Method

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Abstract. This study aims to analyze the inventory of materials before the production process begins and design an e-SCM system that aims to facilitate the flow of information on material stocks and product processes from raw materials to finished materials. analysis using the material requirements planning (MRP) method. MRP will analyze material inventory calculations before the production process begins, the system determines the Master Production Schedule and the stock of raw materials for the products needed to make finished materials. Furthermore, the system will convert from the number of Production Master Schedules to production needs and compare the needs with the amount of available stock so as to produce information about the stock of materials that must be ordered. The results of the analysis that MRP can predict stock and reduce the amount of material stock in warehouses reaches 50%. The e-SCM application is expected to facilitate the flow of stock information and integrate between companies with suppliers and customers so that information between suppliers and customers becomes more integrated.

1. Introduction

Utilization of the Internet is not only limited to internal company activities but can help companies in external activities by means of integration with other companies so as to create mutually beneficial collaborations to produce quality, safe and appropriate products. One business process that can be developed is the supply chain management (SCM). SCM is a series of activities including coordination, scheduling, and control of procurement, production, inventory and delivery of products or services to customers and processing information from customers to suppliers [2,8].

The rapid development of Internet technology has caused a change from the concept of traditional supply chain management (SCM) to electronic supply chain management (e-SCM) [3]. E-SCM is a collaboration of the use of technology to expand B2B, B2C processes and increase speed, timely control and customer satisfaction and enhance SCM's own operations [4,7].

The application of e-SCM greatly helps achieve products to be effective and efficient for all stakeholders so as to minimize inventory levels, reduce production time, optimize logistics and distribution, optimize and increase output, accelerate order fulfillment and overall reduce costs associated with this activity. In addition, e-SCM can also improve the operational process of a series of supply chain activities that include the flow of raw materials, information, money, and services ranging

from purchasing raw materials, storing and distributing finished products to consumers. With the many benefits that can be achieved in the use of e-SCM [5].

Production planning is important in the process of a company. Without production planning, the company will have difficulty in meeting product demand. Production planning will not run properly if there is no calculation in predicting the materials needed [6,9]. PT. X is one of the Micro Small and Medium Enterprises (MSMEs) and Si-Jaspro partners engaged in the field of automotive accessories, especially car window film, in the process of pt x production planning based on demand every day and there is no system that can plan material requirements for production, then the company buys materials in large quantities to avoid lack of material in production. things done today are ineffective and inefficient at the company, storage in the warehouse becomes full of materials for production. with this PT. X needs a system. The e-SCM system is based on Material Inventory Management using the material requirements planning method, which is expected to be able to calculate the needs of the material to be produced, so that the purchase of materials to suppliers can be measured and the storage of materials in the warehouse is not full of materials for production.

2. Method

2.1. Production planning

Production planning is an activity to get the product in accordance with specified, related to determining how much is produced, what resources are needed and when to produce. This planning is carried out with the aim to regulate the actions to be taken in the production process as a first step in compiling the stages of activities in the future, so that production on planning must be prepared based on the results of data acquisition in the past. Keep in mind that this production plan may not be able to provide results that are in accordance with the company's needs. Therefore, it is necessary to conduct further analysis and evaluation of the planned production planning which is then followed by production control activities [12,14].

2.2. Material requirement planning (MRP)

Material Requirements Planning (MRP) is a dependent demand technique that uses a list of materials, supplies, expected receipts, and master production schedules to determine material requirements. MRP can be used in forecasting material needs that will come before production begins. This can be useful to overcome the excess stock of materials to be produced by controlling the purchase of materials to suppliers. MRP calculation results in the form of the amount and when the purchase of materials ordered to the supplier. For more extensive matters, the use of MRP can also be used to calculate the cost of storing materials in a warehouse [8,15]. MRP has three required information inputs, namely:

2.2.1. Master production schedule

Master Production Schedule (MPS) is planning in a time phase that determines how much and when the company plans each end of the final product. MPS is made by dividing the total production plan into various specific final products. MPS is an allocation process to make a number of desired products by taking into account their capacity. With MPS can be seen the number of products to be produced in the future. This is very good for forecasting material requirements and scheduling of production for a certain period.

2.2.2. Bill of Material (BOM)

Bill of Materials (BOM) is a list of components displayed to make a finished product. The BOM file contains data about raw materials and components as well as production sequence. BOM is often referred to as a product tree structure because it shows how a product is formed by components. This product structure shows how much each component and product part will be needed, the order of assembly if the product structure is entered into the BOM master, detailing all component names, identification numbers, picture numbers, and sources of materials made inside the company or purchased from outside parties. This component list will be created so that the BOM master can be processed.

2.2.3. Inventory records file

This is a record of the inventory of parts that are in the warehouse and that have been ordered but have not yet been received. This note is used when needed in production. The contents of the note contain the identification number, quality available, level of safety stock, the amount planned for production and the time for procurement for each item. This record must always be updated by recording all transactions that occur such as receipts, expenses, product and order failures, to avoid mistakes in planning. Keeping a record of inventory is very important in the MRP analysis. This can affect the results of the MRP analysis. Inventory transaction records can be used to make safety inventories

In other words, that MRP is a process used to translate the Master Production Schedule into the net requirements of the material to be used for the production process. MRP systems can be developed into computer applications to facilitate the calculation and centralized data processing. The MRP system is designed to help make decisions in the form of when to order materials and how much to order based on the stock of materials in the warehouse. It is hoped that the MRP system can assist companies in controlling materials in the warehouse, as well as overseeing the flow of materials that are in the company. Following are the general forms of MRP.

3. Results and Discussion

This study uses the MRP method required three main components, namely:

3.1. Master Planning Schedule

MPS Is the production schedule that will be produced. Usually the schedule is obtained from the customer by giving a request to the company. Can be in periods per month or even per semester. The following is the master production schedule per month in April to June 2018 in table 1.

Table 1. MPS for Crystal Hi protection material

Type of Material	Qty Bom (m^2)	Master Planning Schedule (unit)					
		Jan	Feb	Mar	Apr	May	Jun
TAVCP2J	1,026	1,540	2,135	2,500	2,242	3,858	2,842
TINCP2J	1,368	1,800	1,900	2,235	2,229	2,645	1,749
THDCP2J	10,716	180	290	222	256	318	186
TSTCP2J	1,368	300	287	290	357	468	382
TVXCP2J	152	60	90	86	92	103	80

3.2 Bill of Material (BOM)

Bill of Material Is the material needed to make a product. At PT. X only has one ingredient in each product structure, because the production process at PT. X only cuts from a roll into a glass to be installed on a car. The following is the product structure for each item:

Table 2. BOM For Crystal Hi Protection Material

Material		Qty	Unit
Type	Name		
TAVCP2J	Crystal hi Protection	1,026	m^2
TINCP2J	Crystal hi Protection	1,368	m^2
THDCP2J	Crystal hi Protection	10,716	m^2
TSTCP2J	Crystal hi Protection	1,368	m^2
TVXCP2J	Crystal hi Protection	152	m^2

3.3. Inventory Records

Inventory recording is a recording of the movement of material stocks in the warehouse. This is important because to predict the number of purchases to come. The following is the recapitulation of material stock at PT. X on the hi Crystal Protection material:

Table 3. Inventory Records For Crystal Hi Protection Material

Description	Period		
	Jan	Feb	Mar
current stock	600	497	474
the next plan	0	100	0

Based on the three components mentioned above, the MRP calculation can be done by calculating the material requirements to be produced, with the conversion from units to square meters(m2), By way of the number of qty bom multiplied by mps per unit. Then order materials according to production requirements. The first thing is to convert the MPS to the amount of material. Following is the calculation of conversion from MPS to the amount of material that must be ordered:

Table 4. MPS and Material Requirements

Type of Material	Material Needs (m^2)					
	Jan	Feb	Mar	Apr	May	Jun
TAVCP2J	1,580,040	2,190,510	2,565,000	2,300,292	3,958,308	2,915,892
TINCP2J	2,462,400	2,599,200	3,057,480	3,049,272	3,618,360	2,392,632
THDCP2J	1,928,880	3,107,640	2,378,952	2,743,296	3,407,688	1,993,176
TSTCP2J	410,400	392,616	396,720	488,376	640,224	522,576
TVXCP2J	9,120	13,680	13,072	13,984	15,656	12,160

But in the production process found production errors or damaged materials due to the production process. This will reduce the accuracy of the data calculation of material requirements. Therefore the company provides tolerance for damaged materials due to the production process which is 1%. So that the calculation must be added by 1% of the total material needs. Here is a table regarding the value of material needs plus 1%:

Table 5. Tolerance for Damaged Materials Plus 1%

Type of Material	Material needs plus 1%					
	Jan	Feb	Mar	Apr	May	Jun
TAVCP2J	1,595,840	2,212,415	2,590,650	2,323,295	3,997,891	2,945,051
TINCP2J	2,487,024	2,625,192	3,088,055	3,079,765	3,654,544	2,416,558
THDCP2J	1,948,169	3,138,716	2,402,742	2,770,729	3,441,765	2,013,108
TSTCP2J	414,504	396,542	400,687	493,260	646,626	527,802
TVXCP2J	9,211	13,817	13,203	14,124	15,813	12,282

After calculating the needs needed, then converted from units of m² to roll. Because the unit of material from the supplier is still in the form of roll. In 1 roll Crystal Hi Protection has 46.36 m². The following is a table of material conversion from m² to roll:

Table 6. Material conversion from m² to roll

Type of Material	Material needs plus 1%					
	Jan	Feb	Mar	Apr	May	Jun
TAVCP2J	34,422.8	47,722.5	55,881.1	50,114.2	86,235.8	63,525.7
TINCP2J	53,645.9	56,626.2	66,610.3	66,431.5	78,829.7	52,125.9
THDCP2J	42,022.6	67,703.1	51,827.9	59,765.5	74,240.0	43,423.4
TSTCP2J	8,941.0	8,553.5	8,643.0	10,639.8	13,947.9	11,384.9
TVXCP2J	198.7	298.0	284.8	304.7	341.1	264.9
TOTAL	139,231.0	180,903.4	183,247.1	187,255.7	253,594.4	170,724.8
ROUND	139.0	181.0	183.0	187.0	253.0	171.0

The next step is to calculate when the purchase plan and how much should be ordered. Calculation of the amount of available stock with the material requirements planning method (mrp). The company provides a safe stock value of 300 roll and lead time for 2 months. So that the excessive amount of stock in the warehouse can be eliminated. The following is an MRP calculation table.

Table 7. MRP Calculation

MRP	**Period**					
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**
GR						
SR						
PoH	600	497	474	291	300	300
SS	300	300	300	300	300	300
NR	139	181	183	187	253	171
PORt		100		196	253	171
PORel		196	253	171		

Information :
GR : Gross Requirement
SR : Schedule Receipt
PoH : Projected on Hand
NR : Net Requirement
PORt : Planned Order receipt
PORel : Planned Order Release
SS : Safety Stock

In the table VII. MRP calculation can be seen that the planning of purchasing goods can be done 2 months before production begins. Because the arrival of materials from ordered to arrive in 2 months. To reduce excess stock in the warehouse, then in production from January to March do not order goods. And for the planning of material needs in April, ordering the materials from suppliers 2 months before, namely in February, so that in April the materials will reach the company.

4. Implementation

The results of the study found that the stock of Crystal Hi Protection has an excess of 300 roll in January 2018. This value is greater than the specified safety stock value of 300 roll. If a percentage is made, the excess value reaches 50%. With the existence of MRP, the order schedule to suppliers has become more scheduled and organized. And the amount of material ordered does not exceed the needs needed.

In designing the e-SCM system using the Material Requirement Planning Method will provide information about of data flow at PT. X. such as: Production Master Schedule Data, Bill of Material, Inventory Record File data, and work order data for production. Following this is the Class Diagram design for the application to be built.

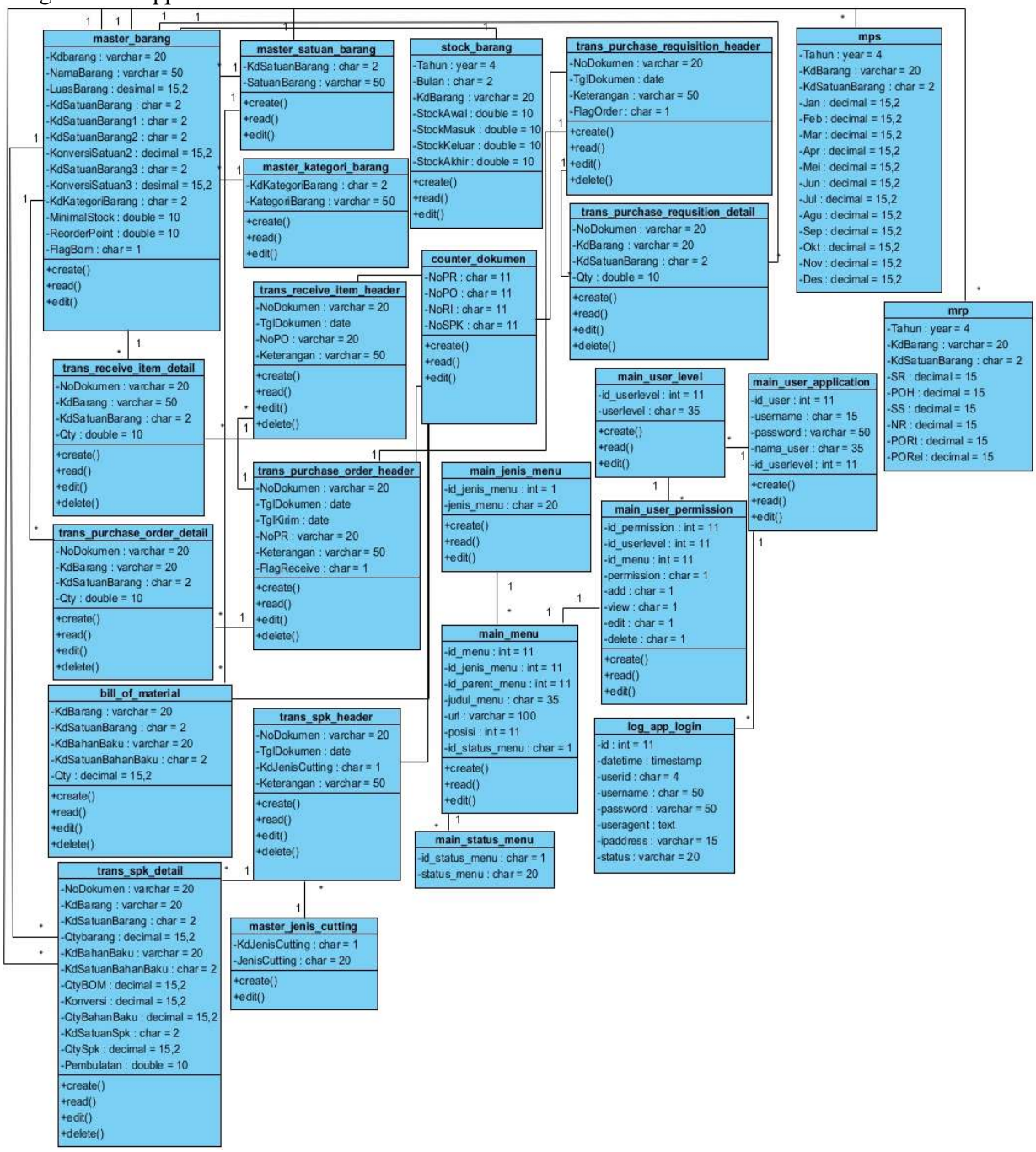
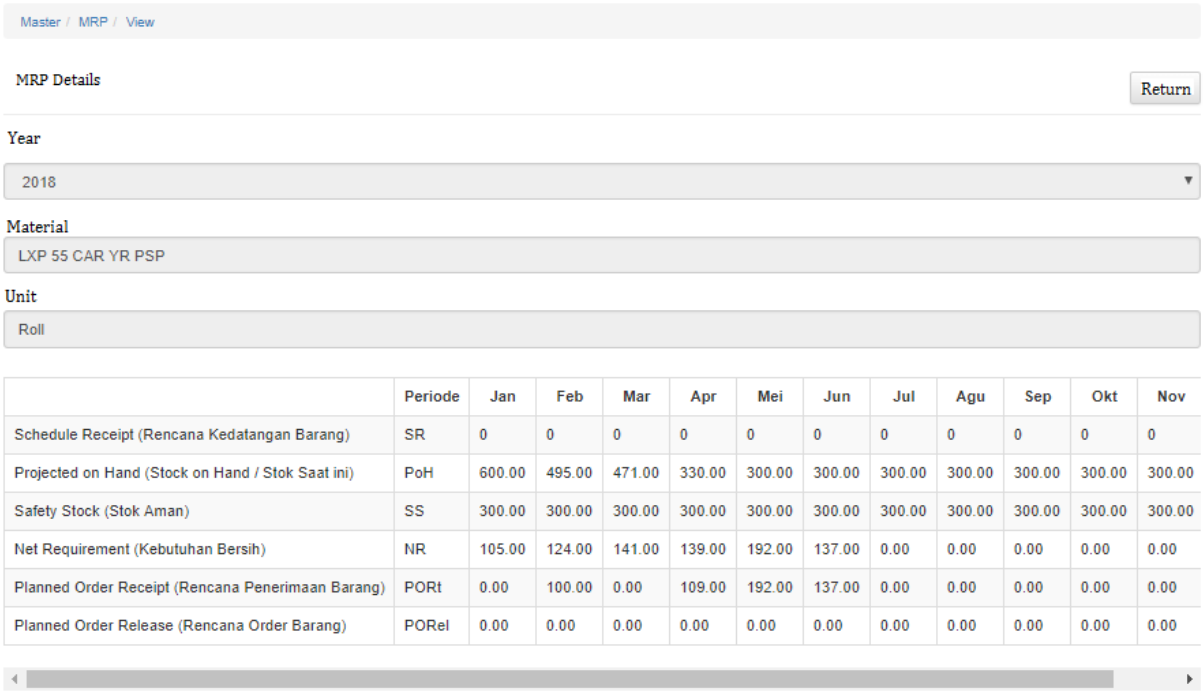


Figure 1. Class Diagram design on e-SCM systems

The following is Figure 2 of the MRP application screen display design (material requirements planning) at PT. X.



	Periode	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Agu	Sep	Okt	Nov
Schedule Receipt (Rencana Kedatangan Barang)	SR	0	0	0	0	0	0	0	0	0	0	0
Projected on Hand (Stock on Hand / Stok Saat ini)	PoH	600.00	495.00	471.00	330.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
Safety Stock (Stok Aman)	SS	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
Net Requirement (Kebutuhan Bersih)	NR	105.00	124.00	141.00	139.00	192.00	137.00	0.00	0.00	0.00	0.00	0.00
Planned Order Receipt (Rencana Penerimaan Barang)	PORt	0.00	100.00	0.00	109.00	192.00	137.00	0.00	0.00	0.00	0.00	0.00
Planned Order Release (Rencana Order Barang)	PORel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 2. MRP Calculation Screen Display

5. Conclusion

Material requirements planning process can be a solution at PT. X to overcome excess stock. In MRP processing, the master planning schedule (MPS) becomes a very important part in the MRP analysis. Without MPS data, companies will have difficulty in determining the amount of stock needed. The existence of safety stock makes it easy for companies to determine safe stock levels. This can help avoid excess stock in the company. As well as the existence of the eSCM system using MRP, companies will be given the convenience to process data in the current MRP process. Provides speed in data processing, as well as providing data accuracy from the results of the MRP process.

6. References

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