A STUDY OF PROCUREMENT EVALUATION

A CASE STUDY OF PHARMACEUTICAL COMPANY

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Abstract

The objective of this study is to find the materials ordering method, which provides low risk of materials shortage, optimum inventory level, less complication logic with minimize level of human intervention in the ERP system. The case study company has already started ERP implementation but the full function of production module has not been obtained. The actual production scheduling was performed outside the system. The evaluation was conducted on important export product groups. Six-month period was selected to simulate based on customer ordering plan of year 2014. The four material ordering patterns were selected for evaluation. The study found that no shortage of raw materials in the 2nd and the 4th method, but the 1st method and the 3rd method were found shortage. The averages of six-month inventory values of the 1st method to the 4th method were 13,090,000 Baht, 34663,333 Baht, 20,056,667 Baht, and 23,220,000 Baht, respectively. The most preferable method was the 4th method. The actual production scheduling was an important tool for material ordering. A safety stock has an important role to prevent the shortage of materials. However safety stock should be carefully monitored to control the level of inventory. For further study, the unstable of demand and supply should be considered.

Keywords : Enterprise Resources Planning (ERP), Optimum Inventory, Safety Stock.

1. Introduction

In the dynamism environment of business competition, one of the most concerned issues by the customer is on time delivery of goods by the promised due date. According to the Just-in-Time (JIT) principle, delivery of products/materials must be adhered to the three criteria: what it needs, in the amount it needs, and by the time it needs. Evaluation of the accuracy of delivery is calculated by the combination of the three criteria. To achieve the accuracy of delivery, demand information from the downstream activities must be synchronized along the supply chain. Thus, the Enterprise Resources Planning (ERP) was developed to overcome the shortcomings of information un-synchronization to improve operations efficiency. The production process is one of the activities in the supply chain. Input materials must arrive at the production facility on time as scheduled by production plan to achieve accuracy of delivery. The case study factory faced with inaccuracy arrival of input materials, for example, the incorrect amount of input material delivery, unable to order the input materials to be delivered on time to keep pace with the production date. These problems caused production incapability and delay of product delivery. Then, the factory decided to implement the ERP system to overcome all the difficulties. However, after the implementation, the production module of ERP system is not fully functioning due to the fact that the production capacity is unknown to the implementer. Thus, the Master Production Schedule (MPS) must be manually created. Consequently, the factory is now in need of a material ordering method of ERP system to match with the actual production schedule [1-3].

In this study, the possible material ordering methods will be evaluated under the conditions of no input material shortage and optimal inventory level control. The comparison of pro and con of material ordering solutions is also described.

2. Research Methodology

To prevent inaccuracy of procurement to reoccur, the company implemented an ERP system to synchronize information of all sections not only production and procurement. However, we need to consider “How to set logical process in ERP system to prevent shortage of raw materials and low level of raw materials inventory?” In the initial phase of ERP implementation, production capacity was not known. When export order was input in system, system suggested date of manufacturing. Suggestion manufacturing date was set by production lead time only and purchasing order was backward period of production lead time plus purchasing lead time.

Evaluation Methods :

1) Collect data of the case study company as follows;

1.1) Export shipment plan of 2014

1.2) Materials receiving plan for production of shipment in 2014

1.3) Master production schedule for shipment of 2014

1.4) Price list of materials of each packing style

2) Evaluate the inventory by 2 methods, which were proposed by 2 sections

2.1) First method: Arrival of materials advance before shipment date 90 days (System production lead time 90 days, no consideration of actual MPS)

2.2) Second method: Arrival of materials advance before shipment date 60 days and grouped safety stock of level 1 and level 2 components for each packing style (System production lead time 60 days, no consideration of actual MPS)

3) Comparison between 2 methods, and set alternative method.

4) Simulation of alternative methods

4.1) Third method: Arrival of materials advance before shipment date 60 days and safety stock of level 2 for each group and safety stock of level 1 for each packing style (System production lead time 60 days, no consideration of actual MPS)

4.2 Fourth method: Arrival of material in 1st day of actual production month and safety stock of level 2 for each group and safety stock of level 1 for each packing style (No consideration of system production lead time).

3. Results

1) Evaluate the inventory by 2 methods, which were proposed by 2 sections.

1.1) Advance arrival of materials before shipment date 90 days (System production lead time 90 days, no consideration of actual MPS)

The production lead time was set as 90 days of all packing styles without consideration of production capacity. This was the conventional method of material ordering. Table 1 shows example of relation between export shipment plan and materials arrival plan of packing style A21.

The lead time from issuing P/O of materials to finished good shipment was 180 days as exhibited in Figure 1. This lead time consists of purchasing lead time 90 days and production lead time 90 days.

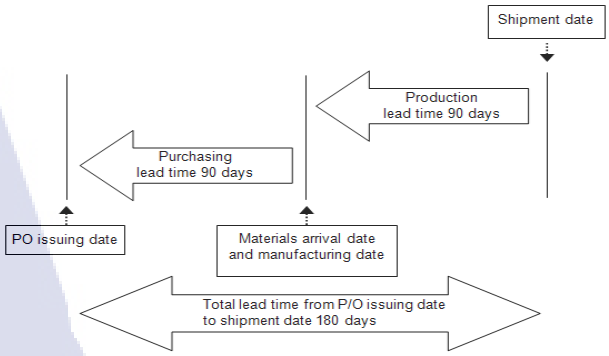

Figure 1: Total Lead Time of the 1st Method

Table 1: Example of 1st Method Export Shipment and Materials Arrival Plan of Packing Style A21

Packing style	Item	2014												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (lot)
Export shipment														
A21	Qty'(lot)			1			1		1	1	1	1	1	7
	Lot no.			001			002		003	004	005	006	007	
Materials arrival plans														
A21	Qty'(lot)	1			1		1	1	1	1	1			7
	Lot no.	001			002		003	004	005	006	007			

Result of average materials inventory value was 13,090,000 Baht (Table 2). The materials inventory cost was quite low. Materials were not ordered, if customer did not order products. But materials shortage problem was found in B53 products for 2 lots in June and August, because these 2 lots were manufactured before export shipment more than 3 months. In this case, production needed to reflect manufacturing date of abnormal lot for procurement section to adjust material purchasing and arrival date. The shortage of materials and materials adjustment for product B53 was shown in Table 3.

Table 2: Materials Inventory of 1st Method and Average Value of 6 Months

Group	MAY'14	JUNE'14	JULY'14	AUG'14	SEP'14	OCT'14	Average* (Baht)
A2	2,470,000	690,000	2,630,000	690,000	2,450,000	1,250,000	1,696,667
A5	3,990,000	5,050,000	4,020,000	4,400,000	8,820,000	9,930,000	6,035,000
A9	0	1,220,000	0	0	610,000	0	305,000
B3	0	0	0	0	0	600,000	100,000
B5	5,880,000	6,320,000	2,940,000	2,820,000	8,820,000	2,940,000	4,953,333
Total	12,340,000	13,280,000	9,590,000	7,910,000	20,700,000	14,720,000	13,090,000

Remark: *Average inventory value of 6 months in Thai Baht.

Table 3: Result from Evaluation of B53 for the 1st Method

Packing style	Item	MAY'14	JUNE'14	JULY'14	AUG'14	SEP'14	OCT'14
B53	B/F* stock	0	1	-1	0	-1	2
2,940,000	Use	1	2	1	1	1	2
Baht/lot	Receive	2	0	2	0	4	0
	C/F** stock	1	-1	0	-1	2	0
	Amount	2,940,000	-2,940,000	0	-2,940,000	5,880,000	0
B53	B/F* stock	0	1	0	0	0	2
2940000	Use	1	2	1	1	1	2
Baht/lot	Receive	2	1	1	1	3	0
(adjust)	C/F** stock	1	0	0	0	2	0
	Amount	2,940,000	0	0	0	5,880,000	0

Remark: *B/F is brought forward

**C/F is carry forward

1.2) Advance arrival of materials before shipment date 60 days and grouped safety stock of level 1 and level 2 components for each packing style (System production lead time 60 days, no consideration of actual MPS)

For this method, the production lead time will be set shorter as 60 days of all packing styles without consideration of production capacity. But the risk of shorter production lead time was compensated by usage of materials safety stock. Table 4 shows example of relation between export shipment plan and materials arrival plan of packing style A21.

Table 4: Example of 2nd Method Export Shipment and Materials Arrival Plan of Packing Style A21

Packing style	Item	2014												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (lot)
Export shipment														
A21	Qty'(lot)			1			1		1	1	1	1	1	7
	Lot no.			001			002		003	004	005	006	007	
Materials arrival plans														
A21	Qty'(lot)		1			1		1	1	1	1	1		7
	Lot no.		001			002		003	004	005	006	007		

The lead time from issuing P/O of materials to finished good shipment was 150 days as exhibited in Figure 2. This lead time consists of purchasing lead time 90 days and production lead time 60 days.

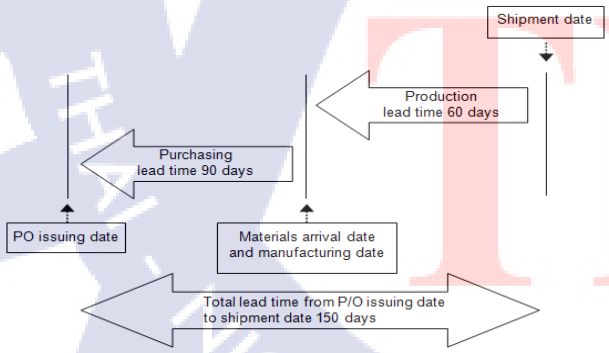

Figure 2: Total Lead Time of the 2nd Method

Safety stock calculation was derived from average lot quantity per shipment of every packing style for 12 months. Safety stock was not calculated from production per month because all packing styles were not manufactured every month. If the change of shipment occurs, PD1 will have high risk of material shortage. The equation was shown below. Quantity of safety stock of all packing styles was shown in Table 5.

For the Second method, the shortage problem was not found in the evaluation. The shortage risk reduces from safety stock, which was the buffer. But the average inventory value per month was very high (34,663,333 Baht). The average inventory value was displayed in Table 6.

Table 5: Safety Stock of Each Packing Style

Packing style	Total quantity per year (lot)	Shipment (time)	Average quantity per shipment (safety stock, lot/time)
A21	7	7	1
A22	2	2	1
A23	6	6	1
A24	3	3	1
A25	6	6	1
A26	2	2	1
A51	18	6	3
A52	4	2	2
A53	35	7	5
A54	11	3	4
A55	19	3	7
A56	6	4	2
A91	6	3	2
B31	2	1	2
B32	3	2	2
B51	3	3	1
B52	5	4	2
B53	10	4	3
B54	3	3	1

Table 6: Materials Inventory of the 2nd Method and Average Value of 6 Months

Group	MAY'14	JUNE'14	JULY'14	AUG'14	SEP'14	OCT'14	Average* (Baht)
A2	3,900,000	3,900,000	3,900,000	3,900,000	3,900,000	4,460,000	3,993,333
A5	9,260,000	11,600,000	9,260,000	12,020,000	9,260,000	15,980,000	11,230,000
A9	1,220,000	1,220,000	1,220,000	1,220,000	1,220,000	1,220,000	1,220,000
B3	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000
B5	15,270,000	18,340,000	12,330,000	18,340,000	5,760,000	21,280,000	15,220,000
Total	32,650,000	38,060,000	29,710,000	38,480,000	23,140,000	45,940,000	34,663,333

2) Comparison between 2 methods, conclusion of results and set alternative method

Shortage of materials

Shortage of materials was found for the 1st method of B53 for 2 lots, because these 2 lots produced before finished goods shipment 4 months. But shortage of materials was not found in 2 methods.

Amount of inventory

The average amount per month values of the first method and the second method were 13,090,000 and 34,663,333, respectively. The average amount of the second method was higher than the first method almost 3 times.

For the first method, production information must be reflected to procurement in time, if PD1 need to manufacture product before 3 months of shipment. It could reduce materials shortage. The second method could produce lower risk of material shortage because safety stock was buffer. But the average inventory amount was quite high. The high inventory amount comes from safety stock. Then calucation of optimum safety stock must be redone to reduce the level of inventory.

3) Evaluation of alternative methods

From the evaluation above, the second method was chosen for evaluation with a new level of safety stock. And this method was named as the third method. The safety stock of each group was recalculated.

3.1) Advance arrival of materials before shipment date 60 days and safety stock of level 2 for each group and safety stock of level 1 for each packing style (System production lead time 60 days, no consideration of actual MPS).

The safety stock was divided into 2 categories. The first category was raw materials, which were the ingredients to manufacture core tablets. The second category was packing materials for each packing style. As description of BOM, all packing styles in the same groups will be produced by same core tablets. The safety stock was calculated from same equation as the second method. But average quantities per shipment of each group core tablets were added. Except group A9 that has only 1 packing style (A91). Table 7 exhibits recalculation of safety stock of both categories. Materials arrival date was 60 days before shipment same as the second method.

Table 7: Recalculation of Safety Stock of 2 Categories (Raw Materials and Packaging Materials)

	Packing style	Total quantity per year (lot)	Shipment (time)	Average quantity per shipment (safety stock, lot/time)
Raw materials	A2	26	12	3
	A5	93	11	9
	B3	5	2	3
	B5	21	7	3
Packaging materials	A21	7	7	1
	A22	2	2	1
	A23	6	6	1
	A24	3	3	1
	A25	6	6	1
	A26	2	2	1
	A51	18	6	3
	A52	4	2	2
	A53	35	7	5
	A54	11	3	4
	A55	19	3	7
	A56	6	4	2
	A91	6	3	2
	B31	2	1	2
	B32	3	2	2
	B51	3	3	1
	B52	5	4	2
	B53	10	4	3
	B54	3	3	1

Table 8: Materials Inventory of the 3rd Method and Average Value of 6 Months

Group	MAY'14	JUNE'14	JULY'14	AUG'14	SEP'14	OCT'14	Average* (Baht)
A2	2,820,000	2,820,000	2,820,000	2,820,000	2,820,000	3,380,000	2,913,333
A5	5,200,000	7,540,000	5,200,000	7,960,000	5,200,000	11,920,000	7,170,000
A9	1,220,000	1,220,000	1,220,000	1,220,000	1,220,000	1,220,000	1,220,000
B3	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000
B5	5,270,000	8,340,000	2,330,000	8,340,000	760,000	11,280,000	6,053,333
Total	17,210,000	22,620,000	14,270,000	23,040,000	12,700,000	30,500,000	20,056,667

Remark: *Average inventory value of 6 months in Thai Baht.

The materials average value per 6 months was reduced after re calculation of safety stock as shown in Table 8. But shortage of raw materials was found in B5 core tablets (Table 9). It shows that the reduction of buffer stock has an effect on shortage of materials. And this problem also came from the material arrival setting does not relate to production schedule. Then, the next method of evaluation needs to consider production schedule.

Table 9: Result from Evaluation of Core Tablets B5 for the 3rd Method

Core tablets	Item	MAY'14	JUNE'14	JULY'14	AUG'14	SEP'14	OCT'14
B5	B/F* stock	3	1	2	0	2	-2
2,500,000	Use	2	2	4	1	5	2
Baht/lot	Receive	0	3	2	3	1	7
	C/F** stock	1	2	0	2	-2	3
	Amount	2,500,000	5,000,000	0	5,000,000	-5,000,000	7,500,000
B5	B/F* stock	3	1	2	0	2	0
2,500,000	Use	2	2	4	1	5	2
Baht/lot	Receive	0	3	2	3	3	5
(adjust)	C/F** stock	1	2	0	2	0	3
	Amount	2,500,000	5,000,000	0	5,000,000	0	7,500,000

Remark: *B/F is brought forward

**C/F is carry forward

3.2) Recalculation of safety stock by categorized raw material and arrival of materials in the first day of production month Safety stock would be calculated the same as the third method. But the materials arrival correlates to production schedule. The example of export shipment, production plan, and material arrival of product A51 was displayed in Table 10. PD1 would like to get materials for all lots, which were produced in this month, on the 1st day of manufacturing month. PD1 has to set supposition manufacturing date of all lots to be the 1st day of month as well, even if all lots was not manufacturing in the same day. For example, factory has to export product A51 lot no. 010-013 in September. A51 lot no. 010-012 was manufactured in August and the remaining 1 lot (lot no. 013) was manufactured in September. Then supposition manufacturing date of lot no 010-012 and 013 will be 1st August and 1st September, respectively. Materials of lot no. 010-013 will arrive in the same day of supposition manufacturing date. The lead time of P/O issuing until finished goods

was variation depend on supposition manufacturing date as shown in Figure 3.

Table 10: Example of the 4th Method Export Shipment and Materials Arrival Plan of Packing Style A51

Packing style	Item	2014												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (lot)
Export shipment														
A51	Qty'(lot)				2	2	2	3		4		5		18
	Lot no.				001-002	003-004	005-006	007-009		010-013		014-018		
Production plan														
A51	Qty'(lot)		2	2	1	1	3		3	1	5			18
	Lot no.		001-002	003-004	005	006	007-009		010-012	013	014-018			
Materials arrival plan														
A51	Qty'(lot)		2	2	1	1	3		3	1	5			18
	Lot no.		001-002	003-004	005	006	007-009		010-012	013	014-018			

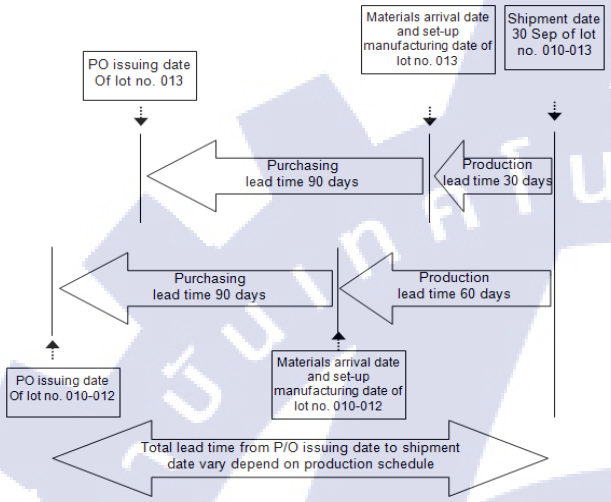

Figure 3: Total Lead Time of the 4th Method

The evaluation result was display in Table 11. Average inventory value (23,220,000 baht) was higher than the third method approximately 15%. But the shortage of materials and materials stock fluctuation were not found in 6 months. If the production and ordering was stable according to the plan, quantity of safety stock could be reduced in order to reduce materials inventory value as well.

Table 11: Materials Inventory of the 4th Method and Average Value of 6 Months

Group	MAY'14	JUNE'14	JULY'14	AUG'14	SEP'14	OCT'14	Average*
A2	2,820,000	2,820,000	2,820,000	2,820,000	2,820,000	2,820,000	2,820,000
A5	5,200,000	5,200,000	5,200,000	5,200,000	5,200,000	5,200,000	5,200,000
A9	1,220,000	1,220,000	1,220,000	1,220,000	1,220,000	1,220,000	1,220,000
B3	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000
B5	11,280,000	11,280,000	11,280,000	11,280,000	11,280,000	11,280,000	11,280,000
Total	23,220,000	23,220,000	23,220,000	23,220,000	23,220,000	23,220,000	23,220,000

Remark: *Average inventory value of 6 months in Thai Baht.

4. Conclusion

The study found that no shortage of raw materials in the 2nd and the 4th method, but the 1st method and the 3rd method were found shortage. The averages of six-month inventory values of the 1st method to the 4th method were 13,090,000 Baht, 34663,333 Baht, 20,056,667 Baht, and 23,220,000 Baht, respectively. The most preferable method was the 4th method. The actual production scheduling was an important tool for material ordering. A safety stock has an important role to prevent the shortage of materials.

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