AN INVENTORY FOR LONG-LEAD-TIME RAW MATERIALS AT SIAM PATKOL

by

Ms. Kulaporn Lumnaokrut

A Final Report of the Three - Credit Course
CE 6998 Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in Computer and Engineering Management
Assumption University

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Name	Ms. Kulaporn Lumnaokrut
Project Advisor	Mr. Smith Tungkasmit
Academic Year	July 2001

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Approval Committee:

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Advisor

Z
(Prof Dr. Srisakdi Charmonman)
Chairman

(Dr. Chamnong J ngdrapanich)
Dean and Co-advisor

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ABSTRACT

This project examines the development of an inventory model for the long-lead-time raw materials of Siam Patkol Co., Ltd.

Siam Patkol Co., Ltd. was established in 1990, with a registered capital of 250 million bahts. Its production facility is located on Onnuch-Ladkrabang Rd., Bangkok. At present, the company has a production capacity of 20,000 commercial freezers per year.

Generally known, reasonable inventory of raw materials is essential for a smooth operation and competitiveness. In current economic crisis, our executives are seriously concerned about the excessive raw material inventory levels. There are a large number of raw materials used in the production. If we stock all items, inventory costs will be extremely high. After the executives' considerations, some of the raw materials, which have long lead time, will be stocked. The others will not be stocked and will be acquired only after potential customer order.

In this project, the inventory model for the long-lead-time inventory was developed. All steps of developing the inventory model are as follows:

(1) To collect the related information of all raw materials.

(2) To define the long-lead-time criticality of the raw materials.

(3) To develop inventory model for the defined long-lead-time raw materials.

After the inventory model had been developed, the inventory items of raw materials and also cost of inventory were reduced. Moreover, further recommendations for maintaining the good inventory and improving the inventory related business process was introduced.

ACKNOWLEDGEMENTS

I am indebted to the following people and organizations. Without them, this project would not have been possible.

I wish to express my sincere gratitude to my advisor, Mr. Smith Tungkasmit. His patient assistance, guidance, and constant encouragement has led me from the research inception to research completion.

I would like to thank Mr. Raksan Chotiphong (Engineering Manager of Siam Patkol Co., Ltd.) for his guidance and allowing me to develop this project. Furthermore, I would like to thank the staff at the Planning Department for providing me with important information.

Special appreciation is due to my family for their fervent and continuous encouragement. Above all, I am forever grateful to my parent whose willingness to invest in my future has enabled me to achieve my educational goal.

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I. INTRODUCTION

Siam Patkol Company Limited has been greatly concerned about the excessive raw material inventory levels and has decided to develop an inventory model for long-lead-time raw materials in the warehouse. Recently, the inventory cost is around 40 million bahts, which is considered too high. Siam Patkol Company Limited would like to reduce the inventory cost and, at the same time, to be nimble enough to react quickly to changes in customer demand. Therefore, reasonable inventory of raw materials has to be developed for a smooth operation and competitiveness.

1.1 Background of Company

Siam Patkol Company Limited is one of the members in Patkol group of companies. Patkol Public Company Limited was established in November, 1963 under the name PATANAKOLKARN by the Chongvatana family members. Since then the company has experienced steady progress and development, including many increases in its registered capital with the latest on March, 1993 when the company was registered as a public company limited and listed in the Stock Exchange of Thailand (SET) with a registered capital of 106 million Bahts. At present, the company is a leader in engineering, designing, manufacturing, and installing complete machinery and equipment for food industry including tube ice plants, block ice plants, poultry and slaughter house plants, frozen and cold storage plants, dairy products industry, ice cream plants, **and** almost all types of modern food processing industries both for local and international markets.

Focussed on producing high quality products, the companies has introduced many new technologies and methodologies to help design and manufacture products to match recognized engineering standards, thus, comply with customer's requirement, and be convenient for installation and operation. In addition the company places importance on maintaining satisfactory After-Sales-Service through its efficient service team managed by experience and expert engineers, all of which contribute to increasing trust and reliability of its products being awarded the 1999 Prime Minister Industry Award for designing its own products, which is a source of great honor and pride for Patkol Public Company Limited. This is regarded as a reward for the continuous devotion to the company's business since its establishment to its present state as a widely recognized company for the quality design products under the brand name: PATKOL. The vision of its management to continuously strive for a leading position in the quality and service of all products designed and manufactured by Patkol is a guarantee that the company will continue to grow and progress successfully.

It is forecast that the high growth rate of the ice cream business in Thailand and the Asia Pacific region is expected to continue into the future, leading to a substantial increase in the demand for ice cream freezers by ice cream manufacturers. Usually, a large number of these freezers must be imported, resulting in a loss of foreign exchange each year. In 1995, to help reduce import of freezers, Patkol Public Company Limited obtained the license for designing and manufacturing ice cream freezers from AHT-Austria Haustechnik AG, a world leading manufacturer of this kind of product. With a good cooperation between the two companies, Siam Patkol business has prospered on a continued basis in spite of the economic crisis in 1997.

Siam Patkol Company Limited was established in 1990 with a registered capital of 250 million Bahts. Its production facility of 50 rais is located on Onnuch-Ladkrabang Road, Bangkok. At present, the company has 220 staffs, and a production capacity of 20,000 commercial freezers per year. Currently, Siam Patkol offers a wide variety of freezers capable of responding to market demand. Our products are widely recognized for their durability, attractiveness, energy saving, and ease of use.

List of our products is:

(1) AHT Ice Cream Freezers

(2) PATKOL Beverage Coolers

(3) PATKOL Ice Packs

(4) PATKOL Shelf Contact Freezers

The key to Siam Patkol's success includes several factors such as its long experience and expertise in refrigeration engineering, production standards transferred from AHT, selection of high quality raw materials, and stringent quality control at each stage of work. Combined, they all contribute to the market's wide recognition of Siam Patkol products as being of the highest quality. To help maintaining its position in the freezer industry, the company is now capable of achieving speedy delivery due to its ability to adjust the production process to increase production quantity in response to demand.

At present, Siam Patkol is in the forefront of Thailand's market with over 50 percent of market share, and wide recognition from leading customers, because Siam Patkol's products are durable, modern looking, energy saving, easy to maintenance and attaining standard certified by the multi national companies.

1.2 Excessive Inventory **Problem**

Generally known, companies today must be fast and nimble enough to react quickly to changes in customer demand and do with little inventory. Availability of inventory can eliminate delays in supplying customers. Forecasts are seldom fully accurate, so extra inventory helps a company to meet unanticipated demand. The situation is the same for our company. Our customers do not like to wait for a product to be back-ordered, and often they will not tolerate a delay. They may revise their requirements or acquire the item from a competitor if it is not available in time. As a result, the company misses a sale and loses the profit it would have made. Therefore, reasonable inventory of raw materials is essential for a smooth operation and competitiveness. However, especially in current economic crisis, our executives are seriously concerned about the excessive raw material inventory levels. There are a large number of raw materials used in production. If we stock all items, inventory costs will be extremely high. After the executives' considerations, some of the raw materials, which have long lead time, will be stocked. The others will not be stocked and will be acquired only after potential customer order.

1.3 Research Objectives

In this research, we will focus only on the long-lead-time raw materials. These raw materials may be extremely important because it may effect the company in terms of smooth operation or quick response to customer need. So, the company will stock the long-lead-time raw materials in the warehouse to protect the productivity of the plant.

The objective for this research is to develop an inventory model of long-lead-time raw materials that minimize the cost of inventory.

1.4 Scope of Research

The scope of this research is to analyze the raw materials, identify long-lead-time parts that will be stocked, and make optimum inventory of these raw materials.

1.5 Benefits of Research

The benefits of this research are the effective inventory model and minimum stock for long-lead-time raw materials. The cost of inventory will be reduced.

1.6 Project Plan

Table 1.1. Project Plan.

Item	Description	Duration	Date
1	Study and set criteria of long-lead-time	4 days	21/05/01-24/05/01
2	Analyze and identify long-lead-time raw materials	12 days	25/05/01-05/06/01
3	Study inventory model	3 days	06/06/01-08/06/01
4	Set inventory model for long-lead-time raw materials	3 days	09/06/01-11/06/01
5	Define minimum stock of long-lead-time raw materials	7 days	12/06/01-18/06/01
6	Conclude and prepare the report	4 days	19/06/01-22/06/01
7	Submit the project	1 day	23/06/01
8	Approve the project	7 days	24/06/01-30/06/01
9	Presentation	1 day	29/07/01

II. LITERATURE REVIEW

In this chapter, we will introduce the method of long-lead-time assessment and the concept in developing the effective inventory model.

2.1 Long-lead-time Assessment

Lead time is the amount of time from the point at which you determine the need to order to the point at which the inventory is on hand and available for use. It should include vendor or manufacturing lead time, time to initiate the purchase order or work order including approval steps, time to notify the vendor, and the time to process through receiving and any inspection operations.

Companies hold inventory for a variety of reasons, one of which is mentioned here. Inventories of finished goods or finished subassemblies may be held so the company can respond to customer demand in less than the lead time required to obtain the inputs and produce the products. Inventories of inputs protect a company against interruptions of supply due to strikes, weather, or other natural disasters. Companies now try to deal with reliable suppliers who are nearby to reduce this risk, instead of just looking for the supplier with the lowest price.

At Siam Patkol, there are a large number of raw materials used in production. If we stock all items, inventory costs will be extremely high. Therefore, some of the raw materials, which have long lead time, will be stocked. The others will not be stocked and will be acquired only after potential customer order.

In this study, we will use the lead time criticality assessment, which is the method that assesses the raw materials by using two parameters for assessment — lead time level and probability of shortage. After the raw materials have already been assessed, it would find which raw materials are important or negligible to be stocked.

2.1.1 Lead Time Criticality Assessment

Lead Time Criticality is defined as the combination of two parameters, lead time level and probability of shortage, and is presented in the form of 2*3 matrix.

The criteria for lead time level takes account of reasonable span of raw materials lead time. The probability of shortage is assessed using relevant information from the warehouse and purchasing department records.

The lead time level and the probability of shortage are sub-divided into 2 categories, composed of "Low", "High", and 3 categories, composed of "Low", "Medium", "High", respectively. The lead time criticality matrix (please see lead time criticality matrix at Figure 2.1), in which the criticality rating is determined by combining the two parameters - lead time level and probability of shortage, comprises 5 levels composed of Extreme(E), High(H), Medium(M), Low(L), and Negligible(N). In order to guarantee the smooth operation and quick response to customer demand, we will stock all the raw materials in E, H, M, and L level, but the raw materials in N level will not be stocked and will be acquired only after potential customer order.

Lead Time Level

High	M	H	E
Low	N	L	M
	Low	Medium,.	High •

Probability of Shortage

When

	Criticality	Action,
E	Extreme	Will stock
H	High	Will stock
M	Medium	Will stock
L	Low	Will stock
N	Negligible	Will not stock

Figure 2.1. Lead Time Criticality Matrix.

2.1.2 How to Get the Lead Time Level?

Lead Time Level is the level of lead time span. If the lead time level is so high, this raw material may be extremely critical because it may effect the company in terms of smooth operation or quick response to customer need.

The criteria to determine lead time level was conducted by ad hoc team comprised of key persons from every department: Sales and Marketing, Purchasing, Warehouse, Production, and Engineering. Overall, lead time level is based on either our product lead time satisfied by customers or our production capacity.

Eventually, the criteria for lead time level is described as the following table.

Table 2.1. Lead Time Level.

Lead Time Span	Rank
Greater than two weeks.	H
Equal to or less than two weeks.	L

2.1.3 How to Get the Probability of Shortage?

The probability of shortage is the chance of shortage of raw materials to be occurred during the latest-one-year period by using relevant information from the warehouse and purchasing department records. Remarkably, the shortage events concerned in this study are significantly from delay or missed delivery of suppliers.

The probability of shortage rating is assessed by using a set of rules as described in the following table.

Table 2.2. Shortage Probability Level.

Shortage Probability Level	Rank
Greater than 20%	H
Greater than 10% and less than 20%	M
Less than 10%	L

2.2 Managing Inventory

Inventories are neither totally good nor totally bad. Many of the problems of running out of materials and products are obvious. Many of the problems of having too much inventory are less obvious, which is the reason why companies sometimes carry more than they need. Too much inventory causes excessive holding costs, extra space requirements, and product obsolescence, and it hides other problems the company should find and solve. However, not having at least a certain amount of inventory also costs money. As a company increases its inventory, some costs increase, other costs decrease, and still other costs are unaffected. Therefore, the decision as to the best size of an order is seldom obvious. The best lot size will result in adequate inventory to reduce some costs, yet will not be so large that it results in needless expenses for holding inventory. A compromise must be made between conflicting costs.

The nature of the inventory problem consists of repeatedly placing and receiving orders of given sizes at set intervals. From this standpoint, an inventory policy answers the following two questions:

(1) How much to order?

(2) When to order?

The answer to the first question determines the economic order quantity (EOQ) by minimizing the following cost model:

(Total Inventory Cost) = (Purchasing Cost) + (Setup Cost) + (Holding Cost)

+ (Shortage Cost)

All these costs must be expressed in terms of desired order quantity and the time between orders:

(1) Purchasing cost is based on the price per unit of the item. It may be constant, or it may be offered at a discount that depends on the size of the order.

(2) Setup cost represents the fixed charge incurred when an order is placed. This cost is independent of the size of the order.

(3) Holding cost represents the cost of maintaining the inventory in stock. It includes the interest on capital as well as the cost of storage, maintenance, and handling.

(4) Shortage cost is the penalty incurred when we run out of stock. It includes potential loss of income as well as the more subjective cost of loss in customer's goodwill.

The answer to the second question (when to order?) depends on the type of inventory system with which we are dealing. If the system requires periodic review (e.g., every week or month), the time for receiving a new order coincides with the start of each period. Alternatively, if the system is based on continuous review, new orders are placed when the inventory level drops to a pre-specified level, called the reorder point.

2.3 The Basic Economic Order Quantity Model

The economic order quantity (EOQ) model provides assistance in reaching a decision when the conditions are appropriate for its use. EOQ is essentially an accounting formula that determines the point at which the combination of setup costs and inventory holding costs are the least. The results are the most cost effective quantity to order. In purchasing this is known as the order quantity, in manufacturing it is known as the production lot size.

The basic EOQ model is applicable to a procurement situation in which an item is purchased from another company. This EOQ model is based on several conditions or assumptions:

(1) The use rate is uniform and known (that is, constant demand).

(2) The item cost does not vary with the order size (that is, no quantity discounts).

(3) All the order is delivered at the same time (that is, no back-order conditions).

(4) The lead time is known well enough that an order can be timed to arrive when inventory is exhausted (that is, minimum inventory is zero, but no shortage occurs).

(5) The cost to place and receive an order is the same regardless of the amount ordered.

(6) The cost of holding inventory is a linear function of the number of items held (that is, no economies of scale in holding cost).

The problem is deterministic-that is, there is no uncertainty or probability to consider-when these conditions are met. Some of these assumptions differ from the typical real-world situation.

While EOQ may not apply to every inventory situation, most organizations will find it beneficial in at least some aspect of their operation. Anytime you have repetitive purchasing or planning of an item, EOQ should be considered. Obvious applications for EOQ are Purchase-to-stock distributors and Make-to-stock manufacturers; however, make-to-order manufacturers should also consider EOQ when they have multiple orders or release dates for the same items and when planning components and sub-assemblies. Repetitive buy maintenance, repair, and operating (MRO) inventory is also a good application for EOQ. Though EOQ is generally recommended in operations where demand is relatively steady, items with demand variability such as seasonality can still use the model by going to shorter time periods for the EOQ calculation. Just make sure your usage and carrying costs are based on the same time period. The objective of the EOQ is to minimize the total annual cost of inventory factors for the item under consideration.

The simplest of the inventory models involves constant rate demand with instantaneous order replenishment and no shortage. Let:

Order quantity (number of units)

Demand rate (units per unit time)

to = Ordering cycle length (time units)

An order of size y units is placed and received instantaneously when the inventory level is zero. The stock is then depleted uniformly at the constant demand rate D. The ordering cycle for this pattern is:

to = y/D time units

The resulting average inventory level is given as:

Average inventory level = y/2 units

The cost model requires two cost parameters.

Setup cost associated with the placement of an order (cost per order). Also known as purchase cost or Order cost, this is the sum of the fixed costs that are incurred each time an item is ordered. These costs are not associated with the quantity ordered but primarily with physical activities required to process the order. For the most part Setup cost is primarily the labor associated with processing the order; however, you can include the other costs such as the costs of phone calls, faxes, postage, envelopes, etc.

Holding cost (cost per inventory unit per unit time). Also called Carrying cost, holding cost is the cost associated with having inventory on hand. It is primarily made up of the costs associated with the inventory investment and storage cost. For the purpose of the EOQ calculation, if the cost does not change based upon the quantity of inventory on hand it should not be included in holding cost. The primary components of holding cost are interest, insurance, taxes, and storage costs.

The total cost per unit (TCU) is thus computed as:

TCU(y) = Setup cost per unit time + Holding cost per unit time

Setup cost + Holding cost per cycle t_o / t_o

$K + h(y/2)\, t_o) / t_o$

The optimum value of the order quantity y is determined by minimizing TCU(y) with respect to y. Assuming y is continuous, a necessary condition for finding the optimal value of y is:

$$dTCU\,(y)/\,dy = -KD/y^2 + h/2 = 0$$

The condition is also sufficient because TCU(y) is convex. The solution of the equation yields the EOQ y* as:

$$y^* = Sqrt\,(2KD/h)$$

The optimum inventory policy for the proposed model is summarized as:

Order y* = Sqrt (2KD/h) units every $t_0^* = y^*/D$ time units

Actually, a new order needs not be received at the instant it is ordered as the preceding discussion suggests. Instead, a positive lead-time, *L*, may occur between the placement and the receipt of an order. In this case, the reorder point occurs when the inventory level drops to LD units.

On the other hand, if the lead time L is more than the cycle length t_0^*, we will define the *effective* lead time as:

$$L_e = L - nt_0^*$$

Where *n* is the largest integer not exceeding L / t_0^*. This result is justified because after n cycles of t_0^* each, the inventory situation acts as if the interval between placing an order and receiving another were L_e. Thus, the reorder point occurs at L_eD units, and the inventory policy can be resulted as order the quantity y* whenever the inventory level drops to L_eD units.

III. AN INVENTORY MODEL FOR LONG-LEAD-TIME RAW MATERIALS AT SIAM PATKOL

3.1 An Introduction

There are 1,279 items of raw materials at Siam Patkol. The cost of raw material inventory is around 40 million bahts. This cost is considered too high. Our management would like to reduce this inventory cost and, at the same time, be nimble enough to react quickly towards a customer demand for a smooth operation. Therefore, proper inventory of raw materials has to be developed.

In this chapter, the inventory of long-lead-time raw materials will be focused, and inventory model of the defined items will be developed in order to minimize the inventory cost.

3.2 The Lead Time Criticality Assessment of Raw Materials

Lead time criticality is defined as the combination of two parameters, lead time level and probability of shortage, and is presented in the form of 2*3 matrix. Therefore, the lead time level, the probability of shortage, and the result of lead time criticality assessment can be defined as the following table. However, because of a very long list of more than one thousand items of raw materials, the following Table 3.1. will show only the item in E, H, M, and L level of lead time criticality rating, which will be stocked. The item in N level, which will be ignored, will not be listed in the following table.

Table 3.1. Lead Time Criticality Assessment for Raw Materials.

Item	Part No.	Lead Time Level	Probability of Shortage	LT Criticality Rating
1	000-1100011	H	H	E

Table 3.1. Lead Time Criticality Assessment for Raw Materials. (Continued)

Item	**Part** No.	**Lead Time Level**	**Probability of Shortage**	**LT Criticality Rating**
2	000-1100021	H	L	M
3	000-1200021	L	H	M
4	000-1200051	H	L	M
5	000-1200061	L	M	L
6	000-1200132	H	H	E
7	000-1200142	H	L	M
8	000-1200162	L	H	M
9	000-1200172	H	H	E
10	000-1300011	L	M	L
11	000-1300021	H	M	H
12	000-1300172	H	L	M
13	000-1300252	L	H	M
14	000-1300272	L	M	L
15	000-1300282	H	H	E
16	000-1300322	H	H	E
17	000-1300352	L	M	L
18	000-1400011	L	H	M
19	000-1400021	L	H	M
20	000-1400031	H	H	E
21	000-1400041	L	H	M
22	000-1401042	H	L	M
23	000-1601032	L	H	M
24	000-1700011	H	M	H
25	000-1700021	L	H	M

Table 3.1. Lead Time Criticality Assessment for Raw Materials. (Continued)

Item	**Part** No.	**Lead Time Level**	**Probability of Shortage**	**LT Criticality Rating**
26	000-9200011	H	H	E
27	000-9200021	L	H	M
28	000-9600011	**H**	**L**	M
29	000-9600021	L	M	L
30	000-9600041	H	H	E
31	000-9700011	L	M	L
32	010-1100321	H	L	M
33	010-1100752	H	H	E
34	010-1100762	H	L	M
35	010-1400362	L	M	L
36	010-1400821	H	M	H
37	010-1400831	H	H	E
38	010-1400832	L	H	M
39	010-1400841	H	H	E
40	010-1400842	L	M	L
41	010-1400851	H	L	M
42	010-1400852	L	H	M
43	010-1400861	H	H	E
44	010-1400871	H	M	H
45	010-1400872	H	L	M
46	010-1400881	H	M	H
47	010-1400882	L	H	M
48	010-1400891	H	H	E
49	010-1400892	L	M	L

Table 3.1. Lead Time Criticality Assessment for Raw Materials. (Continued)

Item	**Part** No.	**Lead Time Level**	**Probability of Shortage**	**LT Criticality Rating**
50	010-1400901	H	M	H
51	010-1400902	L	H	M
52	010-1400911	H	H	E
53	010-1400972	H	H	E
54	010-1400982	L	H	M
55	010-1400991	L	M	L
56	010-1401032	H	H	E
57	010-1401042	H	H	E
58	010-1401071	L	H	M
59	010-1401081	L	H	M
60	010-1401091	H	L	M
61	010-1401101	H	L	M
62	010-1401102	H	H	E
63	010-1401121	L	M	L
64	010-1401131	H	H	E
65	010-1401141	H	H	E
66	010-1401142	H	H	E
67	010-1401152	H	H	E
68	010-1401191	H	H	E
69	010-1401201	H	H	E
70	010-1401231	H	L	M
71	010-1401301	H	L	M
72	010-1401531	H	M	H
73	010-1401551	L	M	L

Table 3.1. Lead Time Criticality Assessment for Raw Materials. (Continued)

Item	Part No.	Lead Time Level	Probability of Shortage	LT Criticality Rating
74	010-1600971	L	H	M
75	010-1600981	L	H	M
76	010-1601022	H	M	H
77	010-1601031	H	H	E
78	010-1601091	H	M	H
79	010-1601101	L	H	M
80	010-1601111	H	H	E
81	010-1601121	**H**	**M**	H
82	010-1601141	H	H	E
83	010-1601151	H	M	H
84	010-1601191	L	M	L
85	010-1601201	H	L	M
86	010-1601211	H	M	H
87	010-1601221	L	H	M
88	010-1601231	L	M	L
89	010-1601241	L	H	M
90	010-1701381	H	M	H
91	010-1701391	H	H	E
92	010-1701851	L	H	M
93	010-1701902	H	H	E
94	010-1900021	H	H	E
95	010-1900031	H	L	M
96	010-1900041	L	H	M
97	010-1901531	L	H	M

Table 3.1. Lead Time Criticality Assessment for Raw Materials. (Continued)

Item	Part No.	Lead Time Level	Probability of Shortage	LT Criticality Rating
98	010-1901541	H	H	E
99	010-1901551	L	H	M
100	012-1100532	H	M	H
101	012-1500282	H	H	E
102	012-1500491	H	M	H
103	012-1500501	L	H	M
104	012-1500511	L	H	M
105	012-1500521	L	M	L
106	012-1500531	L	H	M
107	012-1500541	L	H	M
108	012-1500551	H	H	E
109	012-1500561	L	H	M
110	012-1701492	H	M	H
111	013-1100562	H	H	E
112	013-1500272	H	H	E
113	013-1500561	L	H	M
114	013-1500571	L	M	L
115	013-1500581	H	M	H
116	013-1500591	L	M	L
117	013-1500601	L	H	M
118	013-1500611	H	M	H
119	013-1500621	H	M	H
120	013-1500631	L	H	M
121	013-1600011	H	H	E

Table 3.1. Lead Time Criticality Assessment for Raw Materials. (Continued)

Item	Part No.	Lead Time Level	Probability of Shortage	LT Criticality Rating
122	013-1701522	L	H	M
123	014-1100652	H	M	H
124	014-1500262	H	L	M
125	014-1500272	H	H	E
126	014-1500571	H	H	E
127	014-1500581	L	M	L
128	014-1500591	H	H	E
129	014-1500601	H	M	H
130	014-1500611	H	L	M
131	014-1500621	H	L	M
132	014-1500631	H	H	E
133	014-1500641	H	H	E
134	014-1701572	L	H	M
135	014-3000201	H	H	E
136	015-1100622	L	M	L
137	015-1500512	H	L	M
138	015-1500581	H	M	H
139	015-1500591	H	H	E
140	015-1500601	L	M	L
141	015-1500611	L	H	M
142	015-1500621	H	H	E
143	015-1500631	H	H	E
144	015-1500641	H	M	H
145	015-1500651	H	M	H

Table 3.1. Lead Time Criticality Assessment for Raw Materials. (Continued)

Item	Part No.	Lead Time Level	Probability of Shortage	LT Criticality Rating
146	015-1600011	L	H	M
147	015-1701562	H	H	E
148	015-1701602	H	L	M
149	110-1500322	L	H	M
150	110-1500342	L	H	M
151	110-1500352	H	M	H
152	. 110-1600011	H	H	E
153	112-1600042	L	H	M
154	112-2004104	H	M	H
155	112-2004304	H	H	E
156	112-2004504	L	M	L
157	113-1600011	L	H	M
158	113-1600021	H	H	E
159	113-1600042	H	H	E
160	113-2003004	H	L	M
161	113-2500032	L	M	L
162	113-2500042	H	H	E
163	114-1600011	H	L	M
164	114-1600021	L	H	M
165	114-1600052	H	L	M
166	114-2003004	H	M	H
167	115-1600102	L	M	L
168	115-2003104	H	H	E
169	115-2100022	L	H	M

Table 3.1. Lead Time Criticality Assessment for Raw Materials. (Continued)

Item	Part No.	Lead Time Level	Probability of Shortage	LT Criticality Rating
170	120-1500302	L	H	M
171	120-1500312	L	H	M
172	120-1500332	H	H	E
173	120-1600161	H	H	E
174	120-1600171	L	M	L
175	122-1100522	H	L	M
176	122-1100532	L	M	L
177	122-1600111	L	M	L
178	122-1600121	H	H	E
179	122-2002101	L	H	M
180	122-2002201	H	M	H
181	122-2002301	L	M	L
182	122-2002401	H	M	H
183	122-2005504	H	H	E
184	122-2005804	L	H	M
185	123-1100662	L	H	M
186	123-1100672	H	H	E
187	123-1600121	H	H	E
188	123-1600131	L	H	M
189	123-2001401	H	L	M
190	123-2001501	H	M	H
191	123-2001601	L	M	L
192	123-2001701	L	M	L
193	123-2003304	H	L	M

Table 3.1. Lead Time Criticality Assessment for Raw Materials. (Continued)

Item	Part No.	Lead Time Level	Probability of Shortage	LT Criticality Rating
194	124-1100612	H	M	H
195	124-1100622	H	H	E
196	124-1600131	L	H	M
197	124-1600141	H	H	E
198	124-200] 401	H	M	H
199	124-2001501	H	M	H
200	124-2003404	H	M	H
201	125-1100702	H	H	E
202	125-1100712	L	H	M
203	125-1600141	L	H	M
204	125-1600151	L	M	L
205	125-2001401	H	H	E
206	125-2001501	L	M	L
207	125-2003304	L	H	M
208	131-1100202	H	L	M
209	131-1100222	H	H	E
210	131-1100282	H	H	E
211	131-1500032	H	L	M
212	131-1500042	H	M	H
213	131-1600202	H	H	E
214	131-1600252	L	H	M
215	131-1600322	H	L	M
216	131-1600332	H	L	M
217	131-1600382	H	L	M

Table 3.1. Lead Time Criticality Assessment for Raw Materials. (Continued)

Item	**Part No.**	**Lead Time Level**	**Probability of Shortage**	**LT Criticality Rating**
218	131-1600392	L	H	M
219	131-1600402	H	H	E
220	131-1700382	H	M	H
221	131-1700392	H	M	H
222	131-1700402	L	H	M
223	131-1700412	L	H	M
224	131-1700442	H	H	E
225	131-1700452	H	H	E
226	131-1700502	L	H	M
227	131-1700512	L	H	M
228	131-1700522	H	L	M
229	131-1700532	H	H	E
230	131-1700542	L	M	L
231	131-1700552	H	M	H
232	131-1700562	L	H	M
233	131-1700572	H	H	E
234	131-1700622	L	M	L
235	131-1700672	L	M	L
236	131-1700682	L	M	L
237	131-1700692	H	H	E
238	131-1700702	L	H	M
239	131-1700712	L	M	L
240	131-1700722	L	M	L
241	131-1700732	H	H	E

Table 3.1. Lead Time Criticality Assessment for Raw Materials. (Continued)

Item	**Part** No.	**Lead Time Level**	**Probability of Shortage**	**LT Criticality Rating**
242	131-1700742	H	M	H
243	131-1700772	L	M	L
244	131-1700782	L	M	L
245	131-1700792	L	M	L
246	131-1700822	L	H	M
247	131-1700852	H	L	M
248	131-1700912	L	H	M
249	131-1800032	L	H	M
250	131-2003301	H	L	M
251	142-2000121	H	H	E
252	143-1100422	H	H	E
253	143-1100432	L	M	L
254	143-1600102	L	H	M
255	143-1700112	H	**H**	E
256	143-1700122	L	H	M
257	143-1700162	L	H	M
258	143-1700172	L	M	L
259	153-1700102	H	H	E
260	153-2000104	H	H	E
261	153-2000204	L	M	L
262	153-2000604	H	H	E
263	153-2000804	H	L	M
264	153-2000904	H	M	**H**

Note: N = Negligible, L = Low, M = Medium, H = High, and E = Extreme

3.3 The Inventory Model of Long-lead-time Raw Materials

As the result of long lead time criticality assessment, it has been found that only 264 items of raw materials should be stocked.

From the basic EOQ inventory model, the defined items can be considered as the following examples:

Example 1: Part No. 000-1100011

From the company database:

K = Set up cost = 130 bahts per order

H = Holding Cost = 0.4 bahts per unit per week

D = Demand = 300 units per week

L = Lead Time = 3.5 weeks

Thus, the optimum order quantity is:

y* = sqrt (2KD / h) = sqrt (2*130*300 / 0.4) = 441.59, rounded up to = 442 units

The associated cycle length is:

*to** = y*/D = 442/300 = 1.47 weeks, which less than lead time (L), so we have to find effective lead time (L_e) as following:

*n = L / to** = 3.5/1.47 = 2.38, rounded down to = 2.

The associated effective lead time is:

$L_e = L - nto^*$ = 3.5 — 2*1.47 = 0.56

Thus, the reorder point is:

L_eD = 0.56*300 = 168 units

On the other hand, if the cycle length *to** is greater than the lead time (L), we can find the optimum inventory policy as following:

Example 2: Part No. 000-1200021

From the company database:

K = Set up cost = 130 bahts per order

h = Holding Cost = 0.3 bahts per unit per week

D = Demand = 76 units per week

L = Lead Time = 2 weeks

Thus, the optimum order quantity is:

y* = sqrt (2KD / h) = sqrt (2*130*76 / 0.3) = 256.65, rounded up to = 257 units

The associated cycle length is:

*to** = y*/D = 257/76 = 3.38 weeks, which greater than the lead time (L)

Thus, the reorder point is:

LD = 2*76 = 152 units

For the other defined long-lead-time raw materials, the inventory policy is shown in the following table:

Table 3.2. Inventory Model for Long-lead-time Raw Materials.

Item	**Part No.**	**Optimum Order (unit)**	**Reorder Level (unit)**
1	000-1100011	442	168
2	000-11.00021	417	216
3	000-1200021	257	152
4	000-1200051	625	276
5	000-1200061	625	450
6	000-1200132	434	252
7	000-1200142	434	252
8	000-1200162	226	114

Table 3.2. Inventory Model for Long-lead-time Raw Materials. (Continued)

Item	Part No.	Optimum Order (unit)	Reorder Level (unit)
9	000-1200172	578	321
10	000-1300011	1350	168
11	000-1300021	1264	486
12	000-1300172	1416	772
13	000-1300252	1000	128
14	000-1300272	226	152
15	000-1300282	448	7
16	000-1300322	617	99
17	000-1300352	708	420
18	000-1400011	280	42
19	000-1400021	280	42
20	000-1400031	245	67
21	000-1400041	241	120
22	000-1401042	21	7
23	000-1601032	37	9
24	000-1700011	1653	105
25	000-1700021	1307	294
26	000-9200011	250	87
27	000-9200021	218	210
28	000-9600011	548	61
29	000-9600021	638	450
30	000-9600041	510	390
31	000-9700011	2793	600
32	010-1100321	513	27

Table 3.2. Inventory Model for Long-lead-time Raw Materials. (Continued)

Item	Part No.	Optimum Order (unit)	Reorder Level (unit)
33	010-1100752	388	143
34	010-1100762	373	174
35	010-1400362	167	135
36	010-1400821	59	16
37	010-1400831	25	3
38	010-1400832	293	235
39	010-1400841	66	9
40	010-1400842	109	57
41	010-1400851	28	4
42	010-1400852	174	113
43	010-1400861	20	20
44	010-1400871	20	20
45	010-1400872	110	66
46	010-1400881	21	19
47	010-1400882	110	45
48	010-1400891	23	18
49	010-1400892	100	45
50	010-1400901	18	13
51	010-1400902	90	45
52	010-1400911	23	19
53	010-1400972	100	66
54	010-1400982	97	35
55	010-1400991	300	39
56	010-1401032	24	8

Table 3.2. Inventory Model for Long-lead-time Raw Materials. (Continued)

Item	**Part No.**	**Optimum Order (unit)**	**Reorder Level (unit)**
57	010-1401042	24	8
58	010-1401071	167	150
59	010-1401081	205	22
60	010-1401091	158	67
61	010-1401101	174	51
62	010-1401102	17	2
63	010-1401121	140	40
64	010-1401131	249	39
65	010-1401141	23	18
66	010-1401142	21	6
67	010-1401152	21	6
68	010-1401191	27	9
69	010-1401201	27	9
70	010-1401231	20	20
71	010-1401301	21	12
72	010-1401531	20	20
73	010-1401551	14	4
74	010-1600971	272	181
75	010-1600981	272	181
76	010-1601022	663	390
77	010-1601031	955	190
78	010-1601091	585	469
79	010-1601101	676	526
80	010-1601111	558	495

Table 3.2. Inventory Model for Long-lead-time Raw Materials. (Continued)

Item	**Part No.**	**Optimum Order (unit)**	**Reorder Level (unit)**
81	010-1601121	585	469
82	010-1601141	676	377
83	010-1601151	585	469
84	010-1601191	617	526
85	010-1601201	585	469
86	010-1601211	585	469
87	010-1601221	617	526
88	010-1601231	676	526
89	010-1601241	755	526
90	010-1701381	585	469
91	010-1701391	325	74
92	010-1701851	297	229
93	010-1701902	574	479
94	010-1900021	105	48
95	010-1900031	105	76
96	010-1900041	111	90
97	010-1901531	353	174
98	010-1901541	341	27
99	010-1901551	123	27
100	012-1100532	39	6
101	012-1500282	24	21
102	012-1500491	32	14
103	012-1500501	31	30
104	012-1500511	29	2

Table 3.2. Inventory Model for Long-lead-time Raw Materials. (Continued)

Item	Part No.	Optimum Order (unit)	Reorder Level (unit)
105	012-1500521	30	30
106	012-1500531	31	30
107	012-1500541	31	30
108	012-1500551	30	15
109	012-1500561	30	30
110	012-1701492	35	11
111	013-1100562	37	8
112	013-1500272	23	23
113	013-1500561	30	30
114	013-1500571	30	30
115	013-1500581	29	17
116	013-1500591	29	2
117	013-1500601	30	30
118	013-1500611	29	17
119	013-1500621	29	17
120	013-1500631	29	2
121	013-1600011	323	252
122	013-1701522	33	30
123	014-1100652	33	12
124	014-1500262	22	1
125	014-1500272	22	1
126	014-1500571	28	17
127	014-1500581	29	2
128	014-1500591	39	6

Table 3.2. Inventory Model for Long-lead-time Raw Materials. (Continued)

Item	Part No.	Optimum Order (unit)	Reorder Level (unit)
129	014-1500601	29	17
130	014-1500611	28	17
131	014-1500621	28	17
132	014-1500631	27	18
133	014-1500641	28	17
134	014-1701572	40	6
135	014-3000201	20	6
136	015-1100622	41	6
137	015-1500512	21	3
138	015-1500581	27	18
139	015-1500591	28	17
140	015-1500601	28	2
141	015-1500611	28	2
142	015-1500621	27	18
143	015-1500631	26	20
144	015-1500641	27	18
145	015-1500651	27	18
146	015-1600011	295	12
147	015-1701562	38	32
148	015-1701602	34	1
149	110-1500322	35	30
150	110-1500342	33	30
151	110-1500352	33	12
152	110-1600011	187	180

Table 3.2. Inventory Model for Long-lead-time Raw Materials. (Continued)

Item	Part No.	Optimum Order (unit)	Reorder Level (unit)
153	112-1600042	71	26
154	112-2004104	45	45
155	112-2004304	32	14
156	112-2004504	39	23
157	113-1600011	56	23
158	113-1600021	59	45
159	113-1600042	68	8
160	113-2003004	31	14
161	113-2500032	28	26
162	113-2500042	28	17
163	114-1600011	54	45
164	114-1600021	55	30
165	114-1600052	65	11
166	114-2003004	29	17
167	115-1600102	60	26
168	115-2003104	28	17
169	115-2100022	58	30
170	120-1500302	33	30
171	120-1500312	35	30
172	120-1500332	33	12
173	120-1600161	99	75
174	120-1600171	99	26
175	122-1100522	57	45
176	122-1100532	52	30

Table 3.2. Inventory Model for Long-lead-time Raw Materials. (Continued)

Item	Part No.	Optimum Order (unit)	Reorder Level (unit)
177	122-1600111	119	26
178	122-1600121	119	75
179	122-2002101	40	30
180	122-2002201	40	5
181	122-2002301	40	30
182	122-2002401	40	5
183	122-2005504	41	5
184	122-2005804	32	30
185	123-1100662	54	30
186	123-1100672	49	45
187	123-1600121	106	75
188	123-1600131	106	26
189	123-2001401	37	8
190	123-2001501	37	8
191	123-2001601	37	30
192	123-2001701	37	30
193	123-2003304	31	14
194	124-1100612	53	45
195	124-1100622	49	45
196	124-1600131	97	26
197	124-1600141	97	75
198	124-2001401	37	8
199	124-2001501	37	8
200	124-2003404	29	17

Table 3.2. Inventory Model for Long-lead-time Raw Materials. (Continued)

Item	Part No.	Optimum Order (unit)	Reorder Level (unit)
201	125-1100702	52	45
202	125-1100712	47	30
203	125-1600141	85	26
204	125-1600151	85	26
205	125-2001401	35	11
206	125-2001501	35	30
207	125-2003304	28	2
208	131-1100202	2	1
209	131-1100222	23	23
210	131-1100282	44	2
211	131-1500032	67	27
212	131-1500042	44	20
213	131-1600202	96	91
214	131-1600252	128	61
215	131-1600322	355	209
216	131-1600332	185	97
217	131-1600382	124	4
218	131-1600392	103	38
219	131-1600402	307	282
220	131-1700382	28	2
221	131-1700392	27	4
222	131-1700402	42	38
223	131-1700412	46	38
224	131-1700442	251	32

Table 3.2. Inventory Model for Long-lead-time Raw Materials. (Continued)

Item	Part No.	Optimum Order (unit)	Reorder Level (unit)
225	131-1700452	307	282
226	131-1700502	30	8
227	131-1700512	44	38
228	131-1700522	27	4
229	131-1700532	31	27
230	131-1700542	46	38
231	131-1700552	27	4
232	131-1700562	48	38
233	131-1700572	50	8
234	131-1700622	217	188
235	131-1700672	30	8
236	131-1700682	44	38
237	131-1700692	27	4
238	131-1700702	48	38
239	131-1700712	30	8
240	131-1700722	45	38
241	131-1700732	27	4
242	131-1700742	49	8
243	131-1700772	46	38
244	131-1700782	48	38
245	131-1700792	50	38
246	131-1700822	48	38
247	131-1700852	355	282
248	131-1700912	45	38

Table 3.2. Inventory Model for Long-lead-time Raw Materials. (Continued)

Item	**Part,No.**	**Optimum Order (unit)**	**Reorder Level (unit)**
249	131-1800032	260	188
250	131-2003301	211	72
251	142-2000121	38	24
252	143-1100422	49	42
253	143-1100432	58	45
254	143-1600102	34	12
255	143-1700112	53	37
256	143-1700122	51	46
257	143-1700162	52	9
258	143-1700172	174	60
259	153-1700102	62	11
260	153-2000104	64	53
261	153-2000204	57	20
262	153-2000604	59	4
263	153-2000804	54	18
264	153-2000904	55	16

After the inventory model of long-lead-time raw materials of Siam Patkol has already been carried out by considering the lead time criticality, it has been found that the inventory items of raw materials can be reduced from 1,279 items to 264 items. Therefore, Siam Patkol can save around 16 million bahts from reducing the cost of inventory.

IV. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

The inventory model of long-lead-time raw materials of Siam Patkol has already been done. The inventory items of raw materials can be reduced from 1,279 items to 264 items. Therefore, Siam Patkol can save around 16 million bahts from reducing the cost of inventory. However, in making inventory model most effective, accurate product costs, activity costs, demand forecasts, history, and lead times are crucial.

While the calculation itself is fairly simple, the task of determining the correct data inputs to accurately represent your inventory and operation is a bit of a project. Exaggerated setup costs and holding costs are common mistakes made in EOQ calculations. Using all costs associated with your purchasing and receiving departments to calculate setup cost or using all costs associated with storage and material handling to calculate holding cost will give you highly inflated costs resulting in inaccurate results from your EOQ calculation.

As preparing to undertake this project, keep in mind that even though accuracy is crucial, small variances in the data inputs generally have very little effect on the outputs. For purchased items, these would include the cost to enter the Purchase Order and/or Requisition, any approval steps, the cost to process the receipt, incoming inspection, invoice processing and vendor payment, and in some cases a portion of the inbound freight may also be included in the setup cost. It is important to understand that these are costs associated with the frequency of the orders and not the quantities ordered.

Associating actual costs to the activities associated with setup cost is where an EOQ formula runs afoul. Do not make a list of all of the activities and then ask the people performing the activities "How long does it take you to do this?" The results of this type of measurement are rarely even close to accurate. It is more accurate to determine what percentage of time within the department is consumed performing the specific activities and multiplying this by the total labor costs for a certain time period (usually a month) and then dividing by the line items processed during that same period.

Moreover, holding cost is the cost associated with having inventory on hand. If the cost does not change based upon the quantity of inventory on hand, it should not be included in holding cost. One of the most important components in holding costs is storage costs. Mistakes in calculating storage costs are common in EOQ implementations. Generally companies take all costs associated with the warehouse and divide it by the average inventory to determine a storage cost percentage for the EOQ calculation. This tends to include costs that are not directly affected by the inventory levels and does not compensate for storage characteristics. Holding costs for the purpose of the BOO calculation should only include costs that are variable based upon inventory levels. Areas such as shipping/receiving and staging areas are usually not included in the storage calculations, however if you have to add an additional warehouse just for overflow inventory then you would include all areas of the second warehouse as well as freight and labor costs associated with moving the material between the warehouses.

A portion of the time spent on cycle counting should also be included in holding cost, remember to apply costs which change based upon changes to the average inventory level. So in cycle counting you would include the time spent physically counting and not the time spent filling out paperwork, data entry, and travel time between locations.

Other costs that can be included in holding cost are risk factors associated with obsolescence, damage, and theft. Do not factor in these costs unless they are a direct result of the inventory levels and are significant enough to change the results of the EOQ equation.

4.2 Recommendations

To monitor project results, it is recommended to run a simulation or use a representative sampling of items to determine the overall short term and long term effects the EOQ calculation will have on warehouse space, cash flow, and operations. If the projection shows inventory levels dropping and order frequency increasing, you may need to evaluate staffing, equipment, and process changes to handle the increased activity.

To maintain EOQ, the values for setup cost and holding cost should be evaluated at least once per year taking into account any changes in interest rates, storage costs, and operational costs.

The EOQ calculation is "Hard Science", if we have accurate inputs the output is absolutely the most cost-effective quantity to order based upon our current operational costs. To further increase inventory turns we will need to reduce the setup costs. E-procurement, vendor-managed inventories, bar coding, and vendor certification programs can reduce the costs associated with processing an order. Increasing forecast accuracy and reducing lead times which result in the ability to operate with reduced stock items can also reduce inventory levels.

Most of the senior executives who responded said that excessive inventory levels were a major concern for them. Some saw inventories as just a vehicle that absorbs massive amounts of cash while others understood that high inventories were also an indication of other serious problems. Also, the money unnecessarily tied up in inventory could be better spent elsewhere such as: new product development, expanded marketing and sales, modernization, reengineering, and debt reduction. Even though inventories are under constant analysis and manipulation, permanent inventory reduction opportunities go largely untapped as evidenced by the fact, most manufacturers consistently carry too much inventory. Yet, well-intentioned efforts to reduce inventory get only temporary results. Without effective business process changes, the organization can easily slip back to old ways with inventories (and costs) just climbing up again.

In some cases, too much inventory is a certain indicator that more serious and costly business process and system problems exist, which are very likely deeply rooted in the organization. Some of these problems include poor forecasting, inadequate product specifications, ineffective production scheduling, low quality, bottlenecks, long cycle times, product and process problems, high costs, poor vendors, and wrong performance. For instance, poor sales forecasts are often used to schedule vendors and production sometimes for months in advance. When actual customer demand is not what was forecasted, as is often the case, inventory quickly accumulates, salable throughput decreases, and customer service goes down. Then, the cycle just keeps repeating itself, further compounding cash flow, profit and service problems.

One of the major impediments to inventory reduction is the mistaken notion that just improved inventory management is all that is required to get the job done. The real culprits arc the inefficient business processes that cause excessive inventories to exist in the first place. For the most part, inventory excesses can only be significantly reduced or eliminated when the cross-functional business processes that cause the need for excessive inventory buffers to exist are fixed. It is futile to think inventories can be isolated and singularly managed. Inventories are the result of how well many cross-functional business processes really work.

Many companies limp along with well-intentioned, but ineffective approaches to their business process. As a result, management is often frustrated by the inability to solve the inventory and service dilemma once and for all. Therefore, the company will use the following self-assessment questions to help benchmark company's capabilities. These assessment questions are intended to assist executives to evaluate their circumstances and to identify potential improvement opportunities. One way in which to utilize these diagnostic questions is to have the entire management team:

(1) answer each question.

(2) meet and discuss each question that received one or more 'no' answers.

(3) outline the corrective action needs.

During step (1), as proceed through the diagnostic questions, should make appropriate notes about particular areas of concern. The notes could be very helpful during subsequent discussions and corrective action planning.

(1) Has every product a well-defined manufacturing and inventory deployment strategy?

(2) Have we clearly defined organizational accountability for the performance of each segment of inventory?

(3) Is our inventory record information real time and 99% plus accurate?

(4) Are our bills-of-material 100% accurate?

(5) Is our forecasting process and demand variability integrated with a service oriented inventory deployment strategy?

(6) Have we a comprehensive and effective Sales and Operations Planning process that is management's handle on sales, production and inventory plans?

(7) Do we start the assembly process without any material shortages?

(8) Have we a comprehensive and dynamic inventory performance monitoring system that pinpoints problems before they occur?

(9) Has the impact on service and inventory from cycle time reduction been properly analyzed and quantified?

(10) Have we mapped all processes clearly identifying value added and non-value added activities, bottlenecks, queues, cycle times, etc.?

(11) Have we specifically defined the barriers that prevent us from achieving increases in service and reductions in inventory and are actively removing the barriers?

(12) Have we organized and trained multi-functional teams that are aggressively working on relieving bottlenecks and improving flow and balance to achieve high velocity throughput?

(13) Have we decreased our manufacturing and vendor lead time by at least 50% over the past 3 years?

(14) Have our lot sizes and set-up times been reduced by at least 50% over the past 3 years?

(15) Have we reduced queues and work-in-process inventories by 50% or more over the past 3 years?

(16) Do our processes perform to a level where no inventory buffers are required?

(17) Have we agreements with key vendors for short cycle deliveries and mutually agreed upon goals for continuous improvement?

(18) Has our approach to supply base management each critical vendor's processes certified to a "no inspection required" status?

(19) Are our vendor delivery dates very predictable?

(20) Can we precisely predict our delivery lead time/date for customers or to replenish inventories?

(21) Have we an active on-going program for vendor delivered, point-of-use inventories?

(22) Do our production supervisors spend little to no time expediting materials or fire fighting due to parts or material shortages?

(23) Are our primary performance measurements and reward system heavily weighted toward short cycle times and quick response?

In fact, all yes answers would indicate that the company is in an elite class of top performing companies and more advanced than most. Of course, yes answers are only indicators of near and longer-term business success. However, no answers are solid indicators that improvements are necessary to help ensure business success.

Lastly, to evaluate past efforts at improving business processes and inventory performance, try the following:

(1) Make a list of every improvement program that company has initiated in the past five years where better customer service and inventory performance should have been a result.

(2) Then compare the expected results with the permanent and measurable results that were actually achieved.

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