IMPROVEMENT OF SUPPLIER DELIVERY LEAD TIME IN LOCAL PURCHASING SECTION SUPPLY CHAIN MANAGEMENT PT FREEPORT INDONESIA

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ABSTRACT
In the last quarter of 2008, the world faced global economic slowdown, copper tumbled below US$2 a pound for the first time since December 2005 on speculation that the world economy is headed for a recession that will reduce demand for metals. The situation forced Freeport to do some efforts to reduce production cost. President Directors of PT Freeport Indonesia announced his statement on company’s cost reduction, including in Supply Chain Management. Analysis for improvement in supplier lead time is an interesting study to reduce cost in Supply Chain Area. The faster the lead time, the lesser inventory level and value needed to cover the requirement and achieve required service level, and vice versa. Further analysis were performed to get an appropriate number and type of stock to be analyzed, and purchasing process for fast moving item stock class N and level A&B is selected as the best object of study in order to see the impact and correlation of improvement to inventory value. Six sigma framework (Define, Measure, Analyze, Improve, Control) is used to improve the existing business process. Major problems identified for the cases are unavailability of stock in supplier, additional order process, and late order information to supplier. The solutions for the problems were involving four aspects: Business process, Communication, Technology and People. The estimated cost reduction on inventory cost through improvement in supplier lead time should it meet the expected target is US$ 54,955, with increasing 10% in inventory turnover. However, integrated action of the implementation plan from the four aspects and support from management must be in place to ensure that the solutions will solve the problem in the long term.

Keywords: supplier lead time, inventory turnover, supply chain, six sigma

1. INTRODUCTION
The history of PT Freeport Indonesia existence in Indonesia goes back to the year 1936 when a Dutch geologist Jean Jacques Dozy found Erstberg Mountain in Papua with its rich mineral (copper and gold) contents; however the first contract of work (COW) with Government of Indonesia has just been signed off on 7th of April 1967. In the end of 2006, FCX (the mother company of PT Freeport Indonesia), acquired Phelps Dodge-a Phoenix Arizona based mining company-and makes FCX the second largest copper producer in the world. At the moment, PT Freeport Indonesia contributes about 40% of the total Freeport McMoRan revenue and plays significant role in the development of the local community in Papua Province and Indonesia in
general. The Grasberg mining complex is one of the world’s largest single producers of both copper and gold, and contains the largest recoverable reserves of copper and the largest single gold reserve in the world. Open-pit operations are expected to continue until mid-2015, at which time the Grasberg underground mining operations are scheduled to begin.

In November 2008, the world faced global economic slowdown, driving the price of copper below US$1.80 per pound. The situation forced Freeport to do some efforts to reduce production cost, President Directors of PT Freeport Indonesia announced his statement on company’s cost reduction. One of the points is a tighter control in materials usage.

Supply Chain Management, the biggest section in non-operational department, responded to this situation with making some strategies, with the focus are to reduce inventory and maximize purchasing and expediting effectiveness. Supply Chain Department manages purchasing for about US$ 1.2 million (year 2008) with inventory value stored nearly US$ 350 million (March 2009), 15 onsite warehouses are built to manage the physical materials. There are some ways to support the goal, in inventory side, it means a tighter inventory control, while in purchasing point of view, it is how to make a strategy to have a more efficient supply process in an optimum quality, cost and delivery time.

2. BUSINESS ISSUE
Supply chain management has a standard policy of 21 days delivery time (supplier lead time), this is set into the Ellipse Inventory system as guidance for all buyers and inventory controllers. However, in actual, it has never been achieved, table 1 shows supplier lead time from year 2006 to 2008.

Table 2 Supplier Lead Time for All Purchasing Types, Stocks and Location from 2006 to 2008 (in days)

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>3 Yrs Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOLA</td>
<td></td>
<td>35.2</td>
<td>32.9</td>
<td>32.1</td>
<td>33.4</td>
</tr>
<tr>
<td>Singapore</td>
<td></td>
<td>25.9</td>
<td>27.0</td>
<td>21.6</td>
<td>24.8</td>
</tr>
<tr>
<td>Cairns</td>
<td></td>
<td>30.7</td>
<td>30.8</td>
<td>26.2</td>
<td>29.3</td>
</tr>
<tr>
<td>Jkt&amp;Sby</td>
<td></td>
<td>37.2</td>
<td>41.6</td>
<td>35.7</td>
<td>38.2</td>
</tr>
<tr>
<td>Papua</td>
<td></td>
<td>35.7</td>
<td>31.8</td>
<td>28.5</td>
<td>32.0</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>32.9</td>
<td>32.8</td>
<td>28.8</td>
<td>31.5</td>
</tr>
</tbody>
</table>

This can be viewed as a problem as well as opportunity to improve efficiency and effectiveness of the system. With a number of demands of materials, lead time will impact the order frequency and inventory level. The faster the lead time, the lesser inventory value needed to cover the requirement. In the opposite, the longer and more uncertain the lead time, the more inventory and buffer stock needed to ensure that required service level will be achieved. Therefore, Lead time issue has been one most critical issue in supply chain optimization and the evaluation of lead time is become an interesting way to reduce inventory cost without hurting service level.

Further analysis is performed to find the best measurement that can best represent the alternative solutions proposed. Figure 1 present the result for lead time measurement for stock class N, level A&B, in all locations:

2
Figure 1 Breakdown of Supplier Lead Time by Location and Materials Grouping

Analysis of Business Situation
Factors that were primarily considered to be linked with supplier lead time in the company purchasing system are depicted in conceptual framework in figure 2.

Figure 2 Conceptual Framework
In brief, supplier’s capability is the ability to meet satisfactory quality, quantity, delivery, stock usage information is part of communication built between SCM buyers and suppliers, Information system comprised of interconnected components that collect, process, store data and distribute information, while Expediting related with routing and tracking.

**Process Capability Index**

To measure process capability of the process, capability index is calculated with equation:

$$C_{pk} = \min \left( \frac{X - LSL}{3\sigma}, \frac{USL - X}{3\sigma} \right)$$

The larger the ratio, the greater the potential for producing parts within tolerance from the specified process. A ratio that is greater than 1 indicates that the tolerance limit range is wider than the actual range of measurements. If the ratio is less than 1, then some parts will be out of tolerance. From data calculation, we get $Z_{LSL}$ is -0.345 and $Z_{USL}$ is -0.043 From the table of Standard normal distribution, we get that cumulative are for $Z= -0.345$ is 36.5% and cumulative area for $Z= -0.183$ is 48.3%. It means that the probability of the current process fall outside the lower specification is 36.5%, while the probability of the process fall outside the upper specification is 51.7% (1-48.3%). Thus, it can be concluded that the probability of the current process fall outside the LSL and USL limit is **88.2%**.

Figure 3 portrayed the normal distribution of current process compared with standard (not in exact scale):

![Figure 3 Normal Distribution of Current Process Compared with Standard](image)

**Root Cause Analysis**

Primary causes are observed from outstanding report followed up by two biggest suppliers with 67% purchase portion and it was found that the reasons are:

1. Unavailability of stock : 51%
2. Late order information : 15%
3. Order revision : 21%
4. Order information discrepancy : 7%
5. Internal supplier administration problem : 4%
6. Others : 2%

From the initial identification, an Issue Tree diagram is analyzed to find root cause of the problem. The diagram is depicted as follows:

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1 Fundamentals of Operation Management, p.271
Using the issue tree for process above for the top three issue that may represent 87% of all problem, a severity matrix is developed which assign a severity index on root causes, weighted factor and criteria whether it is a controllable, procedural, or noise factor. The objective is to rank and prioritize the proposed solution. The severity and weight factor is taken from observation record that placed unavailability of stock as the main factor, followed by revision process and late order information process, while for weight of each root cause and severity index are conducted through interview session involving purchasing, inventory control, end user and supplier. For severity index, the bigger the index, the bigger the risk of having the problem.

Table 2 details the suppliers lead time cases, in association with weight and severity index.

<table>
<thead>
<tr>
<th>Main causes</th>
<th>Root Causes</th>
<th>Classification</th>
<th>Weight</th>
<th>Severity</th>
<th>Points</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unavailability of stock in suppliers location</td>
<td>Lack of information and communication on materials usage</td>
<td>Procedure</td>
<td>0.2</td>
<td>7</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Unavailability of stock in suppliers location</td>
<td>No agreement/contract on supplier performance</td>
<td>Procedure</td>
<td>0.3</td>
<td>5</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Unavailability of stock in suppliers location</td>
<td>Unplanned Usage</td>
<td>Controllable</td>
<td>0.1</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Late order information process (order information is not received by supplier)</td>
<td>No standard procedure on order delivery information system</td>
<td>Procedure</td>
<td>0.06</td>
<td>7</td>
<td>0.42</td>
<td>4</td>
</tr>
<tr>
<td>Late order information process (order information is not received by supplier)</td>
<td>Lack of human resources skill</td>
<td>Controllable</td>
<td>0.03</td>
<td>3</td>
<td>0.09</td>
<td>8</td>
</tr>
<tr>
<td>Late order information process (order information is not received by supplier)</td>
<td>Lack of control system to ensure order document delivery</td>
<td>Procedure</td>
<td>0.06</td>
<td>9</td>
<td>0.54</td>
<td>3</td>
</tr>
<tr>
<td>Late order information process (order information is not received by supplier)</td>
<td>Weight sub-total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.15</td>
</tr>
<tr>
<td>Additional purchase order process (revision)</td>
<td>Late update on inventory database</td>
<td>Procedure</td>
<td>0.05</td>
<td>1</td>
<td>0.06</td>
<td>9</td>
</tr>
<tr>
<td>Additional purchase order process (revision)</td>
<td>Supplier does not inform data changes until new orders released</td>
<td>Procedure</td>
<td>0.07</td>
<td>5</td>
<td>0.35</td>
<td>5</td>
</tr>
<tr>
<td>Additional purchase order process (revision)</td>
<td>Lack of understanding on Freeport purchasing system</td>
<td>Controllable</td>
<td>0.05</td>
<td>7</td>
<td>0.42</td>
<td>4</td>
</tr>
<tr>
<td>Additional purchase order process (revision)</td>
<td>Internal consideration to revise order quantity</td>
<td>Noise</td>
<td>0.06</td>
<td>3</td>
<td>0.18</td>
<td>7</td>
</tr>
<tr>
<td>Additional purchase order process (revision)</td>
<td>Weight sub-total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.25</td>
</tr>
</tbody>
</table>
3. BUSINESS SOLUTION

Business solution is approached by Six Sigma Framework. Six sigma seeks to identify and remove the causes of defects and errors in manufacturing and business processes. It uses a set of quality management methods, including statistical methods, and creates a special infrastructure of people within the organization who are experts in these methods.

**Methodology**

The approach for the case is depicted in diagram below:

- **Define**
  - Standard lead time of 21 days is not achieved
  - SCM focus in 2008: To improve lead time by 15%
  - Focus on expediting to increase the speed materials flow through the supply pipeline from order origination to receipt at the warehouse (pipeline velocity)
  - Lead time reduction will increase inventory turnover, decrease inventory level, without hurting service level

- **Measure**
  - Find the appropriate data measurement that relates to the goal
  - Benchmark lead time and time of purchase type and purchasing location
  - Lead time measurement for each regional stock class, inventory at each level of each location: Cairns (10.2 days), NOLA (22.9 days), Singapore (18.0 days), Biddigby (24.2 days), and Papua (26.4 days)
  - Standard deviation: Papua (27.8 days)
  - Capability index for Papua process: 0.014
  - Probability of the current process: failed outside the 3σ and 5% level in Papua: 61.9%

- **Analyze**
  - Identification of the major cause that affects lead time
  - Identification of the root causes of the problem
  - Discussion panel on root causes weighing and severity index

- **Improve**
  - Problem solution based on the root causes that have been identified
  - Eliminate solution from every aspect that may relate to the business processes (People, process, technology, communication, coordination)

- **Control**
  - Create a monitoring system for supplier regarding purchasing orders process and delivery
  - Set possible agreement with suppliers regarding quality, cost, delivery, safety, and environmental

**Figure 4 Methodology of Business Process Improvement Using Six Sigma Framework**

**Alternative Solution**

The alternatives are grouped into four aspects: People, Business process, Technology, and Communication. Matrix of solution in table 3 grouped the proposed solution with the aspects considered to solve the problem.
### Table 3 Proposed action under the aspect of solution

<table>
<thead>
<tr>
<th>Stock Unavailability</th>
<th>Communication</th>
<th>Business Process</th>
<th>Technology</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine coordination meeting on materials usage between purchasing and supplier</td>
<td>Create contractual system in materials supply and performance</td>
<td>Delivery of routine information on materials usage (monthly/annually)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routine coordination between Purchasing and End Users</td>
<td>Delivery performance monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Establish system to provide appropriate information on materials usage for supplier</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late order information process</td>
<td>Coordination between Purchasing and Inventory Control</td>
<td>Control system on purchase order delivery to supplier</td>
<td>Utilize information technology in data delivery</td>
<td>Improve human resources competences</td>
</tr>
<tr>
<td>Order Revision</td>
<td>Proactive information from Purchasing</td>
<td>Stock information update procedure</td>
<td>Automation system to recognize order data discrepancy</td>
<td></td>
</tr>
</tbody>
</table>

The actual form of the action and implementation are:

- **Communication**
  Basically, integrated communication needs to be built strongly between internal SCM parties and external party. The kind of communication between the parties is in the form of:
  - Routine Material information
  - Meeting (Internal and external meeting)
  - Supplier visit

All with planned and directed frequency

- **Business Process**
  Improvement required in business process which identified in root cause analysis consists of two main things:
  - Create agreement with supplier (Vendor Held Stock)
  - Improve control/monitoring system in the process

- **Technology**
  Related with the use of technology to enhance the effectiveness of the system, in this case:
  - Reporting automation
  - PTFI Supplier Portal
  - Electronic Data Interchange (EDI)

![Figure 5 Purchasing EDI Process Overview](image-url)
4. IMPLEMENTATION

Solution concluded from each are in the previous chapter is then summarized and due to the nature of the solution, implementation plan will be based on the timeline of each possible solution:

- Short Term
- Medium Term
- Long Term

In diagram, the implementation is portrayed in figure 6.

![Implementation Plan](image)

**Figure 6** Implementation Plan

Chart of the timelines of the implementation is planned as is in figure 7.

![Implementation Timeline](image)

**Figure 7** Implementation Timeline
Every plan is related that the details of the short or medium term planning is made to support the plan for the longer term (e.g., external meeting, beside to correct the current supply problem, it will also be a media to best setup the type of supply contract type that suitable for both companies).

**Benefit and Cost Analysis**

As mentioned in the previous section, with a number of demands of materials, lead time will impact the order frequency and inventory level. The faster the lead time, the lesser inventory value needed to cover the requirement and so in the opposite. Simulated calculation is performed to see correlation between lead time and inventory turnover, with assumption that service level in the periods remain the same. The data can be plotted in figure 7.

![Figure 7 Lead Time vs Inventory Turnover](image)

In year 2007 and 2008, it can be seen that the shorter the lead time, the higher the inventory turnover, and vice versa. Assume that annual usage in 2009 is similar to that in 2008, US$ 4,932,799 and with all the effort, we can get supplier lead time 21 days, take freight lead time 6.3 days, similar to 2008. Inventory turnover will be 5.97, while average monthly inventory value is US$ 826,264 there is US$ 94,117 reduction or 10.2% for the improvement in supplier lead time to 21 days. However, since our analysis of improvement only takes major factors and suppliers, we will assume that the effectiveness of the improvement is can reach 58.3% (from 87% major factors and 67% of value from two big suppliers analyzed). Multiply the percentage with reduction opportunity, we got value US$ 54,955 as the actual inventory value reduction.

There will be minor number of cost shall be involved, since most of the improvement effort is to optimize current system and condition, the only cost incurred such as for purchasing training that will require expertise from external party. With calculation of US$ 54,955 potential benefit and cost incurred above, it will be a good opportunity for the company to improve supplier lead time as a way to reduce cost in a whole.

**Conclusion**

- Analysis for improvement in supplier lead time is an interesting study to reduce cost, in this case, the tangible cost reduction is regarding inventory value.
• In analyzing late supplier lead time problem in the company, major problems identified for the cases are unavailability of stock in supplier, additional order process, and lateness of order information.

• The solutions for the problems are grouped into for area: Business process, Communication, Technology and Human Resources. The conclusion and action plan for the solutions is to create a mutual agreement between Supply Chain Management and supplier on their performance regarding quality, cost, delivery, safety and environment, improve process control, improve communication, optimize the use of technology, and improve the skill of people.

• Estimate cost reduction on inventory cost through improvement in supplier lead time is US$ 54,955 for fast moving materials stock class N, level A&B sourced from local supplier.

• Above all the possible solutions and analysis, sponsorship and direction from management is highly required to ensure that an integrated and strategic rather than segregated plan and solution can be applied.

Further Recommendation

• Solutions given in this analysis only covers 87% of the problem identified, there are still some factors that may have room for improvement, such as order information discrepancy and supplier administration problem. These can be of subjects for improvement in the next stages.

• Those root causes identified are based on 67% of cases from two suppliers, there are still 33% of cases that may open possibilities for more problem solutions in the future.

REFERENCES


