Wind Turbine Manufacturing Supply Chain

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Abstract: Wind turbine industry is one of the upcoming renewable energy businesses in the world. The power generated by this wind turbine is without generating any pollution. Unfortunately, world wide the industry is not doing good. To support this industry one of the problem inventory management is taken for research. The research is how to optimize the inventory through a appropriate model. A case study has been done in wind turbine company. This study will help to find a long term solution for creating a new inventory model for such industries. To meet our objective the following methodology has been adopted. Study the present system, collection of data and understands the system gap. Based on this study put the action points and check the results. If the results found OK conclude. If this is not meeting the requirement change the action points and check the results. This is the methodology adopted for this case study. The results indicate the study is useful to form a strategy for such industries to form a long termsourcing model. Pull systems is one of the method which has given much better results. This case study was conducted on particular industry on a particular condition. This study may not be applicable for all industry. The study is optimized for the production plan versus actual production, under the assumption there is no delay in delivery of components and no quality issues with the components.

Keywords: Pull system, inventory, renewable energy.

1.0 INTRODUCTION

Inventory dynamics possess a quite complex behavior in supply chain. Since business competition is already reducing the profitability, to maintain the profitability, all the targets should have to meet as per the plan to meet the planned profits [1]. Inventory level is an invisible cost to an organization. Most of the companies, especially those companies involved in project kind of business, higher inventory cause loss to the company [2]. I have been watching wind turbine manufacturers for more than one decade. Worldwide these companies facing serious problems in making consistent profit [3]. There are many reason for not making profit, Like execution of project not happened in time, technological upgradation, long lead time causes higher inventory, government policies etc. This paper represents how a wind turbine manufacturer in India brought down the inventory level by adopting different model of inventory system [4]. It explains the different parameters and strategies focused to meet this target. It also suggests and recommends the supply chain design for such industry/situation so that this will become an input for such industries to get benefit in long term [5]. Though the wind industry started manufacturing wind turbines from the year 1990 in India, the industry has not yet reached the matured stage. Due to this fact most of the manufacturers are not able to implement a much better system in many areas [6]. Also the supply chain model is most complicated. Most of the critical components are imported, with long lead time. Due to volatile market in India many wind turbine manufacturers are struggling to make profit consistently [7]. Also they are not able to implement the latest technologies like lean concept, JIT as in the auto industry. The total capacities of the installations in India are 1500 MW, 2300 MW and 2500 MW for the year 2009, 2010 and 2011 respectively.

The trend looks upward. One of the organizations in India has suggested that the potential of wind power generation in India is up to 45000MW [8]. Many new manufacturers are setting up their manufacturing facility in India because of this higher potential. The future of this industry looks bright [9]. This case study has been conducted in one of the reputed wind turbine manufacturing company in the southern part of India. The company was struggling to make profit due to many reasons [10]. One of the major root causes is the higher inventory. I have taken up this as a case study; the objective is to make almost zero inventory by year end. The idea of this zero inventory is impossible in reality, what I have taken an objective, is after completion of the planned production the inventory should be as minimum as possible [11]. I also suggested the inventory design explained here, so that this will become a future model for the company to have control over inventory [12].

2.0 LITERATURE REVIEW

2.1 Cycle View of Supply Chain Process

Four stages of a supply chain are given below

- Customer order cycle
- Replenishment cycle
- Manufacturing cycle
- Procurement cycle

2.2 Push/Pull View Of Supply Chain Processes

The author Michael H. Veatch, 2003 talks about „Make to stock” mode. When the demand arrives to the system, it is satisfied with the on-hand inventory of the required part type. He also talks about dynamic scheduling. The author Ronald Armstrong-Su Gao- Lei talks about zero inventory production and distribution problem with single transporter and a fixed sequence of customers. The author Ingrid Farasyn talks about P&G’s more complex supply chains implemented multi-echelon inventory optimization software to minimize inventory costs across the end to end supply chain. In 2009 this drove $1.5 billion in cash savings. The author Herbert J. Grunwald studied about Z (ZI) and Just In Time (JIT) which are the two buzz words that
introduce entirely new concepts. Also a more realistic goal is MRI, the Minimum Reasonable Inventory. Bonney(1) mentioned in his paper that attention in manufacturing industry has to concentrate on inventory using JIT production, usually accomplished by visible pull or consumer-driven systems.

3.0 METHODOLOGY
The methodology adopted is given in the chart below in this section

3.1 Study Objective
The study has been conducted in one of the wind turbine manufacturing company in India. The organization where I carried out the case study is a 10 year old organization [13]. The organization was struggling to make profit; the new team at top management had taken many different steps for the profitability of the organization. But they were not fruitful [14]. I took up the area of reduction of inventory to make the organization profitable. Every year the production plan and the actual is much lower the mismatched inventory is accumulated over a period of time. This year I have taken a target of bringing down the inventory. The inventory level was always for the past three years hovering between 1700 million INR to 2500 million INR. This year at the starting this was 1500 Million INR and the target to bring down to less than 0.5% value as fixed as 5 million INR [15]. The idea was to bring the matched inventory and complete the planned production and subsequent year starting inventory can be brought in the month of January of next year. From this study to evolve a supply chain design model which will optimize the inventory level so that the organization adopts the model for their future requirement and make the organization lean [16].

3.2 Study of the Present System

3.3 Data Collection
The data at the start of the year was taken. It was worth Rs.1500 million INR consisting of both imported and local material inventory. Based on the production plan further inventory procurement is planned [18].

3.4 Gaps Identified and Its Action Points
A brief business model is given in the figure below. In this the procurement lead time takes 6 months from the date of placing the purchase orders. The production lead time takes one to two months depending upon the number of turbines required. The excavation, foundation laying and and erection of turbines takes 3 months period and finally the commission and the government approval takes 1 month time frame [19]. If you look at the cash flow from the customer at the time of releasing the purchase order the customer will release only 10%, on delivery of turbines 30%, after erection 40% and finally after commissioning 20%. This is the general payment terms and may vary depending on the customer and volume of business. This gives an idea about how the cash flow requirement of wind turbine industry.

Based on the study of literature the solution suggested is „Make to order“ pull system implementation. The present system of production planning is having high fluctuation with the production plan changing frequently. As the production plan changes, the procurement of components is not aligned [17]. Further to the above, the following points are the observation about the present system

- There is no proper system for reconciliation of sub-contractor inventory
- There is no proper system for accounting vendor rejection
- There is no system for reconciliation of supplier account
- Basically the production is based on the production plan as Push system.

Fig. 1: Methodology
system of procurement and the pull system of procurement is given below.

4.0 FINDINGS
The major changes made in the system especially previously the production plan is released based on the annual operating plan. These plans keep changing frequently. Based on this changes is production plan , all procurement components cannot be changed due to contractual obligation. Due to this always mismatched inventory lying for a longer period due to this higher inventory and obsolete inventory occurred. Now the system is changed the production plan is released based on the confirmed customer order. So the material order also released based on the customer order. is as against of annual operation plan sales After implementing the Pull system of inventory and the correction of the existing system gap the inventory trend started coming down. After introduction of Pull system and Make to order most of the components procurement also postponed even though the order has been released .The materials are in warded exactly based on the production requirement. In the initial eight months the actual inventory level was higher than the planned due to implementation delay in Pull system, because of this the inventory is higher than the planned,after that the inventory meet the exact planned level. The graph,1 and Table 1 given below shows how the inventory trend started coming down against the plan. Finally the Rs170 crores inventory was reduced to less than Rs.50 lakhs. This shows that the focus given with the right strategy will reduce the inventory level to the minimum.

In this „make to order” system, procurement order will be released based on customer’s confirmed order and hence eliminates the stocking/storage of finished goods.

| Table 1: Inventory Trend Jan 2019 to Dec 2019 (million INR) |
|-----------------|-----------------|-----------------|
| S.No. | Month       | Plan  | Actual  |
| 1    | January     | 1303  | 1467    |
| 2    | February    | 1227  | 1509    |
| 3    | March       | 1152  | 1433    |
| 4    | April       | 1049  | 1373    |
| 5    | May         | 1109  | 1503    |
| 6    | June        | 870   | 1335    |
| 7    | July        | 737   | 1147    |
| 8    | August      | 686   | 1040    |
| 9    | September   | 1620  | 1151    |
| 10   | October     | 1407  | 1035    |
| 11   | November    | 940   | 847     |
| 12   | December    | 790   | 415     |

5.0 CONCLUSION
Based on the Production plan as per the confirmed order there is a firm production plan is established. Because of
this firm production plan the inventory levels are moving as per the plan and reducing gradually. The study made it clear the sourcing model for such industries can be brought as per this model. Make to order and pull system will make optimized inventory level for such kind of industries. This model is established under the assumption that the delivery of material from supplier is as per the schedule and the quality of components without any rejection. In practical this is not possible. Further research can be extended by take up with this limitation. This model cannot be generalized for all companies. This study can also take up for future research.

6 REFERENCES


