International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161

Available at http://inpressco.com/category/ijcet

Research Article

Effects of shortages for assembling subassemblies in customized product based companies

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Accepted 12 March 2017, Available online 16 March 2017, **Special Issue-7 (March 2017)**

Abstract

Lead time reduction is an essential part of lean manufacturing as in product companies the lead time of manufacturing is the dormancy between initiation and accomplishment of a process. Working according to the lead time of the product company to produce optimum amount of products is difficult because of various reasons; one of them is shortages of required material. The shortages of material causes problems like pausing the assembly line, over time for completing the work on time after procurement of material to match the lead time, use of proprietary items without test certificates, problems in work of in process quality department etc., which are commonly faced by product companies, specially the companies implementing customized product assembly. The shortage of material will definitely lead to practices which are deviated from the ideal process flow and will affect the companies' efficiency to deliver the product on time. The errors caused due to shortages can be eliminated to a great extent by studying the reasons and its implications on assembly and in process quality department of a company which will definitely help in achieving optimum efficiency of delivering product on time to the customer.

Keywords: *BOM mismatch, material shortages, lead time, Product Company and vendor management.*

1. Introduction

Most of the big product companies are assemblers i.e. they procure material from supplier and then assemble these parts to form subassemblies which are then mounted together to form a complete assembly. For example if there is a product company 'A' which builds motorcycle, then it will procure different proprietary parts like engine, battery, base frame, chassis etc. from different suppliers and then assemble them to form a single unit. This package is offered to customer as a whole. The product companies are also divided in 2 types:

1. Standard Manufacturing
2. Customized Manufacturing

In standard manufacturing, the company makes a product and gives minimal choice to the customer, whereas in customized manufacturing the product company makes the product according to customer requirements.

In both the product companies the lead time of manufacturing is very important as lead time is the latency between start and end of a process. For example, the lead time between placement of order and delivery of a new car may be anywhere from 2 months to 6 months. In industry, lead time reduction is an important part of lean manufacturing. In simple words, lead time in manufacturing environment is the time from the moment the customer places an order to the moment it is delivered, including the time required to ship the parts from the supplier. This lead varies for almost all product companies due to various reasons.

Lead time may differ due to various factors as lead time changes for different conditions. Because there is actual lead time which is required to build the product and there is requested order lead time which is demanded by the customer. Working according to the lead time of the product company to produce more products is difficult to cope up because of various reasons. One of them is shortage of the material caused due to late delivery of parts from the supplier, an example of this situation is delay in launch of flagship handset by Asustek (Asus mobile) due to shortages of components like DRAM, flash memory and flat panels used its Smartphone's. Shortages are caused due to various reasons.

2. Reasons for shortages

Following are some reasons that contribute for shortages. Stated reasons may directly or indirectly hampers the production. Also the stated reasons are one of the main reasons which plays a role in part shortages

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2.1 BOM mismatch

A bill of material consist list of raw materials, sub-assemblies, intermediate assemblies, sub-components, parts and quantities of each and every part needed to manufacture the end product. A bill of material is also used for communication between associated manufacturing partners (vendors). And if there are any changes in the diagram (revisions of diagram) and any new part gets added or part gets deleted it should get reflected in Bill of material. If any changes are done without modifying the BOM then it may cause problems downstream (sourcing, and assembly) for procuring the material. The issue may gets raised at any time even at the end of an subassembly by the assembly department about the shortage of a particular class of item, due to which assembly line may get paused.

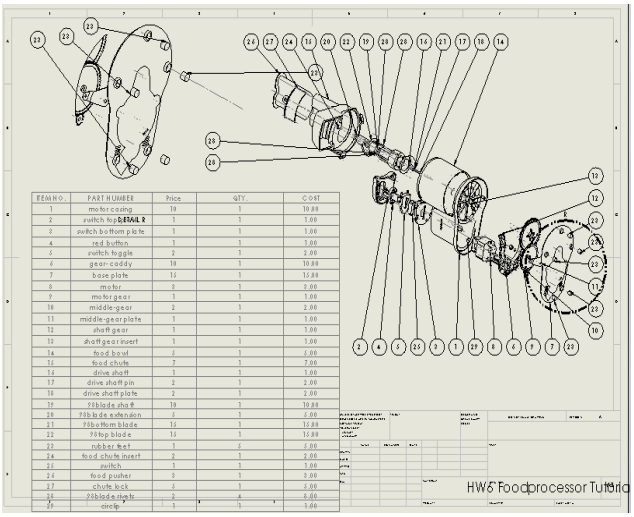

Fig.1 Drawing BOM

2.2 More lead time of the component

Normally the component having more lead time are ordered by forecasting about the number of units to be manufactured and a safety stock is also maintained. But if the forecasted quantity and safety stock quantity is insufficient to fulfill the requirement of production due to more number or excess orders than expected then, it causes shortages. Also if such parts are rejected due to fitment validation issues then it can pause the assembly line.

2.3 Late delivery by supplier

Supplier is the third party which supplies goods or services to the product company. Even if other conditions are satisfied for delivering the product on time, one important condition is to get the required material for assembly on time from the supplier. This is one of the main reasons for items facing shortages. They arise due to more workload at suppliers end or less priority to a particular product company. This can be stopped by implementing good supplier relationship management. For example if material which was to be arrived in week zero arrives in week two, then production gets hampered.

2.4 Releasing the PO late to the vendor/supplier

Late execution of action for releasing PO of a material can cause shortage. A purchase order (PO) is a corporate document and first official offer issued by a buyer to a seller, indicating types, agreed prices and quantities for product or services provided. It is normally used to control the purchasing of product and services from external suppliers. But if this action of execution of purchase order is done late by the buyer then the lead time increase for a particular machine with respect to the lead time of the item to be procured from the supplier. This creates shortage at its initial stage.

2.5 Inaccurate drawing revision conveyed to the supplier

If there are any changes made in a particular component or it is reworked due to fitment validation issues, the drawing containing the component or the system must be redrafted, updated and issued again. As the component or system is modified, and the drawing is updated to reflect the changes and the revision number is increased by one to recognize the change. If there are lots of revisions or customization of a particular drawing and the buyer fails to accurately communicate the latest drawing to the supplier or vendor then it can be a case of shortage of accurate item required for assembly and it will be identified very late during supplier quality inspection as the drawing and component will not match.

3. Effects of shortages on assembly

Following are the effects or implications that shortages contribute for. Stated implications may directly or indirectly hampers the production. Also the stated effects are the important ones, other implications may follow.

3.1 Assembly line gets paused due to A, B and few C class items

Most of the companies maintain a safety stock i.e. an additional amount of an item held in the inventory in order to degrade the risk that the item will be out of stock. Safety stock also acts as a buffer stock in case the sales are increased than planned or the supplier is unable to deliver the required units at the expected time. But if this forecast of maintaining the safety stock is wrong for A and B class items, then it creates shortage. And if supplier also fails to deliver it on time, the assembly is paused. This is because A and B class items are important for company and no other alternative item can be used for taking deviation in this

class of shortage. A and B class items are well engineered and posses the recipe of the whole assembly as all these subassemblies gets completed with assembling the material to form a complete unit. Any obstruction in the procurement of these classes of items can pause the assembly stations especially if the company is following flow line concept because in flow line concept, each station has specific work to do and they are interdependent. So if there is a lag in completion of the assembly of a single station due to shortage, it will affect the entire flow line on the floor and increase the lead time. For example Toyota stopped Japan production for one week due to part shortage in February of 2016. Therefore this shortage of A and B class hampers the production 100% and increases the lead time of the product hampering the overall efficiency of the product company.

3.2 Deviation for C class or Kanban items

Analysis of A, B, and C class prove that the inventories of an organization are not of equal value. Thus the inventory is grouped into three categories in order of their estimated importance and C class items are marginally important. C class items are the one whose alternative can be used by taking a proper deviation action and approval of engineering department in urgency period to complete the production in given lead time. Such practices of deviation should be less time consuming and should not occur each and every time. But this deviation causes increase in inventory for the alternative item used. For example if there is shortage of adapter A then in urgency condition to continue the work on assembly line, deviation is taken and alternative adapter B is used to complete the subassembly. It will cause shortage of adapter B for the other subassembly. In short shortage remains constant and will cause a problem for future assemblies. If this practice is taking place in any product company without taking proper approval of engineering then it can harm companies' reputation because of failure in a particular assembly due to such practices. Also the hard work of designing the component goes in vain and becomes questionable during root cause analysis of the failure.

3.3 Use of proprietary parts without test certificates

Proprietary items are the one which are manufactured, sold or offered only under the exclusive rights of the property ownership of a seller or manufacturer. Proprietary items usually have distinct characteristics or features and are often not compatible with the competing items. The shortage of this item creates urgency at both ends (supplier and Product Company). So in critical conditions, these items may surpass the testing norms and can be directly used in the machine.
These test certificates denote that the product has passed performance test and quality assurance test. This takes place most probably in Asian countries as Asian countries are less concerned about quality than the European countries.

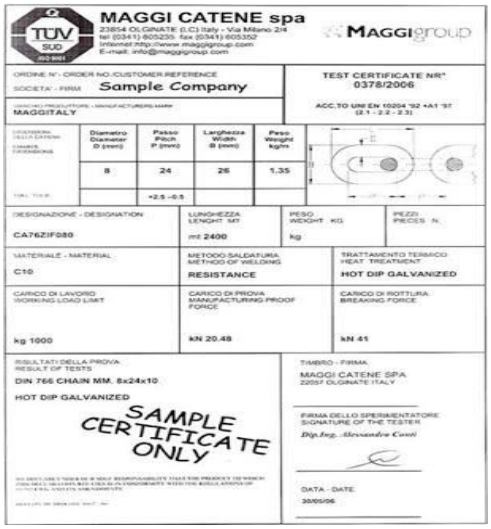
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Fig.2 Sample test certificate for proprietary items

Lead time may increase if the proprietary item used without test certificates fails during product testing. For example if a cylinder and piston arrangement is used as a proprietary part in a subassembly, in urgency conditions to match the lead time if this item is getting used without test certificate and if it fails during testing of the whole assembly or on the field, then it will consume time to replace it, thus increasing the lead time of the product. If there is any monetary or human loss due to failure of a particular component then product company will be in legal troubles plus it will hamper companies' reputation in market.

3.4 Over time to match the lead time

To complete the product and deliver it on time, most of the product companies choose extra time for their workers. This condition can be created due to shortage, because the assembly line gets stopped for some time (case of A and B class) and when this shortage listed material is procured, assembly is resumed with a goal to the time lapse due to unavailability of the material. Plus overtime as effects on inventory and moral of the workers. The Yawning of a New Era, An article by Michelle Rafter, published on Dec 2010 in Work Force management magazine documents the facts related to the rise of human fatigue in workplace due to over time with few good examples and proves the point stated in current paper.

3.5 Work of In-Process Quality control (IPQC) department gets difficult

The checks which are carried out before the manufacturing process is completed are done by in process quality control department. The function of IPQC is to monitor and if necessary adapt the manufacturing process in order to comply with the

specification provided. But these checks can get hurdles in the way which is termed as shortages. In most of the product companies, the in-process quality checks are carried out after the completion of specific amount of work which are expected to be completed according to a particular schedule abided by the lead time. But if there is shortage of a particular item of a assembly whose ninety percent of work is completed than the output quality will have to wait till the assembly gets completed after the procurement of the material for the remaining ten percent or they will have to give no clearance to the assembly and check it again when the assembly gets completed. But if they miss a small error due to shortage it will create a problem during the testing of the product and indirectly will affect the lead time. If such errors are not identified while testing then the product can malfunction due to this on field and will cause degradation of companies reputation plus the cost of repairing the product at companies end.

Conclusions

Shortages creates problem for product companies and can hamper company's reputation for delivering the product late than the quoted shipping date or the Order may get cancelled. So by studying the reasons and effects of shortages which are practical based; helps in improving the process flow, systems used in a product company and indirectly the quality of work of its work force. The problem of shortages leads to root cause to lot of deviated practices followed in the company. Solving the shortage problem can cure all the deviated practices. Solving the shortage problem should be on high priority because it forces various departments to work with the deviated process and also makes these deviated practices a bench mark for a particular time which can harm companies' efficiency. The problem of shortages can be solved by creating a error less bill of material, by integrating proper links between the software used in the company, by constantly training work force abiding to practical use of software, by using effective tools for communication between the departments, by regularly checking the inventory and consumption list of Kanban items etc. Eliminating shortage will definitely increase companies' efficiency

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