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BECAUSE OF ADVANCEMENT IN TECHNOLOGY & BROUGHT OUT PART (BOP) CAPACITY PLANNING IN AUTOMOTIVE INDUSTRIES

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ABSTRACT

In present competitive age, customer never waits for product availability. Unavailability of product means loosing of market for competitors. Proactive capacity planning is ensuring the maximum utilization of available resources. To achieve highest level of customer satisfaction, it is very essential to utilize advance technology, continuous improvement and on time delivery within desired cost. To do focus in marketing area, most of OEM's are arranging maximum required sub-assembly and parts from his supplier partner. Arranging parts from supplier means opportunity to utilize expert's skill and advance technologies. This paper is focus on area, in which OEM are taking supply assurance from his supplier partner and participate in capacity allotment and physical verification activity.

Capacity confirmation & verification is one of proactive activity, in which customer toss his annual forecasted requirement with his supplier partner. After studying all necessary resources, supplier shares his all 4M (Men, Machine, Method & Material) preparation to catch customer requirements. This paper considers one of casting part as case study and process wise capacity allocation against customer requirement.

***Keywords** : Bottleneck, 4M, Outsourcing, Capacity Planning, Efficiency, Takt Time, Cycle Time.*

Introduction –

Present age is the competitive age; every organization is focusing to prove their products are obtained more customer satisfaction by showing extraordinary performance with his competitive commodity. Those products are aligned with advanced technology and achieving more customer interest in declared performance, they will achieve market leader position. Quality, Cost and on time delivery are the key factor; which always require sustaining organization growth rate.

Outsourcing is a great option for automotive industry to make the work process easier to handle. Those working in an Automotive Industry may choose to **outsource** work so that they can continue to focus on the core business processes. Outsourcing reduces certain costs, which may include peripheral or "non-core" business expenses, high taxes, high energy costs, excessive government regulation or mandates and production or labour costs.

Almost all OEM's around 60%~70% working capital are engaged in the Outsource material inventory, that means Outsourcing activity are major player to decide organizational growth towards Profit making objective. Unnecessary increase in

Outsource material inventory is creating direct impact on organization profit calculation. Also the unplanned reduction in the inventories will increases manufacturing losses or unnecessary addition expenses burden on the organization.

Proactive Capacity planning is one of essential organizational activity; in which management team allocate his in-house resources as per the Marketing team business projection. Proactive Capacity planning calculates the gap between business demand and available capacity. Gap calculation provides direction to organization to take Make or Buy decision.

"A make-or-buy decision is the act of selection between producing a product in-house or purchasing it from an external supplier". To take make-or-buy decision, it is necessary to calculate associated costs of production and whether the business has the Capacity to produce at required levels.

Organization business forecasting –

Organization success is always depending on accuracy of sales prediction. Business forecasting is one of organization technique, which guides organization for deciding their operation strategies. Normally OEM has defined their 5yrs~10yrs business targets, known as a long term business plan. To decide these long term business target, organizations sales and marketing team are reviewed their market situation and customer demand. By considering market feedbacks, organization will plan to add new product for maintaining growth rate and also obsolete the slow and non-moving products for avoiding unnecessary locking of working capitals. Addition and deletion of products are essential to maintain interest of his business partners.

To fulfil marketing and sales requirement, organization operation planning team are arranged to make annual production plan or catch up plan. To achieve these annual production plan, operation planning team are reviewed his in-house resources and make further expansion plan against in-house bottleneck processes. Finish products are always combinations of different types of chain processes, which are required to achieve products dimensional, functional and defined performance characteristics. The process which has high "Q" factor (yield) and more production Tact time are called bottleneck process. Ramp-up production plan are always depending on bottleneck elimination time.

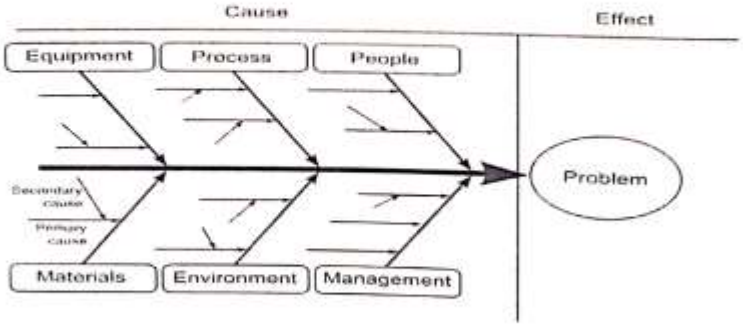

Fig. 1 - Fishbone Diagram - for finding bottleneck
Ref.: Bottleneck (production) - Wikipedia

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A fish bone diagram is a graphical means to find out potential problems in the chain of processes. By collecting data related to problem and putting them into the diagram, it becomes easier to analyse problem. The data put in the fish bone diagram are determined roots of problem. This method is usually used to realize the bottleneck in the chain of processes because of having the ability to pinpoint the machine, which is exactly responsible for the delay in production.

Capacity planning is one of important term, which find-out the discrepancy between available capacity and demand of his customer. Discrepancy between available capacity and demand may create inefficiency, either underutilized resources or dissatisfied customers. The former may be a heavy gain but the latter may lead to lost sales, lost customers and probably loss of reputation.

Operation management can also take Offloading decision to minimize gap between required and available capacity. Outsourcing strategies has been addressed supplier commodity strategies, cost reduction plans, innovative and efficient new programme development and flawless product launch via robust safe launch planning. Supplier performance will be closely monitored and supplier status will be result. No organization can succeed without the superior quality, cost, service and technology offered by its supply base.

Brought out Parts capacity can be increased using a number of methods which involve adjusting the resources and inputs at supplier organization such as:

* Introducing new approaches and materials.
* Increasing the number of suppliers or machines.
* Increasing the number of working hours.
* Acquiring additional facilities.
* By doing Automation.

Brought out parts Capacity Planning –

OEM production planning team makes the annual production plan, which is always align with the sales requirements. Production planning team reviews the in-house available capacity and available scope for expansion.

Finish Product is combination of different kinds of processes, which requires achieving dimensional, functional and defined performance of the product. Capacity is always replica of the bottleneck process. The process which has very high "Q" factor (yield production) and more production Takt time as compared to other processes are called bottleneck process.

Organization purchasing team shares their annual BOP requirements with concern supplier and ask for Capacity confirmations. As like as OEM capacity planning, tier 1 suppliers are also reviewing their other customer requirements and availability of his spare facilities. Capacity review and confirmations are always by considering all aspects of 4 M conditions i.e. Machine, Men, Material and Methods. Review of available resources and their production capacity are essential to find out scope for capacity expansion. Capacity is elaborated under three categories; design capacity, effective capacity and actual capacity.

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Design Capacity -

This is a theoretical number and calculated by dividing available time with process cycle time, design capacity means ***maximum conversion rate without stopping*** for any shift changeovers, maintenance or any other delays.

$$\text{Design Capacity} = \frac{\text{Available Time}}{\text{Process Cycle Time}}$$

Effective Capacity -

In ideal situation, there are certain planned or fixed losses considered to calculate actual available time. These losses create the gap between design capacity and effective capacity.

Shift changeovers time, lunch / tea breaks, set up time and many other operational factors are considered as a fixed or planned loss.

$$\text{Effective Capacity} = \frac{\text{Available time} - \text{Fixed Losses}}{\text{Process Cycle Time}}$$

Actual capacity -

In actual situation, as like as fixed losses there are also certain unplanned or variable losses, which need to be considered while calculating organization actual capacity. Poor work rate, absenteeism, machine breakdown, production plan change etc. are considered in the unplanned losses. Calculation of unplanned losses is based on past data.

To increase production efficiency, it is essential to minimise these unplanned or variable losses.

$$\text{Actual Capacity} = \frac{\text{Available time} - (\text{Fixed Losses} + \text{Variable Losses})}{\text{Process Cycle Time}}$$

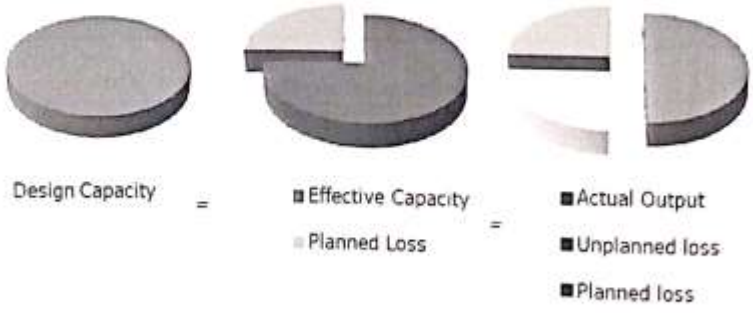

Fig. 2 - The proportions of capacity measures

Ref.: BOYDELL_2011_pub_Ch7_Capacity_planning_and_management.pdf

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Calculation of Organization Efficiency –

Organization production efficiency is the important term to improve production and increase utilization of available resources. Manpower utilization, machine efficiency, material availability and method effectiveness are the factors contributing into production line efficiency.

"Organization efficiency can be calculated by dividing actual capacity with effective capacity".

$$\text{Organisation Efficiency} = \frac{\text{Actual Capacity}}{\text{Effective Capacity}} \times 100$$

Efficiency is one of important factor to judge the performance of the organization. Efficiency is directly depending on the effectiveness of all Four "M" (Men, Machine, Material and methods).

1) **Manpower utilisation –**

Manpower is normally indicated by their skill level, such as fully skilled, semi-skilled and unskilled manpower. Organizations are defining their critical and quality operations in PFMEA (Process Failure Mode Effect Analysis) sheet.

"Those operations are required more accuracy or minor errors can also create non conformities in the final product are called critical operations".

"Those operations are more sensitive with respect to final products performance, dimensions and characteristics are called Q or quality operations."

Process FMEA are always recommended, to what level of manpower skill required for carrying out allotted task. Unavailability of recommended skill level manpower increase the quality issues and reduces the productivity.

2) **Machine Efficiency –**

Machine efficiency is one of important factor, which are frequently overlooked by management and this can lead towards losses which reduces the yield. Regular preventative maintenance and health check-up are necessary to reduce the breakdowns in the machine. The purpose of machine is to work efficiently but due to improper preventative maintenance, machine can be less productive. The preventative maintenance activity on machines needs extra attention by the management along with the responsible personnel to ensure optimum usage of machineries, which will eliminate unwanted losses due to machine stoppages.

3) **Availability of Material –**

Productivity is strongly depending on availability of right quantity of material, at right time, right quality and at right place. Material unavailability at point of use can be a problem for smooth production activity. Material unavailability creates delay in production, rework, uses of extra resources and also increase work in process inventories etc., which can involve additional cost. Quality of input material are always affects the quality of final products.

4) **Effectiveness of Methods -**

Method of carrying out specific task is also one of important factor which directly relates with organization productivity. Defined operation sequence, minimum transit lead time, minimum motion loss and fatigueless process are key terms to improve productivity. Designing effective methods is one of continuous improvement activity. Simplification and fatigueless operations are always supported to increase moral of operators.

Efficiency calculation is one of management decision making tool, which always helpful to management for his resource planning i.e. manpower, machines and input material requirement.

Steps for calculating machines requirements –

1) **Customers requirement –**

It is very essential to properly understand the requirements of customer. Customer forecasted schedule is one of decision making tool, which guides organization for calculating his available resource capacity. Achievement of customer peak schedule is the target for supplier capacity & production planning team.

2) **Process sequencing –**

To achieve defined performance, dimensional and functional characteristics at final stage, it is essential that product must go through into different processes. To find out bottleneck process, it is required to calculate process wise existing utilization and available spare capacity for new business. Overbooking of capacity can always create trouble for achieving customer schedule.

3) **Process wise efficiency –**

Each process has own process capabilities and criticalities. To calculate actual capacity of any product, it is required to consider process wise efficiencies.

4) **Customer Cycle Time –**

It is calculated by dividing available working time with customer requirement.

$$\text{Customer Cycle Time} = \frac{\text{Available Working Time}}{\text{Customer Requirement}}$$

5) **Machine Requirement –**

It is calculation of machine allocation, which requires fulfilling customer requirement. Machine requirement can be calculated by dividing Customer cycle time with operation cycle time.

$$\text{Machine Requirement} = \frac{\text{Customer Cycle}}{\text{Operation Cycle Time}}$$

Capacity Planning for Casting Part (Aluminium foundry)-

Process Flow –

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Melting Furnace

Core Shooter

LPDC

Decoring

Riser Cutting

Fettling

Heat Treatment

Visual Inspection

Finish Part

Melting Furnace -

A Furnace is a device which used to melt the metal for further metallurgical process.

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Core Making –

To create the interior surface (shape angle more than 180^0) chemically bonded sand is used, which is known as core. Core making is a process, fine AFS graded sand is coated with resin and blown into a preheated core box to get desired shape. The surface temperature is around 210^0 - 250^0 C (as per process requirement).

Casting –

Casting is the process, in which molten metal is poured into a mold and allowed to solidify to get desired shape. Ejected solid part is known as casting.

Decoring –

Decoring is the process in which sand core are removed by vibrating casting. Normally pneumatic hammer is used to vibrate the casting, which results loosen the sand.

Riser Cutting –

Riser is known as a feeder; it is a reservoir built into the mold to prevent cavities from shrinkages.

Fettling –

Fettling is a process, in which unwanted and unnecessary parts are removed to make finish casting. In sand casting when casting has solidified, there are reaction between product and sand. Burn sand creates impression on casting surface which results casting surface not smooth as we expected.

Heat Treatment –

Heat Treatment process is created effect on material structure and grains, which results alter the chemical, mechanical properties of the product. Heating, soaking and cooling are the three stapes of heat treatment process.

Heat treatment techniques are used to achieve desired results such as hardening or softening of a product.

Visual Inspection –

Customer provides the limit sample for defining acceptance level, training supplier quality inspectors and making awareness of operators.

Visual Inspection is required to prevent outflow of aesthetical and visual defects.

Machine Requirement Calculation Table –

Process Name	Capacity Requir e-ment	Cycle Time in Sec.	Cavity or Batch Quant-ity	Average Fixed Losses in Sec / Day	Average Variable Losses in Sec. / Day	Available Time	Customer Cycle Time	Machine Requirement
Note	A	B	C	D	E	F	G	H
Formula	Customer Demand	Actual Machine (Process) Cycle Time		Lunch/ Dinner + Tea Break + Machine PM etc..	Machine B/d + Quality Issue + Absenteeism etc..	= ((24*60 * 60) - (D+E))	= (F / A)	= (B /(H * C))

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Core Making	3000	220	2	15600	10800	60000	20	5.50
LPDC		250	2	15600	13200	57600	19.2	6.51
Decoring		40	1	15600	5400	65400	21.8	1.83
Riser Cutting		20	1	15600	5400	65400	21.8	0.92
Fettling		100	1	15600	1200	69600	23.2	4.31
Heat Treatment		10800	350	3000	3600	79800	26.6	1.16
Visual Inspection		60	1	15600	3600	67200	22.4	2.68

Significance of Capacity Planning -

1. **Buyer & supplier relation –**

   "Trust on each other" is the key to achieve success in the Business. Buyer Supplier relation is getting spoiled due to non-transparent activities and unethical behaviour. In capacity review process, customer gives the clarity about annual peak requirement and against of these peak requirements supplier confirms the availability or allotted capacity. Capacity confirmation is the process in which supplier calculate the overall customer demands and allocate the resources to fulfil customer requirements. If there is any gap between customer requirement and available capacity, then supplier confirm his proactive capacity expansion plan to maintain interest of customers.

2. **SWOT analysis –**

   Capacity planning always effective to maximise the utilization of their available resources. Capacity planning finds out the bottleneck, elimination of this bottleneck provides scope to increase available capacity. Available spare capacity attracts new business & increase customer confidence.

   SWOT analysis is strategic planning techniques, which recognise strength and weakness of organization process. SWOT analysis also diagnoses current problems and to sketch future action lines.

3. **Control on variable cost –**

   Overbooking of capacity or no provision for contingencies are always created eleventh hour rush and increase stress on concern resources. Insufficient capacity increases labour overtime and handling costs. To avoid on time delivery failure, delivery required to be send by fastest transport mode and minimum lot size. All cumulative results increase in transportation and manpower cost.

4. **Bottleneck identification –**

   A **bottleneck** is a process in the chain of processes, such that its limited capacity reduces the capacity of the whole chain. Drawback of having bottlenecked and capacity constrains means increasing work in process inventory, pressure from

customer and reduce employee morale. Capacity review finds out the bottleneck process and defines the ability of production. Bottleneck identification always do support for capacity expansion decisions. Bottleneck process is constrained for achieving increase customer demands. Proactive bottleneck eliminations and advance capacity preparation for forecasted demands are always helpful for catching new business opportunities.

Conclusion –

Buyer – Seller relationship is one of important factor to achieve highest level of success at both manufacturer & supplier end. Proactive sharing of business plan with supplier & coordination for the capacity preparations are always beneficial to avoid eleventh hour rush & hand to mouth situation. Manufacturing business plan provide guideline to supplier in Capacity expansion budget or Capex preparation process.

Capacity verification process creates the confidence at manufacturing end & also beneficial for supplier to do focus on achieving their defined process efficiency.

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