Bottle Neck Elimination In Production Management

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Introduction

In the world of competitive business, cost minimization and efficient management of manufacturing unit is a very big task. Identifying and removing the bottleneck is critical to a business. It is an ongoing process which needs to be carried throughout the year in order to utilize resources of production and maximize profit of the firm.

Bottlenecks are obstacles, which reduce the entire capacity of the system. Bottlenecks are always present in the system in different forms like constraints of management, people, material, equipment, process, policy, environment etc. Its forms can be different according to the type of business but the methods to identify can be same.

A congestion, encountered in any system from computer networks to a factory assembly line, is described with the term "bottleneck". In a system that is subject to a bottleneck, there is always a process, task, machine, etc. acting as the limiting factor for a greater throughput, thus determining the capacity of the entire system. Knowing about the bottleneck allows increasing the flow through improvement of a single process without having to intervene the whole system. In other words, the amendments made on any point other than the bottleneck, will not contribute to the output Goldratt and Cox's (1984).

Production lines involve various parameters such as processing times and setup times, which render keeping the balance of the line a serious challenge. As suggested by Van Delft et al., (2008) solution of such problems by means of mathematical modelling and similar deterministic methods in polynomial time is not possible due to their complexity and stochastic nature instead heuristic and approximate methods can be used for this type of problems. Goldratt and Cox's (1992). Theory of Constraints (TOC) is one of the heuristic methods which can be easily implemented to a simulation environment. Therefore, the problem, main theme of which is based on the elimination of the bottlenecks, is solved using TOC by means of a simulation based heuristic method. TOC has been used in various topics such as health care, finance, production, operations management, and quality management (Mabin and Balderstone (2003); Orouji (2016).

Bottleneck elimination process has four main steps which should be investigated thoroughly. These are material, machine and man (workforce) (Üstün 2005). Bottleneck detection and elimination methods have been studied since the industrial revolution, since detection of a bottleneck in a production system is a complex task. In the literature, there have been numerous studies about current bottleneck detection methods which can be divided into two categories as analytical and simulation-based Li et al., (2007).

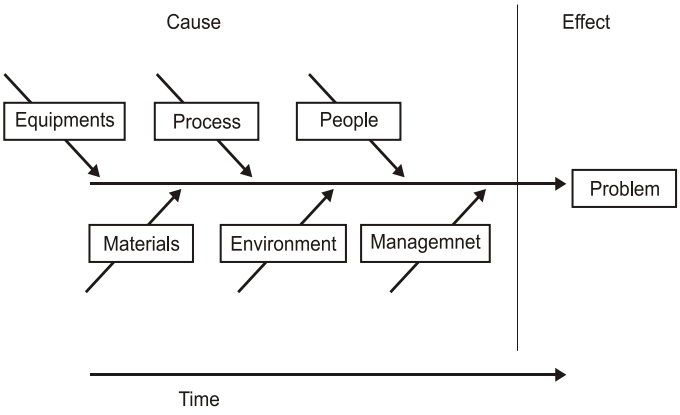
Approaches to find Bottleneck

Bottleneck is the main reason for slowdown of the production in a manufacturing unit. It has to be identified, analyzed and needs to be resolved on the basis of facts. Once the bottleneck is identified correctly and efficiently; It helps to reduce production cost increasing overall efficiency of the system. There can be long term or short term constraints in the system.

Bottleneck can be identified in a process/system by following the simple approach as follows:

1. **Fishbone diagram**

   "Fishbone diagram is a tool that provides a systematic and graphic way of identifying possible causes for a problem, using categories to focus and structure the thinking, in order to work toward determining root causes. Also known as the Ishikawa diagram (After Dr. Kaoru Ishikawa, the Japanese quality control statistician credited with investing it) and cause effect diagram" John Kamauf, (2010).According to this approach there should be a cause to see the effect. Under this approach, different data related to the problem are collected. These data are analyzed precisely in order to find the root cause for that particular problem Peter D.Mauch, (2010).



Fishbone diagram (Peter D. Mauch,2012)

2. **Theory of Constraints**

   In a production or service system all processes are related with its predecessor and successor if available. Each process has a limited production capacity within its constraints. In almost all cases there is only one process that limits or restricts the performance of entire system Theory of constraints is based on the premise that the rate of goal achievement by a goal oriented system is limited by at least one constraint and adopts the common idiom as "a chain is no stronger than its weakest link". That is to say systems or part of systems are vulnerable because the weakest element or part can always damage or break them or at least adversely affect the output. In other words if there was no obstacle that prevents a system from achieving higher throughput, its throughput would be infinite which is not possible in a real-life system. Overall throughput can be increased only by increasing the flow through the constraint Goldratt and Cox (1984).

Assuming the goal of a system has been articulated and its measurements defined, the logical thinking is based on a continuous improvement cycle with five steps Goldratt and Cox (1992).

1. Identify the bottleneck,
2. Decide how to exploit the bottleneck,
3. Subordinate everything else in the system to the previous step,
4. Elevate the bottleneck, and.
5. Evaluate if the bottleneck has been broken, and return to the beginning

Types of Bottleneck in Manufacturing

There can be many different types of bottleneck in manufacturing industry as for example labor, time, material or machine etc. In general, different forms of bottleneck can be described as below:

People constraints

People are one of the most important factors of the production and difficult to manage in an effective way. In any manufacturing unit there are different people working together with different experience, background and educational qualification. Each people have their own way of motive towards work. So in an manufacturing unit different constraints of bottleneck can be due to union problem, illness, unexpected vacancy, hiring and training problems etc.

Material constraints

Production capacity is highly affected by the poor management of inventory, inadequate forecast, inefficient supplier, poor production planning,

inadequate finance, changing product mix etc. one or all of these factors may cause improper flow of materials resulting reduction in overall production capacity and increasing lead time.

Equipment constraints

Equipment for manufacturing should meet the current demand. The machines and equipment should be flexible to expand in order to meet future demand, but sometimes due to inappropriate planning, break down of machine, unavailability of spare parts, improper maintenance, low level of infrastructure machines and equipments becomes a constraint of manufacturing.

Process constraints

Process constraints in manufacturing unit can be due to quality problems, insufficient resources, poor plant layout and inflexible process (not able to change according to time and market demand). The constraints can occur anywhere in the process, supply chain, customer, supplier etc. Hence any kinds of problems affecting entire output of the system is known as process constraints.

Management constraints

Efficient management means better performance resulting in higher output and profit. Overall management of a manufacturing unit should comply with aim and objective of the company. Sometimes the management is not be able to meet the needs of the system and becomes a constraint causing different problems like demotivation of employee, ineffective flow of material and information etc.

Policy constraints

Policy of a manufacturing unit should meet the goal of company, it should be clearly defined what actions are to be taken at what conditions. Generally (not always) the management is not able to define all the issue in specific way, this may leads to a constraint in manufacturing. It is the most common form of constraint.

Environmental constraints

Operating environment of any business includes competitors activities, rules and regulations formulated by government, labour law, union law, customer demands & expectation, economical situation, technological improvement, development in infrastructure etc. at the same time the firm should bear the social responsibilities. All these all factors affecting the activities of business are called environmental constraints.

Strategies to increase capacity at the Bottleneck

Here are some ways to increase capacity at the bottleneck:

- **Add resources at the bottleneck operation.**

  The number of resources can be increased by performing the operation without adding head count if an employee can be assigned from another operation to help perform the bottleneck operation during unutilized time.

- **Always have a part for the bottleneck to process.**

  Be sure to monitor the WIP in front of the bottleneck and that it always has a part to process. This involves managing the resources feeding the bottleneck to ensure that nothing is slowing them down, such as equipment failures. If scheduling overtime, make sure that the bottleneck has enough parts to process during the overtime period.

- **Assure that the bottleneck works only on quality parts.**

  Don't waste the bottleneck's time on bad parts. If quality checks are required in the process, place them before the bottleneck operation. This increases the thru put of the process.

- **Examine your production schedule.**

  If a process is used to make several different products that use varying amounts of the bottleneck's time, then an analysis of the production schedule can create a product mix that minimizes overall demand on the bottleneck.

- **Increase the time the operation is working.**

  Keeps the bottleneck resource working. Always have someone assigned to the operation, including

during scheduled breaks and lunch periods, and use overtime if necessary. Though doing so won't technically reduce the cycle time, it will allow the bottleneck to produce when other operations are idle. The more time the bottleneck works, the more parts the system produces.

- **Minimize downtime.**

  Avoid scheduled and unscheduled downtime. If the bottleneck equipment suffers a breakdown during scheduled operations, dispatch repair personnel immediately to get the bottleneck up and running. This may involve keeping replacement parts on hand and performing preventive maintenance on equipment. In addition, changeover times can be reduced from one product to the next, because this time takes away from actual production time.

- **Perform process improvement on the bottleneck resource.**

  A good place to start is to document everything the resource does. Then eliminate all non-value-added activities and look for ways to reduce the time it takes to do value-added activities by getting rid of all the waste in the operation. This results in a shorter cycle time. Process improvement is almost always focused on eliminating waste.

- **Reassign some of the bottleneck's work.**

  If possible, break the operation down into smaller activities and reassign some to other resources. Doing so results in a shorter cycle time and increased capacity.

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