RESEARCH REPORT:

Bottlenecks

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Within the manufacturing environment the pathway of processes in which result in the final product often encounters slowing points as raw materials find their destination in becoming finished goods. These are known as bottleneck and can be a significant challenge to the efficient and profitable manufacturing firm.

A Bottleneck can be defined as a narrow passage hindrance to movement or progress. Simply stated, that in the manufacturing world, a bottleneck implies a resource that is physically restricting production. Identifying and managing bottlenecks can better optimize assembly line efficiency and throughput (Rosar, 1998).

In modern facilities, the use of dynamic models of manufacturing require leaders to move and alter manufacturing lines in order create different products or product configurations. This enhances the opportunity for bottlenecks to occur and creates even greater challenges.

There exist three types of Bottlenecks. They include: static, dynamic, or multiple (Rosar, 1998).

A static bottleneck occurs when the ideal throughput rate of a single machine is unable to equal or exceed the remaining machine line rates. This type of bottleneck simply means that one machine’s capacity cannot keep up with the rest of the line and therefore creates constraint. The solution to this type of bottleneck is to better match the machine with other machines that are comparable to its performance or replace the machine with one that’s capacity is more compatible to the rest of the line.

Dynamic bottlenecks can be more difficult to determine. These restrictions are caused by factors other than the machine's ideal throughput limitations. Factors such as reliability, machine-to-machine interaction and personnel-to-machine interaction can be the contributors towards dynamic bottlenecks. Often dynamic bottlenecks can be best assessed and observed by using simulation models.

In both static and dynamic situations, multiple bottlenecks may exist within a manufacturing environment. For example, a single point may be the true bottleneck; however it cannot be corrected without addressing more than one control point on the line.

As mentioned, the source of both types of bottlenecks can be attributed to any of the following:

Machine capability upgrades: As one machine's capability is improved the pace is increased. Other machines downstream might struggle to keep up.

Machine configuration changes: Often times the configuration of machines will either slow or speed up the pace in which it produces product. This will also affect the pace of the overall line.

Environmental changes: Heat, cold, dirty, or clean, can alter the performance of machinery and can once again improve or reduce the machine's performance.

Maintenance: Whether or not proper maintenance has been conducted either as Preventative Maintenance (PM), or repairs to the machine will affect its performance and service life.

Personnel: The interface of machine and worker will also affect and can create bottlenecks. If the machine is dependent upon human interaction its performance is affected the personnel's training, speed, and overall efficiently. This can especially be a challenge because bottlenecks can emerge as personnel changes or during the course of a single day (Rosar, 1998).

Although the concept of bottlenecks is simple in scope, the above list suggests that

Locating and monitoring bottlenecks can be more complicated than simply declaring the "slowest" machine as the bottleneck.

The best approach to identifying the location of bottlenecks is through a systems analysis effort and creating a model of the manufacturing line. The method in which to create the model can vary between a simple spreadsheet to a fully detailed simulation.

Solutions related the managing the existing bottleneck can vary. One approach known as capacity balance is applied when the entire line is synchronized to permit a consistent flow of product. Unfortunately, in practice, achieving such a perfect design is usually impossible.
The reason being that for most non-automated lines demand for the product downstream will vary this is typically not seen in automated lines which serve as one large machine that is calibrated with itself. There are a number of ways to deal with imbalance. One way is to add capacity to the bottleneck. This can be achieved through temporary measures such as scheduling overtime, leasing equipment, or perhaps subcontracting additional capacity (Davis & Heineke, p. 390, 2005).
Buffering is a method where materials are slowed along the line so that when the materials arrive at the bottleneck, they can pass more easily. This is a very traditional approach to maintaining a constant production rate (Rosar, 1998).

Managing bottlenecks requires open communication with personnel and a good manufacturing model. Manufacturing line employees and engineering staff should be constantly aware of the existence of bottlenecks in their area and be prepared to either address them or report them as appropriate. Often times their feedback is an excellent source for reviewing day-to-day and bottleneck problems. Also, the manufacturing model is the manager's tool for planning future changes in the line and to prepare for whatever challenges that might exist.

As bottlenecks emerge and are corrected it appears that this is an ongoing battle to achieve efficiency, which in essence it is and one that all members of the manufacturing organization should be concerned. It is in the magnitude of the bottleneck that true concern should lay and in order to prevent a catastrophic bottleneck the use of effective planning measures is highly necessary.

Capacity planning uses present information to apply towards future production changes

and new product introductions as well as dealing with added machine capability, running multiple products and attempting to compensate for marginal resources. This is especially important since in competitive environments organizations must be able to respond to dynamically changing market conditions and demands. Therefore, a unified approach to capacity management is necessary in order to deal with customer demands, changing product lines, and production expectations in the pursuit of being competitive (Ashayeri & Selen, 2005). In order to do so, the ability to review "what-if” scenarios is a powerful tool for making accurate and safe decisions.   By using effective forecasting tools to predict line performance through simulation models can help, manufacturing managers plan for volume changes, product changes and emergencies, or simply optimize their current production rate. It is then necessary for manufacturing firms to develop capacity strategies in order to response to the goals established in the forecasting process. There are three major strategies for adding capacity including, proactive, neural, and reactive (Davis & Heineke, p. 390, 2005).

In the proactive strategy, management anticipates future growth and builds the facility so that it is up and running when the demand is there. This is a preferred approach as opportunity costs resulting from lost sales due to an inability to meet demand are minimized by being prepared to meet competitors or lead competitors.

The second approach is known as neutral. This is considered to be the “middle of the road” approach since capacity becomes available when demand is about 50 percent of planned added capacity. This permits an organization to ease into capital investments while keeping a reasonable pace with future demands.

The last approach is a reactive strategy. In this method, plant capacity is not added until all of the planned output from the facility can be sold. This can be beneficial especially when the product lifecycle is coming to an end and future capital investment would result in a loss to the company. This can also be a reasonable solution when competitiveness is not a major concern or when increasing capacity can be done quickly.

Conclusion

To manage bottlenecks, knowledge of various bottleneck types and configurations and constraints that surround these restrictions is required. Both a good line operating staff and a complete assembly line model are key ingredients to properly locating and evaluating bottlenecks in the pursuit of organizational excellence.

References

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