CONSTRAINT MANAGEMENT SYSTEM – OPTIMIZED PRODUCTION TECHNOLOGY (OPT)

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System developer: Israeli physicist Goldratt (in the 1970s in the USA and introduced in the 1980s by Creative Output). The basis of this system is the notion that constraints that occur, also known as bottlenecks, have a significant impact on production activities as well as on the utilisation of raw materials and materials in the production process.

A constraint, or bottleneck, is any machinery, equipment or other production resource that limits production.

This contains 4 modules:

1. Buildnet - an information database;
2. Serve - identification of constraints, or "bottlenecks";
3. Split - division of workspaces into 2 groups:
   - Normal worksites,
   - Bottlenecks;

The OPT system is designed for production shop scheduling. It is very sensitive to changes in data, including for example new orders, missing information, etc. A failure at a bottleneck cannot intervene because the entire planning process is meaningless. For this reason it is necessary that increased capacity be available at bottlenecks. In order to eliminate bottlenecks capacity must be expanded at the given bottleneck, e.g. via overtime work.

Goldratt's Rules

It is necessary to emphasise that the OPT system represents another significant step towards the systematic understanding and resolution of production management problems. These advances in the systematic understanding of production management problems are best reflected in the OPT rules formulated by its developer, the Israeli physicist A. Goldratt. Specifically these are the following 10 rules:
1. Balancing materials flow rather than balancing capacity leads to more efficient production management,
2. The level of resource utilisation at areas other than at production system bottlenecks is defined by system limitations and not the potential at the specific location.
3. Utilisation and activation of a resource are not synonymous.
4. An hour lost at a bottleneck is an hour lost for the entire system.
5. An hour saved at a non-bottleneck does not provide any value for the system.
6. Bottlenecks determine throughput as well as the level of inventory in the system.
7. The transport batch does not have and often should not be the same as the production batch.
8. The production batch should be variable over time along the entire production process schedule.
9. Production schedule should be created with respect to all limitations of the production system.
10. Lead times are a product of the schedule and cannot be established in advance.

**The Basic OPT Concept**

The central idea of the OPT system is the concept of bottlenecks in terms of the entire system (connected to production systems). OPT defines bottlenecks as the part of the production system that has the lowest production potential. The production potential of a production system is composed of all production factors (labour, equipment, technology, organisation, materials, financing and management) and their dynamics (with regards to individual production process operations). Complete harmony between the partial potentials of the individual factors is nearly impossible to achieve. The production system bottleneck is the factor with the lowest production potential.

Consideration afforded to bottlenecks for this very reason cannot be simply reduced to only equipment, as is frequently the case. The bottleneck itself is the decisive factor in determining how much the given production system is capable of producing (in a given time period). It is clear from the reasoning above that if a bottleneck can be removed from the system (for example by hiring new workers, expanding or perfecting equipment, depending on what the specific bottleneck happens to be) then the bottleneck becomes the factor in the new situation, again, the has the lowest production potential. For this reason it is possible to characterise a production system using various kinds of bottlenecks.

The core OPT concept stems from the bottlenecks as these bottlenecks themselves define the productive potential of the system and as a consequence these must be given specific attention within production management. The first and most
important task is uncovering the first level bottlenecks in the current situation. Bottlenecks dynamically change depending on production conditions, required quantities and the range of products. First level definition of bottlenecks is not enough on its own it is necessary (based on experience) to move into the second, third, fourth and higher levels.

Due to the fact that the production system can only produce so much due to bottlenecks it follows that bottlenecks also define the system's potential. If the need to increase the volume of production is shown then the key question becomes how to "expand" bottlenecks using technical, organisational and other measures.

It has also been shown that the concept of bottlenecks corresponds to the volume of production and has significant economic consequences. If a continuous flow of materials can be secured (it is here than the OPT concept is connected to JIT) in spite of the bottlenecks it is possible to achieve significant reductions in inventories, improved capacity utilisation as well as decreases in lead times for products, all of which have a positive effects on costs and the competitiveness of the company.

The OPT system modifies the JIT approach in that it applies the pull principle, exactly as applied in the JIT system, yet in an adapted manner so that such a pull force is generated by the bottlenecks. The pull principle is applied on the downstream side of the bottleneck and subsequently the push principle is applied on the upstream side of the bottleneck until the end of the process itself. The no-inventory principle is also modified in that a specific level of inventory is allowed but only for the bottlenecks in the system.

This gives rise to a production management concept some have named "DBR - Drum - Buffer - Rope".

The bottleneck provides a rhythm to work in the system (drum); the bottlenecks "pull" materials (rope) and it is necessary to secure necessary inventory levels (buffer).

The OPT system can also be characterised as a significant advance in perfecting production management and it is no wonder that is has a significant repercussions in production management theory and practice. It has been incorporated into a specific philosophy that is underpinned by application software. A number of companies apply it (in spite of the high costs and limitations as only the application version of the system can be purchased) as it has been shown that it brings significant returns on investment. [1]
Benefits of the OPT System

The basic benefits of the OPT system can be seen in the increase in production system performance and efficiency. The OPT system eases a number strict requirements of the JIT system, thereby allowing it be more suitable for companies outside of Japan.

*The main benefits of the OPT system are considered to be:*

- An increase in the volume of production using the same resources of up to 10 %,
- A decrease in the level of inventory by up to 20 %,
- A decrease in costs of up to 7 - 10 %,
- Shortening of production lead times by 20 - 30 %.

In addition to the benefits shown above the OPT system also brings a number of other benefits in terms of increasing the level of the organisation and improved conditions (in particular the ability to concentrate on key company business and problems).

Conditions for OPT Application

The OPT system brings a number of progressive elements to the concept of production management. Priority is given to the use of MRP I and MRP II systems as well as the JIT system; however some of this system's strict requirements are eased. This makes the OPT system very attractive for our companies. In terms of its application it brings a number of advantages. The most important advantages were presented below:

- The OPT system matches the management culture and mentality used within managerial thinking by our managers.
- The OPT system can be implemented progressively, starting from the smallest organisational units, which can then be gradually expanded and deepened.
- The system is compatible with MRP I and MRP II systems and uses them for support.

Overall the OPT system can be assessed as a very progressive system with great future prospects for our companies. [2]
Summary

The paper deals with the constraint management system – optimized production technology (OPT). The basis of this system is the notion that constraints that occur, also known as bottlenecks, have a significant impact on production activities as well as on the utilisation of raw materials and materials in the production process. The basic benefits of the OPT system can be seen in the increase in production system performance and efficiency.

Key words

Optimized production technology (OPT), system, management

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