"THEORY OF CONSTRAINTS"

QUALITY TOOLS
Lean

Description of Theory of Constraints

Theory of Constraints or TOC is a thinking process developed by Eliyahu Moshe Goldratt, an Israeli physicist, while working for a software company in the early 80s'. Goldratt noticed that several software implementations did not come close to their estimated potential. He researched and discovered that the habits and assumptions of employees and managers prior to using the software negatively influenced results after implementation.

The Goal, his book that synthetized and exemplified the Theory of Constraints application in business novel form, was written to answer to those issues. It states that, in order to solve a performance problem, one should start from a systemic instead of a local point of view. It also says that every system, no matter how well it performs, has at least one constraint, or weakest link, that limits its performance.

In Goldratt's own words "Every action taken by any organization – any part of the organization – should be judged by its impact on the overall purpose. This immediately implies that, before you can deal with the improvement of any section of a system, you must first define the system's global goal; and determine the measurements that will enable us to judge the impact of any subsystem and any local decision, on this global goal… A system's constraint is nothing more than what you feel to be expressed by these words: anything that limits a system from achieving higher performance versus its goal… In our reality any system has very few constraints… and at the same time any system in reality must have at least one constraint."

When to use the Theory of Constraints

When there are complex, interrelated and difficult to identify performance problems associated to a system, local measures tend to drain resources without necessarily improving the system's performance. On the other side, starting with identifying the system's constraints and working with them can leverage the improvement efforts and rapidly increment the system's performance.

Therefore, TOC can be used to prioritize actions and, allied to Lean Six Sigma, develop a roadmap toward operational excellence.

How to use the Theory of Constraints

Before start improving performance with kaizen or Lean Six Sigma projects and getting rid of every waste, one should give a broad look at the organization as a whole. In order to do that, Goldratt suggests three key measurements:

1. Throughput - rate that the system is used to generate money through Sales or the money coming in minus raw materials and purchased parts.

2. Inventory - all the money that the system has invested in purchasing things which it intends to sell, or the money currently inside the system like

- Raw materials and finished goods.
- Machines and fixtures (if owned).
- Scrap material that is to be sold is inventory until sold.

3. Operational expense - all the money used to turn inventory into Throughput or the money one should pay out to make throughput happen like

- All employee time.
- Depreciation of a machine
- Scrap material thrown away.
- All expenses not deducted in arriving at throughput, including direct labor and all operating and maintenance expenses.

5 Steps of TOC

1. Identify the system's constraint(s)

   What process or process step limit system's throughput because of its own performance?

2. Decide how to exploit the system's constraint(s)

   Is the system constraint idle for a period of time? Why? How to change it?

3. Subordinate and synchronize everything else to the above decisions

   How to change processes around the constraint to minimize the constraint idle time and ensure that it works most of the time?

4. Elevate the performance of the system's constraint(s)

   Is it possible to increase the constraint performance at little or no cost? Will an additional resource to elevate the constraint performance bring a return

that worth the investment?

5. If in any of the above steps, the constraint has shifted, go back to Step 1 but do not allow inertia to cause a system constraint.

   With the improvements in the constraint, is another process or process step performance holding the system's performance?

Tips on use of Theory of Constraints

1. It's important to challenge the idea of start improving everything and get a holistic view of the organization.

2. Mapping the process, identifying its most important steps and calculating the performance per unit of time of each process or process step helps identify the constraint(s). The constraint of the system is the process or process step with the smallest performance per unit of time.

3. The unit of time can be hours, days, months or even years and should be the same throughout all comparing performances.

4. Look for overloaded resources and product inventories throughout the shop floor as a hint to identify a constraint.

5. Calculating the local performances will also allow balancing the work load and number of resources.

6. Once the constraint is identified all the resources should follow the constraint's rhythm of production otherwise either the system will produce much inventory or the constraint will not have enough to work with.

Application of Theory of Constraints

Autoclaves and resources around them should be looked at carefully. In a real life example a facility had automatic washers as a constraint at certain times but the real burden for the system's performance was a resource responsible for administering the autoclaves. As the prior steps produced something to sterilize, either the items waited throughout the line or piled up for long hours to be properly prepared by the constraint. Some effective measures to improve the system were

1. Elevate the constraint, putting another resource to administer the autoclaves at peak times.

2. Make sure all the produced items were in a queue before the autoclave administrators.
3. Balance the line before the constraint to make sure all the steps produced in a rhythm to make sure the constraint was working all the time.

4. Keep reminding the supervisors about the importance of the autoclaves administrators work reflected and measured on the autoclaves idle time.

After putting these measures in place both the time to finish all the sterilizations and sterilizers idle time reduced.

References

Bates, Dr. Seth, *Theory of Constraints Presentation*, Department of Technology, Charles W. Davidson College of Engineering, San José State University.

Goldratt, E.M. and Cox, J. 1992. *The Goal - A Process of Ongoing Improvement. Second Rev*. Ed., North River Press Publishing Corporation, Great Barrington, MA.

Goldratt, E.M. (1994). *It's Not Luck*. North River Press Publishing Corporation, Great Barrington, MA.

Dee Jacob, Suzan Bergland and Jeff Cox. 2010. *Velocity: Combining Lean, Six Sigma and the Theory of Constraints to Achieve Breakthrough Performance - A Business Novel*. Free Press, New York, NY.