The Goal

A Process of Ongoing Improvement

Second Revised Edition

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1. ***The Goal* is a novel about a manufacturing plant manager's quest to improve his factory.** He learns: Since any organization has one goal, improvements must directly address that highest organizational goal. Local optimizations are irrelevant, and may be harmful to the overall goal. Every complex process is constrained by the slowest process. Improvements must address this constraint. Efforts elsewhere are meaningless. Machine constraints have many solutions. Policy constraints are difficult to address.

2. **Any organization can have only one goal.** Defining the goal is therefore critically important. Productivity is work that brings an organization closer to its goal. Every action that does *not* bring a company closer to its goal is *not* productive. In the novel, the goal is: "To increase net profit, while simultaneously increasing ROI, while simultaneously increasing cash flow." The measures are:

   - **Throughput** (T) is the rate the system generates money through sales, not production.
   - **Inventory** (I) is the total money invested in purchasing things intended to sell.
   - **Operational Expense** (OE) is the money spent to turn inventory into throughput.

   All three measures are optimized simultaneously. Firing people does one, but hurts the other two. Cost saving at each step does NOT support the goal. Focus on throughput, not cost. Don't cut each link of the chain, measure the overall strength, then help the weak links, also known as "bottlenecks." Local efficiency is nothing. System efficiency is the key.

3. **Dependent sequential events are uniquely related.** The example is a column of boy scouts on a hike: you can go slower, but you can't go faster. The speed of the column is tied to differences in walking speed. Not an average, but an accumulation of slower fluctuations. Dependency limits the faster fluctuations. Throughput is the rate of the last event.

   The amount of trail is inventory. Slower walkers increase inventory. Inventory goes up (bad), throughput goes down (bad), and operational expense (to catch up) goes up (bad). With a slow file of boys, put the slowest up front to reduce inventory. Lessen his load to speed the pace, and increase throughput.

4. **Robot example**. Two stations: Preparation station prepare 25 pieces an hour. Then a robot works on 25 pieces per hour. When prep people fall behind, they do 19, 21, 28, and 32 = 100. Still 25 pieces per hour. But robot does 19 (max available), 21 (max available), 25 and 25 = 90. Prep is bottleneck.

5. **Bottleneck insights:**

   - All processes are either a bottleneck (constraint where flow < demand), or a non-bottleneck.
   - Bottleneck flow should be equal to market demand. Use bottlenecks at 100%. No idle time.
   - Bottleneck throughput equals plant throughput. *An hour lost at a bottleneck is an hour lost to the whole system*. An hour saved at a non-bottleneck is irrelevant.
   - Cost of bottleneck is the cost of the *entire plant* divided by number of bottleneck hours available.

6. **To increase bottleneck throughput:**

   - Keep machine continuously manned. New lunch rules. Extra workers. Immediate maintenance.
   - Put quality-control checks in *front* of machine to prevent working on rework items.
   - Reduce load on bottleneck. Activate older machines to augment bottleneck machine.

- Work only on things needed now: current demand.

7. **A measure of performance is work-in-process (WIP) inventory**. Cut batch size in half to reduce cycle time, save WIP inventory. If setup time is 120 minutes and process time is 5 minutes each, then 100 parts cost 6.2 minutes per part. 50 parts cost 7.4 minutes per part. This efficiency is an illusion. Use the excess capacity that exists. The real savings is inventory. Cut batch size to reduce inventory, which saves money.

8. **The Theory of Constraints.** TOC is elegantly simple. *Throughput* (T) is the critical index of performance. *Inventory* (I) and *Operating Expense* (OE) are the other two.

   (1) **Identify the constraint**. The weakest link that limits the system's capacity. The system's efficiency, the system's throughput rate, the system's cost, is defined solely by the weakest link. It may be a physical or behavioral constraint. Look for piles of built-up inventory
   (2) **Exploit the constraint**. Use 100%. Maximize the performance of the constraint. That pace is the heartbeat of the operation. Usually, there are multiple steps that increase this throughput rate.
   (3) **Subordinate everything else to the constraint**. All other processes support the constraint, even if some portions of the process are made less efficient or actually slow down. Capacity lost on a non-bottleneck has no effect. That resource had extra capacity anyway.
   (4) **Elevate the constraint**. If performance cannot meet demand, acquire more capability.
   (5) **Once constraint is addressed, go back to step (1).** TOC is iterative. Once one constraint is solved, the next slowest process becomes the new constraint.

   The real constraints are usually policies, not procedures or machines!

9. **"Drum – Buffer – Rope" (DBR) is an implementation of the theory of constraints**. The drum is the pace of the bottleneck, the production schedule which regulates the whole system. Buffers are allotments of materials or time. A buffer of WIP inventory in front of a bottleneck keeps the bottleneck working when the system experiences delays. The rest of the system should have very low inventories. The rope is the demand signal to pull new material into the system. Queues are short or non-existent. It is one hundred times easier to schedule one constraint than to try to schedule all of them.

10. **Old habits die hard.** Avoid local measures of effectiveness or efficiencies. Measure the performance of the entire system to the goal. Performance is improved when *T* increases, *I* reduces and/or *OE* reduces.

Additional Notes on the Theory of Constraint (TOC) taken from:

1. Boyd, Lynn and Mahesh Gupta, "Constraints management: What is the theory?" *International Journal of Operations & Production Management*, Vol. 24, No. 3/4 (2004), p. 350.

2. Coughlan, Pamela, and John Darlington, "As fast as the slowest operation: The theory of constraints," Management Accounting, Vol. 71, No. 6 (1993), p. 14.

3. Dickey, Lynn M., "Slashing cycle time in all we do: Techniques for success," *Hospital Material Quarterly*, Vol. 17, No. 4 (1996), p. 62.

4. Lubitsh, Guy, Christine Doyle, and John Valentine, "The impact of theory of constraints (TOC) in an NHS trust," *The Journal of Management Development*, Vol. 24, No. 1/2 (2005), p. 116.

5. Mabin, Victoria J., and Steven J. Balderstone, "The performance of the theory of constraints methodology: Analysis and discussion of successful TOC applications," *International Journal of Operations & Production Management*, Vol. 23, No. 5/6 (2003), p. 568.

6. Pegels, C. Carl and Craig Watrous, "Application of the theory of constraints to a bottleneck operation in a manufacturing plant," *Journal of Manufacturing Technology Management*, Vol. 16, Iss. 3 (2005), p. 302.

7. Smith, Frank O., "A little TOC goes a long way," *MSI*, Vol. 21, Iss. 8 (2003), p. 34.