

A BRIEF NOTE ON THE THEORY OF CONSTRAINTS

In 1977, Eliyahu M. Goldratt, an Israeli physicist turned management consultant and philosopher, established Creative Output, Inc. (COI) and developed production-scheduling software called Optimized Production Technology (OPT). The software was criticized for being a “black box” whose underlying principles were incomprehensible to most managers. So, in 1985, Goldratt published *The Goal*, a novel about manufacturing. In it, a plant manager fights to save both his plant and his marriage, and is successful only after adopting the OPT doctrines offered by a thinly disguised Goldratt. This creative approach to marketing his theory proved to be ideal, as the book was easily understood by all kinds of company personnel all over the world. In fact, many manufacturing managers believed that the book was actually written about their own facilities because the story was so close to their own experiences.

This brief note offers an introduction to the Theory of Constraints (TOC), and summarizes the principles outlined in Goldratt’s novel and TOC. **Exhibit 1** contains excerpted editorial reviews of *The Goal* taken from Amazon.com.

The Goal of a Business

In *The Goal*, Goldratt illustrates that the goal of manufacturing organizations is to make money, and that the process can be defined in terms of three criteria: (1) throughput, defined as the rate at which money is generated through sales; (2) inventory, defined as the money invested in purchasing things intended for sale; and (3) operating expense.

The philosophy had three major tenets. First, scheduling that maximizes production profitability must focus on constraints (bottlenecks) and match operational output to market demand. Second, the widespread use of standard costing in decision making is counterproductive. Finally, Goldratt stressed that maximizing the efficiency of each single operation in a production process is quite often detrimental to the performance of the entire process.

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Goldratt devised a set of nine rules that summarize his principles of optimized production:

1. Balance flow, not capacity.
2. The level of use of a nonbottleneck is not determined by its own potential but by some other constraint in the system.
3. Utilization and activation of a resource are not synonymous.
4. An hour lost at a bottleneck is an hour lost for the total system.
5. An hour saved at a nonbottleneck is just a mirage.
6. Bottlenecks govern both throughput and inventories.
7. The transfer batch may not and, many times, should not be equal to the process batch.
8. The process batch should be variable and not fixed.
9. Schedules should be established by looking at all the constraints simultaneously. Lead times are the result of a schedule and cannot be predetermined.

As can be seen from the list, many of the rules address issues related to bottleneck resources—those constraints on the system that limit the ultimate goal, making money. In the book, Goldratt uses the metaphor of a troop of Boy Scouts on a hike through the woods. The scout who slows down the troop's progress (i.e., the bottleneck) is named Herbie. Thus, today, if you go to manufacturing facilities in most parts of the world and ask, where's your Herbie? the plant personnel will take you directly to their bottleneck machines.

In order to have the philosophy of *The Goal* cover more than just manufacturing operations, Goldratt's emphasis on bottlenecks led him to codify his approach to problem solving into a structured process he called the Theory of Constraints. TOC is a five-step process:

1. Identify the system's constraint(s).
2. Decide how to exploit the system's constraint(s).
3. Subordinate everything else to the decisions made in step 2.
4. Elevate the system's constraint(s).
5. If a constraint is broken in step 4, go back to step 1, but don't allow inertia to become the system's primary constraint.

The ideas from *The Goal* are directly related to TOC. The key concept is to prevent "constraints" (i.e., bottlenecks) from limiting the profitability or output of an organization. Once the constraint is identified, it must be "exploited." In TOC, "exploitation" refers to the fact that, once the system's constraint is identified, management's attention should be focused on the constraint above all else. Because this "Herbie" limits output, he/she/it should not be permitted to be idle. Recall from rule 4 above that an hour lost at the bottleneck is an hour lost for the total system. Thus, this constraint

should not remain idle. In many organizations, the constraint may actually be sales or a lack of customers. Step 3 warns us not to let nonbottlenecks create constraints on the system's constraints, and step 4 advises us to increase capacity at the bottleneck resource. Note that steps 2 and 3, through better system management, allow us to find hidden system capacity.

These steps are applicable to manufacturing and service operations as well as for-profit and not-for-profit organizations. Many examples can be found on the Goldratt Institute's Web site, www.goldratt.com.

Since publishing *The Goal*, Goldratt has written a number of other books, including the following:

1. *The Race* (applying TOC principles to accounting)
2. *It's Not Luck* (applying TOC principles to marketing)
3. *Critical Chain* (applying TOC principles to project scheduling)
4. *Necessary but Not Sufficient* (applying TOC principles to enterprise-planning systems)

The Goal is a seminal work that has significantly changed the way managers think. A quote from the video of the book, produced by the Goldratt Institute, summarizes a major tenet of the TOC approach: "Alex, if you're like nearly everybody else in this world, you've accepted so many things without question that you're not really thinking at all."

Exhibit 1

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Excerpted Editorial Reviews of *The Goal* from Amazon.com

Publishers Weekly—“In this intriguing, readable business novel, which illustrates state-of-the-art economic theory, Alex Rogo is a UniCo plant manager whose factory and marriage are failing. To revitalize the plant, he follows piecemeal advice from an elusive former college professor who teaches, for example, that reduction in the efficiency of some plant operations may make the entire operation more productive. Alex’s attempts to find the path to profitability and to engage his employees in the struggle involve the reader; and, thankfully, the authors’ economic models, including a game with matchsticks and bowls, are easy to understand. Although some characters are as anonymous as the goods manufactured in the factory, others ring true. In addition, the tender story of Alex and his wife’s separation and reconciliation makes a touching contrast to the rest of the book. Recommended for anyone with an interest in the state of the American economy.” Copyright © 1986 by Reed Business Information, Inc.

The Economist—“A survey of the reading habits of managers found that, though they buy books by the likes of Tom Peters for display purposes, the one management book they have actually read from cover to cover is *The Goal*.”

[*AudioFile*](#)—“In a business text disguised as a novel, a remarkable cast of actors dramatizes a fascinating tale of discovery and redemption. In the story, the manager of a troubled plant learns from a mathematician turned consultant that many of his management practices and economic assumptions are faulty. After he retools his thinking, he convinces everyone else at the factory to get with the new program. The story’s flow is slowed by extraneous dialogue and subplots, but it’s still a good story and a captivating format for serving up the authors’ message—that businesses weighed down by archaic habits can be wildly profitable when fresh mathematical methods are implemented with courageous persistence.” Copyright © 2001 by AudioFile, Portland, Maine. [This review refers to the [Audio Cassette](#) edition.]

Fortune—“Like Mrs. Fields and her cookies, *The Goal* was too tasty to remain obscure. Companies began buying big batches and management schools included it in their curriculums.”

Punch—“Anybody who considers himself a manager should rush out, buy, and devour this book immediately. If you are the only one in your place to have read it, your progress along the path to the top may suddenly accelerate . . . one of the most outstanding business books I have ever encountered.”

Book Description—“Over 2 million copies sold! Used by thousands of companies and hundreds of business schools! Required reading for anyone interested in the Theory of Constraints. This book, which introduces the Theory of Constraints, is changing how America does business. *The Goal* is a gripping, fast-paced business novel about overcoming the barriers to making money. You will learn the fundamentals of identifying and solving the problems created by constraints. From the moment you finish the book, you will be able to start successfully addressing chronic productivity and quality problems.”