According to the Goal: How Eliyahu Goldratt Helps Organizations Examine Their Processes to Achieve Maximum Results

Christian Winter

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Abstract:
Eliyahu Goldratt's "Theory of Constraints" has helped companies around the world improve their profit margins by effectively managing business processes. Goldratt first introduced his theory in 1984 with the book *The Goal: A Process of Ongoing Improvement*. This paper summarizes Goldratt's book and explains the business model he proposes. The model is expanded in his later book, *The Theory of Constraints*.

Further, Goldratt's business model is examined in a case study of i2 Technologies. i2 Technologies is one of the fastest-growing companies in the world and supplies software to business to help them function according to the "Theory of Constraints." The success story of i2 Technologies explains why managers in the world's top companies embrace Goldratt's model to overhaul their traditional business processes to become more efficient and profitable.
Introduction

Eliyahu Goldratt is one of the most influential persons in business process analysis. His world-renowned book, *The Theory of Constraints*, has overhauled company structures around the world. The book *The Goal: A Process of Ongoing Improvement* was published prior to *The Theory of Constraints*, but includes the core ideas that Goldratt expands on in the later book.

*The Goal* is unique, because it explains a business model in detail through the use of fiction. In fact, the story includes many personal drama elements. Alex, the main character of the story, has extensive marital problems, because he spends too much time at the plant and ignores his spouse and children. Alex eventually balances family life with his career, but only after he deep consideration of business processes and time away from his family.

In order to further promote his ideas, Goldratt founded the *Avraham Y. Goldratt Institute* in 1996, named after his father. Over the years, “Theory of Constraints” (TOC) experts have expanded his model and contracted with businesses to improve their bottom line potential. By now, the TOC model has been applied to diverse industry sectors, including: aerospace, automotive, construction, defense, distribution, education, healthcare, manufacturing, services, semiconductor, technology, and telecommunications (AGI-GoldrattInstitute, 2005).

The list of clients that the AGI-Goldratt Institute serves is impressive. Not only does it include over fifty companies, but among them are some of the world's most renowned companies such as: 3M, Boeing, General Motors, Intel, and Lockheed Martin. Goldratt's TOC has proven to be the most effective way to structure a business, regardless of the business type. Any business will have constraints, which directly affect its ability to increase its net profit (bottom line).

This paper will summarize Goldratt's *The Goal: A Process of Ongoing Improvement* and the business model he proposes. Further, I will conduct a case study on *i2 Technologies*, a Dallas based Supply Chain Management company founded in 1988 on the TOC model by Goldratt. Today, *i2 Technologies* helps companies such as Nokia, Siemens, and IBM improve their net profit and eliminate inefficiencies.

**Summary of Book**

*The Goal: A Process of Ongoing Improvement* is a work of fiction describing a very real thing -- the process of manufacturing a product. This includes the engineering and production process, marketing, sales, and interaction with corporate and regional headquarters. As an employee in a corporate contract manufacturing environment, reading this story does not sound like a work of fiction at all. In fact, in many instances this book seems to describe “my plant.” The following is a brief summary of the fictional story.

The main character in the story is Alex Rogo. He is the plant manager of a UniWare Division plant in Bearington. Readers are never fully introduced to what kind of products they make, but soon learn that UniWare requires heavy machinery and elaborate engineering processes to manufacture their products.

Alex’s plant has not been profitable for some time, and the division president informs Alex that the Bearington plant will be closed within three months, unless there are visible improvements. Alex decides that he will not give up on the plant, because it is in his home town and he has an increased sense of responsibility for the plant’s future.

In order to overhaul the plant, Alex contacts his former professor, Jonah. Curiously, Jonah is a physicist, yet Alex remembers a meeting with Jonah a few months ago during which Jonah questioned Alex’s business decisions. Alex was scheduled to give a presentation at a UniWare Division meeting, but Jonah particularly raised questions about the way Alex defines productivity
and efficiency in his presentation. Alex was upset about this, because he has an MBA, yet he feels that Jonah is "just" a scientist.

It turns out that Jonah has been an independent consultant to businesses to help them be more productive. He is very busy and travels frequently. During several phone conversations and face-to-face meetings, Jonah explains his business model to Alex. He does this by giving Alex definitions to examine plant structures. He also explains correlations that determine the success of the business.

At the heart of Jonah's business model are three definitions: throughput, or "the rate at which the system generates money through sales," inventory, or "all the money that system has invested in purchasing things which it intends to sell," and operational expense, or "all the money the system spends in order to turn inventory into throughput" (Goldratt and Cox, 1992, pp. 60, 61). Using these definitions, Alex always has a basis to determine if his decisions are helping the plant move towards the goal. The goal of the plant is to make money, which is characterized by increasing throughput and decreasing inventory and operational expense.

The story progresses through Alex's struggles at home and in the plant. Just as in everyday life, there are several victories followed by set-backs. However, through hard work and with the use of a skilled team and Jonah's help, Alex is able to make the plant the most productive one within the UniWare Division. Alex is promoted to lead the UniWare division as president and is entrusted with implementing his (Jonah's) business model throughout the entire division. Alex's marital life also ends happily, because he and his spouse resolve their conflicts.

This summary is brief and leaves out many of the fictional elements that make the story such an interesting and fast-paced read. I encourage anyone that is interested in learning about manufacturing a product to read Goldratt's book. It is the most efficient way to understand the challenges involved in manufacturing processes. In this paper, I will focus on the business model Goldratt describes.

Eliyahu Goldratt's Business Model

Eliyahu Goldratt's *The Goal: The Process of Ongoing Improvement* was first printed in 1984.Ever since, the book has sold more than one million copies. In 2004, it was released in its third edition. When Goldratt introduced the book it created a minor earthquake. Goldratt attacked some of the most basic procedures in manufacturing plants all over the US and other parts of the world. Suddenly, a guy from Israel (of all places) comes along and tells manufacturing industries that cost accounting is profoundly flawed. He claimed that managers should refrain from using performance incentives, economic order quantities (EOQ) should be thrown out, and productivity and product cost are really not what they seem (Sytsma, 1997). It seems as if those two years in Business School and that MBA on the wall are worth nothing according to Goldratt's common sense approach. The following will examine and contrast Goldratt's business model with the way we traditionally look at manufacturing businesses.

Goldratt's business model is based on two principles. The first principle defines three ways to measure whether or not businesses are achieving the goal of making money. These three measurements are interrelated and easy enough to apply to any process. The three measurements are throughput, or "the rate at which the system generates money through sales," inventory, or "all the money that the system has invested in purchasing things that it intends to sell," and operational expense, or "all the money the system spends in order to turn inventory into throughput" (Goldratt and Cox, 1992). The second principle of Goldratt's model relates dependent events and statistical fluctuations to the manufacturing process. Dependent events are processes that must first take place before other ones can begin (Goldratt and Cox, 1992). An example would be a car assembly line. Before the engine is put
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into the car the frame must be finished and the steering wheel cannot be attached until the steering column is put into place, etc. Statistical fluctuations occur when one is unable to precisely predict events or quantities (Goldratt and Cox, 1992). The book presents an excellent example illustrating this. Alex and Jonah sit in a restaurant and Jonah points out that they are able to precisely predict the capacity of the restaurant by counting the available seats. On the other hand, they are unable to predict how long the waiter will need to fulfill their order (Goldratt and Cox, 1992). This uncertainty is referred to as statistical fluctuations.

Using these two principles we are able to apply them to the traditional business model. This model relies on forecasting and efficiencies. In this system, it is constantly the goal to reduce cost of production and keep processes running at maximum efficiency. In many cases, this model is on a micro-level, because it accounts for specific areas of the system instead of focusing on the entire system. For example, it is most efficient to have every worker and machines run constantly at 100 percent. If this is the case, a company gets the most out of their investment into the labor force. Companies realize that 100 percent is a utopian figure and scale it to an acceptable range of 85 to 95 percent. This efficiency rating is then used to forecast how long it will take for processes to occur and a production schedule can be determined. Oftentimes this schedule is inaccurate and companies miss out on opportunities to make money. Instead of focusing on the actual capacity of the entire system, capacities are determined for individual stages, limiting the company’s ability to make money.

The business model illustrated in *The Goal: A Process of Ongoing Improvement* can remedy this situation. In 1992, Goldratt titled his model the “Theory of Constraints” after a book he wrote with the same title. It suggests that companies should scale their entire production to the process within the system with the lowest capacity; the bottlenecks. This will make the system appear less efficient, because areas in the factory may stay idle if they have a much higher capacity than bottleneck areas. However, implementing this approach will directly add to the bottom line. The “Theory of Constraints” uses dependent events and statistical fluctuations as its base.

Using the three measurements, we can see why limiting production to traditionally inefficient rates actually increases the bottom line. The starting point to understand this concept is throughput. Every time throughput increases, the company’s sales increase, which directly adds to the bottom line. Throughput can only increase if the area of lowest capacity increases its rate of throughput. Running areas of the factory that have higher capacities at 100 percent will not increase the overall throughput of the system, and sales do not increase. The measure that increases is inventory, because the factory produces parts that cannot be assembled into finished goods until the area of lowest capacity produces enough parts. Inventory is an investment of money and thus subtracts from the bottom line. Keeping large amounts of inventory will further subtract from the bottom line, because warehouse space is costly. Lastly, running every worker and machine at 100 percent seems efficient but does not help the bottom line by reducing operational expense. The worker has been paid regardless if s/he works at all times. Machines have also been obtained and operational expense does not decrease when the highest efficiency rating is reached. In fact, running every machine at 100 percent can increase operational expense for machines, since they lose life-time hours and consume energy. Every machine/worker must adjust its throughput to the throughput of the area with lowest capacity. This assures that operational expense and inventory stay at a desirably low figure. In fact, Goldratt suggests that this is the most efficient way to run any manufacturing business, regardless what the percent-efficiency rating of any area.

In *The Theory of Constraints*, Goldratt introduces mathematical formulas to help organizations further judge their processes. These formulas are:
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- **Net Profit** = **Throughput** – **Operational Expense**

- **Return on Investment** = \(\frac{\text{Throughput} - \text{Operational Expense}}{\text{Inventory}}\)

- **Productivity** = \(\frac{\text{Throughput}}{\text{Operational Expense}}\)

- **Turnover** = \(\frac{\text{Throughput}}{\text{Inventory}}\)

The formulas can aid us to further understand the benefits of Goldratt’s model. For instance, we can identify that throughput is very important, because it influences each of the four additional measurements. The formulas also describe why plants running at 100 percent efficiency do not function well. According to the Theory of Constraints, these plants are highly unproductive. As described earlier, throughput does not increase in this scenario while operational expense does. Goldratt’s formula for productivity will yield a lower value in this case. Using the same analogy, net profit decreases and excess inventory is created, which will decrease return on investment. While inventory increases, throughput remains constant which then will decrease turnover. According to Goldratt, it is wrong to run plants at their highest efficiency rating, a concept that clearly shocked US manufacturers.

Another advantage of Goldratt’s model is that it can be applied on the local plant level. Every worker can apply the three basic measures of throughput, inventory, and operational expense. If they are trained to identify that inventory and operational expense cannot be increased unless throughput increase, it will enable them to make good decisions directly on the local level, without using complicated cost accounting terms (Sytsma, 1997).

Professor Sid Sytsma of Ferris State University goes as far as hypothesizing that Goldratt’s Theory of Constraint could be applied to any business and any organization. This is due to the fact that constraints do not have to be physical [2]. This point is valid and many organizations function under this model without even realizing it. Universities only offer as many courses as are necessary and courses offered are limited to the building and labor force capacities. It makes me wonder why many manufacturing plants needed Eliyahu Goldratt’s book to learn about Theories of Constraints.

**Case Study - i2 Technologies**

*i2 Technologies* was founded in 1988 by Sanjiv Sidhu. Prior to founding *i2*, Sidhu worked for Texas Instruments and optimized production by creating software applications based on constraints of the production cycle. Texas Instruments was not interested in commercializing Sidhu’s software, which prompted him to establish *i2 Technologies*.

*i2 Technologies* offers supply chain optimization to its customers. J. Salmi defines the supply chain as “a chain of units that transfer demand data from customers to suppliers and converts the materials received from the supplier into products and services which are delivered to customers” [Salmi, 1998, p. 3]. *i2 Technologies* creates systems that optimize how companies react to changes in supply and demand, and integrates these systems within the entire work-flow of the company.

One of the foremost principles of *i2 Technologies* is to reduce inventories. Goldratt’s TOC states clearly that excess inventory indicates two things: (1) the overall system has not scaled
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production to the system with lowest capacity and (2) the system wastes money by stocking excess inventory that is not immediately converted to throughput, yet raises operational expense.

One solution, i2 Technologies developed was called RHYTHM Ô. RHYTHM Ô was a software application that helped companies connect with suppliers and customers over the Internet. It helped customers respond to market changes and gather intelligence. This software was completely based on TOC and minimized the inventories that companies held at any given time. It also decreased operational expenses by eliminating costly department overhead needed to effectively communicate with suppliers and customers using traditional communication channels, such as telephone and postal mail. Though RHYTHM Ô has been obsolete for three years, other such programs are still being developed and deployed by i2 Technologies.

The software applications that i2 Technologies develop add directly to the bottom line of a company. Because of this, i2 is often listed as a TOC consultant. The most notable principle used by i2 Technologies is called Closed-Loop Supply Chain Management Ô. Closed-Loop Supply Chain Management Ô provides companies with tools to effectively identify the constraints of their supply chain. Constraints within supply chains directly impact the ability of a company to increase throughput.

Closed-Loop Supply Chain Management Ô is a closed-loop system because it provides immediate feedback, which in-turn adjusts critical aspect of the supply chain, including synchronization of goals, measurements, and communications across groups (i2 Technologies, 2005). Having an effective supply chain that reacts to a changing market and customer demands will increase the ability of companies to reduce operational expense, inventory and ultimately increase sales, which directly affect the company's profit potential.

i2 Technologies has shown that the “Theory of Constraints” can effectively help any company work more efficiently and increase the bottom line. i2 Technology has embraced TOC and used it to write software that enables business to operate according to TOC. Using this customer oriented approach, i2 Technologies was ranked eight among the top 100 fastest growing companies in 2000 according to Fortune magazine (i2 Technologies, 2005). i2 Technologies is valued at US$7 Billion and maintained a three-year revenue growth of 71 percent (i2 Technologies, 2005).

Conclusion


Personally, I feel that this book is a must-read for any engineer. Engineers are sometimes portrayed as being out of touch with the real world, demanding things to happen that are difficult, if not impossible, to achieve. On one hand, that is part of the engineering culture -- nothing is impossible. While Goldratt's book does not try to teach engineering, it strives to give insights into the difficulties of making the products engineers design. Armed with such knowledge, engineers will be more valuable to their companies. I feel that it is essential to know the limitations and goals of the entire company in order to effectively design. This is shown primarily in parts of the book where Jonah questions whether certain treatments on parts are necessary. Production managers in the Goldratt's fictional company explain that the engineering department required the special treatment. However, further investigation showed that only 75 percent of the parts truly required the treatment. Wasting 25 percent of company resources on unnecessary processes is unacceptable.
As an engineering intern for an electronics contract manufacturer I see the "Theory of Constraints" functioning on a daily basis. The company I work for applies it in many areas. However, after reading Goldratt's book, I feel that the company could apply his model to additional processes. Local and corporate politics often prohibit the changes that I and others wish to incorporate, which makes me wonder whether Eliyahu Goldratt should write a book concerning company politics as well!

The case study on i2 Technologies truly showed the capabilities of the Theory of Constraints on a real-world model. i2 was founded entirely on Goldratt's theories and i2's success truly serves as an inspiration to other companies. The Theory of Constraints can be the difference for the success of any company, and Goldratt's The Goal: A Process of Ongoing Improvement is the definitive introduction.
Definition of Terms

Bottleneck  
Stage within production cycle that has smaller capacity than most other parts of the production cycle. There is no set numeric value that identifies a bottleneck.

Net profit  
Money acquired through sales subtracted by money invested to make a finished product by using inventory.

Operator  
Person that controls/uses machines.

Production Floor  
Area of a company where products are manufactured. This area holds the machinery or other utilities to help manufacture goods.

Return on Investment  
Profit made divided by inventory used.

Sub-assembly  
A part or product that is needed to assemble a finished good. Sub-assemblies are usually not sold separately but contain enough parts to be treated as a whole.

Turnover  
Money acquired through sales divided by inventory used to make finished goods.

References


