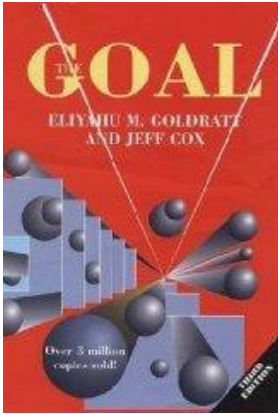


# THE GOAL

## The Theory of Constraints: A Process of Ongoing Improvement

Dr Eli Goldratt's book *'The Goal'* – an overview by Dr Ted Hutchin



Alex Rogo is facing the greatest challenges of his life. The situation has reached crisis point at the plant, and things have been rough at home for as long as he can remember. All the usual business indicators are pointing the wrong way. A chance meeting with his old physics teacher, Jonah, is about to change Alex's life. With guidance from Jonah, his family, and a dash of common sense, Alex and his team uncover the fundamental principles of the Theory of Constraints. Flying in the face of traditional thinking, cost accounting, and accepted procedure and policy, they put the principles into practice to turn the crisis into an unprecedented success.

In this amazing novel you will uncover hidden secrets about yourself and your business as you share in this three-month journey from crisis to triumph. The story revolves around saving a manufacturing plant, but the principles used to save it apply to every industry and every kind of business. You will discover what *The Goal* really is for any business, including yours. You will challenge the accepted measurements and assumptions that have been lying to managers and business leaders for decades. You will learn new measurements, new assumptions and new thinking that – whilst seeming completely wrong to the old system – will bring your company more real success and real productivity than ever before.

You will finally have a clear and accurate picture of your business: whether it is really productive, whether it is really improving, and what to do to turn it around if it's not. Because these principles are presented in a story, a novel, you will automatically start to look at things differently. The journey guides you through your own deductive processes, allows you to prove the theories to yourself, and then draw your own conclusions. Before you know it, you may find your own business – and your life – experiencing just as profound an improvement.

### Alex's Journey Towards The Goal

#### The Ultimatum

Bill Peach turns up early with his Mercedes and his attitude. Peach only turns up when things have really gone sour. After another fight with my wife last night, I arrive at work to find that my manufacturing plant is on the line. All the orders from this plant are shipped late, they always have been, and it's been over seven weeks for order 41427. The plant is losing money; it's a sinking ship. It's been going steadily downhill during my six months here, but this morning Peach tells me I have no more than three months, maybe less, to turn things around or the plant will be shut down. The machinist that Peach yelled at over order 41427 quit after the argument. He didn't tighten a couple of points on the last machine he set up, and brought the whole machine down. It's the biggest machine in the plant and it's the only NCX-10 we've got. It appears that it'll be impossible to get order 41427 out today. We hold everything else, start expediting, and get it out just after 11p.m.

Julie has had her hair done and is all dressed up for dinner and a night on the town (part of the promises while making up after last night's fight). I don't really notice, but say my lines like a well-trained pup, "Looks great." I had forgotten about my promise, and my lack of enthusiasm gave me away. I've got to get back to the plant to sort all this out. Julie cries, but when I explain that they may shut down the plant, her face brightens up. She's always hated this town and she wants out. I grew up in Bearington, and I'm quite happy to be back. Bearington has always been a run-down factory town, and a factory has closed down every year since the mid-1970's. I wonder if it's our turn. At the plant until after midnight, I wrack my brains to figure out how we can be more competitive. We've done everything we can, haven't we? We've got the people, the technology, the materials, efficiency, costcutting, qualifications. What's missing?

## The Meeting

It's still dark. Halfway to the city, the sun rises, but I don't notice. It makes me mad that I'm always running so hard that I don't notice the daily miracles that go on around me. I'm too busy watching the road and worrying about Peach. He and I used to be friends. I worked directly for him in the early days. I did good work and he helped me get up my own ladder: my MBA, my promotions. Once in a while we'd go for drinks together. Everyone thought I was brown-nosing the guy, but I think he liked me precisely because I wasn't. We hit it off together. And now we're screaming at each other. I can't believe it. Peach has called a meeting at 8a.m. for all his plant managers and staff. It's all hush-hush, but everyone has an idea of what it's about. The whole division is going under. Peach has until the end of the year to make good, or in the next merger the division will go, and Peach will go with it. Darn it, I could be on the street in three months! I try to listen to the meeting, but my mind drops out, all I hear are fragments. "... imperative for us to minimise downside risk..." "...required sacrifices..." "...productivity improvements at all locations..."

## Jonah

The meeting is still going on around me. The cigar in my pocket reminds me of when I bumped into Jonah at O'Hare airport two weeks ago. Jonah was a physicist I studied under back at school. I recognised him and we started talking. "Funny, those plans I had back then of going into research, I ended up in business," I say. "I'm a plant manager now for UniCo. That's why I'm on my way to Houston. A manufacturers' association we belong to invited UniCo to be on a panel to talk about robotics at the annual conference, and my plant has the most experience with robots." I reach into my briefcase. "Here we are... 'Robotics: Solution for the Eighties Productivity Crisis'." Jonah seems more interested. But he doesn't seem impressed. "So your plant uses robots. Have they really increased productivity in your plant?" he asks. "Sure they have," I say. "We had a thirty-six percent improvement in one area." "Really... thirty-six percent?" asks Jonah. "So your company is making thirty-six percent more money from your plant just by installing some robots? Incredible." "Well, no," I say. "See, it was just in one department that we had a thirty-six percent improvement." "Then you really didn't improve productivity."

Jonah extinguishes his cigar in the ashtray, and leans in closer. "Let me ask you something. Was your plant able to ship even one more product per day as a result of what happened in the area where you installed the robots?" I mumble, "Well, I'd have to check the numbers." "Did you fire anybody?" he asks. "Because we installed the robots? No! We have an understanding with the unions that we won't lay anybody off because of productivity improvements," I reply. "But the robots themselves didn't reduce your plant's people expense," he says. "Then tell me, did inventories go down?" "No, I don't think so," I say. I feel like I have to defend the robots. "But our efficiencies are up, and our cost per part is down considerably. To stay competitive we've got to be more efficient and reduce costs." "With such high efficiencies you

must be running your robots all the time," says Jonah. "Absolutely," I tell him. "We have to keep producing to stay efficient and maintain cost advantage." "Come on, be honest! Your inventories are going through the roof, aren't they?" asks Jonah. How does he know? "And everything is always late? You can't ship anything on time?" "Okay, I'll admit it. And it's a serious issue with customers. But how do you know all this about us?" I ask, "You just put your finger on a couple of my biggest problems." "Just a hunch," he smiles. "Besides, I see those symptoms in a lot of manufacturing plants. You're not alone. I'm a scientist, and right now you could say I'm doing work in the science of organisations – manufacturing organisations in particular."

Jonah gets up to leave. He walks fast as his flight has been called. I walk with him. "Your people aren't lying to you, but your measurements definitely are," says Jonah, picking up the pace. "You see, Alex, you think you're running a very efficient plant... but your thinking is wrong. If you're like everyone else in the world, especially all the other plant managers, you've accepted so many things without question that you're not really thinking at all." "Jonah, I'm thinking all the time," I tell him, "That's part of my job." He shakes his head. "Alex, tell me why you think your robots are such a great improvement." "Because they improve productivity," I say. "And what is productivity?" I start to rattle off the formula the company uses. Jonah shakes his head. "Just forget about formulas for a minute. In your own words, from your own experience, what does it mean to be productive?" "I suppose it means you're accomplishing something," I say, weakly, as we turn the sharp corner to the gate lounge. "Exactly! But you're accomplishing something in terms of what?" asks Jonah. "In terms of goals," I say. "Correct!" says Jonah.

He reaches into his pocket, pulls out a cigar and hands it to me. "Alex, I've come to the conclusion that productivity is the act of bringing a company closer to its goal. Every action that brings a company closer to its goal is productive. Every action that does not bring the company closer to its goal is not productive. It's just common logic." "It's just common sense. But it's too simplified," I say. Jonah assets: "What I'm telling you is, productivity is meaningless unless you know what your goal is. And your problem is that you don't know what your goal is." He's at the gate; the stewardess is about to close the door. "And by the way, there is only one goal, no matter what the company." He steps onto the plane. "Think about it, Alex. You can find the answer in your own mind." The stewardess closes the door. I still have the cigar in my hand.

## The Goal

I'm starting to think that Jonah is closer to the truth than I first thought. No one in the meeting seems to know what we're doing here. I don't even know what productivity is. How can this be anything but a complete waste? Peach calls a break at ten o'clock. I pack my briefcase and leave. I look around as I'm leaving. The brilliant idiots from Purchasing, Marketing, and all the other plants that are going down sure act like they have a goal, but why are they all sending out their résumés? I know Peach could fire me for walking out of his meeting, but that would just put an end to three months of anxiety. I don't go back to the plant right away. As I drive, I try to keep my mind off business. I stop the car and sit on a hill looking out over the factory, eat my lunch, and let my thoughts wander. Are the measurements really lying to us? Productivity is anything that moves the company towards the goal. How do our measurements show us that? Jonah said there is only one goal for every company. But we have to do dozens of things. They could all be goals. How could it be just one? What is The Goal? What do we do? What must we do? Purchase in a cost effective manner. Employ people... but we've also laid off a lot recently too. Produce products... manufacturing something is what a manufacturing company is all about, isn't it? What about quality? If it were quality alone then Rolls-Royce wouldn't have suffered. It must be efficiency. Producing quality products efficiently. It's got all the buzzwords they've been throwing around head office. That must be it. It sounds like a good goal, but something doesn't sit right. If that's it, then does anybody upgrade machines or

models when the old ones work just fine? It must be technology. No, research. R&D always plays a huge role, and technology is subordinate to it. Maybe some combination of them all.

I glance over at the factory. Beside it there is another long building in which we store all the finished goods. It dawns on me... we don't build all these products just to store them in a warehouse. The goal must be sales! Or market share. But Jonah said specifically that it wasn't market share. I remember someone at head office saying, "We're losing money, but we'll make it up with volume." You can't stay in business long while you're losing money. That's it! Money! That's got to be it! The Goal is to make money. Everything else is just a means to achieve The Goal. Without that goal, all the others are irrelevant. According to Jonah, any action that moves the company towards making money is productive. Any action that moves the company away from making money is not productive. For over a year we've been unproductive more than we've been productive. I'm filled with a renewed enthusiasm and I know it's time to put my new discoveries into action. I head back to the plant.

### The First Step... Are We Making Money?

I never imagined the complete lack of enthusiasm my newfound awareness would be met with. I'm met with two new problems: how do I translate The Goal into something that's useful at the plant? And how do I get my team to shift their thinking and help me make it happen? I meet with Lou (Financial Controller), Stacey (Inventory Manager), Bob (Floor Manager) and Ralph (Data Processing) to make some major changes around the plant. First, to figure out how to make the plant productive by Jonah's definition: 'make money', instead of productive by UniCo's definition: 'high efficiencies and low costs'. I ask Lou, "Is the goal of this company to make money?" He thinks it's a trick question. "Yeah, of course," he says. "So how do we know if we're making money?" I ask. Lou says we measure that by net profit, or loss as we have been recently. We also need a relative reference, for which he suggests return on investment (ROI). If you make \$10 million in net profit, and you only put in \$1 million, that's a great return, ten to one. But if you put in \$200 million and you're making \$10 million in net profit, the relative return is pretty lousy, only 5%. So, if our net profit is increasing and our ROI is increasing, that's great. But it's bad cash flow that kills most businesses that go under. So we have three essential measurements that together tell us if we're making money or not: net profit, ROI and cash flow.

That's all well and good, but it still doesn't translate into anything I can use on the factory floor. How do I translate it into what I need to do to save the plant? I want to ask my shift supervisors: How's ROI in the last hour? What's your shift done to improve cash flow? Are we making money? It's not that they haven't heard of these terms, they're just part of a different world, headquarters world. The world on the floor is measured in terms of parts-per-hour, manhours- worked, number-of-orders-filled. I can't see the next step to make 'making money' meaningful to the guys in the plant. I decide to find Jonah again.

### Throughput, Inventory and Operating Expense

I had promised Julie dinner again. I worked all day to calm an irate Bill Peach after walking out of his meeting yesterday. I call Julie to let her know that I'm going to my mother's tonight and to go ahead and eat without me. I hardly get the words out before I hear the click. I go through all my old things, boxes upon boxes in the basement, the attic, everything. Finally I go up to my old room, and look in the desk drawer, and there it is. My old address book. I go to the phone and start calling, tracking down Jonah. It's now one o'clock in the morning. I reach a friend from university, then someone who worked with Jonah in Israel, then, many calls later, and a number of transfers through some office in London, I leave him a message.

It's still dark when the phone wakes me. It's Jonah. I explain how his words at O'Hare got me thinking, and all the things I thought of since, and where I got stuck. "As you've found," Jonah explains, "conventional measurements don't help you reach the goal at the level of daily operations. That's why I developed new measurements that express the goal of making money perfectly well, while also allowing you to develop operational rules for running your plant. They're called throughput, inventory and operational expense." "Throughput," Jonah continues, "is the rate at which the system generates money through sales, not production." I write down every word. "Inventory is all the money the system has invested in purchasing things it intends to sell. And operational expense is all the money the systems spend to turn inventory into throughput." These words all sound very familiar, but the definitions are not. Jonah says measurements are useless unless they are clearly defined. He urges me to consider these three defined measurements as a group, because if you change one you will have to change at least one of the others as well. Just before he leaves (very busy, can't talk long), Jonah reminds me, "we are always talking about the organisation as a whole, not local optimums." Then Jonah's gone. I fall asleep on my mother's stairs.

## Getting the Team Involved

In my office I think of the two conversations with Jonah, and it all starts to make sense. He simply and specifically asked questions about changes in throughput, inventory and operational expense to determine that the robots didn't help us make money. The goal is to increase throughput while reducing inventory and operational expense. I call Lou, Stacey, Bob and Ralph into my office. We need to do this together. First we all need to see how our current operations are actually costing us money, not making it. The standard process has been to keep the machines, robots and people all working all the time, thinking this would increase our efficiencies and reduce our cost-per-part. Based on the new measurements, this standard causes us to increase inventories dramatically, while operating expense is constant, and throughput is way behind. We've just learned that the way we've been using our robots is actually counter-productive.

The time seems right to let them know about Peach's ultimatum, and the three months we have to turn things around. There's no need to let them know it's the whole division on the line. Not yet. They ask if I think we can do it, or if he'll extend the time if we show enough improvement. I say yes, trying to sound convinced. I'm not sure of the next step, and they suggest I ask Jonah. Fran gets him on the phone. The next thing I know, I'm arranging to be in New York at 7a.m. Julie doesn't understand. To her I'm deserting her and the family every night, and now I'm deserting her in the morning too. But I can't talk it out now, I have a plane to catch.

At 7:10am I meet Jonah in his hotel lobby in New York. I explain the crisis at the plant, and that we have only three months to turn it all around. Jonah explains his tight schedule and commitments that would prevent him from spending much time with me. He also explains that he thinks that I can solve my own problems, and that three months is plenty of time to show an improvement. He'll just give me some basic rules to apply. Jonah asks me questions about the plant, and helps me to see that my ideas about productivity are even more counter-productive than I first thought. He also mentions two new things: "dependent events and statistical fluctuations." There are definitely dependent events in our plant. X needs to happen before Y. And even with the accuracy of our robots, there are still fluctuations in actual production. It sounds a bit like a riddle, but, before he dashes off again, Jonah says I need to think of the effect of these two together.

## Hiking with the Scouts

Davey wakes me at 7a.m. Saturday. I had promised to go on the Scout hike with him, but I had completely forgotten that it was this weekend. We hurry out and leave the girls sleeping. We arrive to meet 15 boys and no adults. One of the kids tells me the troopmaster is sick, leaving me in charge. We're supposed to hike 10 miles in the day. We get going. I lead the troop. I figure if we walk about two miles an hour we'll be there before dark. The trail is clearly marked, but it's narrow, so we have to hike in single file. I look back and see that the troop is spaced out and the gaps are growing. I give the map to the first kid and move to the back of the troop. I can hurry it up better from back here.

As we walk, Jonah's ideas in my head mix themselves with the troop. What if this troop of boys was a manufacturing plant? Each of us is a process, and the dependency is that we all happen in sequence, in single file. The fluctuations are that some boys walk faster and slower than others. Our product is "walk trail", and throughput is how far the whole troop travels together, and it only counts when every person crosses the line. Inventory is the amount of distance between the first boy and the last. Operational expense increases any time we hurry to catch up. So, inventory is going up, throughput is going down, and operational expense is probably increasing. That's exactly what's happening at my plant! One kid breaks my reverie, "Time for lunch, Mr. Rogo?"

## Dependent Events and Statistical Fluctuations

We start walking again. I watch the line spread out in front of me, longer and longer. But it's spreading faster than before. I find myself right on the heels of Herbie, the slowest kid in the troop. How did he get back here? The boys have rearranged themselves in the line from fastest to slowest. So, nobody is holding anyone back anymore, but the line is spreading fast. At this rate we'd soon lose someone. I call to the front of the line for everyone to stop. I get all the boys to hold hands, and I scoot to the front of the line with Herbie, and we line up slowest to fastest. The boys all start to moan about putting Herbie in the front, and they start to taunt him as we're walking. With Herbie in front, there is no space between anyone. When someone stops to adjust a pack, they catch up straight away with no extra effort. But they all want to move faster. One of the boys asks what Herbie has in his bag. We stop and find all kinds of food and drinks, making Herbie's bag incredibly heavy. All the boys take some of Herbie's things, and lighten his load considerably.

Then we take off at a cracking pace. Our average for the morning was one mile an hour and it seemed like we'd never make it. When we get to the campsite, our average for the afternoon was about four miles an hour. It looks like things are finally turning around. After dinner, away from the rest of the troop, Dave says to me, "I'm really proud of you, Dad. None of the other parents ever really cared what was happening with the troop, or did anything about it. You really did great today." It's a wonderful trip.

Dave and I get home to find the house empty. There's a note from Julie saying she's gone away for a while and that Sharon is at my mum's. My head spins. I can't believe it's come to this. I get Sharon. I phone everyone I know of who knows Julie. No sign of her. I finally go to my empty bed and fall asleep.

## Finding Herbie

Fighting to keep Julie off my mind, I explain all I've learned to my team. We set about trying to find our Herbie at the plant. Ralph wades through data but can't help, so Bob tells us where most hold ups are. The NCX-10 and heat-treat. We know we need to let Herbie lead the group, and find ways to speed him up. We can't think of how to do this alone, so I call Jonah for some more tips. This time he comes to visit us. After a quick but thorough tour of our operations, Jonah confirms that the NCX-10 and heat-

treat are indeed our bottlenecks. They become the group leaders by determining capacity for all the other machines and processes.

Jonah offers the following guidelines to speed up the bottlenecks:

1. *No idle time.* We met with the union to adjust staff break times so that the bottleneck machines are always running.
2. *Only current demand parts.* We ensured that only current orders are processed through the bottleneck machines.
3. *No defective parts.* We moved the parts inspectors to just before the bottleneck machines, so that they don't do unnecessary work on defective parts, and they're only working on parts that will actually contribute to finished products.

## Bottlenecks and Non-Bottlenecks

Jonah says an hour lost on a bottleneck is an hour lost to the whole plant. So, instead of the \$2,100 we assumed it meant to the company, it really translated to \$1 million. So we always keep the bottlenecks running, no matter what. Jonah also says an hour lost on a non-bottleneck is a mirage. It doesn't matter, it's irrelevant. Idle time that we would have pounced on in the past, people or non-bottleneck machines standing around doing nothing, is actually more productive than forcing them to produce more than they should be. Don't match production to demand, match capacity to demand, the overall capacity of the plant, which is determined by the capacity of the bottlenecks.

## The Results

During the first month reports showed us making money, the only plant in the division. And we cleared our backlog of late orders for the first time. During the second month reports, Peach demanded a 15% increase in profit. We had a 17% increase, but it could only be reported at 12% because of the false effect that using up inventory has on accounts. During month three, we are really getting the hang of Jonah's system, and we're still learning along the way. We have 20% excess capacity on our bottlenecks, so we start to engineer big sales with marketing, breaking into the European market in a way that could never have happened before. We're able to turn work around in two weeks, when the industry standard is measured in months, opening dozens of new opportunities for the company. This makes our third month reports even better than our second.

The more success I have at work, the more time I seem to be spending with Julie. She started calling the kids from her parents' house a few days after she left. I worked up the courage to ask her out on a date, and she accepted. We actually take time to be together now. We get babysitters, we go on dates, and on walks. It's like we're in high school again. She even moved in with me... again. I tell Julie about the meeting we had at headquarters today. Peach announced that he was moving on, and that I will be taking his place heading up the division. Julie is so excited to be moving out of Bearington again.

## Productivity and the Division

Going to division level is the same process of improvement, but with more intangibles than the plant. To figure out how I'm going to do this, I get the team together every afternoon to identify the process and the thinking that has brought our plant this far. Sometimes Herbie was a bottleneck, but at other times Herbie was market demand. So we'll call Herbie a constraint, not a bottleneck. It appears that we've cycled through the same process over and over again:

- **STEP ONE: IDENTIFY the system's constraint(s).** Find Herbie. Identify the one key bottleneck or constraint that slows everything else down. Herbie then leads the pack. All other parts of the system are run according to Herbie's agenda.
- **STEP TWO: Decide how to EXPLOIT the system's constraint(s).** Make the most of Herbie. Only have critical work run through that constraint. Get more hands on deck to take over some of Herbie's load. Have Herbie run at full capacity at all times.
- **STEP THREE: SUBORDINATE all else to that decision.** Herbie alone makes or breaks the success of the system. Now that we know this, act accordingly.
- **STEP FOUR: ELEVATE the system's constraint(s).** One way or another, increase Herbie's capacity. If productivity improves so much that Herbie has excess capacity, find a way to fill it, because that increases the capacity of the entire system.
- **STEP FIVE: If in this process a constraint is broken, go back to step 1, but don't allow INERTIA to cause a new system constraint.**

This is an ongoing process of improvement.

We continue to cycle through these five steps to continually improve the system's productivity, its ability to take us closer to The Goal. The process to transform the plant was a transformation of assumptions, essentially it was a transformation of thinking. The biggest hurdle I came up against, once my own thinking had changed, was being able to transform the thinking of others enough so that they would enthusiastically join me to transform our actions. I need to trigger breakthrough ideas that solve our problems without causing more negative effects in the process. It must be possible. So, the thinking processes I seek should answer these four questions:

1. What to change?
2. What to change to?
3. How to cause the change?
4. How to maintain the process of change?

Jonah showed me that if only we think, we should be able to figure it out ourselves. We can be our own Jonahs. And for this next journey, I'll be exactly that.

---

## **THE GOAL - What Could it Do for You?**

The principles Alex Rogo used to save his plant are not just fiction – they can be applied to every industry and any kind of business. If you would like to find out more, why not book either Ted Hutchin or Tony Lumb for a morning or afternoon session at your own company? We will present the film to your key personnel, explain its contents and help you to consider the benefits of applying *The Goal's* solutions to your own company.

Please see our website or contact us for further details.

TOC-Lean Institute  
c/o I & J Munn Ltd  
22, Digby Drive  
Melton Mowbray  
Leicestershire  
LE13 0RQ

Tel: 01664 502860

Diane Jeary  
[dianej@toc-lean.com](mailto:dianej@toc-lean.com)

Ted Hutchin  
[tedh@toc-lean.com](mailto:tedh@toc-lean.com)

[www.toc-lean.com](http://www.toc-lean.com)  
[www.constraintmanagement.co.uk](http://www.constraintmanagement.co.uk)