

L6 Advanced Processes schedule

3rd April – Introduction to the Circular Economy and how this fits.

10th April – No lecture, Good Friday

17th April – Assignment Handout and Intro to Industry 4.0

24th April – Lean Thinking and ToC, Drivers, Compelling forces and challenges.

1st May – ‘Digital Twin’ in the Factory of the Future.

8th May – No lecture, Public Holiday.

15th May – Aliquis Manufacturing Simulation #1

22nd May – Aliquis Manufacturing Simulation #2

29th May – Smart manufacturing, smart devices, smart logistics.

5th June – RFID and it’s impact to manufacturing. TBC Potential Guest Lecture

8th to 11th June – Assignment tutorials. Use <https://calendly.com/grahamhowe>

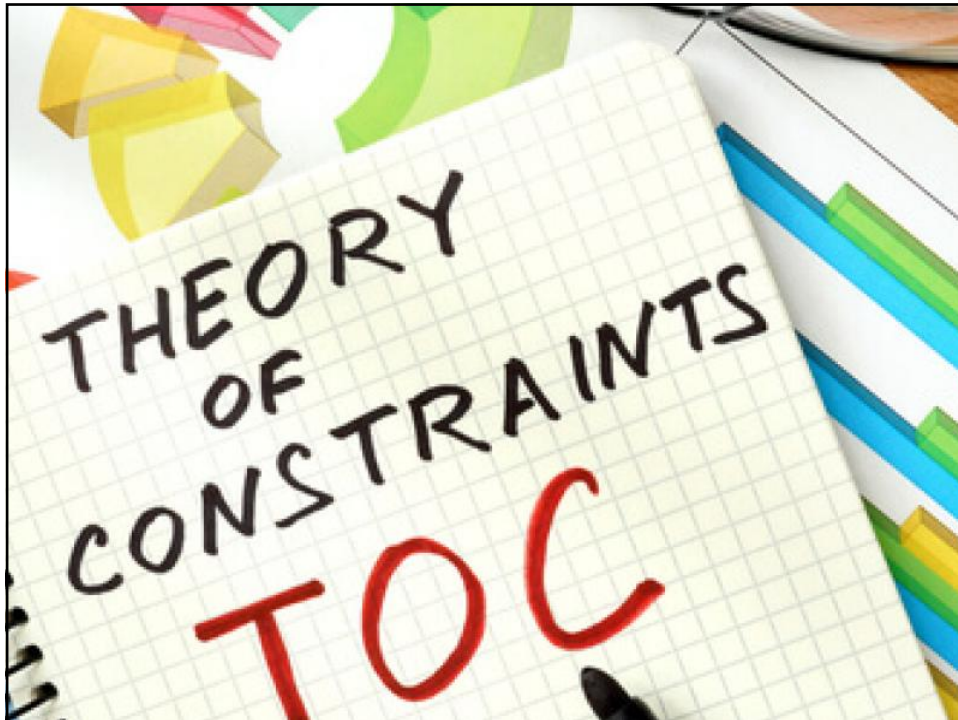
12th June – What have we learnt so far, opportunity for expanding on topics.

19th June – Assignment Hand-in and presentation preparation

26th June – Presentations (10 minutes each, 2 minutes between each)

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Productivity

In your own words, what
is Productivity?

It's about accomplishing
your goals.

So what is the goal of
your organization?



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What is the Goal?

? *How do you know you are making money?*

- Net profit (Income minus expenses)
- Return on Investment
- Cash Flow

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What is the Goal?

How does this translate to our own worlds?

Throughput

- The rate at which the system generates money through 'Sales'

Inventory

- The money the system has invested in purchasing things which it intends to sell.

Operational Expenses

- All the money the systems spends in order to turn inventory into throughput.

? *What is the common word in all of the above statements?*

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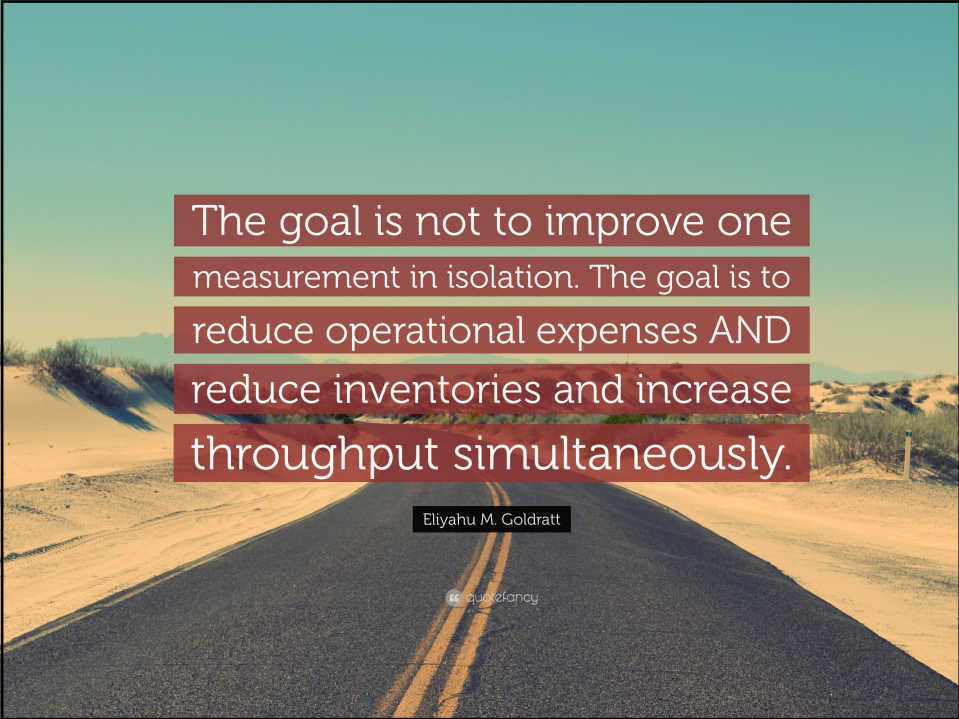
What is the Goal?

Common word in all three measurement definitions;

- Throughput; Money going into the systems
- Inventory; Money stuck inside the system
- Operational Expenses; Money flowing out of the system

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The goal is not to improve one measurement in isolation. The goal is to reduce operational expenses AND reduce inventories and increase throughput simultaneously.

Eliyahu M. Goldratt

quote fancy

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The Goal

Who are the characters?

Plant Manager	Alex Rogo
Production Consultant	Jonah
Division Vice-President	Bill Peach
Plant Production Manager	Bob Donovan
Plant Controller	Lou
Production Control Manager	Stacey Potazenik
Data Processing Manager	Ralph Nakamura

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The Goal

The context, the setting of the drama

- City of Bearington. Location?
- Pennsylvania, Ohio, Indiana Manufacturing Town.
- UniCo Corporation Manufacturing Plant
- Probably 15 years or so old.
- Any other observations?

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The Goal

What is your impression of the manufacturing plant?

- Plant out of Control?
- Division Vice-President expediting an order.
- New robots
- Controlled chaos
- Good at 'fighting fires'
- Excellent at getting orders filled when pressed.
- Lots of inventory

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A balanced Plant?

Alex meets Jonah in New York seeking help to determine steps to take in achieving the Goal.

Jonah *"Do you run a balanced plant? Do you have any idle workers and is it good or not?"*

Alex *"We try to keep all our employees productive."*

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A balanced Plant?

It is impossible to perfectly balance capacity to demand.

Due to two phenomenon;

- 1. Dependent Events** – A series of events must take place before another begins.
- 2. Statistical Fluctuations** – then length of events and outcomes are not complete deterministic.

The combination of these two phenomenon are the issue.

- **Where does Alex see this first hand?**

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Boy Scout Hike

Observations of the Scout Hike

- The walking speed of individuals fluctuates.
- All may have the same average walked speed, but gaps continue to lengthen, why?
- There is no limit to how much an individual can slow down, but your top speed is dependent on the person in front.
- Fluctuations are accumulating over time, and the slow fluctuations tend to accumulate faster because they are not limited like the fast ones.

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Boy Scout Hike

How does the Scout Hike compare to a Manufacturing Plant?

- Each person on the hike is an 'operation'
- The product is the 'Walk the trail'
- Each person (operation) is dependent on the one in front.
- A 'sale' is when the last person walks the trail.
- Throughput is the rate at which the last person walks the trail.
- Operating Expense is the energy output of each person.
- Inventory (material inside the plant) is the distance between the 1st person and the last.
- Fluctuations in operating speed is causing inventory to increase and causing throughput to decrease.
- Attempting to reduce gaps is increasing operation expense.

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Boy Scout Hike

After lunch the boy scouts 'self-arrange' so that the fastest is up front and so until 'Herbie' is at the rear.

- What was the result?
- *The Line got even longer.*
- Did this improve throughput?
- *Completed miles still dependent on last Scout walking the trail, plus 'inventory' has increased.*
- Everyone is always walking, but goal is not being achieved.

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Boy Scout Hike

How does Alex fix the Boy Scout Hike?

- *Put kids in order from slowest first to fastest last. The line then stays compressed (ie inventory has gone down and progress has improved because Herbie is setting the pace and doesn't have to exert energy to catch up.)*

How do they further improve throughput?

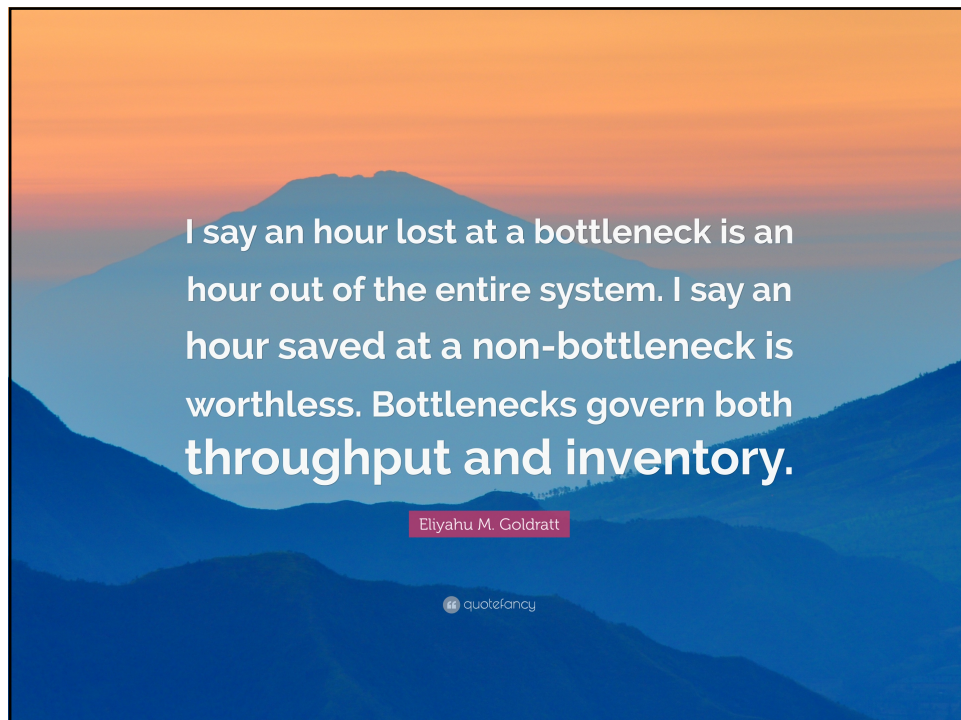
- *Off-loaded Herbie's backpack. In other words, they improved Herbie's throughput so the entire boy troop's throughput improved.*

What have we learned up to this point?

- *Have more capacity at downstream operations.*

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Bottlenecks

Distinguish between bottlenecks and non-bottlenecks

- **Bottleneck** – any resource whose capacity is equal to or less than the demand placed upon it.
- **Non-bottleneck** – any resource whose capacity is greater than the demand placed upon it.

What determines the flow of product through the plant?

- The bottleneck resources

How do you find the bottlenecks?

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Bottlenecks

The next step for Alex and colleagues is to identify the bottlenecks

Once the bottleneck is identified, can you simply move the machines / operations around like Herbie was moved to front of the line?

- *No, production steps often cannot be reorganized.*

So, how do you solve the problem of 'moving Herbie to the front'?

- *Find more capacity for the bottleneck, don't try to move them.
Have enough capacity to meet demand.*

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Bottlenecks

How do you find more capacity?

- *Make sure it is never idea*
- *Increase cycle time on that operation*
- *Add another duplicate operation*
- *Outsource to another Vendor*
- *Reduce demand*
- *Inspect part quality before the bottleneck (ensure bottleneck only works on good parts.)*
- *Ensure process controls on bottleneck are good so bad parts aren't produced.*
- *Don't let it work parts that aren't needed.*

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Implementing theory of constraints in a traditional Japanese manufacturing environment: the case of Hitachi Tool Engineering

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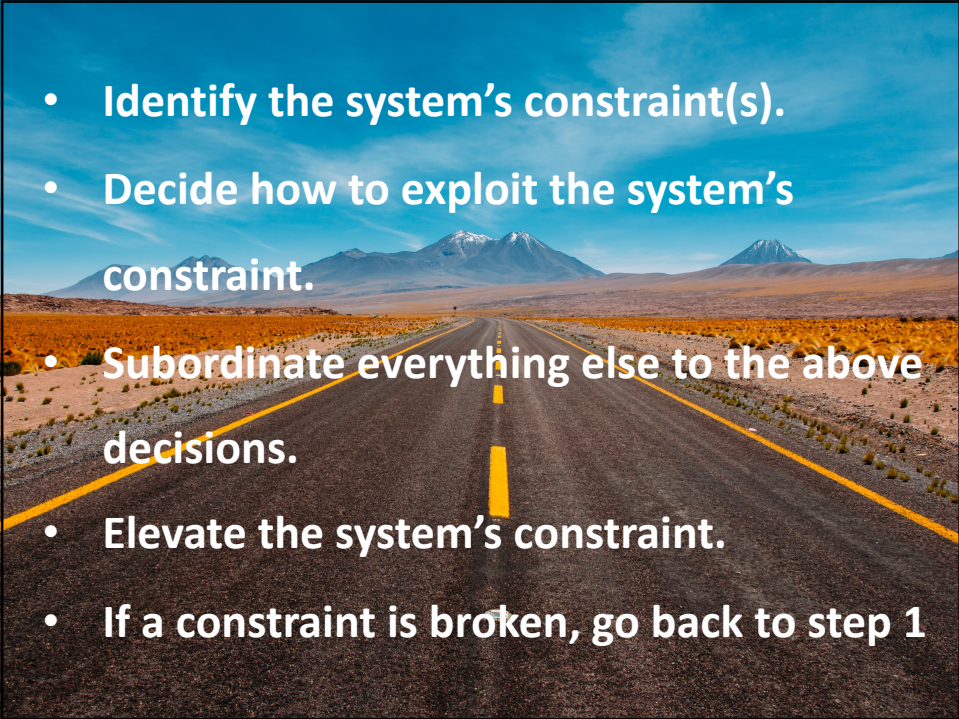
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(Received May 2005)

This research presents a case study of a virtual 'textbook' application of the theory of constraints (TOC) in a Japanese tool manufacturing company. Hitachi Tool Engineering uses state-of-the-art technology to design and manufacture cutting tools known as End-mills. The plant described in this study is a classic V-plant and exhibited all of the standard problems of a traditionally managed V-plant, existing within the unique framework of Japanese work culture. Plant management applied the five focusing steps and used the operations strategy tools, including drum-buffer-rope and buffer management, to improve the system. Following the approach recommended by Eli Goldratt, the thinking process tools of current reality tree and evaporating clouds were used to help identify and resolve problems when the implementation encountered major obstacles. While the implementation was a huge success, the devastating effect of a core problem being left unresolved is well documented. The implementation generated significant improvements in work-in-process inventory, production lead time, on-time delivery, productive capacity, inventory turnover, product quality, sales volume, and profitability. Moreover, management has extended the introduction of TOC to the non-manufacturing functions and TOC is becoming the common company culture that bridges four culturally diverse manufacturing plants.

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- 
- **Identify the system's constraint(s).**
 - **Decide how to exploit the system's constraint.**
 - **Subordinate everything else to the above decisions.**
 - **Elevate the system's constraint.**
 - **If a constraint is broken, go back to step 1**

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Application of TOC in Hitachi

The Yasu plant produces somewhere **between 12,000 to 20,000 distinct SKUs in a typical month** each varying according to specific materials, configurations, and diameters. Competitors typically launch a new product family about **every six months**.

Overall productivity had increased significantly and the Yasu plant was **shipping about 20% more product than one year earlier. WIP inventory and lead times had both been reduced by nearly 50%.**

On-time deliveries had improved substantially. The first-run quality rate increased from 93% to 97%, and the **overall loss due to defective products decreased by 50%.**

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Application of TOC in Hitachi

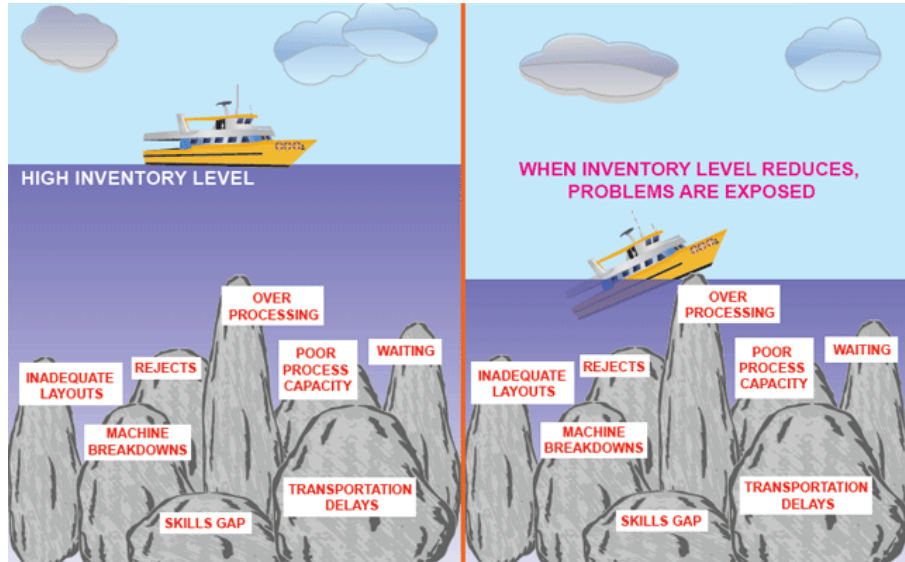
Despite the plant's enhanced competitiveness due to improved product quality and on-time delivery performance, there were simply not enough new orders to utilise all the plant's hard-earned increased capacity.

- **Where is the constraint now?**
- **Do we think the constraint has moved from operations to sales / distribution?**
- **What could we do?**

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Sea of Inventory



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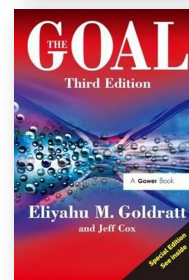
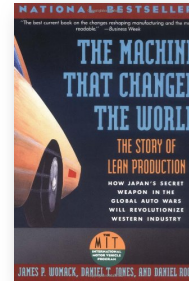
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Further reading....

Lean production is a term that embraces many topics such as flexible manufacturing, minimizing work-in-process, "pull" systems of production control, and setup time reduction

The term "lean production" was coined around 1989 with the popularity of Womack and Jones book, *The Machine that Changed the World*.

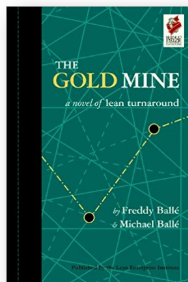
Alex Rogo is a plant manager working ever more desperately to try and improve performance. His factory is rapidly heading for disaster. He has 90 days to save his plant - or it will be closed by HQ, with hundreds of job losses. It takes a chance meeting with a colleague from student days; Jonah - to help him break out of conventional ways of thinking to see what needs to be done.



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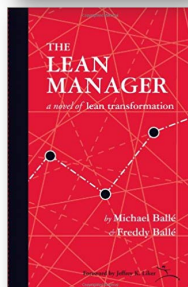
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Further reading....



Novel of Lean Turnaround deftly weaves together the technical and human pieces of implementing lean manufacturing in an engaging story that readers will find both compelling and instructive.

At the heart of the Gold Mine is Bob Woods, a curmudgeonly sensei coaxed out of retirement by his son Mike to help boyhood friend Phil Jenkinson save his struggling company.



Despite terrific products and a backlog of orders, Phil's company cannot generate enough cash from its operations to pay its bills. And so Mike enlists Bob to help his pal fix this crisis. "You're trying to deal with your mess as if it was a technical problem," Bob tells Phil. "Move this machine here, change this design there, which it is to some extent, but it's all about people.

You have a leadership problem not just a production or business problem." As Phil begins to tackle the key challenges necessary to improve his company's operations, he comes to understand the deeper points of lean.

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