

The Theory of Constraints in production

Implementing *The Goal* / ToC to boost a Lean programme

- Training material -

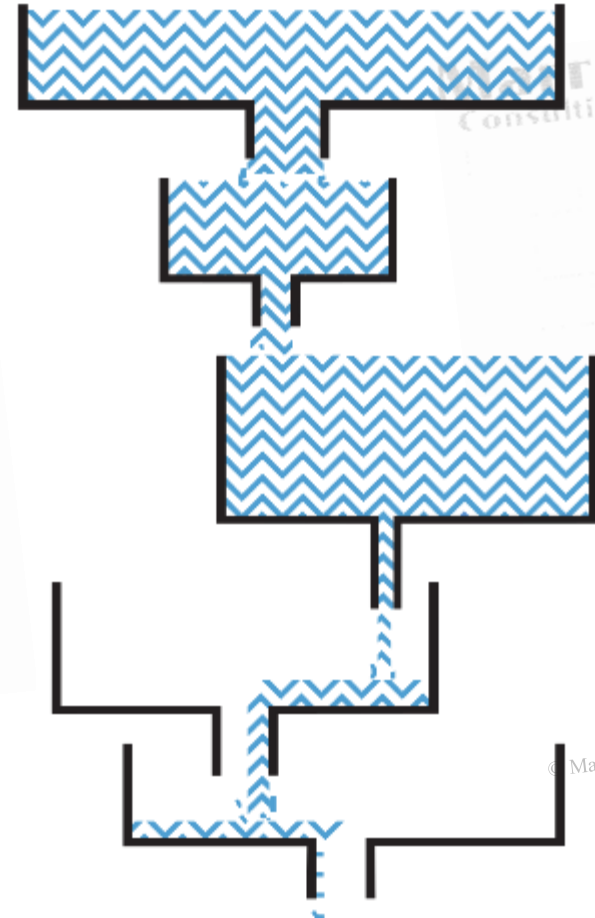


Paris, 15th & 16th of May 2018

Version 1.0 filigranne

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1. Constraints Management book by Philip Marris – Executive summary
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Training facilitator: Philip Marris, CEO of Marris Consulting, ToC & Lean expert, >30 years, >200 projects

- Consultant (warning!).
- Theory of Constraints specialist. 32 years of ToC experience. Started working with the founder Eliyahu Goldratt in 1986.
- Started his Lean journey in 1984, 34 years ago. "Implemented" >200 times.
- Author of the very boring but bestselling French textbook about ToC in manufacturing *Le Management Par les Contraintes*.
- Author of numerous articles. Over 10 conferences a year worldwide on these subjects.
- >30 years of experience helping over 200 companies in all industries.
- Administrator of several LinkedIn discussion groups. Creator of the French website management-par-les-contraintes.com and curator of several ToC and "ToC + Lean + Six Sigma" news websites.
- >15 years of experience in major consulting firms.
- Founder and CEO of Marris Consulting based in Paris, France. Founded in 2004. Motto: *Factories, People & Results*.



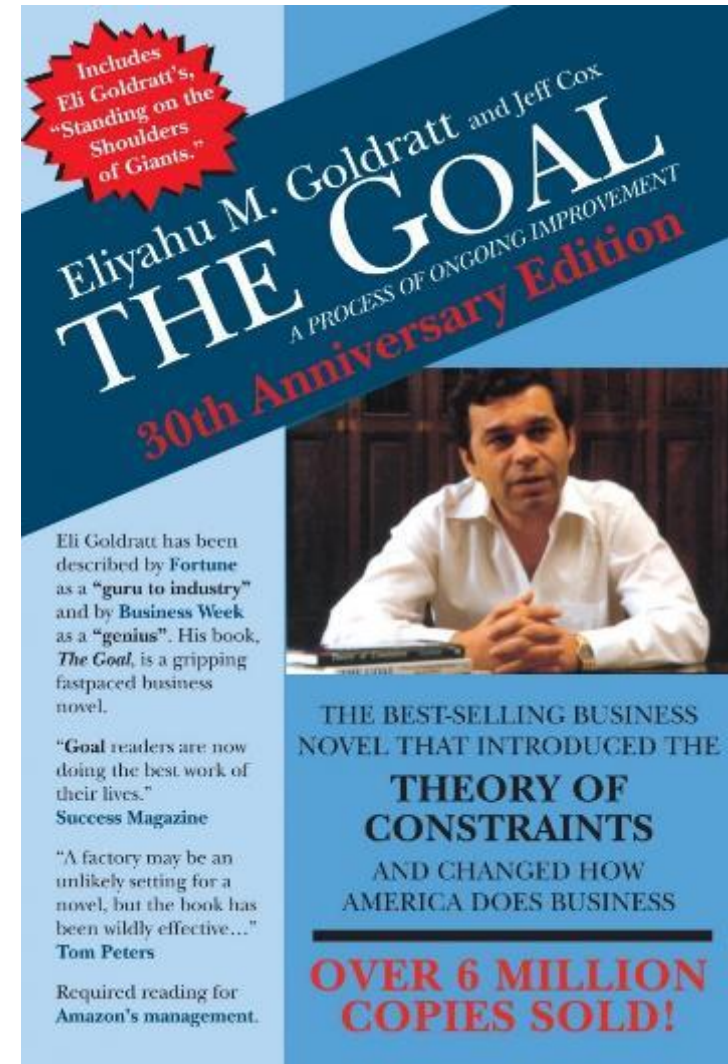
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The Theory Of Constraints gained its global recognition because of the success of the best selling “business thriller” *The Goal* by Eliyahu Goldratt

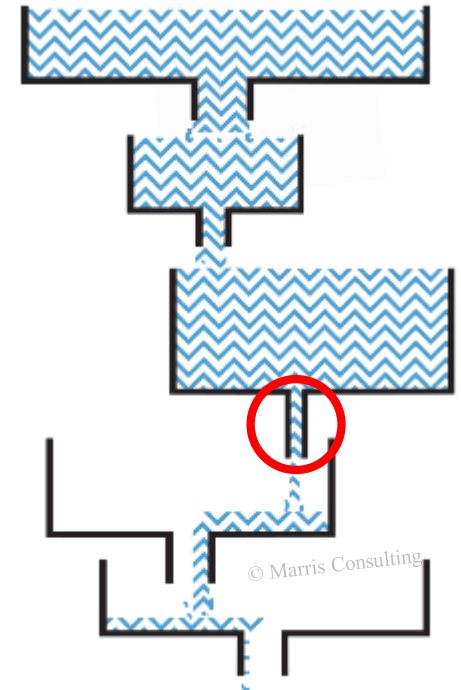
- Over 7 million copies sold in 30 languages. Mandatory reading in most universities/MBAs/...
- Written by Eliyahu Goldratt the founder of ToC with Jeff Cox.
- The first book of its kind: a novel to explain a new approach to management.
- Chosen as one of the 25 most influential business books by Time magazine in September 2011.
- Used by Jeff Bezos, Amazon.com CEO, to build their Supply Chain and redefine the company's goal.
- New graphic edition in 2017.



Focus on improving the system constraints that determine the overall performance

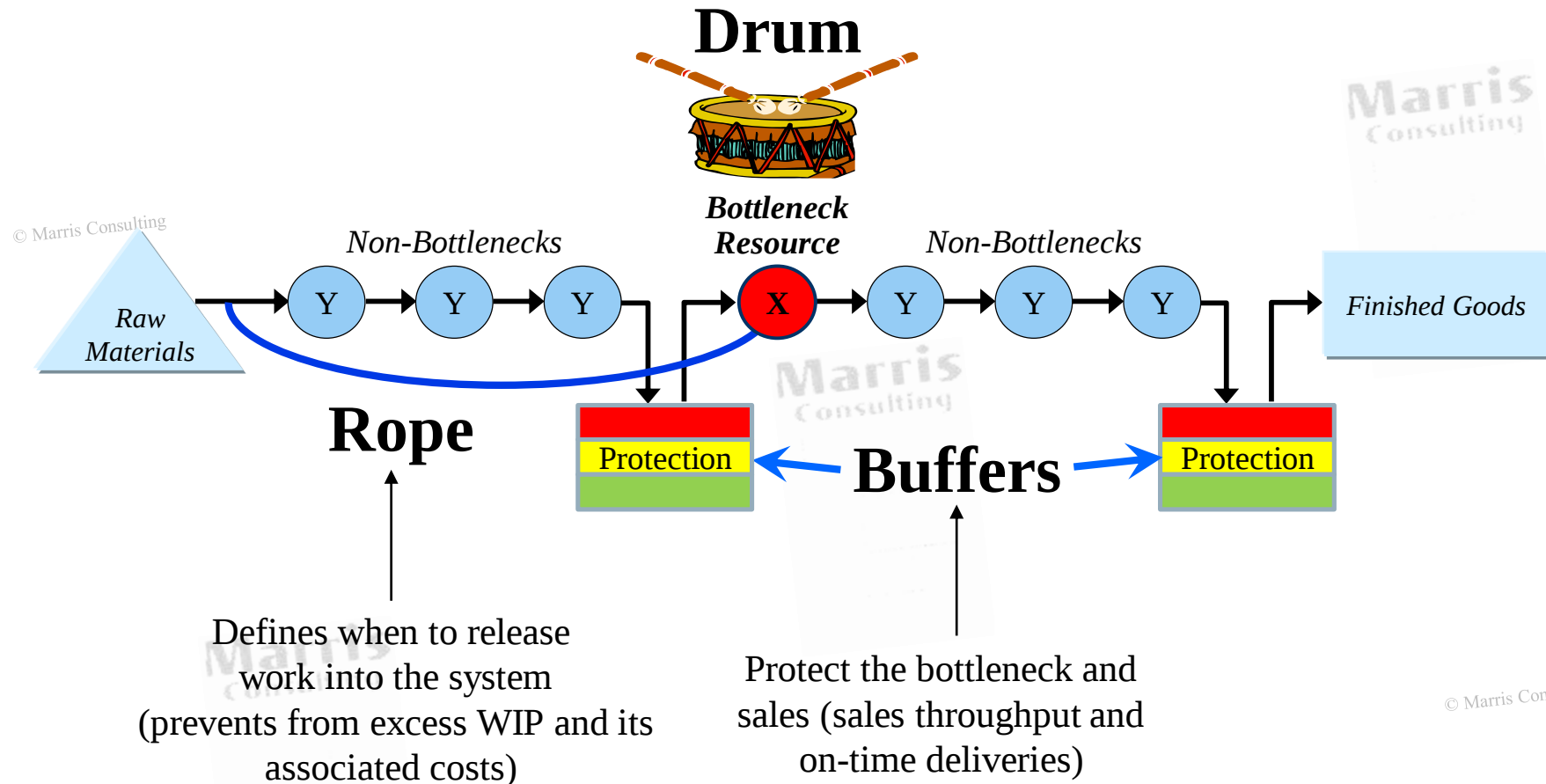
***It is no longer possible to distribute work equitably:
organizations are necessarily unbalanced***

- Companies (factories, engineering departments ...) and other organizations inevitably have unbalanced capacities.
- Annual budgets pretend to balance organizations but they don't succeed.
- There is always a constraint somewhere in the system.
- One hour lost on that constraint (the bottleneck)
= one hour lost for the system = one hour of lost sales.
- One hour gained on a non-bottleneck is an illusion. A non-constraint must only work according to the constraint's requirements.
- A dual view is mandatory: different rules for constraints and non-constraints.



The sum of local optimums is not equal to the global optimum

ToC controls production flow with the Drum Buffer Rope (DBR) mechanism



*We will find a similar mechanism in ToC's project management approach.
One of the key ideas of ToC is to use buffers to protect the bottleneck against variability.*

The 5 steps of ToC's continuous improvement process

1. IDENTIFY the system's constraint(s).
2. Decide how to EXPLOIT the system's constraint
3. SUBORDINATE everything else to the above decision.
4. ELEVATE the system's constraint
5. WARNING!!!!
If in the previous steps a constraint has been eliminated,
go back to step 1,
but do not allow INERTIA to become the system's constraint.

Easy to do in production
but not in projects

Without investments
in \$ or in time

The most
difficult step

With investments
in \$ or in time

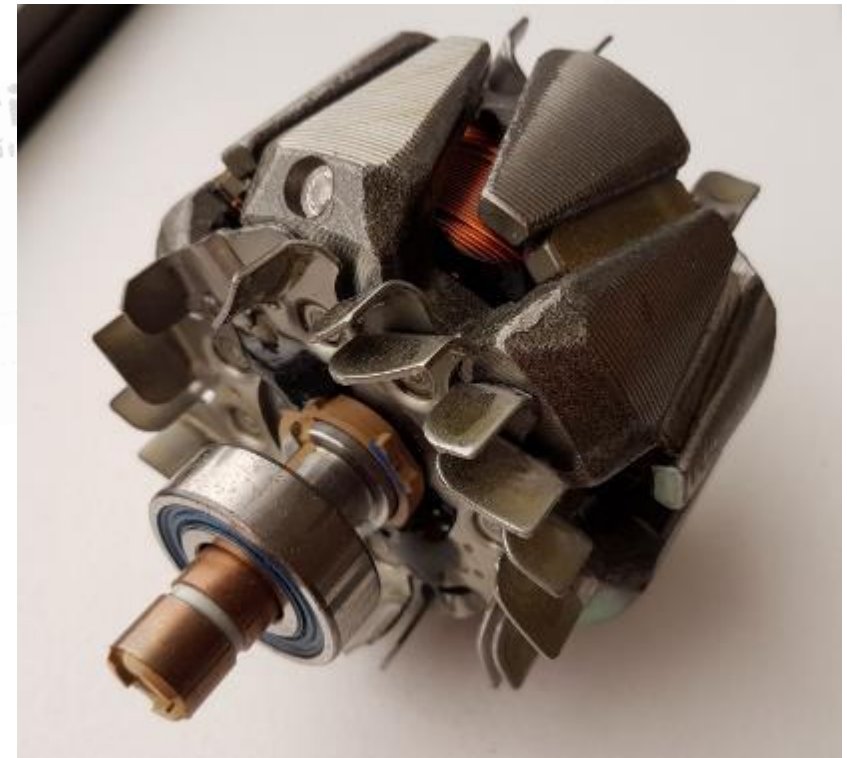
Or choose the "best"
constraint of the system

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Note: Often called *The 5 Focusing Steps* or ToC's *Process Of On-Going Improvement* (POOGI).

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One of the Leanest organisations in the world

- One of the 10 largest automotive OEM suppliers in the world.
- Over 100 factories. Sales >> 10 billion €.
- Was one of the first to begin its Lean journey after Toyota at the end of the 1970s.
- All the Lean techniques are used: Gemba, SMED, PDCA, 5S, ppm, Andon, Poka Yoke, Kanban, VSM, VSD, 8D, ...
- The case study factory:
 - Production of car alternators for the American continent,
 - Over 1 000 people.



There are several videos of this case study on Marris Consulting's Youtube channel

Mid 2011, the factory was in great difficulty...
...desperate, they decided to inject some ToC into their Lean

- The factory was hopelessly overloaded
- Due date performance became a big issue
- They were being threatened by their largest clients
- They had done all they could:
 - Over 10 of their best production managers added to the staff
 - Very fast investment to double the plant 's capacity
 - Additional direct labour added until you could not fit an extra person into the production line
- So...with very mixed feelings among the top management ...they decided to inject some ToC into their xPS



Other improvement actions were implemented on the bottleneck over the next 2 weeks

■ Production 25 hours / 24h:

- breaks,
- shift changes,
- lunch breaks,
- 5 minute stand up, etc.

This was accomplished by placing 4 baskets of parts in front of the bottleneck.

- Identified and resolved the frequent micro stoppages (that did not appear in any data)
- Maintenance priority (preventative and curative)
- Process improvements (some of less than half a second but...
- Etc.



A nearly happy end

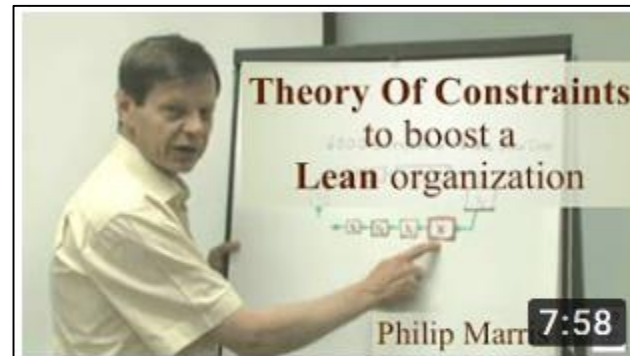
- The client's resident team that was present 24/7 left within a week.
- The express shipping by plane stopped. Due date performance returned to 100%.
- The relationship was restored with this major customer (was "New Business On Hold").
- Overall, over 6 months the plant's output and productivity was improved by 30%.
- And the Theory of Constraints was **NOT** deployed in the xPS system of their company ☹️



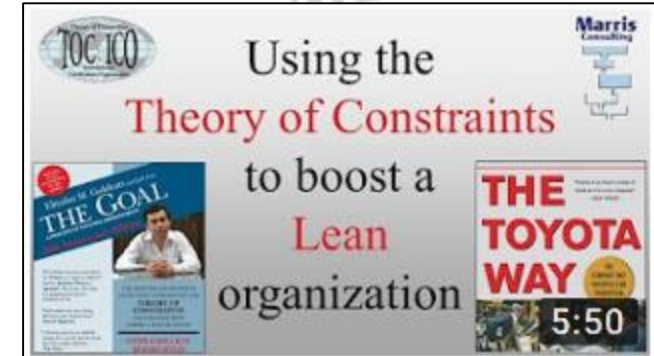
Several videos of this case are available on the Marris Consulting YouTube Channel



(En) TOC to Boost a Lean Organization TOCICO 2012



(En) Philip Marris "Lean + TOC" TOCICO Chicago 2012



(En) Using TOC to boost a Lean Organization +15%

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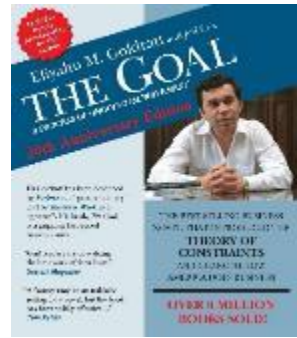
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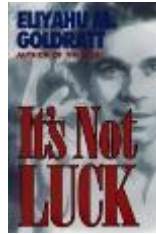


History of Theory Of Constraints



A first novel
The Goal*

1984

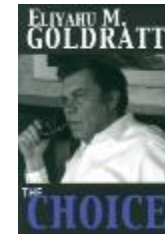


A sequel to The Goal
It's not luck

1994

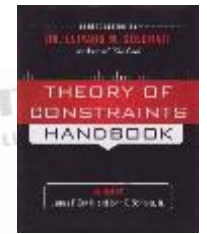
A new ToC
service offering
Viable Vision

2005



The Choice
The ToC Handbook

2010



1970

A production
scheduling
software and a
« Thoughtware »
OPT

A new name for this approach
Theory Of Constraints
or **ToC**

1988

A book that presents
a new approach to
Project Management
Critical Chain

1997

**Necessary but
not sufficient**

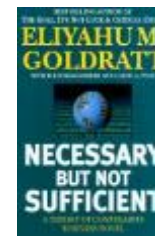
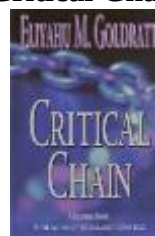
2000

Isn't it obvious
ToC applied to
Distribution

2008

Death of
Eli Goldratt

2011



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The different components of the Theory Of Constraints (ToC)



Theory Of Constraints (ToC)

Approach initiated by Eliyahu Goldratt
A systemic view seeking the global optimum
based on a dual view of constraints/bottlenecks & non-constraints

Thinking Processes or Logical Thinking Process

This could be considered to be at another higher level than simply a component

Drum – Buffer - Rope Production Management

The importance of constraints,
DBR & S-DBR,
Focused approach, ...
[historical origin of approach]

Critical Chain (CCPM) Project Management

Project Buffer (not "local" tasks),
Fever Chart, Critical Chain (not
Path), Bad multitasking, Student
syndrome, ...

Replenishment Distribution

High frequency periodic
replenishment, stocks centralized
(not too distributed),
[DDMRP?]

Marketing & Sales Marketing & Sales

Mafia Offer or (URO)
+ Decisive Competitive Edge
(DCE) + Delta T-Selling
+ Sales force constraints

Throughput Accounting Financial decision making

T,I,O.E.: Throughput, Inventory
& Operating Expenses, TBDM,
Dollar x Days, Total Variable
Cost, Product Mix

Value Added Computing Information Systems

Data & Information
Necessary but not sufficient
The 6 questions
[Philip Marris' personal opinion]

Thinking Processes Problem resolution

Evaporating Cloud, Goal Tree,
Strategic & Tactic Trees,
Current/Future Reality Tree, Pre-
requisite & Transition Trees

Other new ideas!?

Standing on shoulders of giants,
Behavior & Organizations, Viable
Vision, Strategy,
KM, + new TA ,...?

The goal according to Eliyahu Goldratt

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*The goal of a company
is to make more money,
now and in the future.*



The two simultaneous constraints: making more money now and in the future

- The goal of a company being to make more money, **now** and in the **future** there are two simultaneous constraints
- The constraint that limits the capacity to make more money **now** (in the next few weeks or months)
 - The capacity of the bottleneck machines. The availability of raw materials or components. The level of the order book. Etc.
- The constraint that limits the capacity to make more money in the **future** (in the next few months or years)
 - Research. New product development. Strategic acquisitions. Recruitment and training. Etc.
- Note they are usually distinct (not the same). If the same resource determines present and future sales then it is much harder to manage (permanent conflict between short and long term)



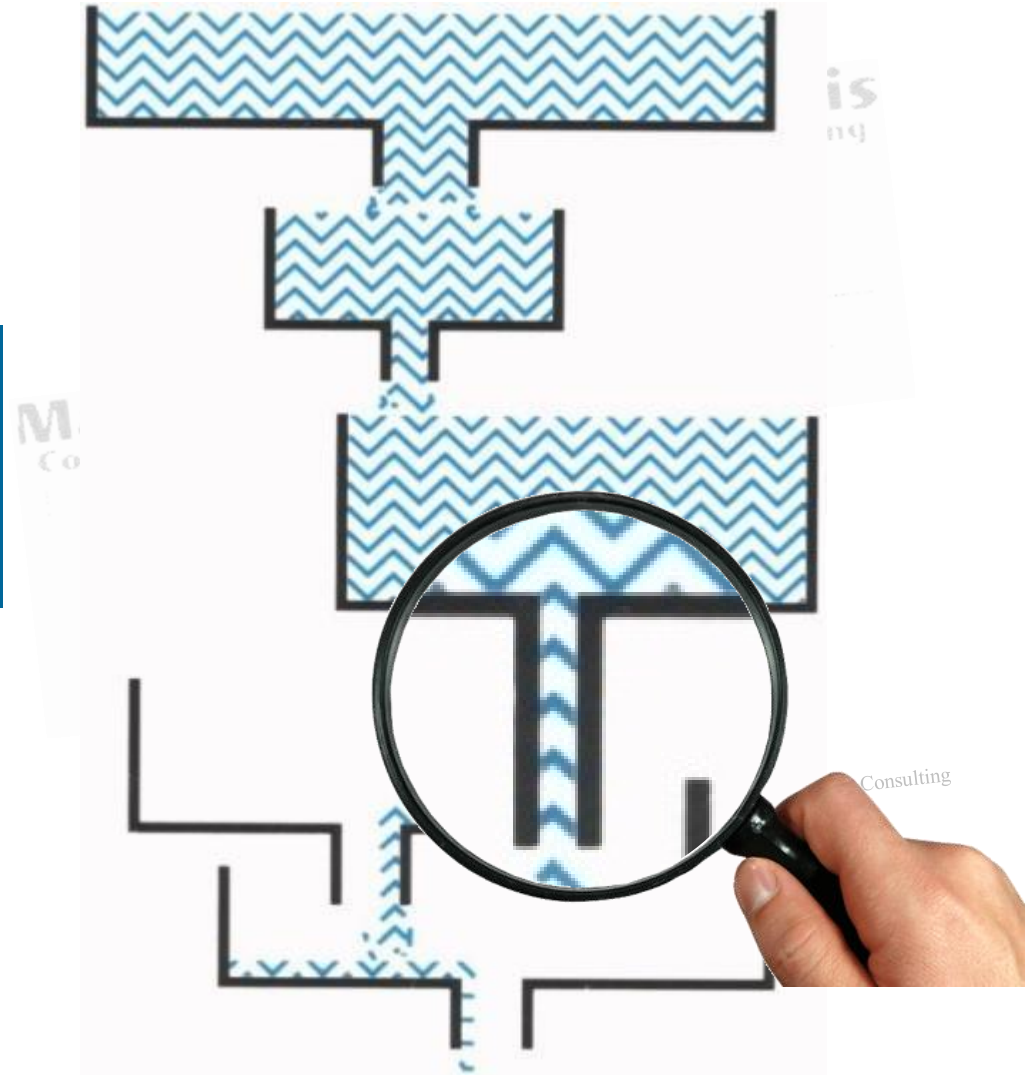
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Focus on improving the system constraints that determine overall performance

- Focus on improving the system constraints that determine overall performance

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*Sometimes referred to as:
“99% - 1% focus”
(i.e.. more focused than the 80/20 Pareto principle)*



Simulation game of a production line

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Identifying constraints: a critical step and not necessarily easy

- It is obviously the critical step. How could you apply the Theory of Constraints if you don't know where your constraint is?
- **WARNING!** Today 80% of companies don't know where their capacity constraint is!
- 10 years ago 50% of the companies we worked with knew where their bottlenecks were before starting to implement the Theory Of Constraints.
- Over the past 10 years (2005 to 2015) we have found that in 8 cases out of 10 the organization is initially mistaken as to where its capacity constraint is.



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To find the constraint use your eyes and your brain...
...not the computer or the management...

- This section is Philip Marris' point of view. It is unorthodox.
 - Do not believe the data coming from the computer systems.
 - Look at the flow (Gemba / shop floor visit):
 - Find the biggest queues of work
 - Double check with shortages
 - The management is often wrong, the shop floor workers are often right.
 - Beware if the bottleneck is too good to be true
-
- To explain this critical step better we will look at a certain number of recent examples in the following pages.



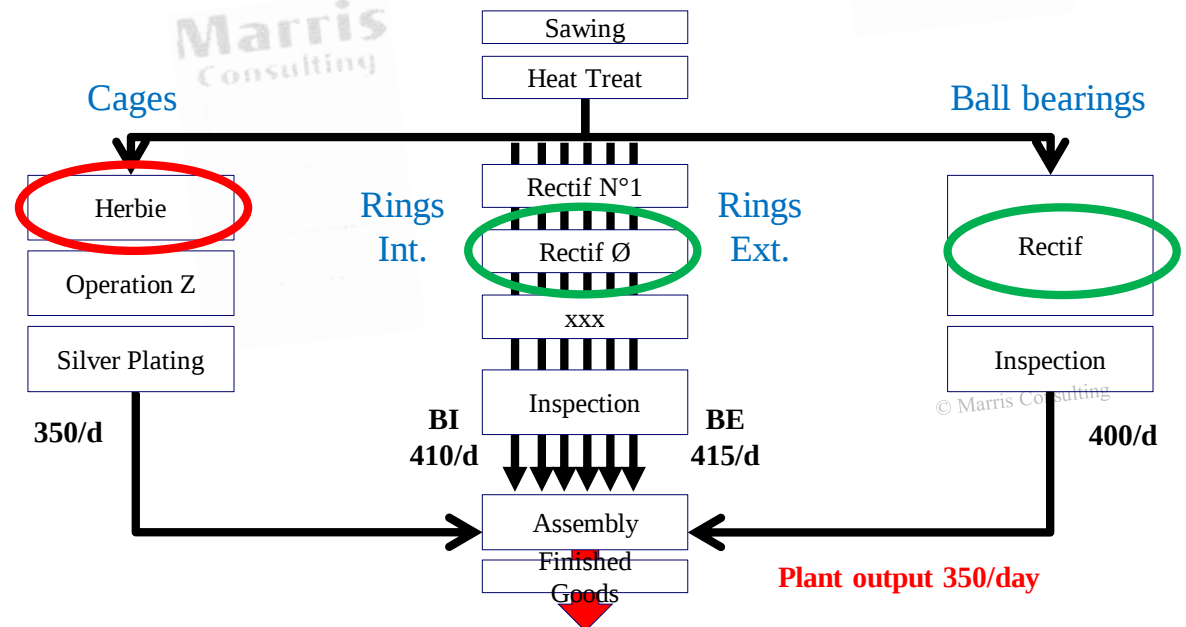
Example: My impressive rolling mill

- A steel manufacturer world leader.
- A 2,900 person factory with a steel mill, a rolling mill, heat treatment and finishing operations.
- They thought it was their big impressive rare sophisticated rolling mill.
- In fact it was their 6 (boring) heat treatment furnaces.



Example: My expensive core skills

- 700 person factory. Aeronautical sophisticated bearings for plane engines, helicopter rotors, etc.
- 2 mistaken identification of constraints:
 - Firstly a set of machines that suffered spikes in demand for very urgent work due to internal quality problems but had a low monthly load.
 - Secondly their expensive milling machines
 - In fact it was another machine of secondary importance



Lessons learned: My big and beautiful bottleneck

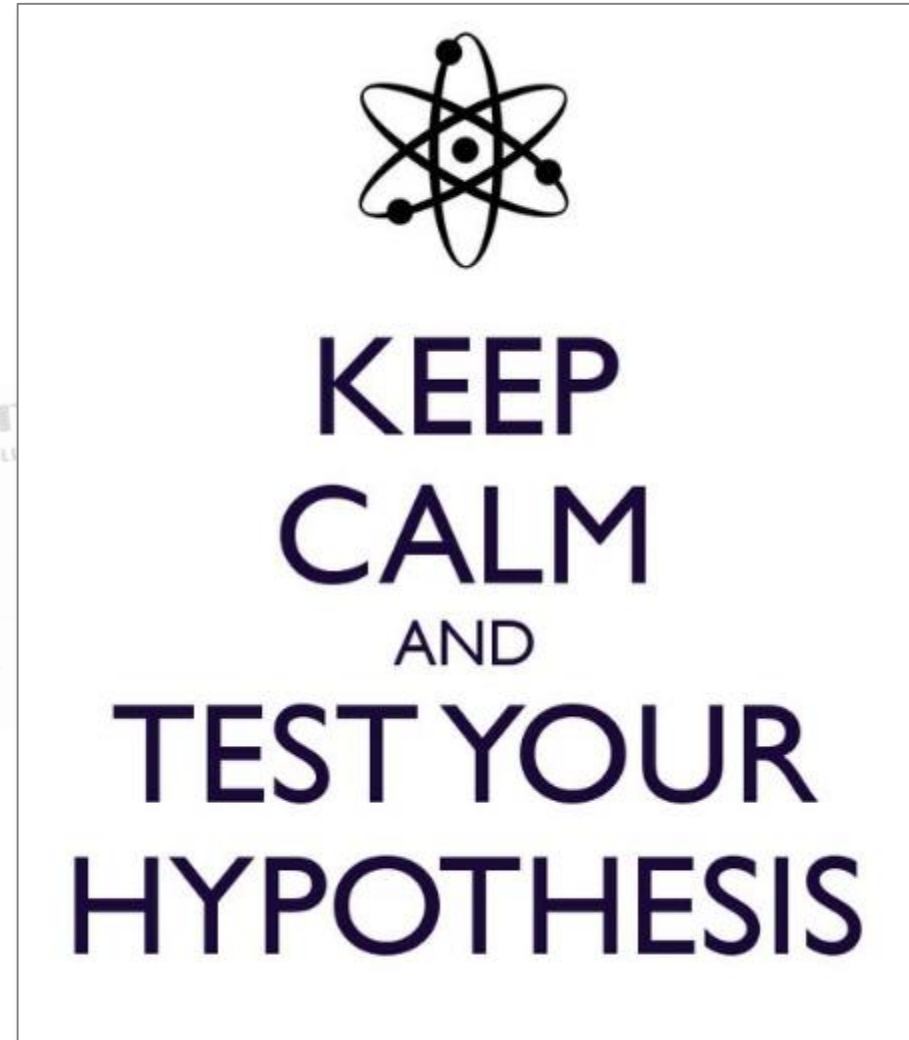
- We find that management often falls into the trap of wishful thinking. They convince themselves that their most expensive machines are the bottlenecks (since this is a sensible / good situation).



The only difference between an adult and a child is the price of his toys

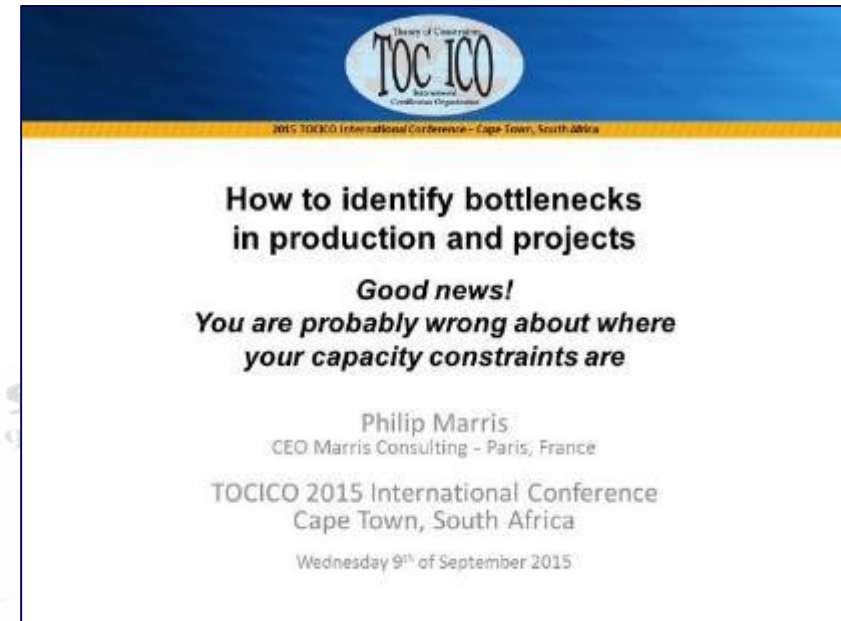
When you have a hypothesis for the location of a bottleneck test it

- When you have a hypothesis for the location of a bottleneck TEST IT.
- Normally everything should make sense.
- Examples:
 - If the bottleneck produces 15% more than the organization should produce 15% more (often with a lag).
 - Late or overdue things waiting in front of the bottleneck.
 - Etc.



See the video on this subject: How to identify bottlenecks in production and projects

- TOCICO Annual Conference in Cape Town South Africa by Philip Marris.
- PDF available here:
http://www.marris-consulting.com/medias/fichiers/tocico_2015_toc_bottlenecks.pdf
- Video here:
https://youtu.be/ulXqO86OfpU?list=PLuB3wmjsgiuMLT_rrMFfHfQ33X3yft4S



See video on Marris Consulting's YouTube channel

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Exploiting a constraint is really easy

- You concentrate all the company's attention on one resource.
- Everybody loves producing as much as possible.
- Because of the previously diluted efforts (all resources receive identical time and money) there are many low hanging fruits.
- Typically:
 - No stopping during breaks
 - No stopping during shift change-overs
 - First priority for labour shortages
 - First priority for support services such as maintenance and engineering methods.
 - Etc.



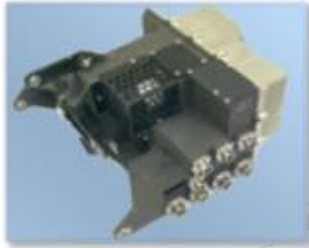
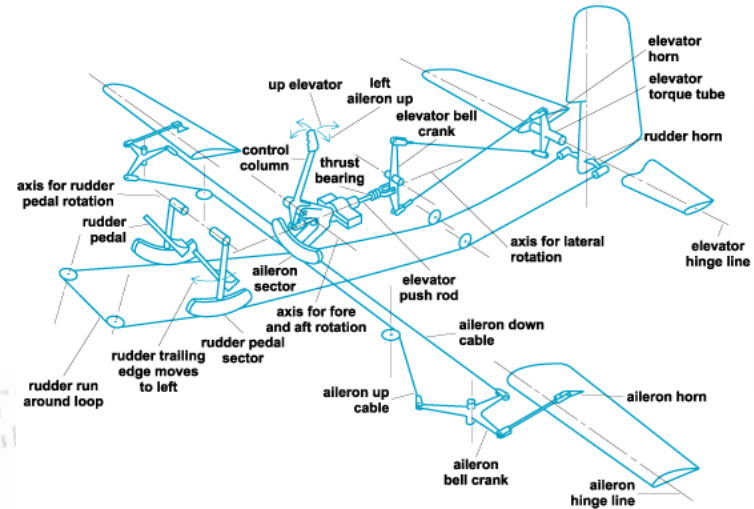
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An example: Flight Control Systems Equipment Manufacturer

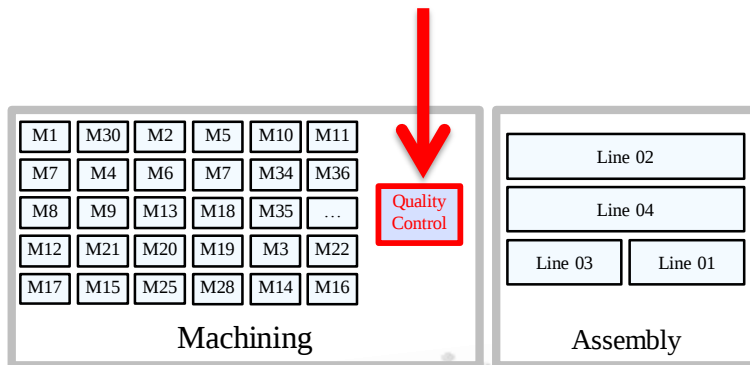
- A 400 person factory in France. Part of a major >\$5 billion, >30,000 people, aeronautical equipment worldwide leader.
- Very poor due date delivery performance of <60% OTIF. Unacceptable for its clients (aircraft manufacturers).
- As a result the plant was losing business year after year. Its future was compromised.



In reality the bottleneck was Quality Control

- Observing the queues of WIP (Work In Progress) easily showed that the constraint was in Quality Control.

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The "2 for 1" rule

Very successful simple technique
Highly recommended

A new Work Order (WO) can only be launched
when 2 WOs have been completed

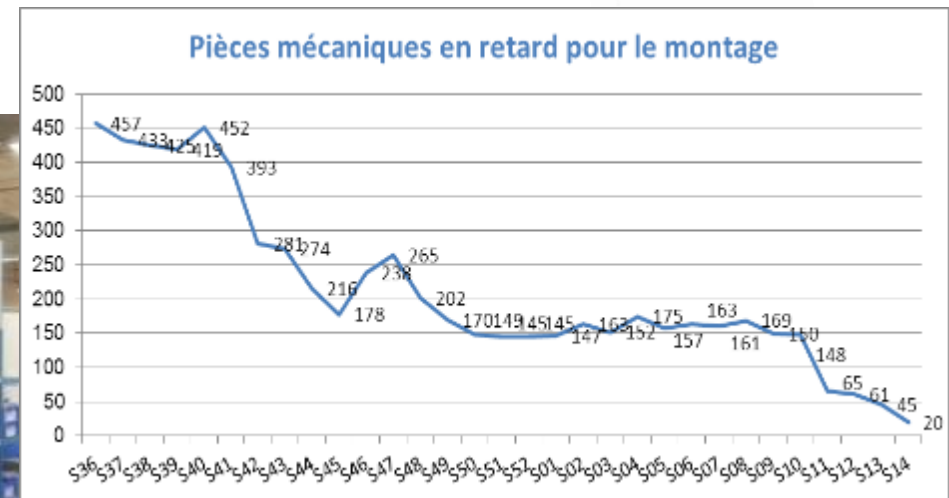
- The choice between several WOs proposed by the ERP/MRP is done manually by the management.
- This technique:
 - Is only pertinent for systems with over 50 WOs in WIP
 - Facilitates the transition to other flow control techniques such as DBR.
 - Is neither ToC, nor Lean

The immediate results were "extraordinaire"

- Within 2 weeks: over 30% increase in plant Throughput and Productivity
- Within 2 months: 95% reduction in the number of parts missing at assembly

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Client summary

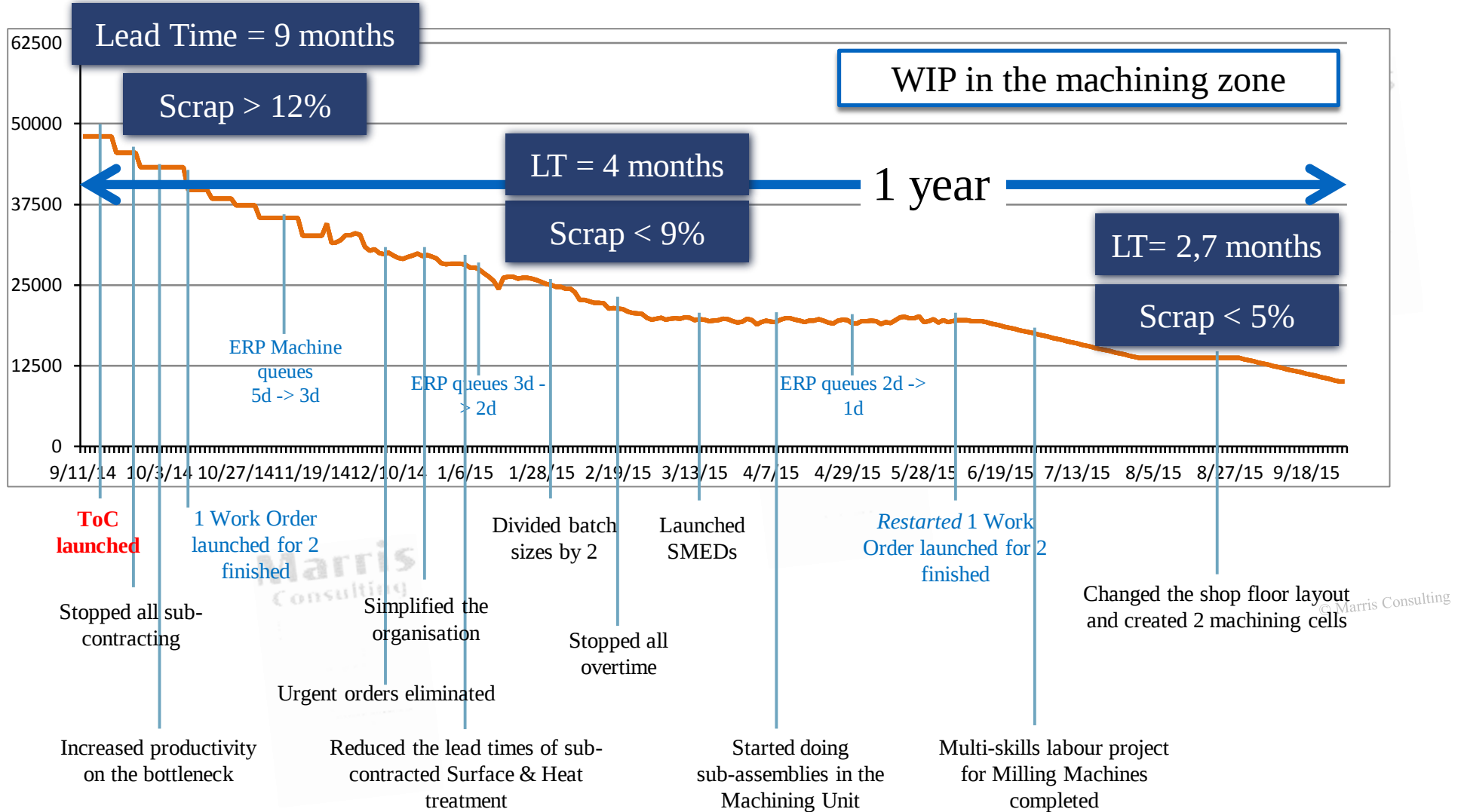


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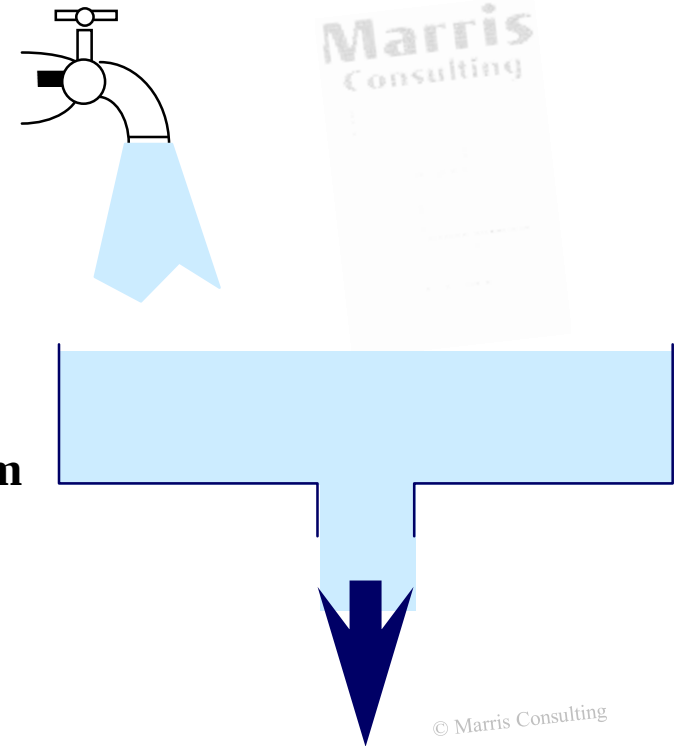


Little's Law:

Process durations are proportional to the quantity of work in progress

- If the factory has 1 000 parts in WIP (or 1 000 litres)
- If the factory produces 5 parts per day (or 5 litres / day)
- Then the **average cycle time** is $V/R = 1\,000 / 5 = 200$ days
 - The average time between start and finish
- This is Little's Law.

V = Volume of the reservoir
= WIP (Work In Progress)
in the factory / organisation / system



R = Rate of flow
 = production rate
 or output rate

Important and not always understood

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Step 3 - **SUBORDINATE** everything else to the above decision (#1 of 2)

The hardest step of the Theory of Constraints

- Rule
- Technically it looks easy: it is just "the rope". Material should only be launched according to the requirements of the constraint.
- But this implies that resources are no longer asked to work according to their own potential (their capacity) but according to the constraint's capacity. They must learn to be sub-optimal.
- So all the local measurements systems must be eliminated. Local O.E.E.s (Overall Equipment Effectiveness or machine utilisation) for instance must be abolished.
- The term "subordinate" can be misunderstood or rejected since common definitions are for instance : *Someone who is subordinate to you has a less important position than you and has to obey you.*

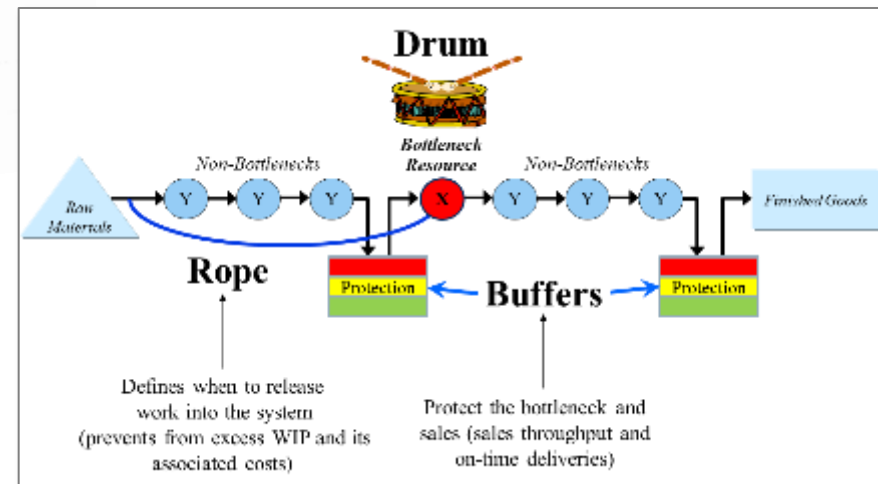


1. IDENTIFY the system's constraint(s).
2. Decide how to EXPLOIT the system's constraint
3. SUBORDINATE everything else to the above decision.
4. ELEVATE the system's constraint
5. WARNING!!!!
If in the previous steps a constraint has been eliminated, go back to step 1, but do not allow INERTIA to become the system's constraint.

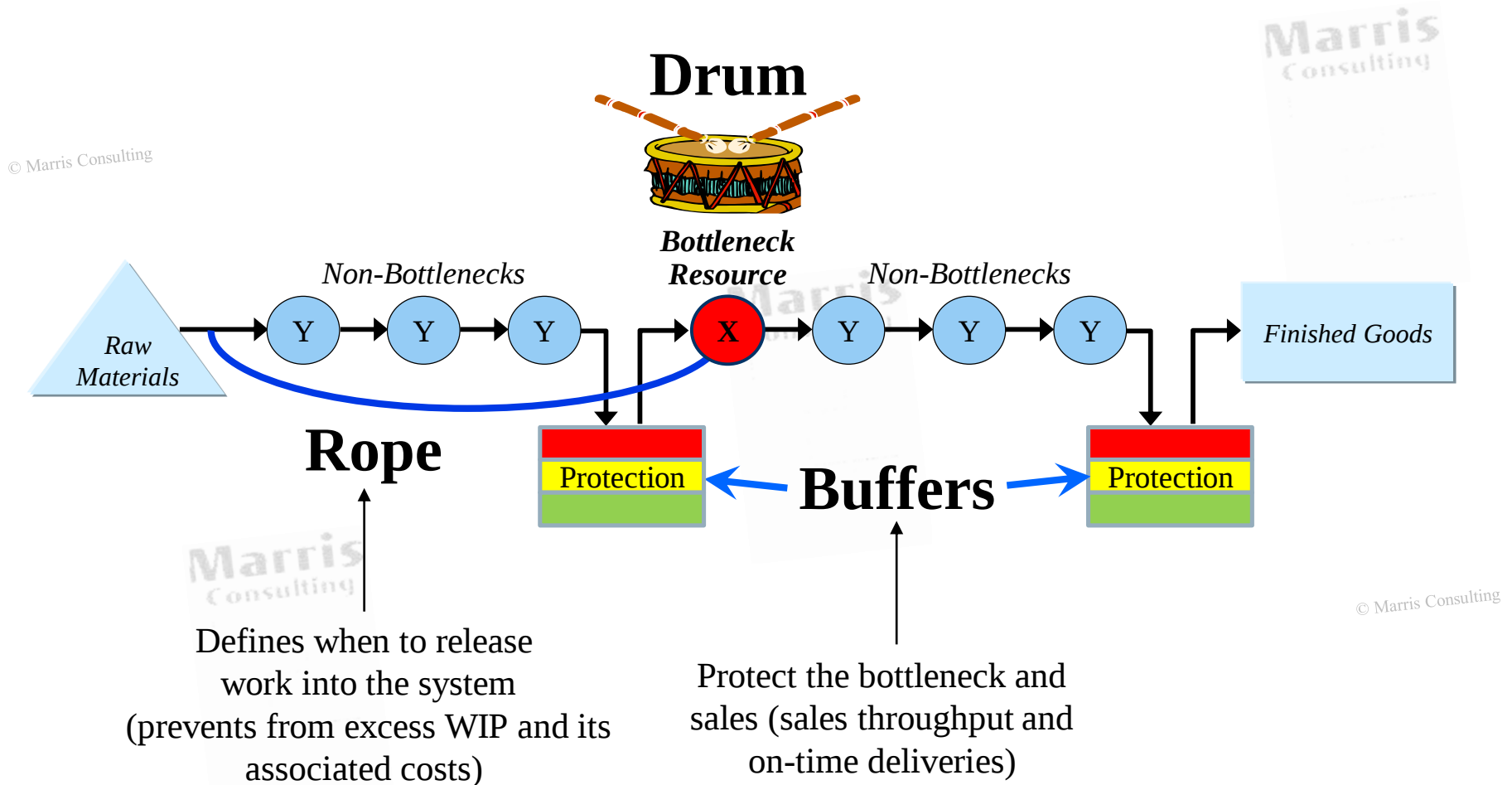
This is the hardest step of the Theory of Constraints

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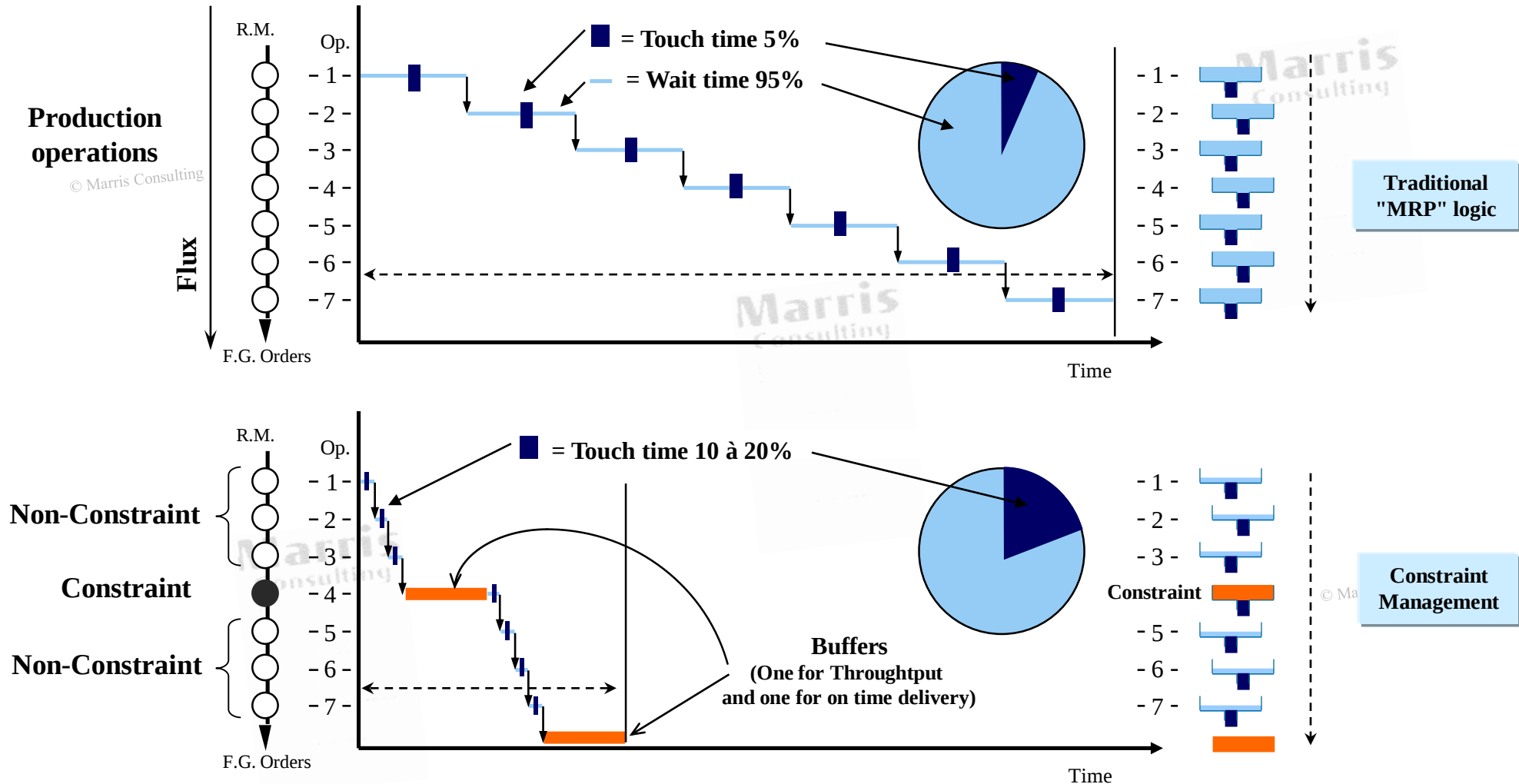
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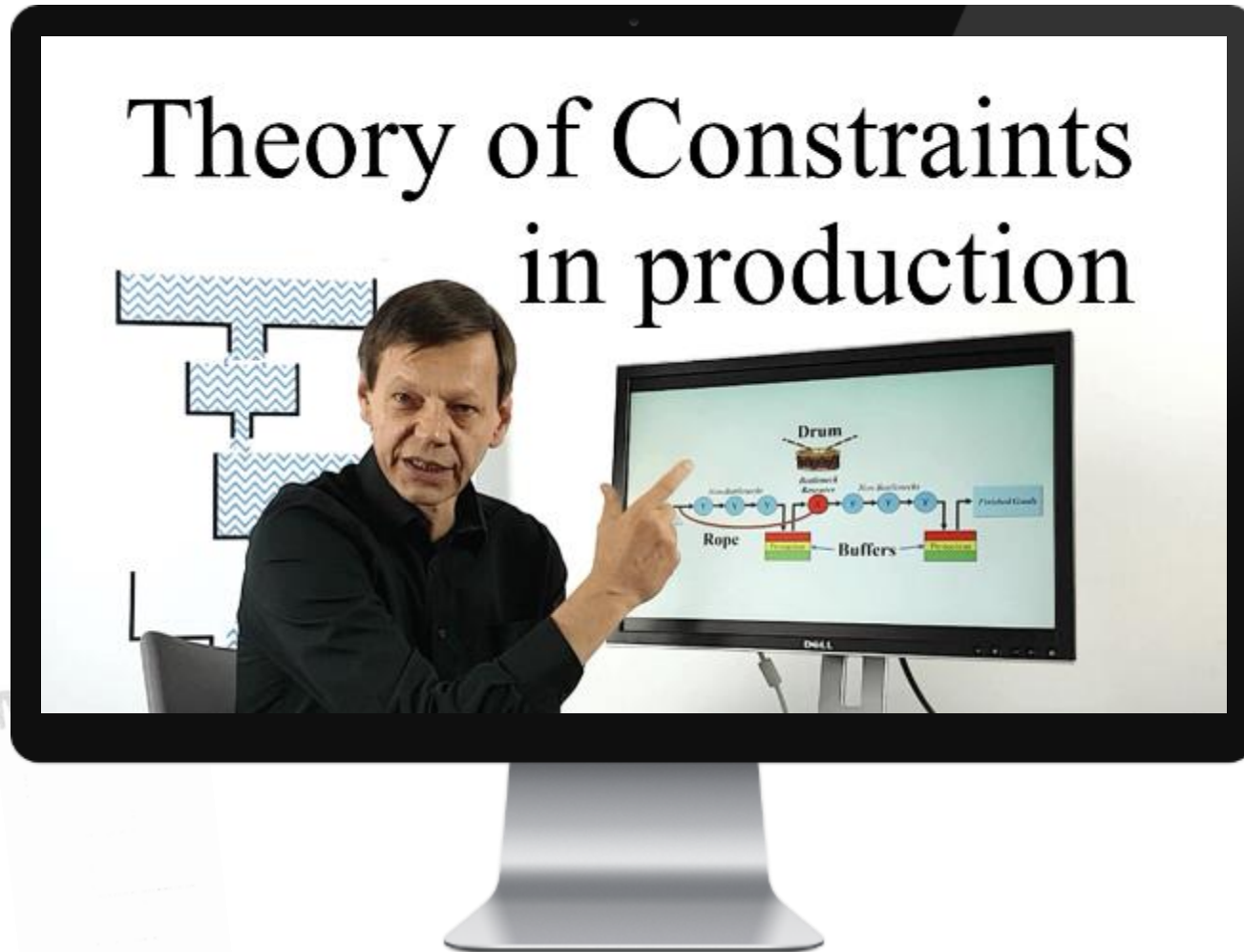
ToC controls production flow with the Drum Buffer Rope (DBR) mechanism



The Drum Buffer Rope (DBR) mechanism in Gantt form



See 5 minute video summary on Marris Consulting's YouTube channel



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Video on Marris Consulting's YouTube channel: *(En) Theory of Constraints in production - 5 min. summary*

Simulation game of a production line

The game of flow – second round: ToC management in presence of a bottleneck

- The capacity configuration is identical to the first round
- Choose the desired level of WIP in front of each item
(Possibility to keep the same levels as in the first round)

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Only change the rule of production flow control

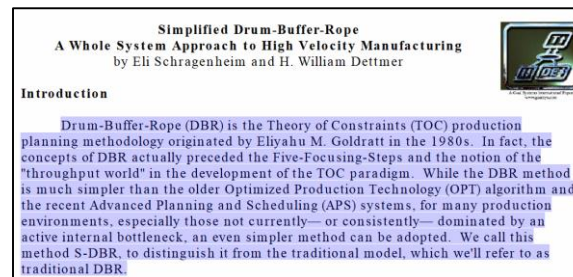
S-DBR / Simplified DBR: ToC flow management without a capacity constraint

- S-DBR or Simplified DBR emerged more recently (circa 2000). It is the ToC solution for scheduling and executing when there is no capacity constraint.
- Some ToC experts claim that S-DBR is the modern replacement of the "traditional" DBR. Philip Marris disagrees with this: both are pertinent depending on the context.
- It is easily implemented using MRP systems since both assume sufficient (infinite) capacity.
- To ensure that there is sufficient capacity it is recommended to monitor the "Planned load" is not excessive.
- The basic logic (very similar to Critical Chain buffering logic) is that you don't need to protect the individual resources, the only important thing to protect is the date promised to the client for his order delivery.



Picture source: Inherent Simplicity's Symphony S-DBR software

- A useful free source: 10 page article [2000] by Eli Schragenheim and Bill Dettmer:
<https://tinyurl.com/y7y434wg>



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[In 2018] S-DBR and DDMRP are 2 alternative solutions to managing flow in the absence of capacity constraints

- DDMRP emerged more recently (circa 2014 although its development began many year previously).
- The 2 founders / thought leaders, Carol Ptak and Chad Smith, had previously worked for decades with the Theory of Constraints.
- DDMRP proposes a 5 stage process:

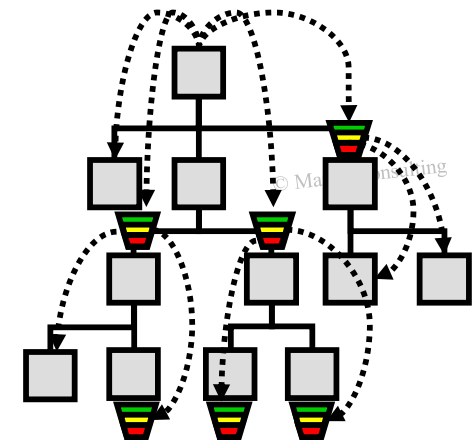
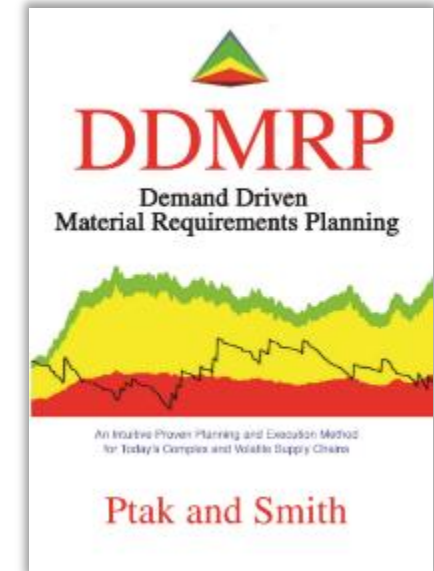
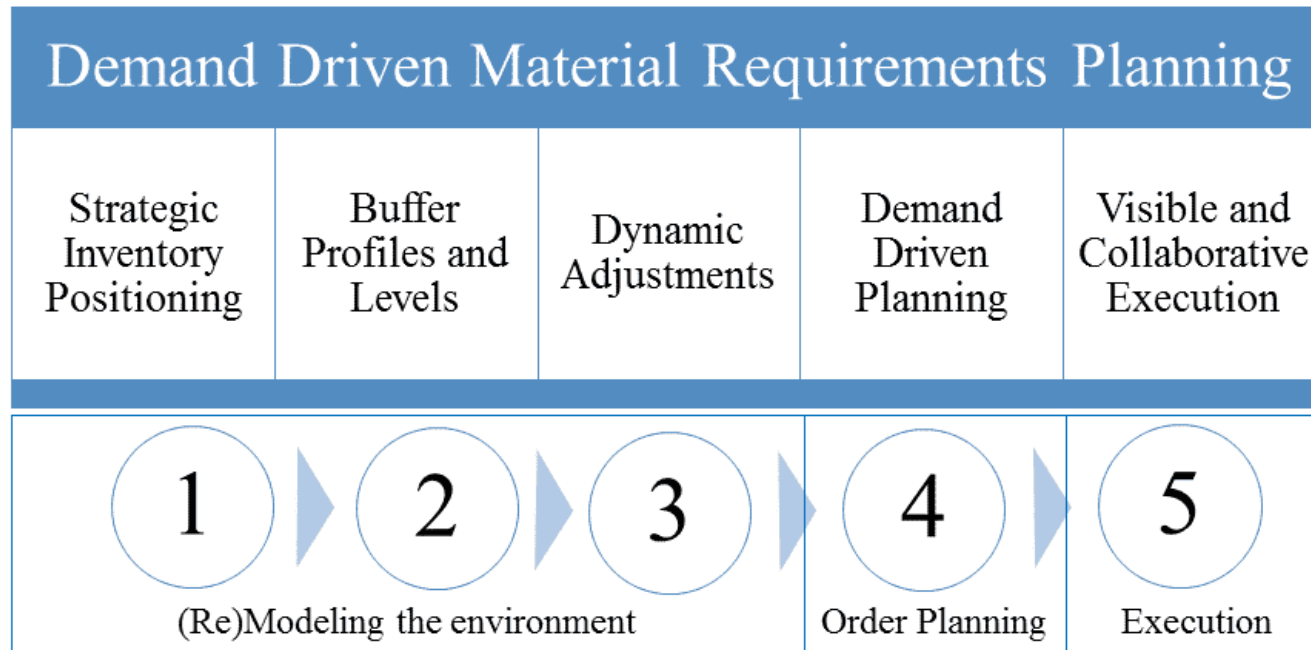
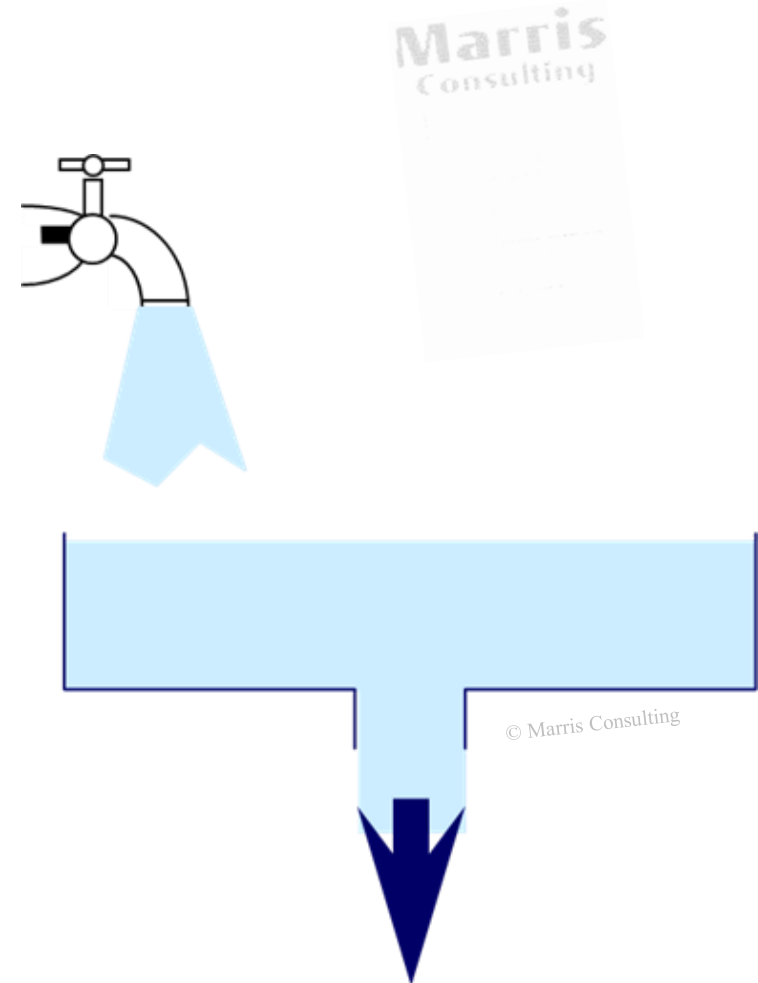


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The magic of the "2 for 1 rule"

- As we have seen in the case studies presented we implement this rule in nearly all our production projects.
- It is neither ToC nor Lean.
- It is very simple.
- Usually the output increases quite significantly:
 - Initially because of the pressure from starving resources upstream
 - And later because since the WIP has been reduced the factory becomes more efficient.
- The units used can vary: Parts, Work Orders, Etc.
- Detail:
 1. Implement the rule. This forces schedulers to choose between 2 Work Orders...they have to start understanding the ERP!
 2. Monitor the quantity of work with an overdue launch date. Don't let it get more than 25% of WIP.
 3. From time to time (about every 2 weeks) you can "tell the MRP / ERP what is going on by reducing the wait times in the routings. This will resorb the work waiting to be launched list.
 4. Go back to step 2.



See 2 min. video on the "2 for 1 rule"
<https://youtu.be/CCeC7QIScJs>

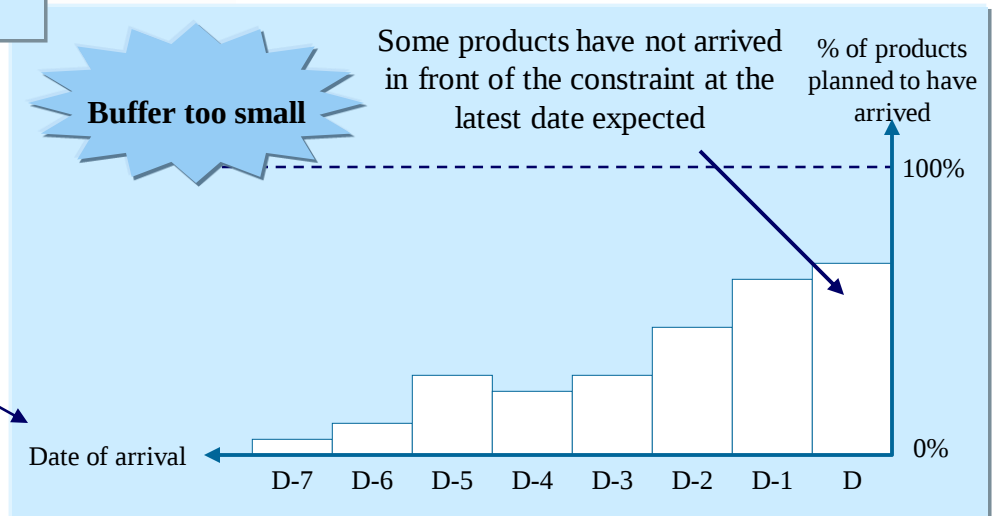
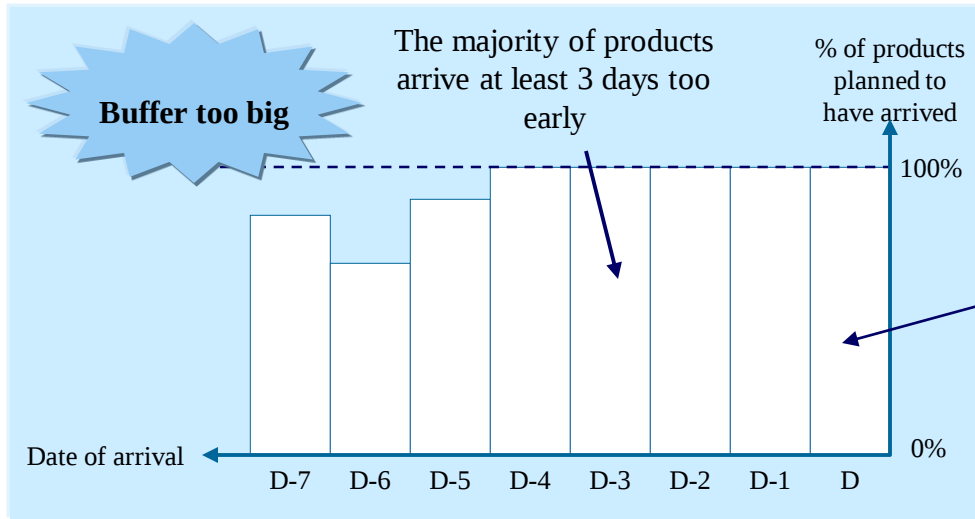
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How to define the size of the buffers (1/2)



In this example we have used days but depending on the environment we could have used hours or weeks

For those who have been using ToC for over 6 months, a word of warning:

WARNING

Don't fall asleep on your buffers



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A fairly easy step: Elevate the system's constraint

- To increase the capacity of the system's constraint is easy but in some cases it can take time.
- The ROI (Return On Investment) is usually easy to justify since the impact on profitability or Throughput will be very significant.
- It can take time though if:
 - It is a long investment process
 - It is a rare human capability that will have to be grown / nurtured internally
 - It involves regulatory approvals
 - Etc.
- The main danger is miscalculating the excess capacity surrounding the constraint. If in the elevation process the constraint moves elsewhere then the ROI justification falls apart and the organisation is destabilized by "discovering" a new constraint. See next section.



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Marris Consulting's point of view

- If you follow standard Theory of Constraints orthodoxy then you just go back to Step 1 and identify the new constraint.
- This means that ToC resembles permanent bottleneck hunting.
- Paradoxically it is an attempt to balance the plant.
- And Goldratt's initial axiom was that this was impossible!
- Philip Marris does not agree with the 5th step of the 5 focusing steps.
- Philip Marris suggests:
 - That constraints are eliminated one after the other until one reaches the best (least worse) constraint.
 - An organized / target unbalanced system with the best constraint surrounded by non-constraints.

In his 1994 book in French the subtitle and "Part 2" of the book is called "A la recherche du bon déséquilibre" or "In search of the ideally balanced plant".

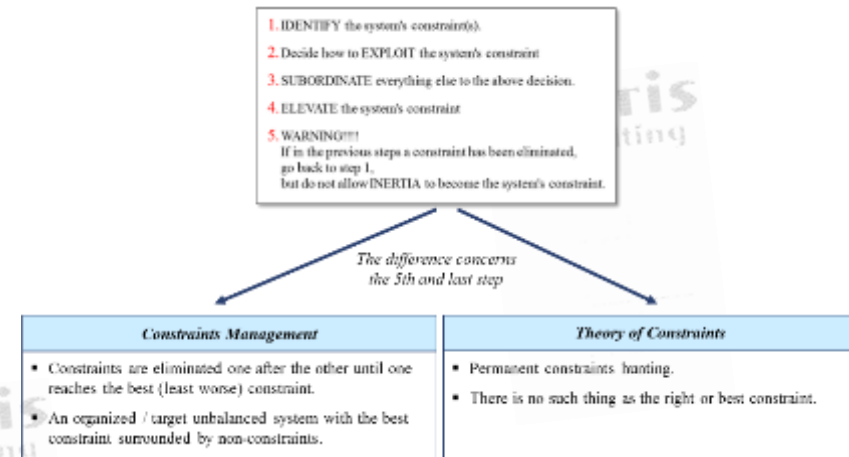
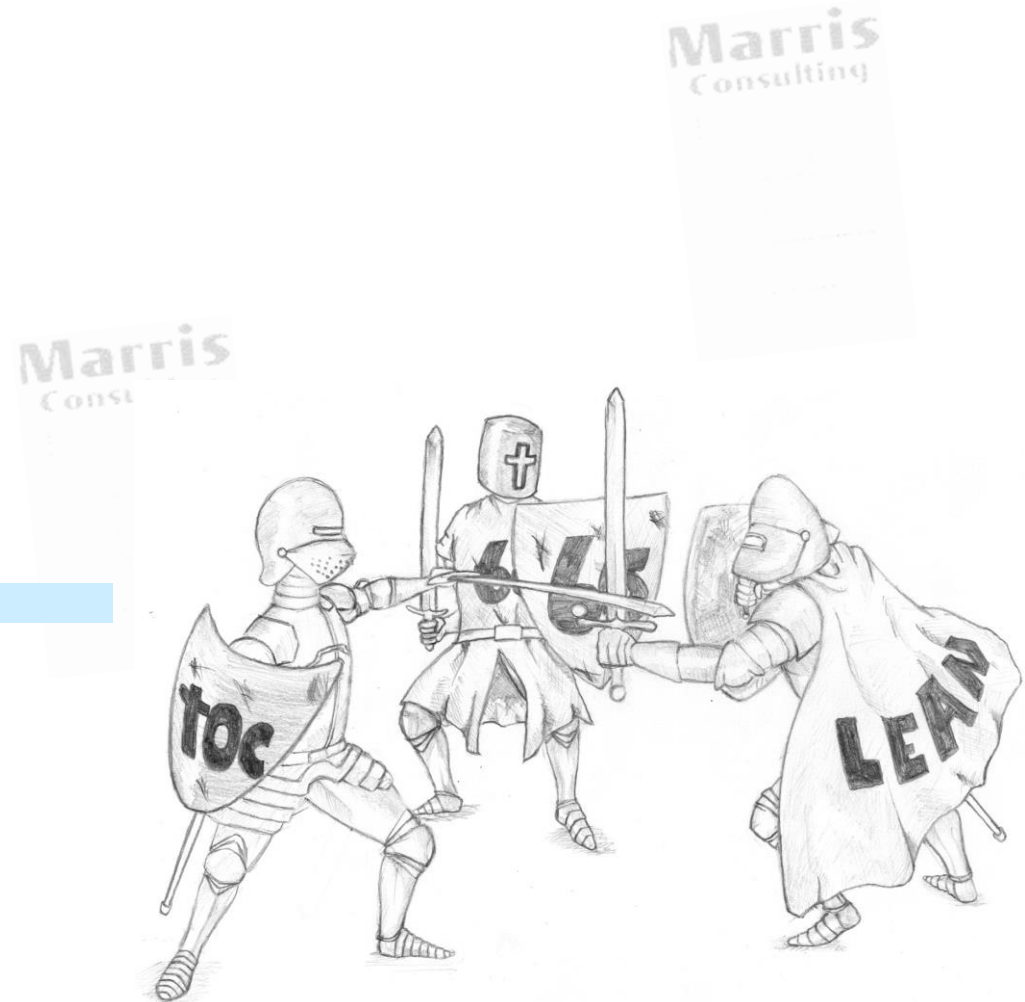


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To better understand we identify sub-types: Good, Bad, Open & Closed

■ Good Lean and Bad Lean

- Good Lean = Toyota = Growth (no downsizing) + A mind-set + Beautiful Manufacturing + Lean NPD + URO + Supplier Partnerships + Kaizen + Etc.
- Bad Lean = A process of continuous downsizing.

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■ Open ToC and Closed ToC

- Open ToC = ToC is powerful, it is necessary but not sufficient.
- Closed ToC = ToC is better than everything else. ToC is the answer, what is your question? ToC is the only way.

■ Good Six Sigma and Bad Six Sigma

- Good Six Sigma = Use data + VOC + Focused projects using DOEs.
- Bad Six Sigma = A lot of belts, a lot of projects, no DOEs, few results.



See video on Marris Consulting's YouTube channel

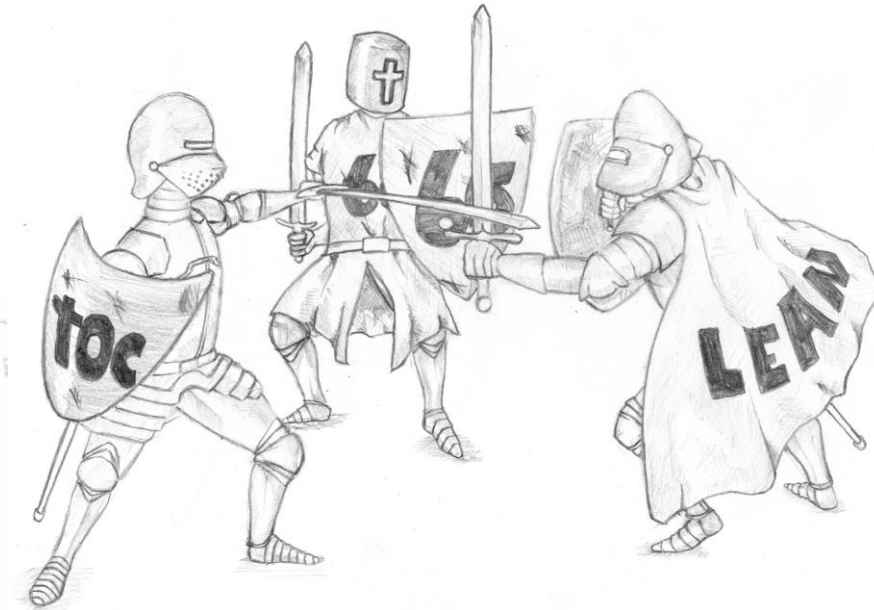
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S.C. = Supply Chain. Lean NPD = Lean New Product Development (Toyota's Lean Engineering). URO = Unrefusable Offer. VOC = Voice Of the Customer. DOE = Design Of Experiments (Taguchi etc.)

Why and how they can reinforce each other

T + L + S has many (obvious?) synergies

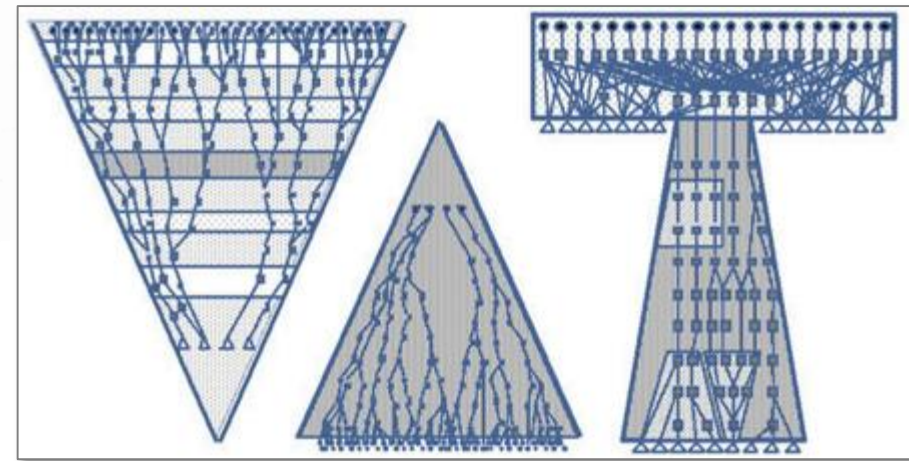
- ToC can help determine what to change and where to act.
- Lean and SS tools can then be used to improve performance.
- ToC can stimulate increases in Throughput.
- Lean can help in reducing Inventory and Operating Expenses.
- Six Sigma can not only be used to reduce variability but also to increase Throughput (increase bottleneck efficiency).
- ToC's (Logical) Thinking Processes could help build a Strategy & Tactics Tree and identify opportunities outside of operations.
- Maybe Lean can help create more durable success stories and provide management best practices & a long term vision.
- Why and how they are incompatible? The incompatibilities are in the mind-sets and nearly non-existent in practice!
 - Lean "One piece flow" versus ToC Buffers.
 - Six Sigma Belts versus other "change agent" organizations.



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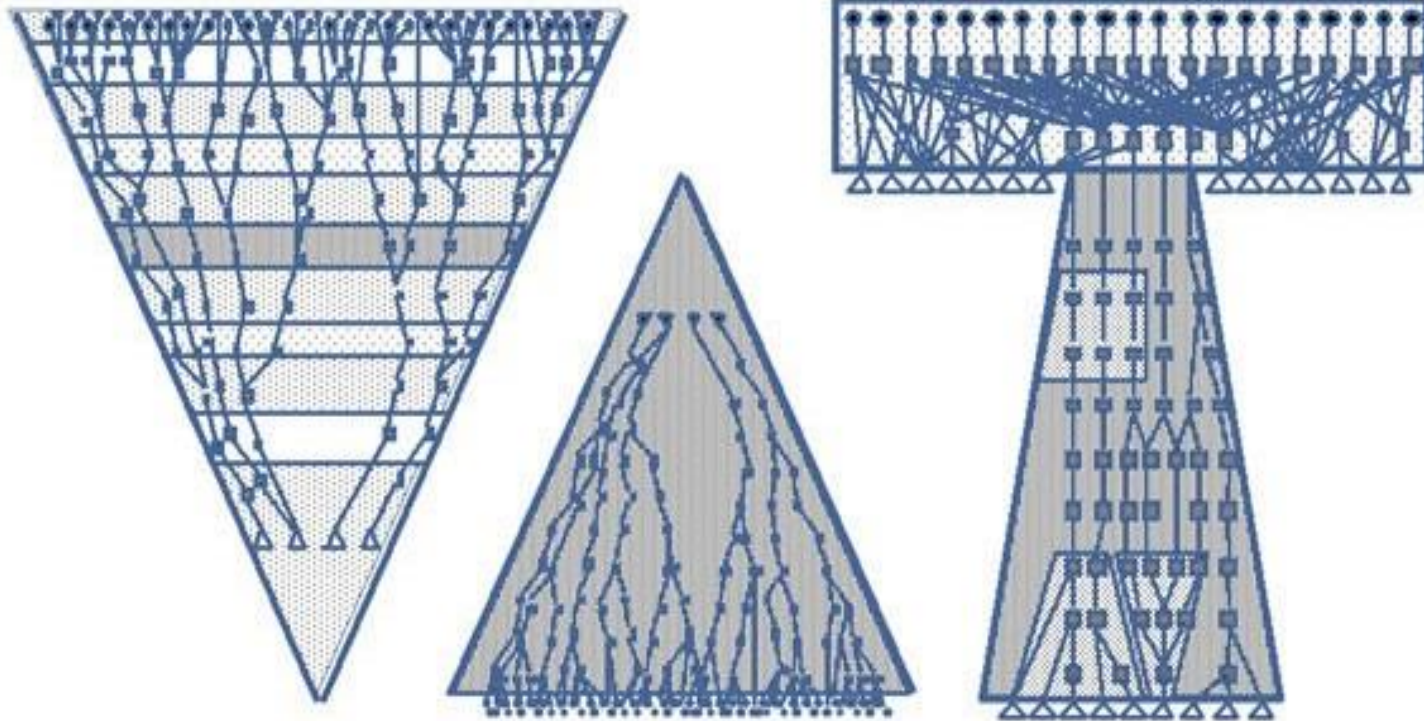
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The V, A and T typologies

Finished Goods



Raw Materials

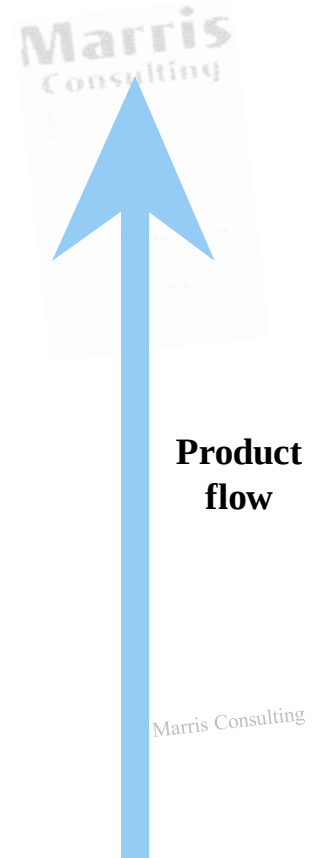
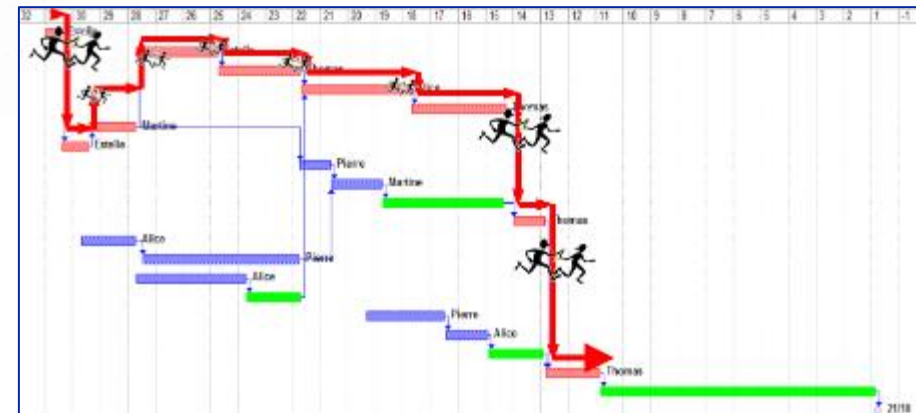


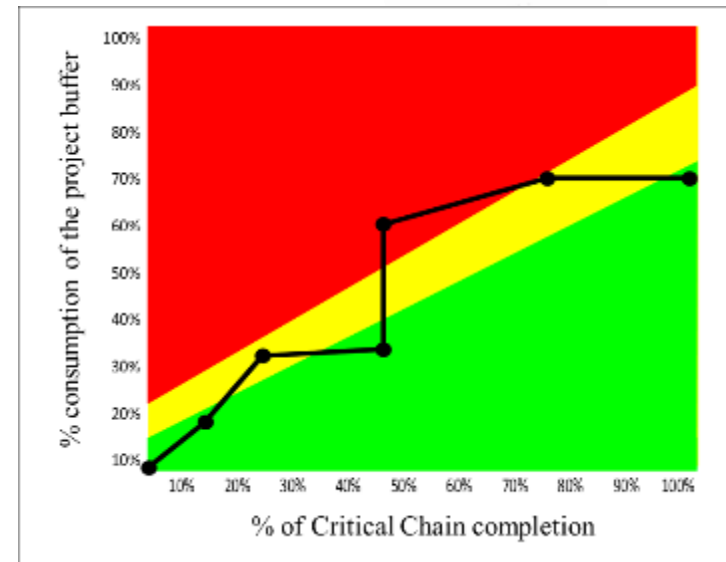
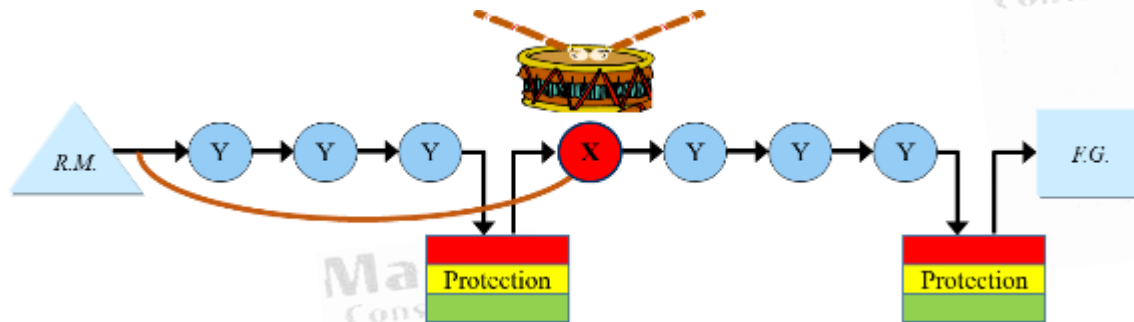
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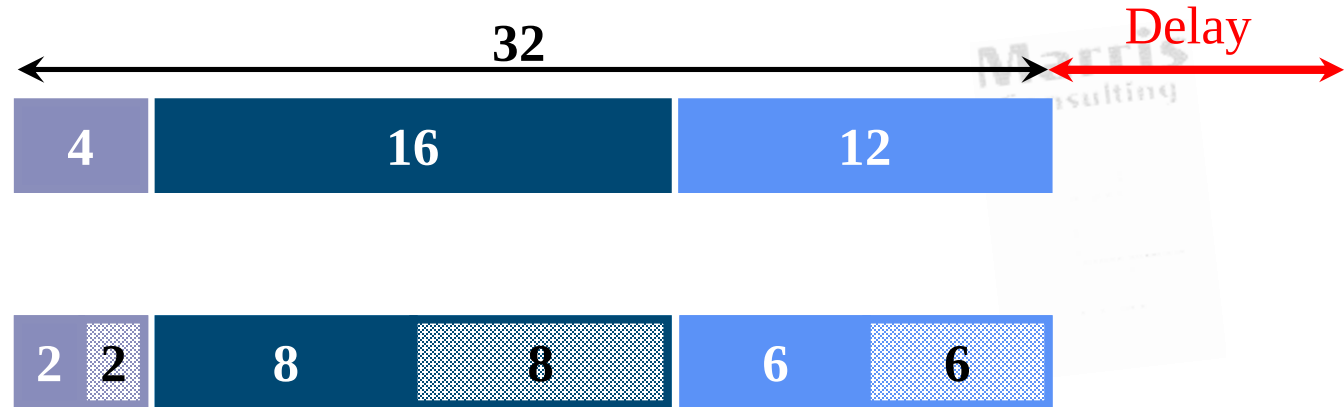
DBR or CCPM?

- Drum – Buffer – Rope is the ToC solution for repetitive manufacturing.
- For non-repetitive environments the ToC solution is Critical Chain Project Management (CCPM)
 - Engineering and Make To Order,
 - Maintenance, Repair & Overhaul (MR.O.),
 - So this includes environments such as satellite manufacturing or shipbuilding for instance.

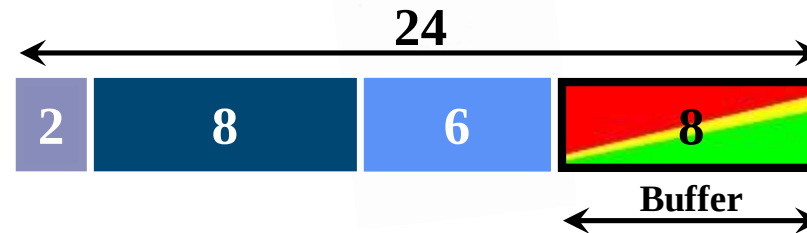


Protecting the whole project and not the individual tasks

With traditional planning,
each task has its own margin...



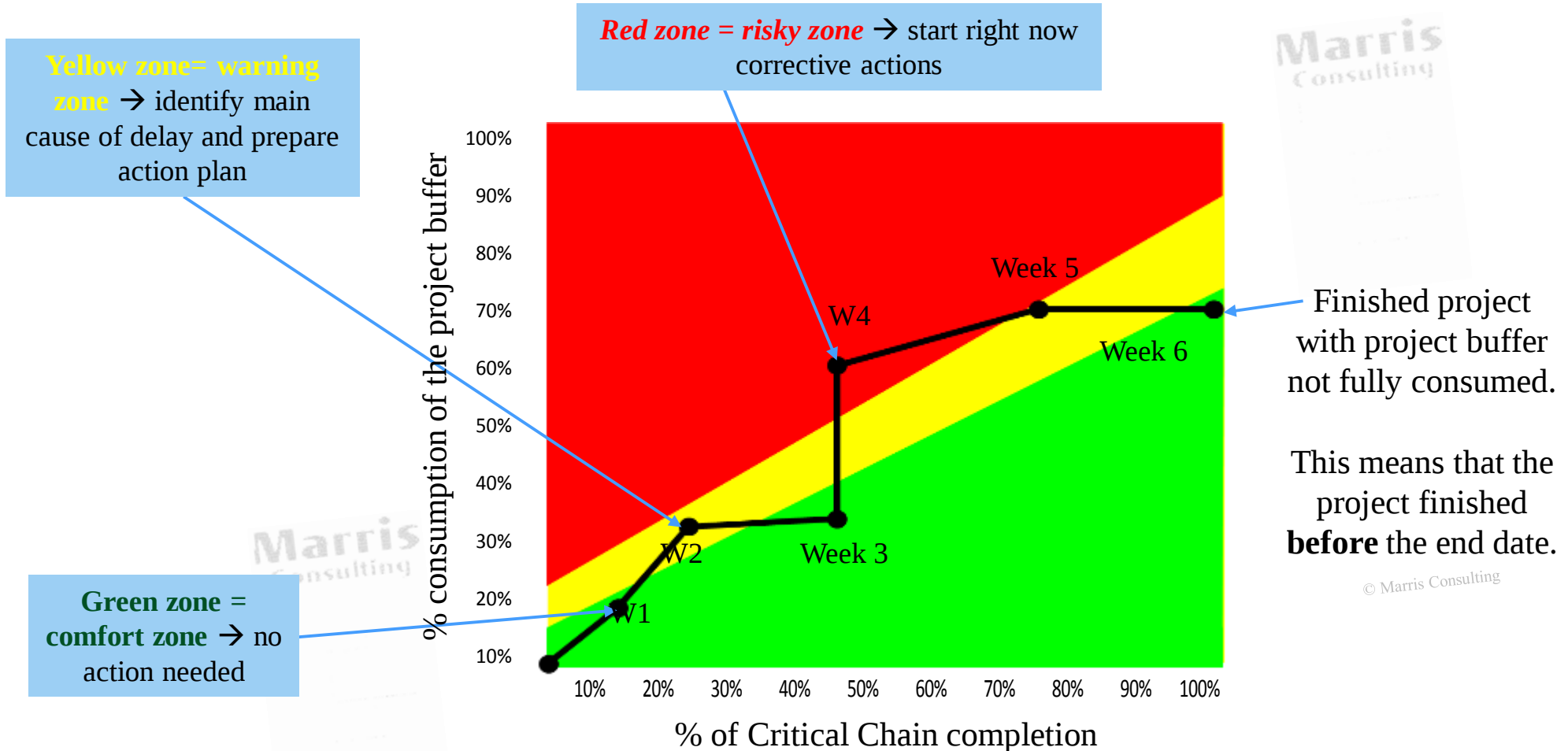
With Critical Chain, margins are
mutualized and
cycle times are challenged



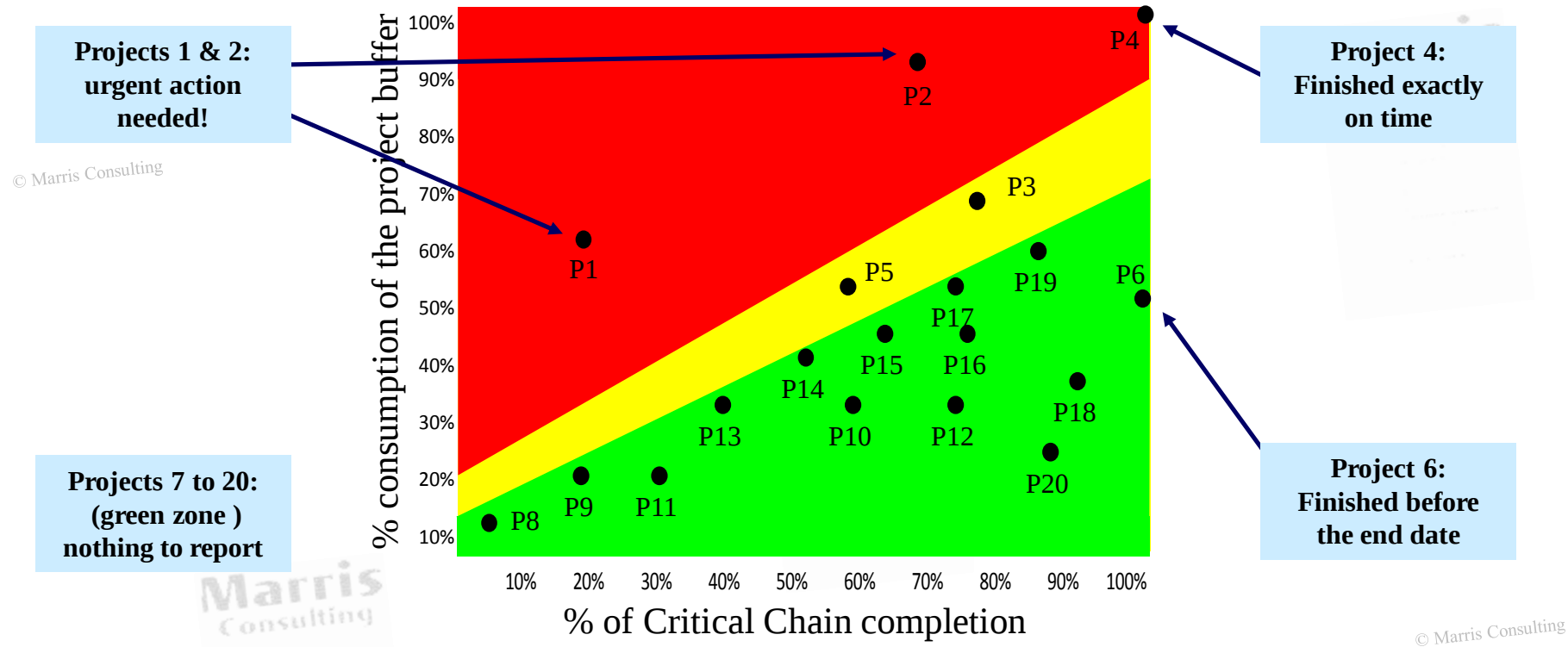
The "Buffer" represents
1/3 of project duration

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Project monitoring is much easier thanks to the **Project Fever Chart**



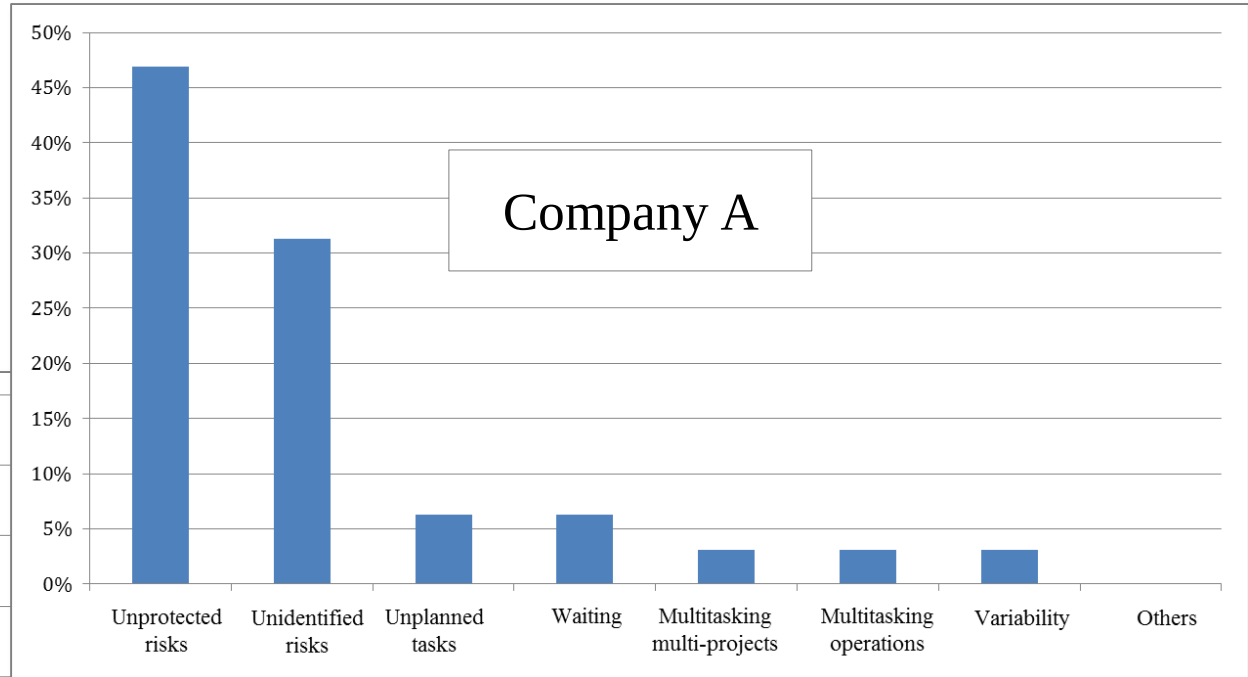
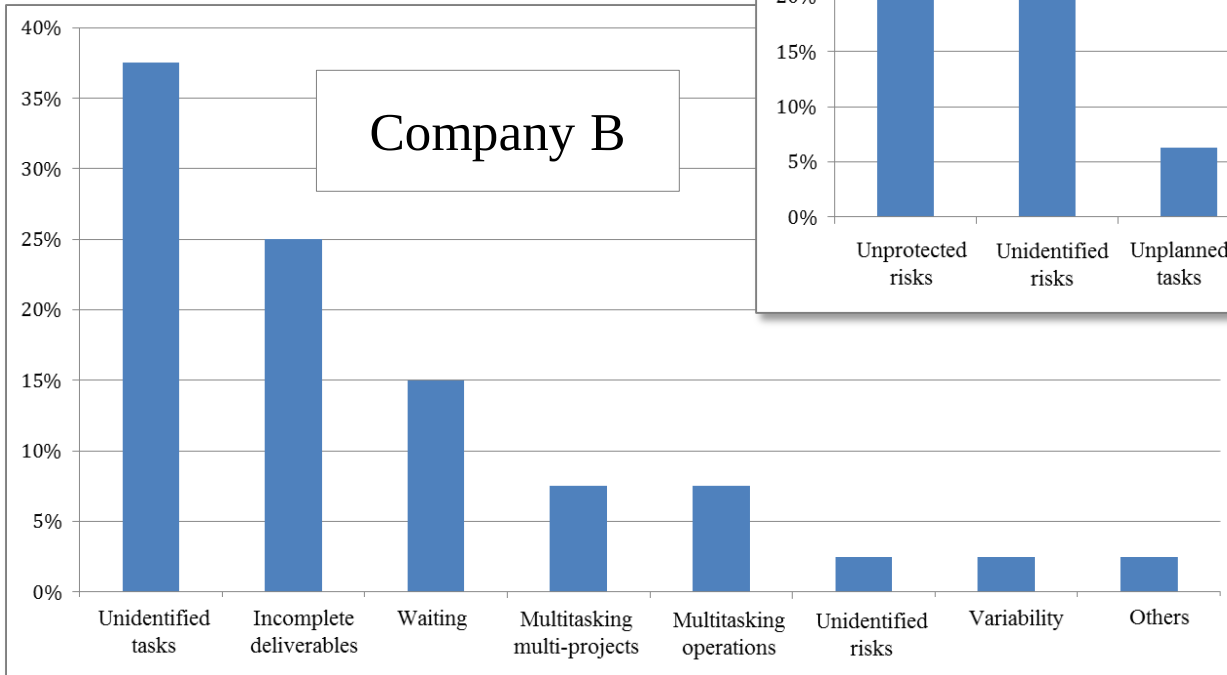
The Portfolio Fever Chart greatly facilitates dynamic arbitration between projects



The Portfolio Fever Chart helps to quickly track all the projects in the portfolio with objectivity and transparency

The project buffer consumption Pareto makes it easy to identify the next improvement opportunities

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Partial list of >600 CCPM references in the world

Industry	Project Type	Company	Results	Reference
Power	Engineering	ABB AG, Power Tech. Division	Throughput increase over 33% from 300 Bays to 430 Bays per year.	www.realization.com
Power	Engineering	ABB Cordoba	Engineering cycle time reduced from eight months to three months.	www.realization.com
Power	Repair	ABB Halle	Number of projects completed per year increased from 42 to 54, >25%.	www.realization.com
Construction	Theme park design, install, and commission	Action Park Multiforme Grupo	Increased number of projects completed from 121 to 153.	www.realization.com
Communications	Product development	Airgo Networks (Qualcomm)	Cycle time improved from 19 months to 8 months.	www.realization.com
Aluminum	Engineering	Alcan Alesa Technologies	Number of projects completed increased over 30%.	www.realization.com
Communications	Telecom switch design	Alcatel-Lucent	Increased throughput by 45% per person.	www.realization.com
Software	See regularly updated list here: www.chaine-critique.com			www.realization.com
Automotive	Product development	Alpine Electronics	Delivery dates compliance rate went from 22% to 88%	www.japan-toc-association.org
Communications	Customized software development	Amdocs	14% increase in revenue/man-month; 20% reduced cycle time.	www.realization.com
Manufacturing	Boiler installation	Babcock	Actual versus planned went from +200% to -20%. Between 20% and 55% reduction of manhours. 40% reduction of cycle time	www.tocpractice.com

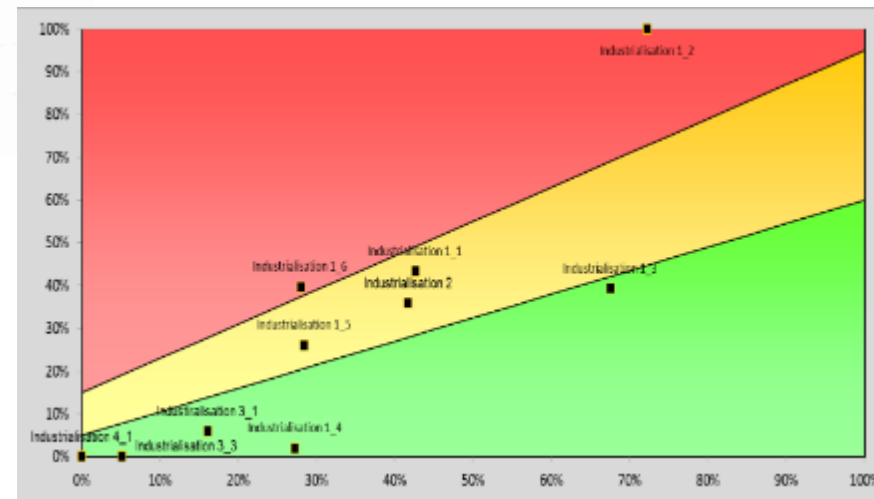
A CCPM software comparison is available on the Marris Consulting website

Software	Lynx TameFlow	BeingManagement 3	Exepron	CC (M) Pulse	P2ware Suite	ProChain Scheduling Pipeline Enterprise	Concerto	CCPM +	Aurora-CCPM
Logo									
Editor	A-dato	Being CO., Ltd.	Exepron	-	P2ware	ProChain Solutions	Realization	Robbin Gioia	Stottler Henke
Release date	Continuous Deployment of Updates	2007	2010	-	Founded in 2004	Version 1 in 1997 Current V 12	V1.0 in 1997	RB founded in 1980	Founded in 1988 CCPM since 2005
Criteria									
Software architecture	Web-based/ Smart Client / Inhouse / Cloud	Cloud / On-premises	Cloud & Private Cloud	Single Machine	Cloud	Single Machine / Customer Server or Cloud	Web-based Option for MSP add-on, Supports SaaS & private/on-premise installations	Single Machine	Cloud, or Standalone, or In-house cloud/server
Langages	 *	 							
Customer service					N/A			N/A	
	Helpdesk (Phone, Email, Online)		Average 9 minutes			Answer within 1 day (e-mail) Optional: annual	Global help desk support through		Dedicated team for

www.marris-consulting.com/en/points-of-view/critical-chain-project-management-software-solution

Equipment manufacturer for aeronautical industry New product development and industrialisation portfolio

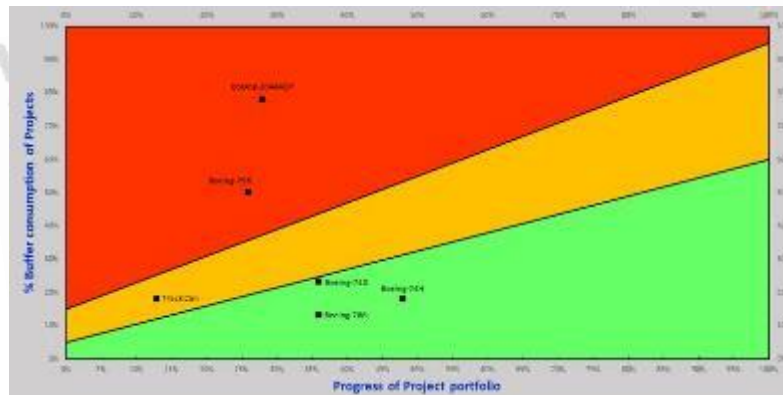
- European leader in aeronautical equipment: flight control systems, aircraft engines, ...
- The Critical Chain approach was applied to the entire New Products Development and Industrialisation portfolio of one of the factories in 4 months.
- Average project duration reduced by more than 50%.
- On time delivery improvement spectacularly.
- Number of projects completed per year increased significantly.
- Recognized as a very powerful decision making tool:
 - Very easy arbitration of resources allocation between different projects.
 - Possibility to simulate the consequences of forcing a new project into the portfolio on the other projects.
 - Etc.



South African aeronautical equipment manufacturer

New Product Development + ERP implementation + Large improvement projects

- 700 people facility. Very diversified product range. Suppliers of Boeing, Airbus, Spirit Aero, Safran, ...
- Implementation of Critical Chain Project Management for all their projects:
 - Especially the development and industrialization of their new products and processes.
 - An ERP implementation project (a major change of software version).
 - Their large "Process Of On-Going Improvement" projects such as the complete warehouse restructuring and modification of associated processes.
- Significant improvement in: project durations, on time finishing, projects completed per month, visibility, what-if modelling, employee satisfaction ...
- This company applies the Theory Of Constraints to all of its operations: projects, production, purchasing, strategy & tactics.



See 5 minute video summary on Marris Consulting's YouTube channel



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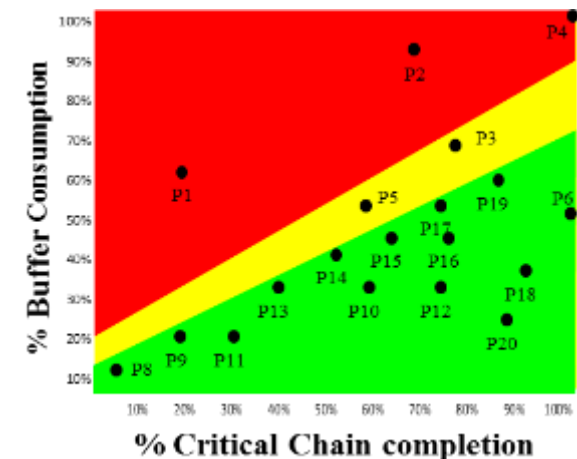
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Video on Marris Consulting's YouTube channel: *(En) Critical Chain Project Management - 5 min. summary*

Summary of the Critical Chain way of managing project portfolios:

- The only important goal is to finish your projects on time, within budget and conform to specifications.
- Safety buffers are reduced and mutualized into project and feeding buffers.
- Monitoring of project execution with a Fever Chart: a simple and efficient visual management.
- Ensuring the proper and smooth execution of Critical Chain tasks (relay race and mascots) to execute projects faster.
- Projects are sequenced to limit the work in progress and devastating multitasking. We avoid launching projects too soon.
- Resource conflicts between projects can be easily, objectively and dynamically managed using the Fever Chart.
- Thanks to the focus on the capacity constraint the productivity of the whole business increases significantly.

Results	Average
Project durations	- 39%
Number of projects completed in a given time	+ 70 %
Throughput	+ 53%



*Critical Chain enables you to take control of your projects portfolio...
...do you dare to finish all your projects on time?*

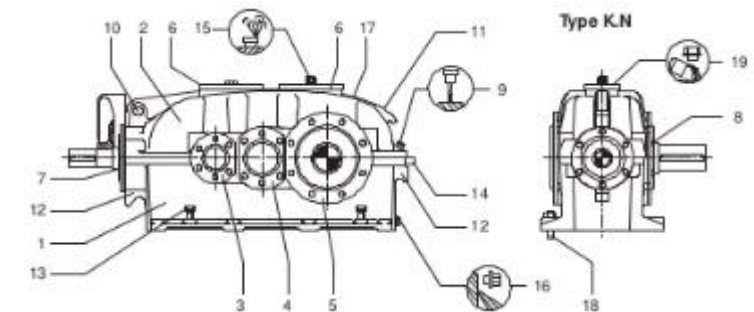
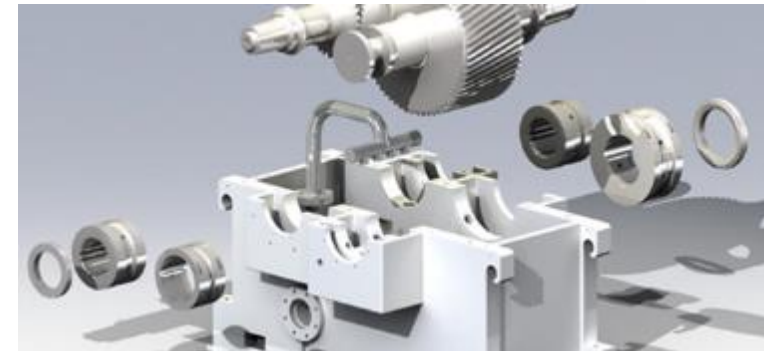
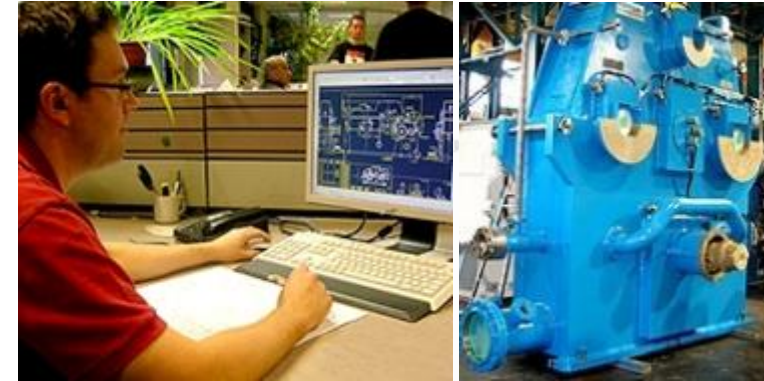
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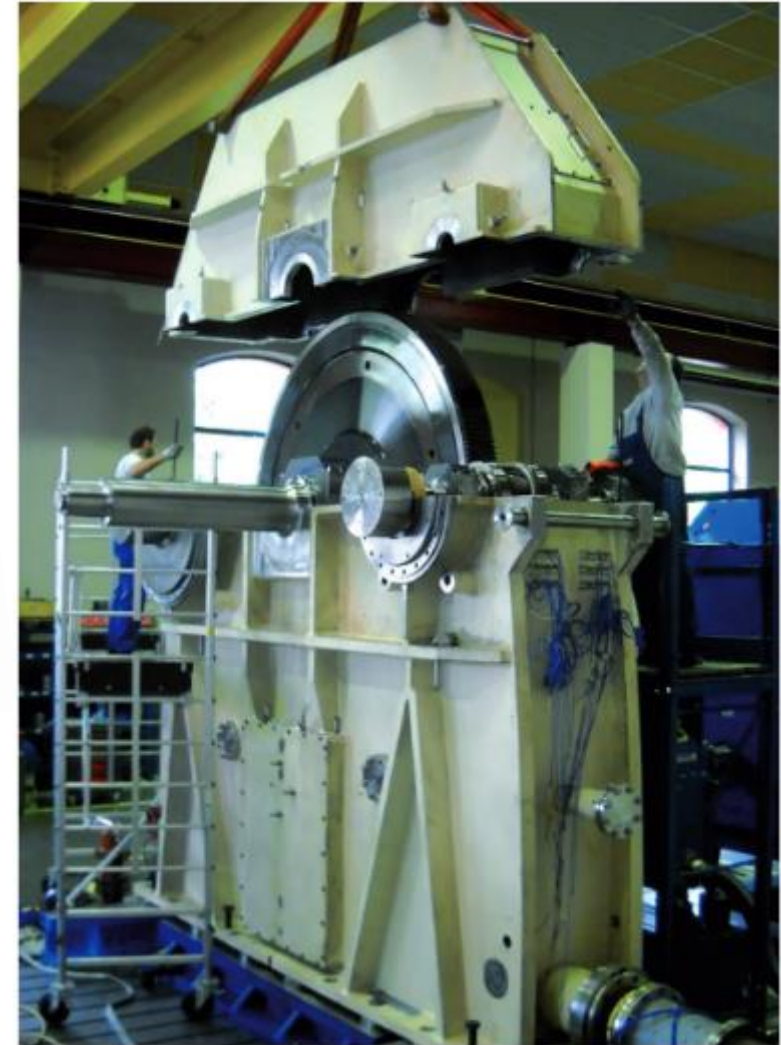
A Engineering To Order and Make To Order company

- The capacity constraint / bottleneck was in the Design Office in the Engineering Department.
- Their job was to design the specific equipment requested by the client.
- The Design office was flooded:
 - 90 projects in progress
 - 50 weeks of lead time
 - 1,8 projects (designs) finished per week.
- The team of 16 technicians were overworked and very stressed:
 - Each person was handling up to 10 projects simultaneously
 - They were being continuously interrupted
 - The work priorities changed all the time
 - The modus operandi was "Decibel management".



Critical Chain was applied to the Engineering Department

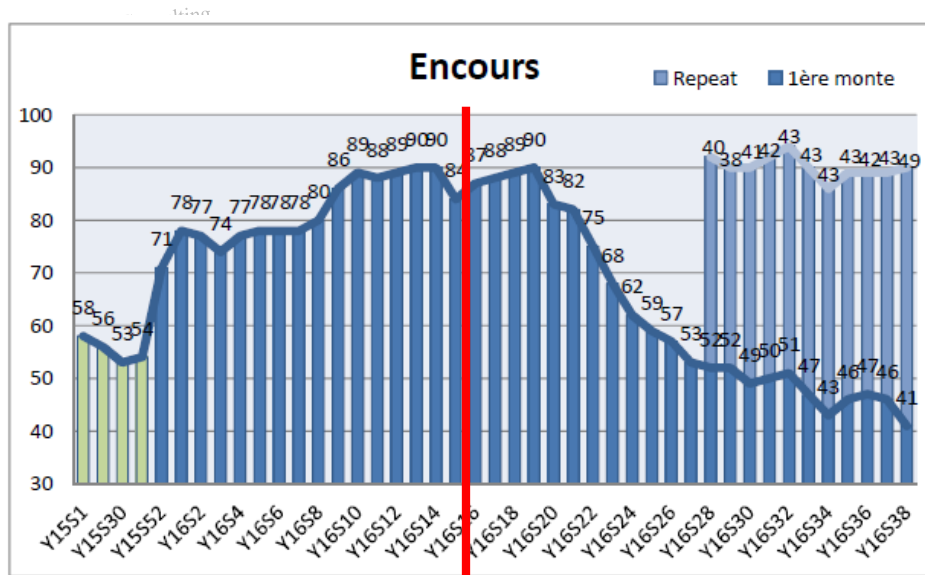
- CCPM was used to manage the Design Team.
- New rules were enforced.
- Once a project is started it must be finished ("Start finishing and stop starting").
- Requests for modifications were filtered by management.
- No new projects were started until the WIP had been reduced to the target level.
- The projects were prioritized by the sales Department and required CEP approval if a change of priority was requested.



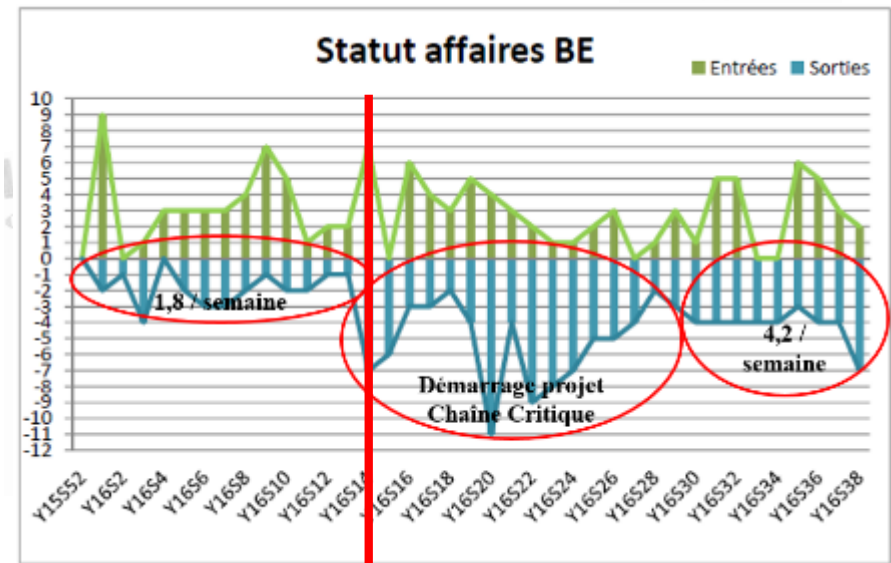
The results:

lead times divided by 5 and Throughput and productivity improved by 130%

- Before: 90 projects in WIP, 50 weeks average to complete, 1,8 projects finished per week.
- Today: 41 projects in WIP, 10 weeks average to complete, 4,2 projects finished per week.



CCPM Project start



CCPM Project start

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Just do it!

- The Theory of Constraints is a phenomenal weapon.
- It enables you, through focus, to improve much faster.
- We know, we have been implementing it for over 25 years.
- It is more or less unknown. So what? That means your competitors are unlikely to catch on.
- It can be seamlessly integrated into whatever "approach" a company is using.
- Your boss objects? Just call it Lean!
- So, why don't you implement it!?



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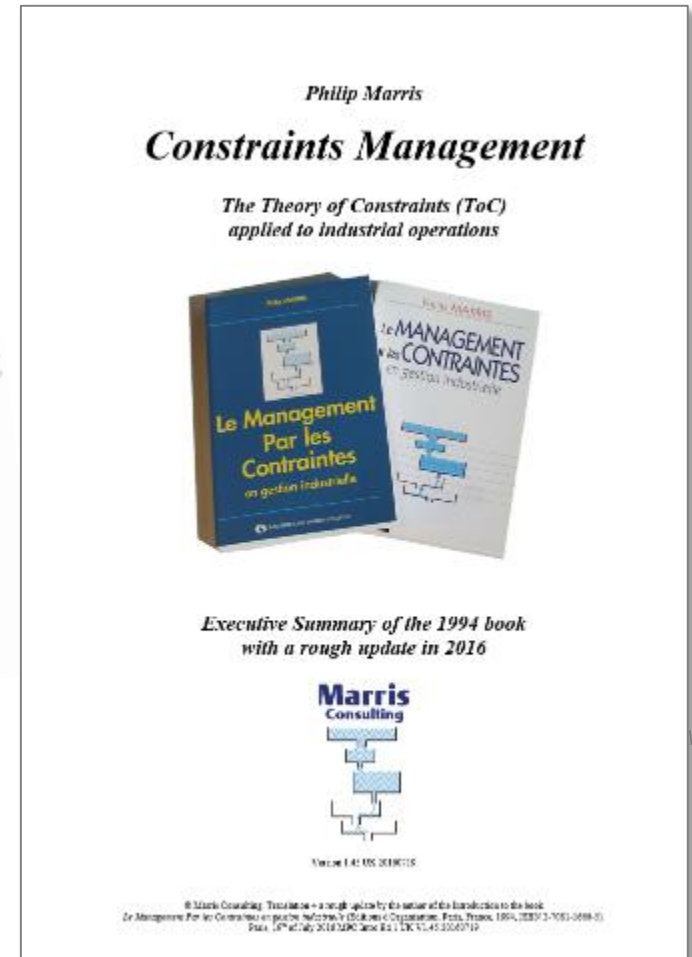


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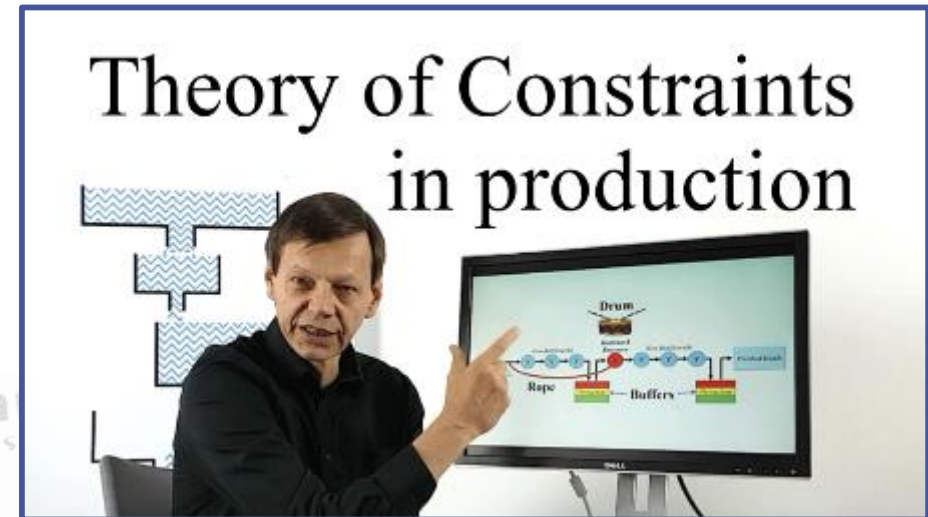
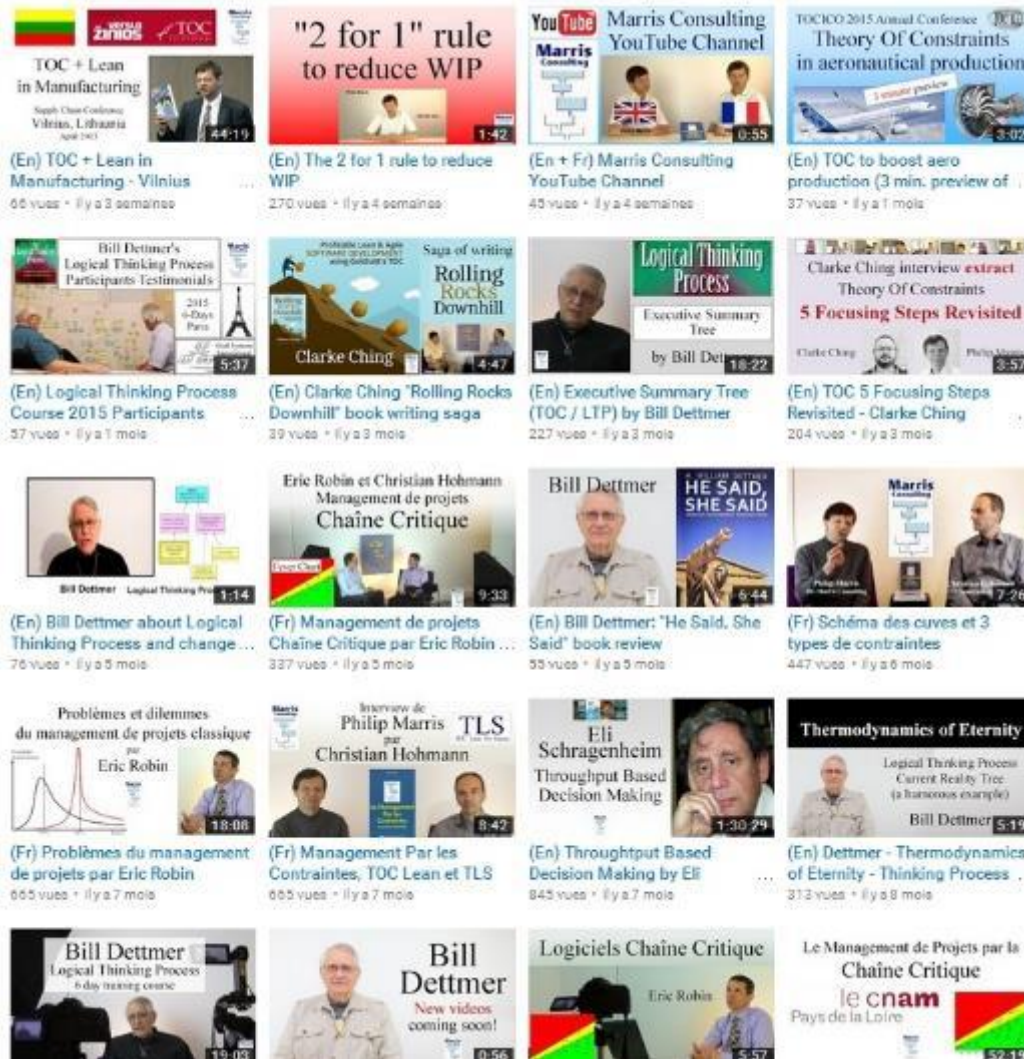
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A video website: Marris Consulting's YouTube Channel

<https://www.youtube.com/user/marrisconsulting/videos>



(En) Theory of Constraints in production - 5 min. summary



A brief 5 minute summary of how one applies the Theory of Constraints in a production environment. It covers: the axiom of the unbalanced plant, the existence of bottleneck, the Drum – Buffer – Rope flow control mechanism and the improvement strategy (the 5 focusing steps).

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To facilitate viewing and video selection use the playlists:

- English videos
- Critical Chain videos
- Etc.

Useful web link: a information website dedicated to TLS
To get the latest news and use the best web sources when surfing

Sur www.scoop.it/t/tls-toc-lean-six-sigma:

Topic « TLS – ToC, Lean Six Sigma »

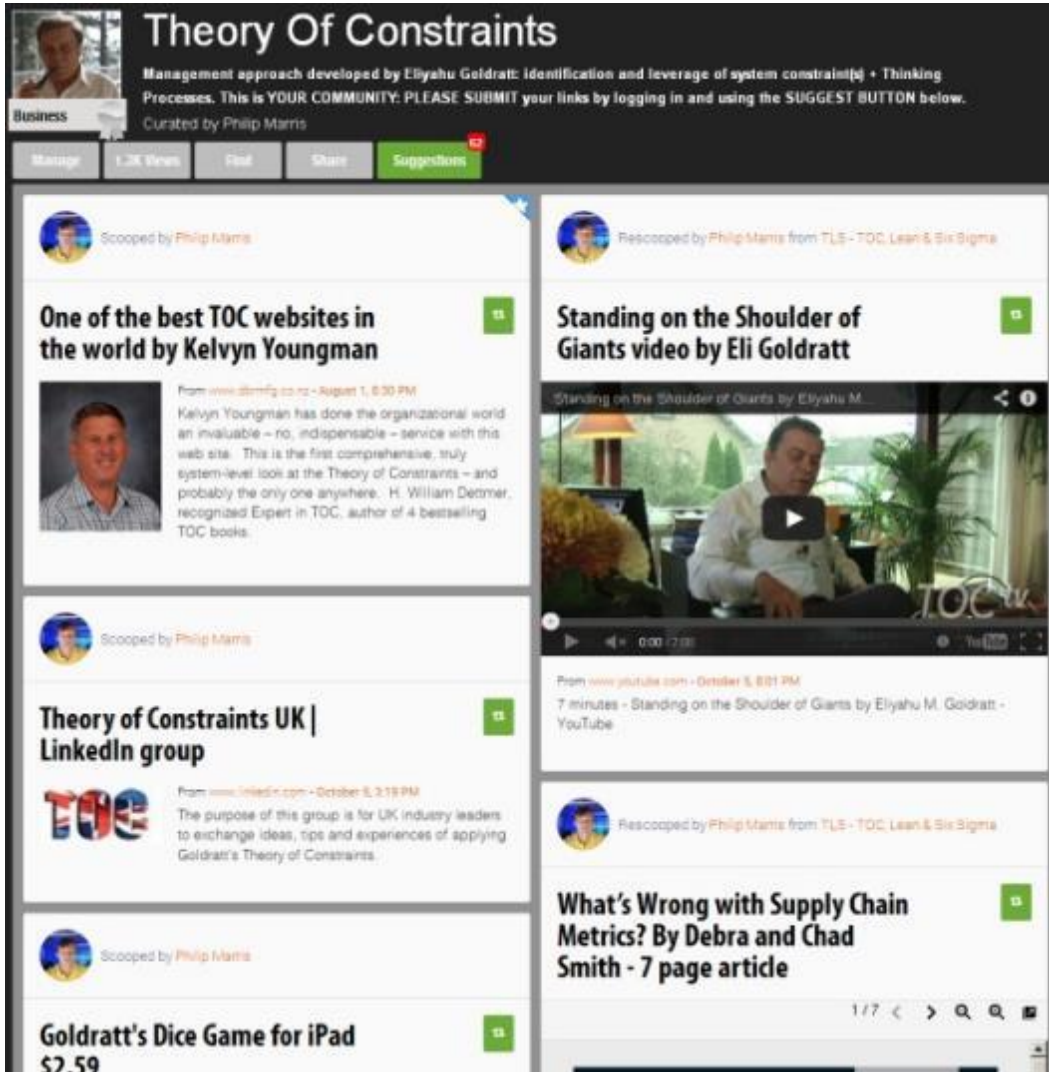
The combination of Lean, Six Sigma and Theory Of Constraints. How to build your own system by choosing what works for you.

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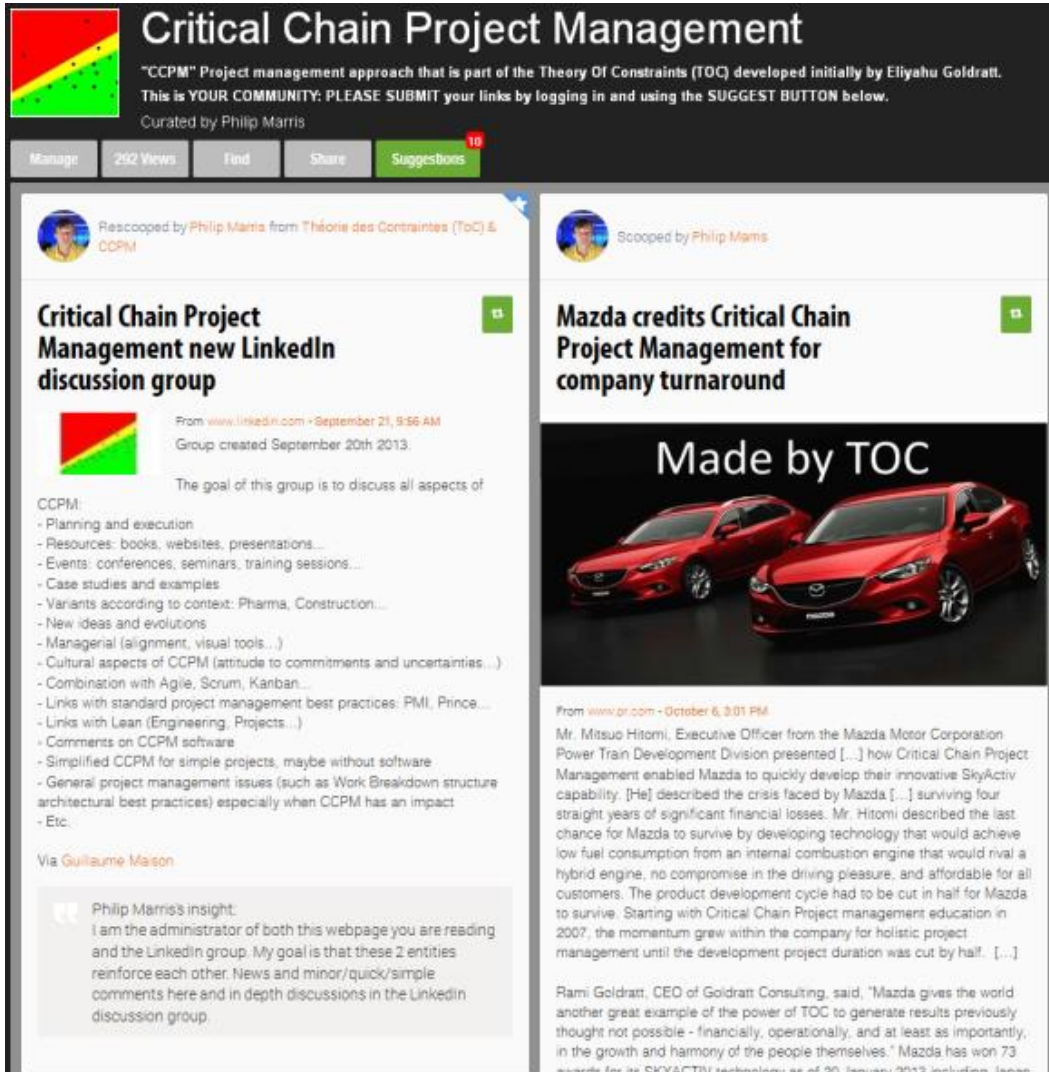
A permanent news website dedicated to Theory of Constraints



<http://www.scoop.it/t/theory-of-constraints-by-philip-marris>

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A permanent news website dedicated to CCPM



Critical Chain Project Management

"CCPM" Project management approach that is part of the Theory Of Constraints (TOC) developed initially by Eliyahu Goldratt. This is YOUR COMMUNITY. PLEASE SUBMIT your links by logging in and using the SUGGEST BUTTON below.

Curated by Philip Marris

Manage 292 Views Find Share Suggestions

Rescoped by Philip Marris from Théorie des Contraintes (ToC) & CCPM

Critical Chain Project Management new LinkedIn discussion group

From www.linkedin.com • September 21, 9:56 AM
Group created September 20th 2013.

The goal of this group is to discuss all aspects of

CCPM:

- Planning and execution
- Resources: books, websites, presentations...
- Events: conferences, seminars, training sessions...
- Case studies and examples
- Variants according to context: Pharma, Construction...
- New ideas and evolutions
- Managerial (alignment, visual tools...)
- Cultural aspects of CCPM (attitude to commitments and uncertainties...)
- Combination with Agile, Scrum, Kanban...
- Links with standard project management best practices: PMI, Prince...
- Links with Lean (Engineering, Projects...)
- Comments on CCPM software
- Simplified CCPM for simple projects, maybe without software
- General project management issues (such as Work Breakdown structure architectural best practices) especially when CCPM has an impact
- Etc.

Via [Guillaume Mason](#)

Philip Marris's insight:
I am the administrator of both this webpage you are reading and the LinkedIn group. My goal is that these 2 entities reinforce each other. News and minor/quick/simple comments here and in depth discussions in the LinkedIn discussion group.

Mazda credits Critical Chain Project Management for company turnaround

Made by TOC

From www.pr.com • October 6, 3:01 PM

Mr. Mitsuo Hitomi, Executive Officer from the Mazda Motor Corporation Power Train Development Division presented [...] how Critical Chain Project Management enabled Mazda to quickly develop their innovative SkyActiv capability. [He] described the crisis faced by Mazda [...] surviving four straight years of significant financial losses. Mr. Hitomi described the last chance for Mazda to survive by developing technology that would achieve low fuel consumption from an internal combustion engine that would rival a hybrid engine, no compromise in the driving pleasure, and affordable for all customers. The product development cycle had to be cut in half for Mazda to survive. Starting with Critical Chain Project management education in 2007, the momentum grew within the company for holistic project management until the development project duration was cut by half. [...]

Rami Goldratt, CEO of Goldratt Consulting, said, "Mazda gives the world another great example of the power of TOC to generate results previously thought not possible - financially, operationally, and at least as importantly, in the growth and harmony of the people themselves." Mazda has won 73 awards for its SKYACTIV technology as of 20 January 2013 including Japan

<http://www.scoop.it/t/critical-chain-project-management>

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A LinkedIn Discussion group dedicated to TLS – ToC Lean Six Sigma

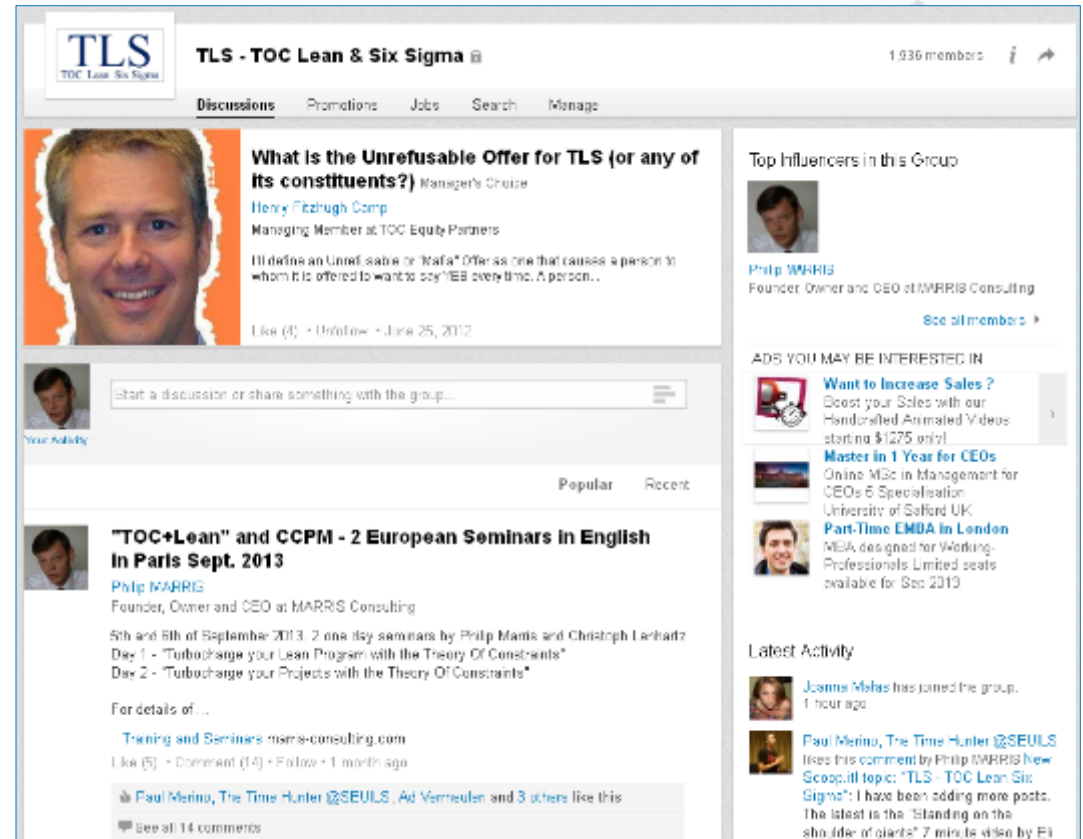
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On www.linkedin.com:

Group: TLS – ToC Lean Six Sigma

The oldest and most established LinkedIn group on the topic of TLS. Almost all of the world's experts of TLS are members of this group.

Marris
Consulting



TLS - TOC Lean & Six Sigma 1,936 members

Discussions Promotions Jobs Search Manage

What is the Unrefusable Offer for TLS (or any of its constituents?) Manager's Choice
Henry Fitzhugh Comp
Managing Member at TOC Equity Partners
I'll define an Unrefusable or "trafic" Offer as one that causes a person to whom it is offered to want to say "YES" every time. A person...
Like (4) • Unfollow • June 25, 2012

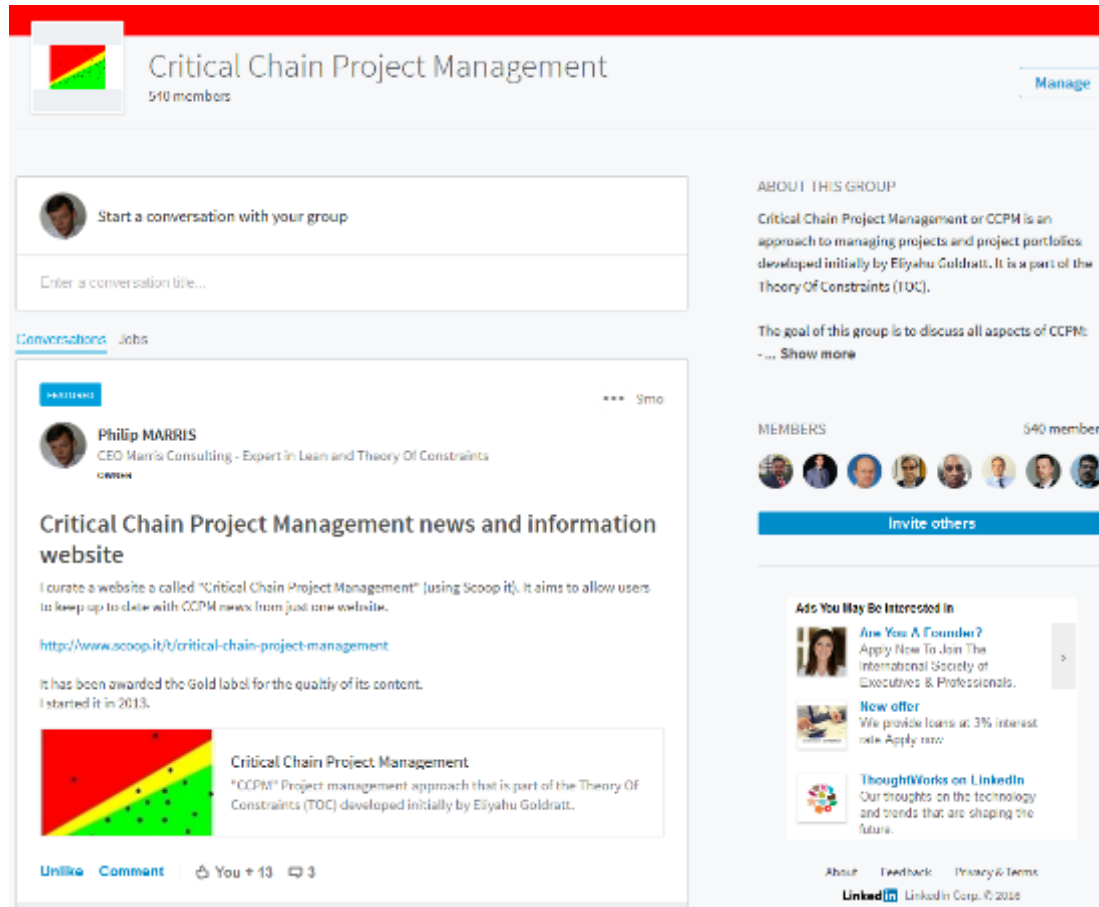
"TOC+Lean" and CCPM - 2 European Seminars in English in Paris Sept. 2013
Philip MARRIS
Founder, Owner and CEO at MARRIS Consulting
5th and 6th of September 2013. 2 one day seminars by Philip Marris and Christoph Lohndorf
Day 1 - "Turbocharge your Lean Program with the Theory Of Constraints"
Day 2 - "Turbocharge your Projects with the Theory Of Constraints"
For details of...
Training and Seminars marris-consulting.com
Like (5) • Comment (14) • Follow • 1 month ago
Paul Marino, The Time Hunter @SEULS, Ad Vermeulen and 3 others like this
See all 14 comments

Top Influencers in this Group
Philip MARRIS
Founder, Owner and CEO at MARRIS Consulting
See all members

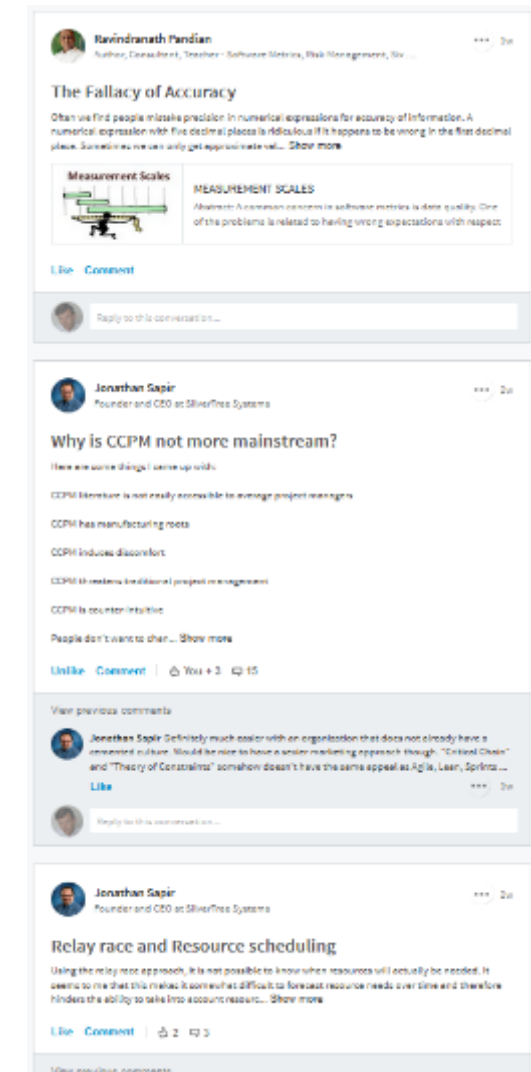
ADS YOU MAY BE INTERESTED IN
Want to Increase Sales?
Boost your Sales with our Handcrafted Animated Videos starting at \$1275 only!
Master in 1 Year for CEOs
Online MSc in Management for CEOs & Specialisation University of Salford UK
Part-Time EMBA in London
MBA designed for Working Professionals. Limited seats available for Sep 2013

Latest Activity
Joanna Mshas has joined the group. 1 hour ago
Paul Marino, The Time Hunter @SEULS likes this comment by Philip MARRIS New Scoop: all topic: "TLS - TOC Lean Six Sigma": I have been adding more posts. The latest is the "Standing on the shoulder of giants" 7 minute video by El

A LinkedIn Discussion group dedicated to Critical Chain Project Management



<https://www.linkedin.com/groups/5183858>



Beware there are several with similar names. This one is named: *Critical Chain Project Management*

TOCICO CCPM Portal (Theory Of Constraints International Certification Organization)

https://tocico.site-ym.com/?page=project_portal



© Marris Consulting



Welcome to the TOC in Project Management Portal

[Success Stories](#) » [Project Management Portal](#)



We're excited to provide free access to 6 of the 87 (and growing) Theory of Constraints (TOC) project management presentations ranging from a workshop presenting the basics of critical chain project management (CCPM) to its use in information technology and software development projects, to and implementations in the Lithuanian government Department of Economy, in a pharmaceutical research and development corporation and in a massive maintenance, repair and overhaul center for a large airline. These selections illustrate the universal use of CCPM across industries and across geographically separated and



Victoria University Wellington New Zealand – ToC Research Database

<http://www.victoria.ac.nz/som/research/theory-of-constraints>



The screenshot shows the website's header with the Victoria University of Wellington logo and 'SCHOOL OF MANAGEMENT'. The navigation bar includes 'Home', 'About Us', 'Study', 'Research', and 'Centre for Labour, Employment and Work'. A breadcrumb trail reads 'You are here: Home > Research > Theory of Constraints'. The main heading is 'Theory of Constraints: A Research Database'. A sidebar on the left lists categories: 'Working Papers', 'Research Seminars Series', 'Research Reports', 'Masters Grants', 'Working Capital', 'Theory of Constraints' (selected), 'Background', and 'Contact Us'. The main content area features a large image of a chain and the title 'Theory of Constraints: A Research Database'.

Theory of Constraints: A Research Database



Welcome to the Theory of Constraints (TOC) online resource, which aims to support collaboration between researchers and practitioners in the field.

About the Theory of Constraints database

A database of TOC articles, books and conference papers was started back in 1996, with our first bibliography published in 2000.

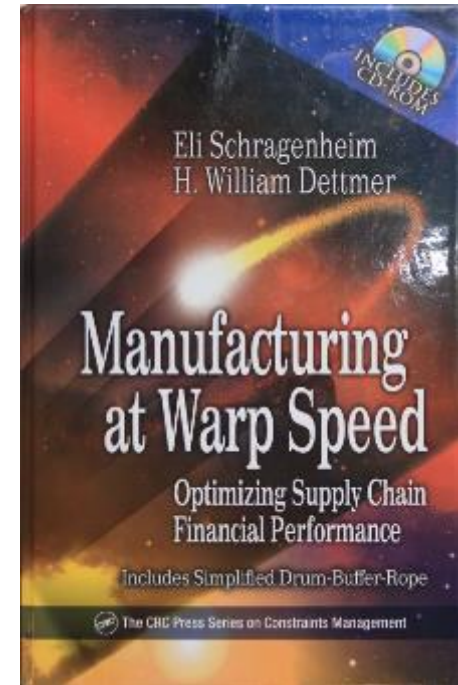
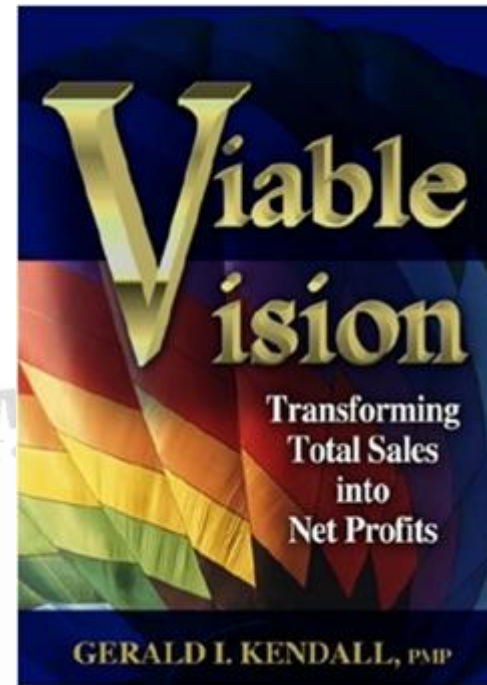
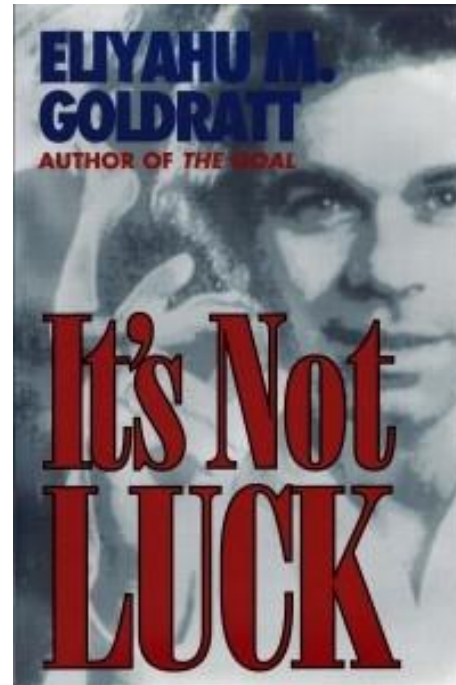
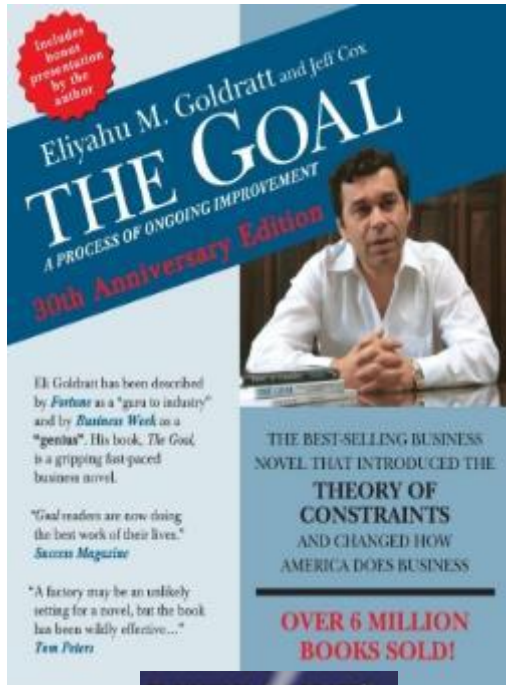
We have recently searched the literature and updated our records and have now assembled over 4000 articles, books, and conference papers, on all areas of TOC. The database here contains journal articles and conference papers, to complement the [listing of TOC books compiled by Prof Jim Cox](#), which is available on the TOCICO website.

This evolving database will be published via regularly updated spreadsheets that build on the great work done to date, and available as a downloadable resource for researchers and practitioners alike.

Database Categories	File size	File type
Critical Chain Project Management (CCPM) (updated April 2016)	6 MB	Excel spreadsheet
Thinking Processes (updated April 2016)	5.967 KB	Excel

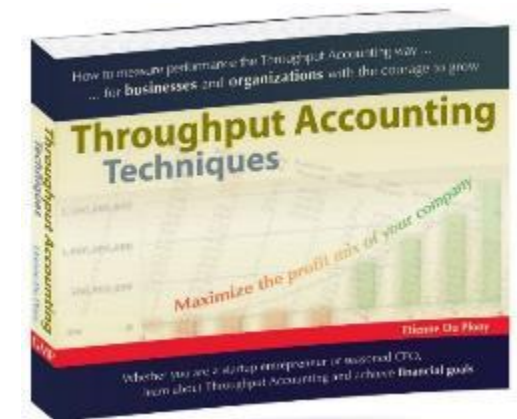
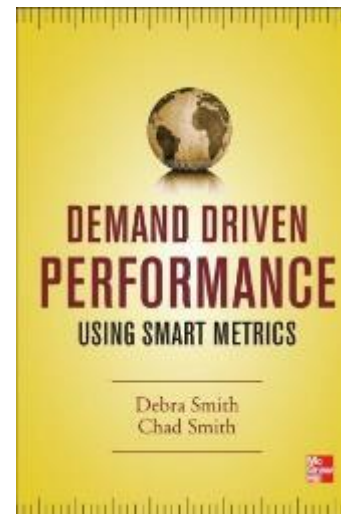
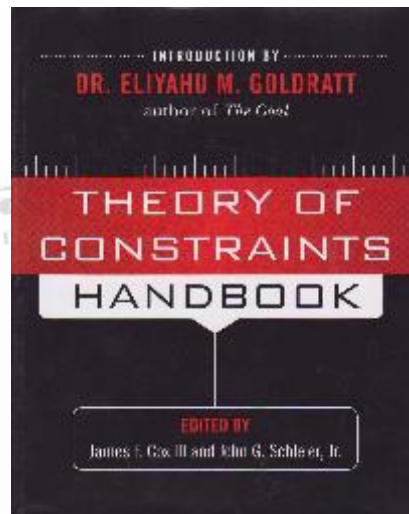
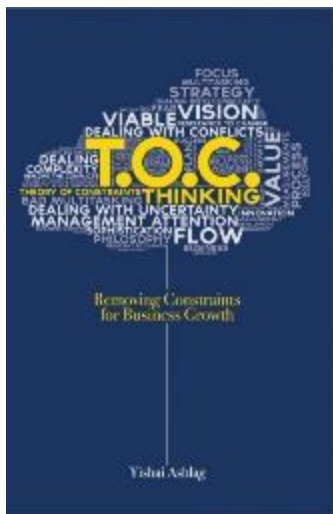
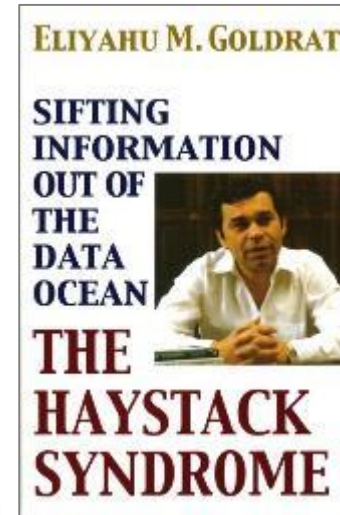
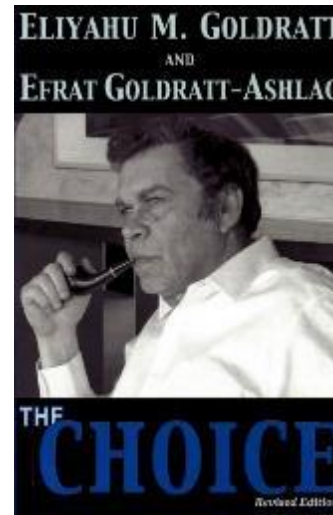
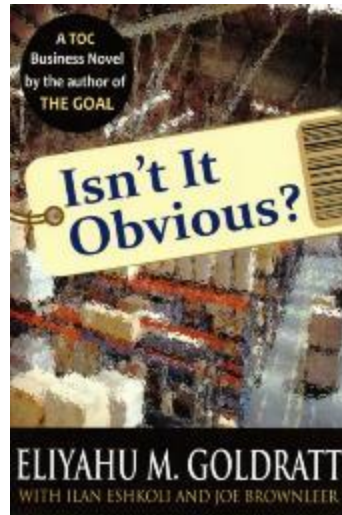
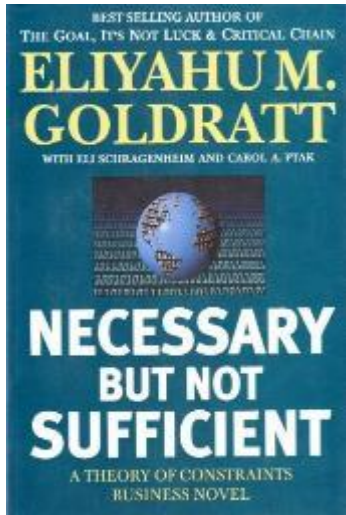
Reference Type	Year	Title	Author	Publication	Abstract	URL
A+ Journal	2016	Zhang, Juegang; Song, Xiwel; Diaz, Estrella	European Journal of Operational Research	Project buffer sizing of a critical chain based on comprehensive resource tightness	A buffer sizing method based on comprehensive resource tightness is proposed in order to better reflect the relationships between activities and improve the accuracy of project buffer determination. Physical resource	http://www.sciencedirect.com
Book Section	2016	Critical Chain Project Management (CCPM)	Ellis, George	Project Management in Product Development	This chapter presents critical chain project management (CCPM). The chapter starts with an overview of the method and then relates it to the Theory of Constraints, the foundation of the technique. A step-by-step	http://dx.doi.org/10.1016/b978-0-12-407888-8.00016-6
A+ Journal	2015	Quantitative Analysis of Rate-Driven and Due Date-Driven Construction: Production Efficiency, Supervision, and Controllability in Residential Projects	Arashpour, Mehrdad; Wakefield, Ross; Blimes, Nick; Abbasi, Shima	Journal of Construction Engineering and Management	Concerns about production efficiency, quality, and affordability in the residential construction indicate there may be benefits in adopting alternative production control strategies to those traditionally used. Reducing adverse	http://ascelibrary.org/doi/10.1061/(ASCE)1090-0268(2015)141:4(401-412)
A Journal	2015	Optimisation of critical chain sequencing based on activities' interaction flow interactions	Zhang, Juegang; Song, Xiwel; Chen, Hongyu; Shi, Ruihua	International Journal of Production Research	One critique for the classic critical chain sequencing methods is that only resource constraints and logical relationships between activities are considered, while interactions of information flows are ignored. However,	http://www.tandfonline.co
Other Journals	2015	Productivity of product design and engineering processes	Hackelrieds, Johannes; Kreutzfeldt, Jochen	International Journal of Operation and Production Management	Purpose – Maintaining and improving productivity of product design and engineering processes has been a paramount challenge for design-driven companies, which are characterised a high degree of development of	http://dx.doi.org/10.1108/ijop-03-2015-0018
C Journal	2015	Inclusion of strategic management theories to project management	Parker, David W.; Parsons, Nicholas; Ishiyanto, Fitri	International Journal of Managing Projects in Business	Purpose – The purpose of this paper is to explore the benefits of integrating the theory of constraints (TOC), resources-based theory (RBT), resource advantage theory (RAT), with a structured project-based methodology e.g.,	http://www.emeraldinsigh
Other Journals	2015	A Model for Continuous Improvement at a South African Minerals Beneficiation Plant	Ras, E.; Visser, Jk	South African Journal Of Industrial Engineering	South Africa has a variety of mineral resources, and several minerals beneficiation plants are currently in operation. These plants must be operated effectively to ensure that the end-users of its products remain internationally	http://www.scielo.org.za/s
A Journal	2015	Dynamic monitoring and control of software project effort based on an effort buffer	Zhang, Juegang; Shi, Ruicui; Diaz, Estrella	Journal of the Operational Research Society	The improvement to the monitoring and control efficiency of software project effort is a challenge for project management research. We propose to overcome this challenge through the use of a model for the buffer	http://www.palgrave-jour
A Journal	2015	Project management for uncertainty with multiple objectives optimisation of time, cost and reliability	Jean, Angus	International Journal of Production Research	This research adopts an approach that uses computer simulation and statistical analysis of uncertain activity time, activity cost, due date and project budget to address quality and the learning process with regard to	http://dx.doi.org/10.1080/00207179.2015.1008060
B Journal	2015	Improving performance in project-based management: synthesizing strategic theories	Kareisa, Calles; David, W. Parker	International Journal of Productivity and Performance Management		http://dx.doi.org/10.1108/ijpp-03-2015-0018
Other Journals	2014	A decomposition heuristics based on multi-bottleneck machines for large-scale job shop scheduling problems	Zhai, Yingxi; Liu, Changqian; Chu, Wei; Guo, Ruirong; Liu, Xiaohong	Journal of Industrial Engineering and Management	A decomposition heuristics based on multi-bottleneck machines for large-scale job shop scheduling problems (JSP) is proposed. In the algorithm, a number of sub-problems are constructed by iteratively decomposing the large-	http://www.jiem.org/index
Other Journals	2014	COMFRC Addresses Legacy Hornet Readiness	Walters, Andrea	Naval Aviation News	According to PMA-265, 114 aircraft have completed inspections and are designated for service life extensions beyond 8,000 flight hours, with an additional 102 aircraft undergoing high-flight-hour inspections at Fleet	http://web.b.ebscohost.co
Other Journals	2014	Software Project Management: Theory of Constraints, Risk Management, and Performance Evaluation	Asselman, Antoine; Alaridj, Nada; Ashgar, Salim; Mariani, Renik	The Journal of Modern Project Management	Constraints and risks are two critical factors that affect software project performance. more attention needs to be paid to constraints and risks in order to improve performance. In this paper, investigation will take place to	http://www.journalmodern
Book Section	2014	Critical Chain Project Management		A Handbook for Construction Planning and Scheduling	Critical Chain Project Management™ (CCPM) is frequently presented as a revolutionary new project management concept, an important breakthrough in the history of project management. CCPM focuses on the uncertainty in	http://dx.doi.org/10.1002/9781118750000.ch10
Other Journals	2014	Critical Chain Method in Traditional Project and Portfolio Management Situations	Anantamala, Vital S.; Webb, James B.	International Journal of Information Technology Project Management (IJITPM)	Critical Path (CP) method has been under scrutiny in recent years as the next evolution of project schedule development, the Critical Chain (CC) project management is gaining attention. Advocates of the Critical Chain	http://www.igi-global.com
Other Journals	2014	Theory of Constraints and Its Application in a Specific Company	Lidhart, Jakub; Skokovský, Jaron; Others,	Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis	This article analyses the possibilities of the practical utilization of Critical Chain Project Management methodology. Our study analyzed key processes related to the implementation and utilization of such a tool in a concrete	http://acta.mendelu.cz/62/
Conference Proceedings	2014	Multi-objective optimization model for multi-project scheduling on critical chain	Wang, Wei-xin; Wang, Xu; Ge, Xiao-long; Deng, Lei	Advances in Engineering Software	In this paper, a multi-project scheduling in critical chain problem is addressed. This problem considers the influence of uncertainty factors and different objectives to achieve completion rate on time of the whole projects. This	http://www.sciencedirect.com
C Journal	2014	Mitigating behavioral outcomes in a multiproject environment: a modified CCPM model	Agarwal, Anil; Larson, David	Academy of Information and Management Sciences Journal	Organizations continue to struggle in managing projects that lead to successful conclusions. While tools such as PERT and CPM have helped the project management process, they have not produced the level of success as	http://search.proquest.com
C Journal	2014	Mitigating Behavioral Outcomes in a Multi-Project Environment: A Modified CCPM Model	Agarwal, Anil; Larson, David	Academy of Information and Management Sciences Journal	Organizations continue to struggle in managing projects that lead to successful conclusions. While tools such as PERT and CPM have helped the project management process, they have not produced the level of success as	http://search.proquest.com
C Journal	2014	Critical chain and theory of constraints applied to yachting shipbuilding: a case study	Bevilacqua, Maurizio; Ciarrapica, Filippo Emanuele; Mazzuto,	International Journal of Project Organisation and Management	Product development projects, like many other types of projects, often can exceed their planned schedule by 50% to 100%. Often this is attributed to uncertainty or the unforeseen. To compensate for this age-old dilemma,	http://www.inderscience
Conference	2014	The ITLS (TM) model-Integration of Theory of Constraints, Lean Manufacturing and Six Sigma: A	Navarro, Carlos I. M.; Cuenca, Marcelo G.	Proceedings of the 2014 Industrial and Systems	Recently the three most applied approaches into the Operations Continuous Improvement are Theory of Constraints (TOC), Lean Manufacturing and Six	http://search.proquest.com

Theory of Constraints main books

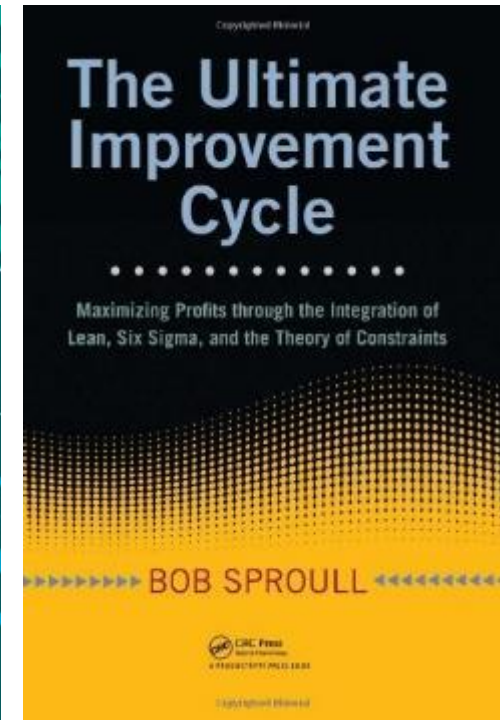
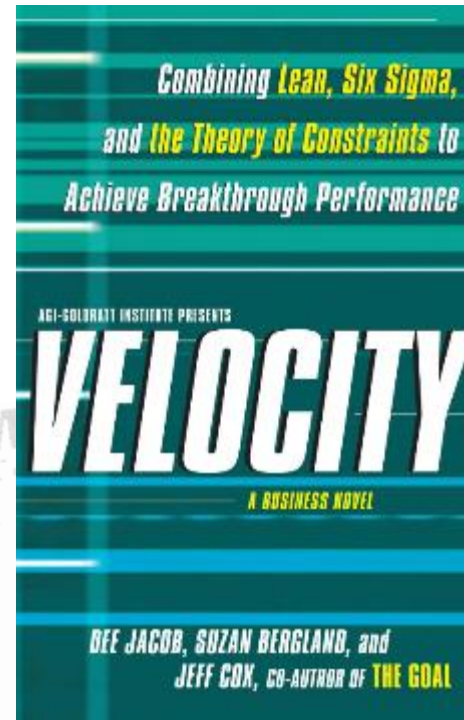
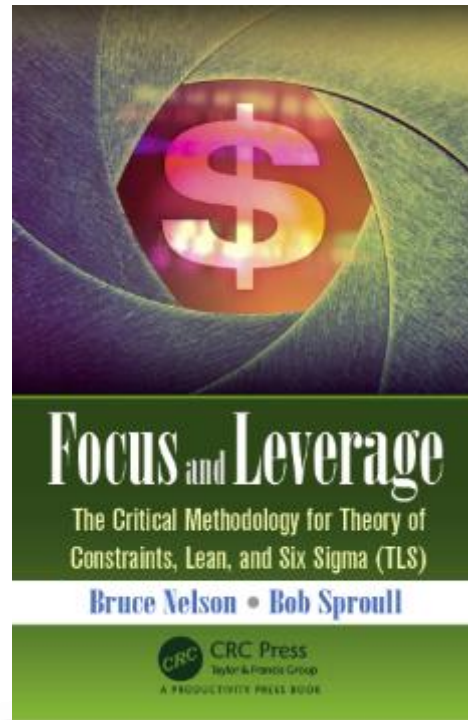
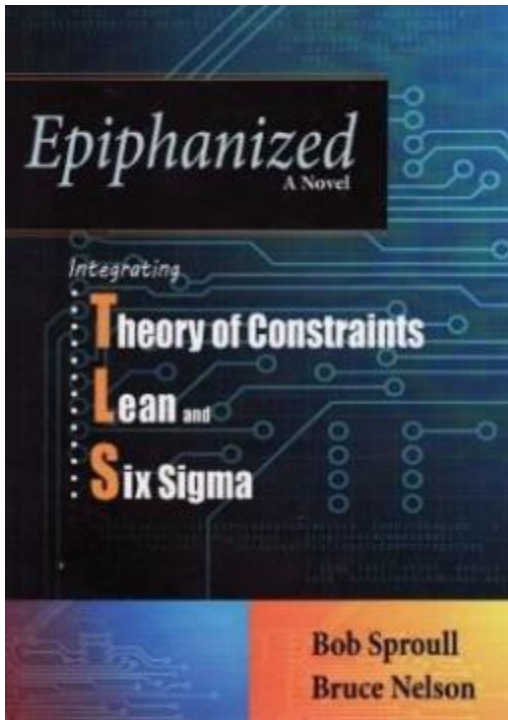


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Other ToC books

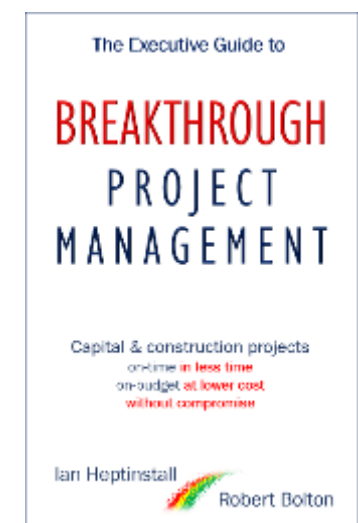
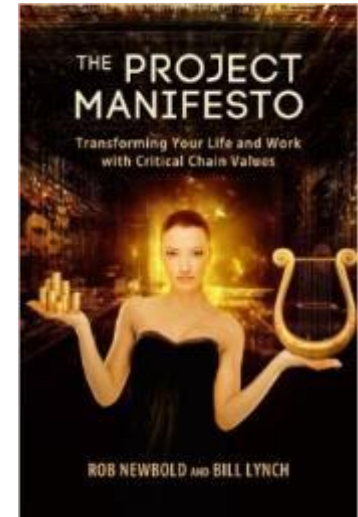
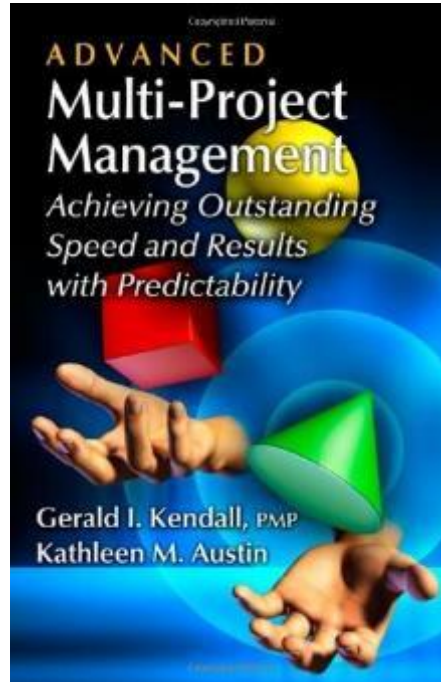
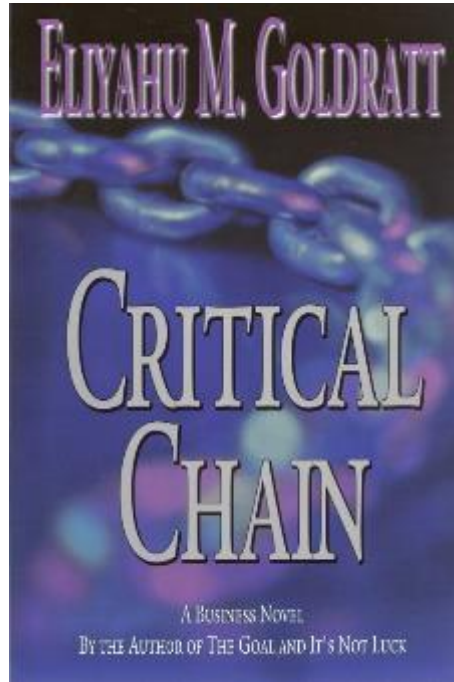


TLS books

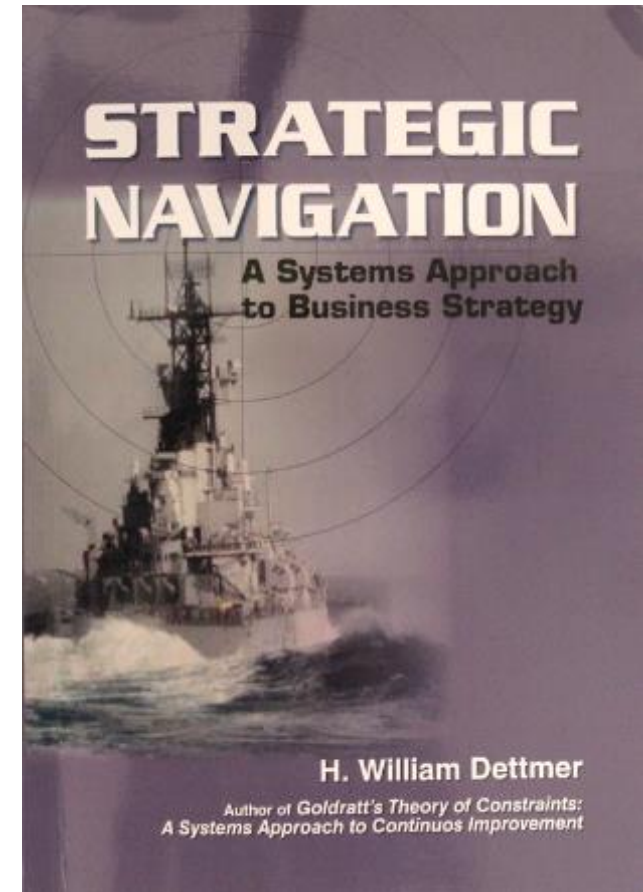
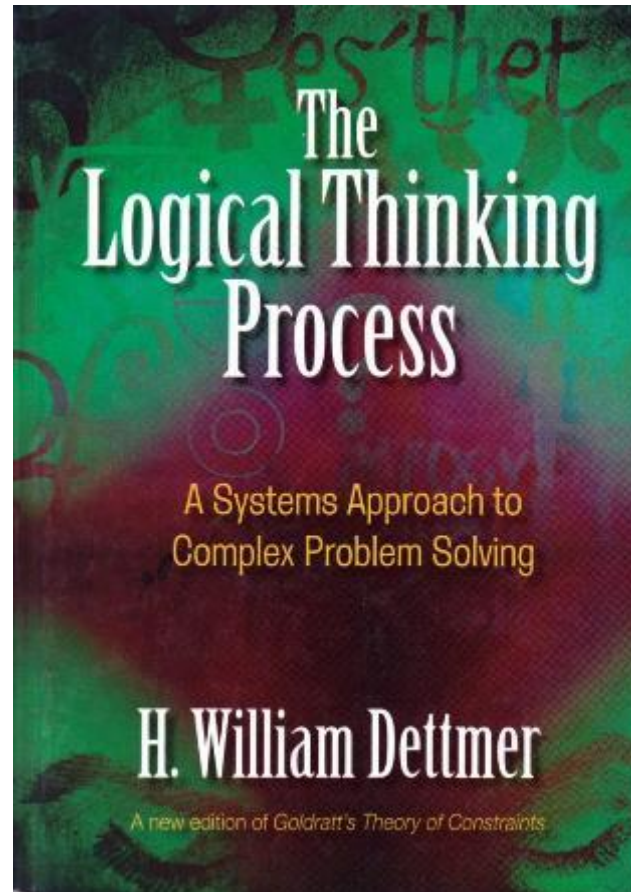
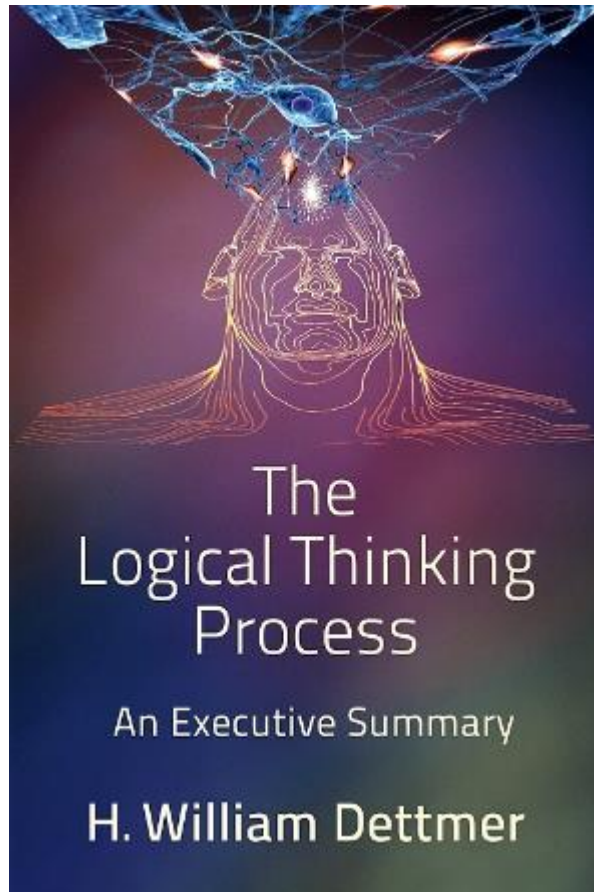


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Critical Chain books



Logical Thinking Process and Thinking Processes books



Lean books

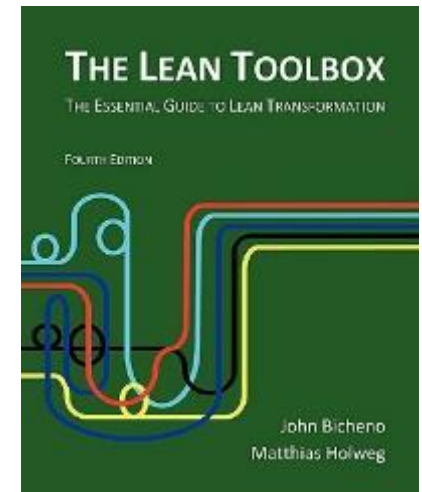
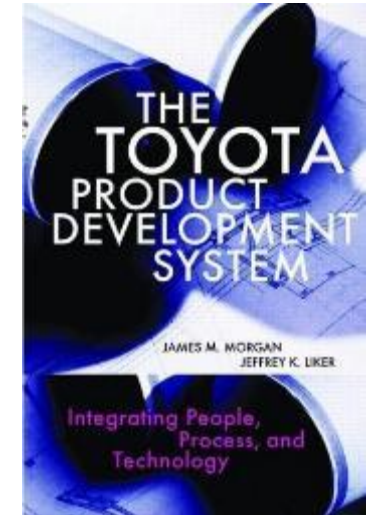
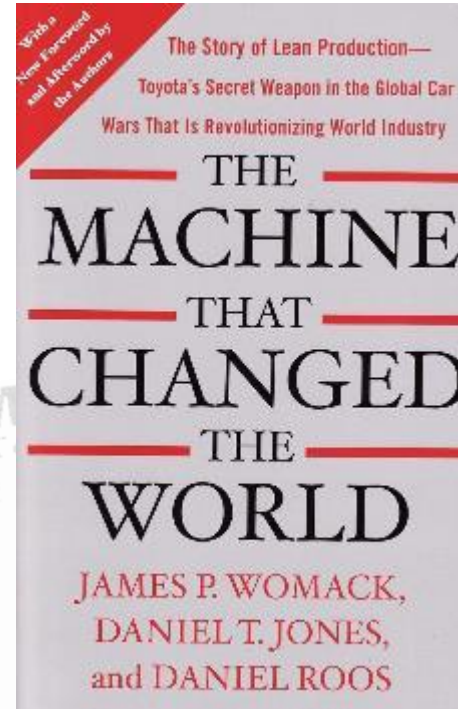
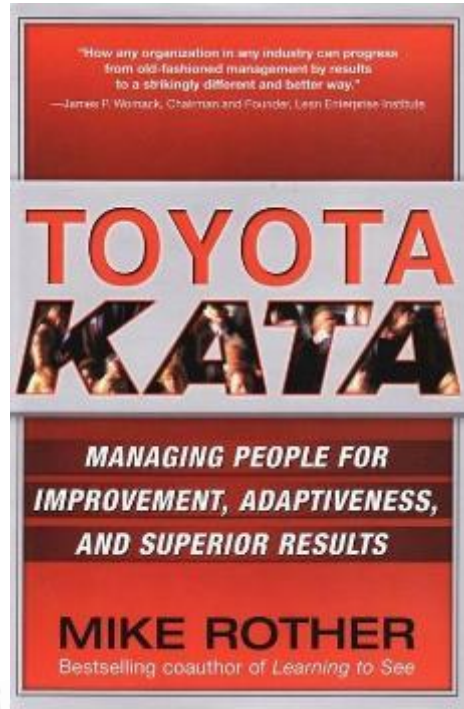
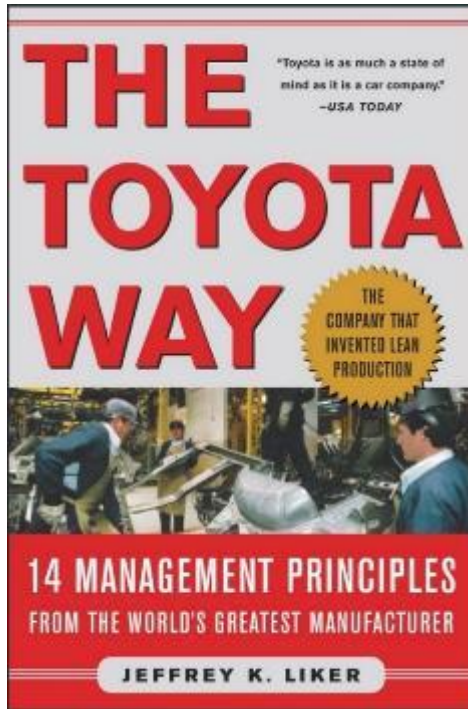


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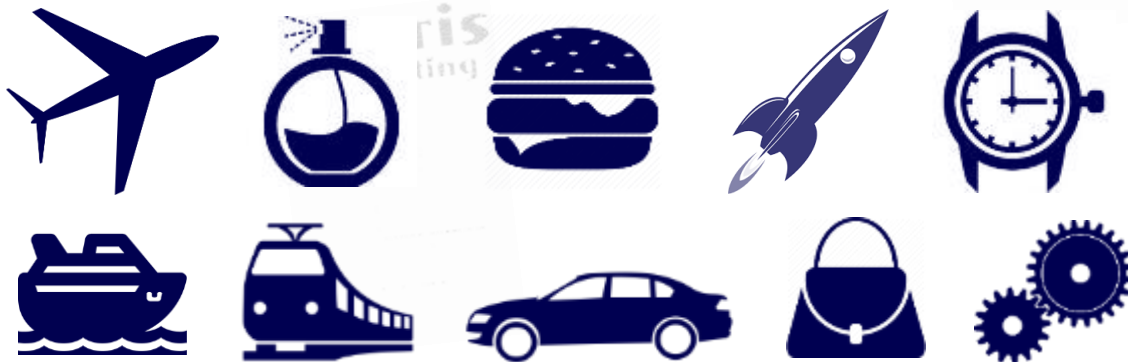
Appendices

1. Constraints Management book by Philip Marris – Executive summary
2. Article – Critical Chain to reduce the time to market and increase productivity
3. TOCICO conference – ToC + Lean + Six Sigma or TLS – What is it?
4. Case study: MRO in aeronautics
5. Case study: perfume bottles
6. Sources of information
7. Marris Consulting

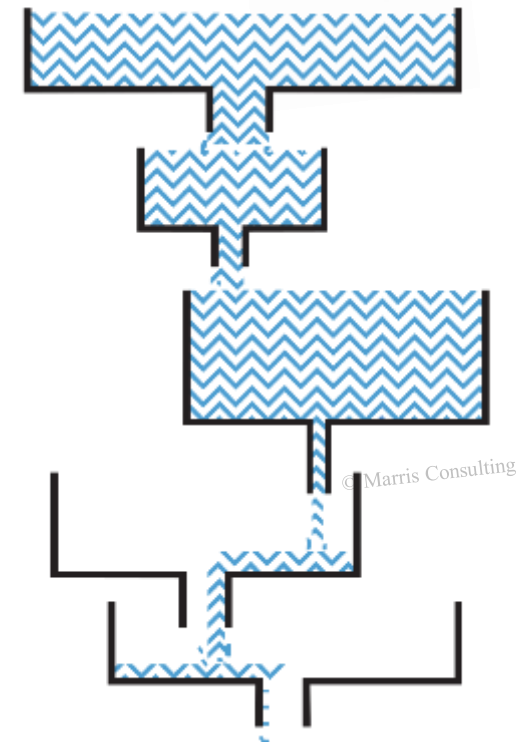


What we do

- Marris Consulting has a reputation for its capacity to be pertinent in nearly all kinds of industry. We have worked in over 200 companies helping in designing, making, selling and distributing:
 - cars, hamburgers, aeroplanes, perfume, trains, rockets, industrial equipment, pharmaceuticals, home delivery services, computer chips, chips (food), maintenance / repair / overhaul (MRO) of planes and trains, luxury handbags, corrugated cardboard production, the defence industry, Swiss watches, steel manufacturing, plastics, bank notes, satellites, gold mines ...
- We are committed, viscerally, to producing results. Results that are well beyond our clients' expectations. And results that last. Better still we incessantly seek to strengthen the process of on-going improvement; we want to see our ex-clients getting better and better many years after we intervened.



Marris Consulting



How we do it

- We understand that the hardest part of what we do is to change "people". Apart from the pertinent ideas that we must have we must directly and indirectly change individual and collective behaviour.
- We work simultaneously at all levels of the company from the front line to the board room.
- We are recognized experts in many different fields: "Lean" (manufacturing/engineering/management/..., the Theory Of Constraints, Six Sigma, Industry 4.0, DDMRP ...
- One of our key strengths is that we analyse each of our new client's business & culture and then we mix up the right cocktail of solutions. We never impose a so called industry best practise.
- We like simple solutions. Simple is beautiful.



Philip Marris presents the
38th TOCPA Conference program

Theory of Constraints marketing & awareness activities

- 5 Permanent news websites (www.Scoopit.com)
 - Theory Of Constraints (English & French)
 - Critical Chain in (English & French)
 - TLS: ToC + Lean + Six Sigma
- >200 free videos (YouTube Channel)
- Discussion Groups (LinkedIn)
 - Critical Chain
 - TLS: ToC, Lean and Six Sigma
- 2 dedicated websites in French
 - ToC in Production
 - ToC in Projects
- Others:
 - Twitter, Facebook, Viadeo, Etc.








We are honoured to have been able to help...





Philip Marris, Founder and CEO of Marris Consulting

Business transformation, Theory Of Constraints and Lean expert

30 years of experience, 58 years old, Manufacturing & Supply Chain expert
Bilingual & bicultural English/French

COMPETENCIES

- **Transformation programs in industry**
- **Industrial Excellence Expert (manufacturing and product development).** Recognized expert in Lean, Six Sigma and Theory Of Constraints. Often combines these ("TLS").
- **Author** of an industrial management bestseller in France: *Le Management Par les Contraintes en gestion industrielle*, Editions d'Organisation [1994, 1996, 2000, 2nd Edition currently underway).

FORMER POSITIONS

- Cap Gemini Ernst & Young / Bossard Consultant: In charge of Manufacturing Operations for France & Europe (>200 consultants)
- Cap Sogeti Industrie
- Creative Output: collaborated with E. Goldratt author of *The Goal*
- Vallourec: Shop floor foreman, Methods Engineer
- Professor at HEC Management School (Supply Chain & Manufacturing).

SECTORS / CLIENTS

- Over 150 engagements in industry.
- Aeronautical
- Pharmaceuticals
- Automobile industry: car makers and suppliers
- Process industry: steel, glass, cardboard, extruded plastic
- World leader in ball bearings
- MRO rail and aeronautical
- Packaging: cardboard, steel, plastic
- Electrical power systems: world wide leader
- Furniture manufacturer, Marine engine manufacturer, Armoured vehicles manufacturer, Electronics: printed circuit boards, ...

MISSIONS / RESULTS

- **Production, Operations & Supply Chain (sample):**
 - Worldwide automotive OEM tier 1 supplier: increase in Throughput of 17% in 15 minutes. Savings >\$400M per year. saved relationship with largest customer.
 - Large MRO (Maintenance, Renewal & Overhaul) Division of a major European railway operator (France, 25 000 p.): in one of the main factories (940 p.) reduction of the production lead-times for the renovation of high speed trains from 126 days to 38 days . Further lead-time reductions are underway over 2 years after the end of our assignment.
 - Labour productivity: furniture manufacturer +35% in 6 weeks, M.R.O: 80% in 2 months, manufacturing equipment (assembly) +70%, ...
 - Automotive Supplier (France, 350p.): Increase in the O.E.E. of the bottleneck resource by more than 30%, change from 5x8 shifts to 2x8 while providing the same output.
 - Complete reengineering of the Supply Chain of a steel manufacturer: Long term strategic planning, Sales & Operations Planning, Scheduling. Implementation of ToC/MPC. Increase in 40 points of the due date performance
 - Manufacturer of large machines for cardboard packaging: reduction in the delivery lead-time by over 50% and a reduction in the number of hours of labour per machine of over 30%.
 - Aircraft MRO: reduced durations by over 50% and increased productivity by over 80% in 2 months.
- **R&D & Industrialisation / Engineering / New Product Development (sample):**
 - Aeronautical product industrialisation portfolio: reduced durations and projects finish on time
 - Complete transformation of an Engineering department of 150 people. Reduction in project durations of over 40%. Improvement in productivity of over 25%. Projects completed on time went from less than 30% to over 85%.
 - Several aeronautical product development and industrialisation projects involving up to 500 people per project in up to 6 different simultaneous facilities with budgets up to 20M€ each.
 - New product development and product relooking: reduction of over 45% of average project duration, increase in number of projects completed each year of over 50%.
 - New product portfolio analysis and development strategy
 - Quotation process reengineering: handling speed multiplied by 4.

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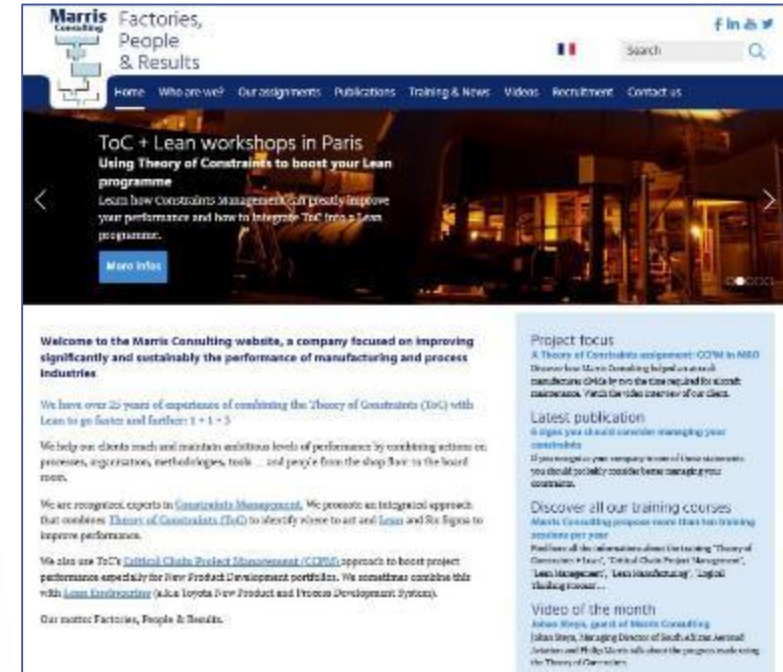
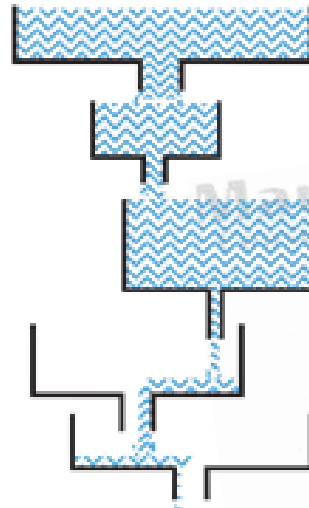
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