



focus on essentials

Using Lean for competitive advantage
Presented by Dr Ted Hutchin

The starting point

- ⇒ All companies sit within a supply chain of some sort, from supply base to client
 - ⇒ Material tends to flow from raw material/components through to the client
 - ⇒ Information is required to support the flow of material at all stages of the flow
 - ⇒ Money is also supposed to flow back from the client to the starting point in the chain
 - ⇒ In many companies today the order book is full
 - ⇒ The expectation of the client is that you will deliver what was asked
 - ⇒ The deliveries are made
 - ⇒ The company makes money – which is the goal!
- ⇒ This is how it is supposed to operate but.....

But.....

- ⇒ However in many companies, even where there is a full order book the following are also present:
 - ⇒ The flow is not smooth,
 - ⇒ It takes too long to get to the client,
 - ⇒ There are many stoppages and breakdowns,
 - ⇒ Delays are commonplace,
 - ⇒ Problems are a continuing nightmare
 - ⇒ We cannot track material after release
 - ⇒ Priorities are always changing
 - ⇒ WIP is too high
 - ⇒ Costs are too high
 - ⇒ There is a lot of waste
 - ⇒ and all these issues demand urgent attention from the very people who already have a full workload – sound familiar?

→ *Then perhaps this short presentation will help*

The outline of this webinar

⇒ To show:

- ⇒ What is “Lean” in business terms and how the Lean approach can make a difference to the bottom line
- ⇒ How the combination of Lean and the Theory of Constraints (TOC) becomes a much more powerful tool for making money – what we call TOC - Lean
- ⇒ How we can develop a focused approach to material flow which applying the TOC - Lean principles, delivers better performance in terms of delivery, material release, lead time, waste reduction and addressing defects thus enabling better financial performance to the bottom-line

Where to start?

- ⇒ Where do you start on your lean strategy and what are the requirements to make it successful?
- ⇒ What is your current position is as a Lean organisation?
- ⇒ How do you integrate the TOC with the Lean approach?
- ⇒ How do you keep focus throughout the implementation and beyond?
- ⇒ Conclusions

Why TOC - Lean?

It Works!

TOC - Lean transformation – long term results

- ⇒ 100% Delivery to promise and fill rate from stock
 - Target is 100% on-time, in-full (OTIF) with zero defect as a given
- ⇒ 90%+ Reduction in manufacturing lead time
- ⇒ 90%+ Reduction in WIP
- ⇒ 70%+ Reduction in required floor space
- ⇒ Fast time to market
 - Incorporating new product development
- ⇒ Multiple times productivity improvement
- ⇒ Zero unplanned overtime
- ⇒ Supplier partnerships across the whole of the supply chain
- ⇒ Etc...

What Is TOC - Lean?

⇒ TOC - Lean Is:

- ⇒ The fusion of two powerful tools for improving the bottom-line performance of a manufacturing company
- ⇒ The Philosophy of constantly eliminating waste from the value stream, in all areas and in all forms as defined by TOC and the Buffer Management
- ⇒ A systemic approach across the whole of the supply chain

The basic principles of Lean

- ➔ Specify Value from the perspective of the client
 - ⇒ This is not the same as the price paid for the product, in many cases the price paid is much lower than the real value to the client
- ➔ Identify the Value stream
 - ⇒ This I often call the revenue stream as it is all about making money – but how well do we know this stream?
- ➔ Make Value flow
 - ⇒ What else would you want to do – yet many companies waste large sums of money and vast amounts of time preventing value from flowing!
- ➔ Pull
 - ⇒ Make what you need and never more than the market requires, no matter what the internal measurement system might say
- ➔ Perfection
 - ⇒ Zero defect is the goal and only measure against that

What Is Theory of Constraints (TOC)?

- ⇒ Based on the best selling book “The Goal”
- ⇒ Every system is a chain comprising dependent links
- ⇒ Thus there is a “weakest link” in the chain – the constraint
- ⇒ The constraint determines the performance of the whole chain – totally!

The TOC process of analysis and improvement for any chain

➔ Identify the constraint

⇒ This is the weakest link in the chain from supply to market, it might be a physical resource, or it might be a set of policies or rules

➔ Exploit the constraint

⇒ Once the constraint has been identified make it work effectively, attack any waste, but make sure it is doing the right work: effective not efficient

➔ Subordinate to the constraint

⇒ Make sure that all other activities and functions within the organisation support the operation of the constraint, this applies to every function within the organisation with no exception! The key measure for these resources is not their own, individual, efficiency but their ability to keep the constraint properly fed.

➔ Elevate the constraint

⇒ Once the constraint is under control and the organisation is stable it is possible to elevate the constraint, which often means...

➔ Prevent inertia – go back to step one

⇒ Elevation will usually mean that the constraint may well have moved so go back to step one and keep going round the loop – this is now a process of on-going improvement

The Revenue Chain and TOC - Lean

- ➔ Lean operates within a clear environment – a revenue chain
- ➔ The chain starts in the supply base and ends with the final link – typically the end user
- ➔ If Lean is to deliver, then the notion of the chain and in particular the weakest link in the chain becomes paramount – the link with TOC
- ➔ Hence our definition of TOC – Lean as the fusion of these two powerful approaches as one definitive philosophy for manufacturing

Specify value from the perspective of the client

- ⇒ Who is the client?
 - ⇒ The end user?
 - ⇒ The customer you are supplying
 - Internal
 - External
- ⇒ What is meant by “value”?

Identify the value stream

- ⇒ The application of Value Stream Mapping (VSM) tools and techniques
- ⇒ Focus horizontally not vertically
- ⇒ Obtain data from the level of the flow, not that of the manager
- ⇒ Confirm by walking the flow if at all possible

Make Value Flow

- ⇒ If the flow stops then the organisation stops making money!

Pull

- ⇒ Pull in line with demand
- ⇒ Pull reduces time and waste
- ⇒ This should ensure never producing more than is needed
- ⇒ Pull works across the whole of the chain

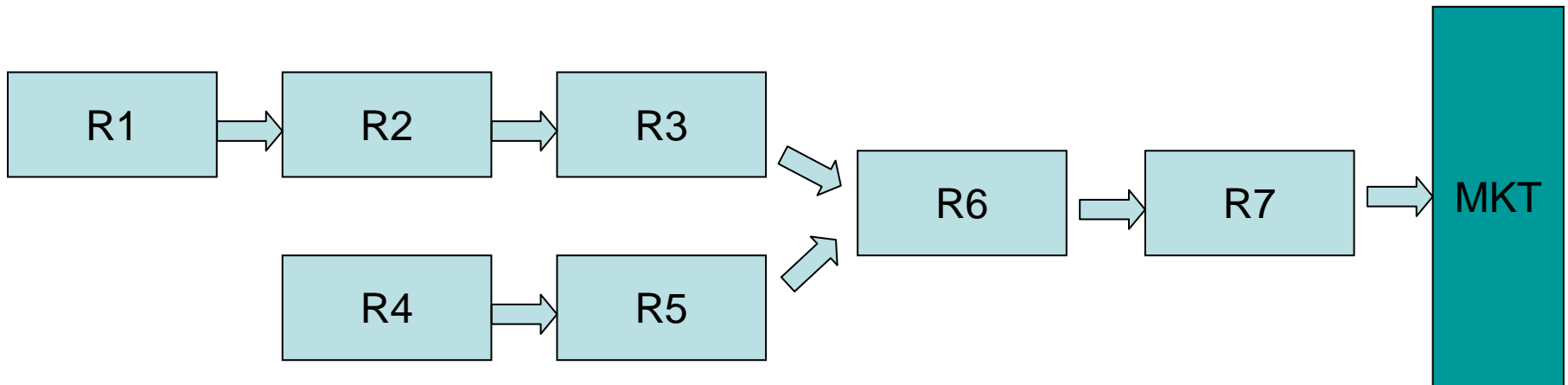
Perfection

- ⇒ Don't make defects!
- ⇒ The principle of getting it right first time
- ⇒ Understanding the impact of variation – common cause and special cause
- ⇒ The role of measurements in this process

First: capture the basic flow of material in the chain

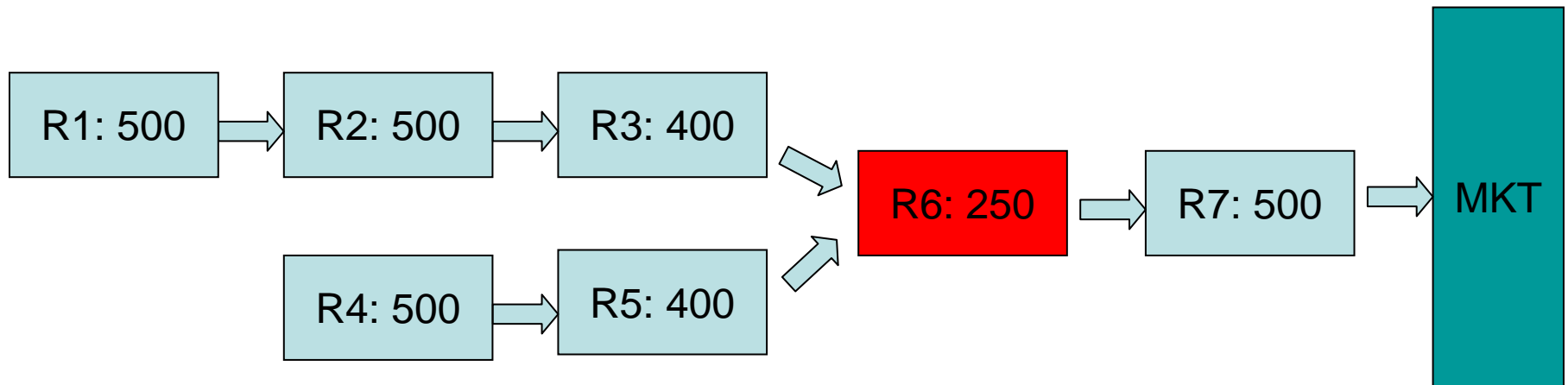
Basic flow of material from supply to market derived from a revenue stream mapping exercise which also includes other functions within the company such as engineering, purchasing, sales etc

The intention is to surface the chain as it really is and the problems created
This is our revenue chain.



Second: check capacity – finding the weakest link

- ➔ For each resource it is necessary to understand just what the capacity of each is



- ➔ Thus the number following the resource # shows the stated full capacity of each resource

OK so we know where the weakest link is?

- ⇒ From our analysis the maximum it can take in any one day is 250 units
- ⇒ This also determines the maximum amount that can be earned in the day: $250 \times$ the selling price
- ⇒ So any loss here goes straight to the bottom-line – thus the need to make sure that this resource works as much as effectively as possible – we need a schedule

What thieves rob us of capacity at the constraint?

- ⇒ Set-Up
 - ⇒ Breakdown
 - ⇒ Material
 - ⇒ People
 - ⇒ Defects
-
- ⇒ These are the five main thieves of capacity, so what can we do about them?
 - ⇒ Let's use some key lean tools and techniques

Set-Up

- ⇒ It is part of any Lean environment to attack set-ups, particularly when they create poor performance
- ⇒ But not all set-ups are an issue
- ⇒ The starting point for addressing set-up is at the constraint
- ⇒ In our case the constraint is an assembly which may have no set-ups, in which case reducing set-up is not an activity that has immediate priority.
- ⇒ If the assembly did have a set-up then this is the place to reduce set-up time by understanding the difference between internal and external set-up time and reducing the set-up as much as possible
 - ⇒ *One final thought – there is no cost attached to any set-up whatever some might argue so do not be drawn into that debate*

Breakdown

- ➔ Breakdowns at the constraint must be addressed. This involves an understanding of the six big losses that apply:
- ➔ **Down-Time**
 - ⇒ Equipment failure
 - breakdowns
 - ⇒ Set-up and adjustment
- ➔ **Speed Losses**
 - ⇒ Idling and minor stoppages
 - Blockages
 - ⇒ Reduced speed
 - Differences between actual and designed speed
- ➔ **Defect**
 - ⇒ Process defects
 - Scraps and quality defects to be repaired
 - ⇒ Reduced Yield
 - From machine start-up to stable production

⇒ Production Led Maintenance

⇒ Key measures

→ Mean Time To Repair (MTTR)

→ Mean Time Between Failure (MTBF)

⇒ These measures must be maintained and watched over time – they show trends of resource effectiveness and can be used to determine when new equipment will be required

⇒ On the constraint always schedule maintenance time in, in other words reduce the available capacity of the constraint for customer orders in order to give confidence that the likelihood of breakdown is reduced significantly

- ➔ Place quality control right in front of the constraint
- ➔ Never let a defective part be processed on the constraint – this equates to losing three times the selling price of the product to the bottom-line of the plant
- ➔ The resources after the constraint form what is called the **Red Lane** – a defect created here is not different to being created at the constraint – so treat all red lane resources in the same way as the constraint resource.

⇒ This is a function of the schedule:

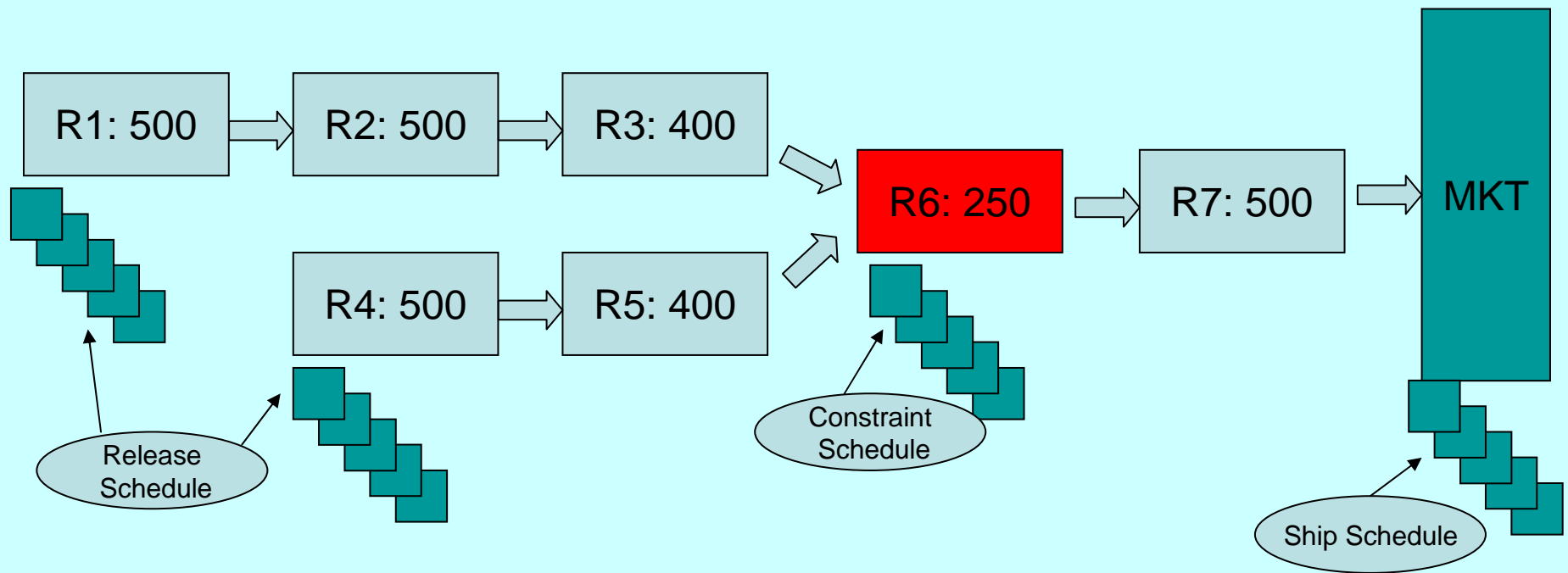
- ⇒ It comprises the ship schedule which is the combined list of orders due to be shipped, say on a daily basis to clients, it includes both volume and mix, and is driven by the due date to the client. The target is 100% On Time, In Full (OTIF) defect free. The ship schedule can never be greater than the volume of the constraint, in our case (assuming the perfect plant) 250 items
- ⇒ The constraint schedule which is that material required to go through the constraint in order to meet the demand from the market.
- ⇒ The release schedule at each entry point which is that material and components required to meet the demand from the market. The measure at each release point is Material Released On Time (MROT) and the target is 100% defect free.

Driving the schedule from the market

- ⇒ The schedule should be linked to market demand – a combination of making value flow and pull scheduling
- ⇒ If the demand is only for 200 units then that is what we are going to make
- ⇒ If for more than 250 units then we have to recognise that for the moment we cannot meet that demand: so our limit for the present is 250 units.
- ⇒ But what about problems with the Capacity Constraint Resource?
 - ⇒ The distinction between protective and demand capacity

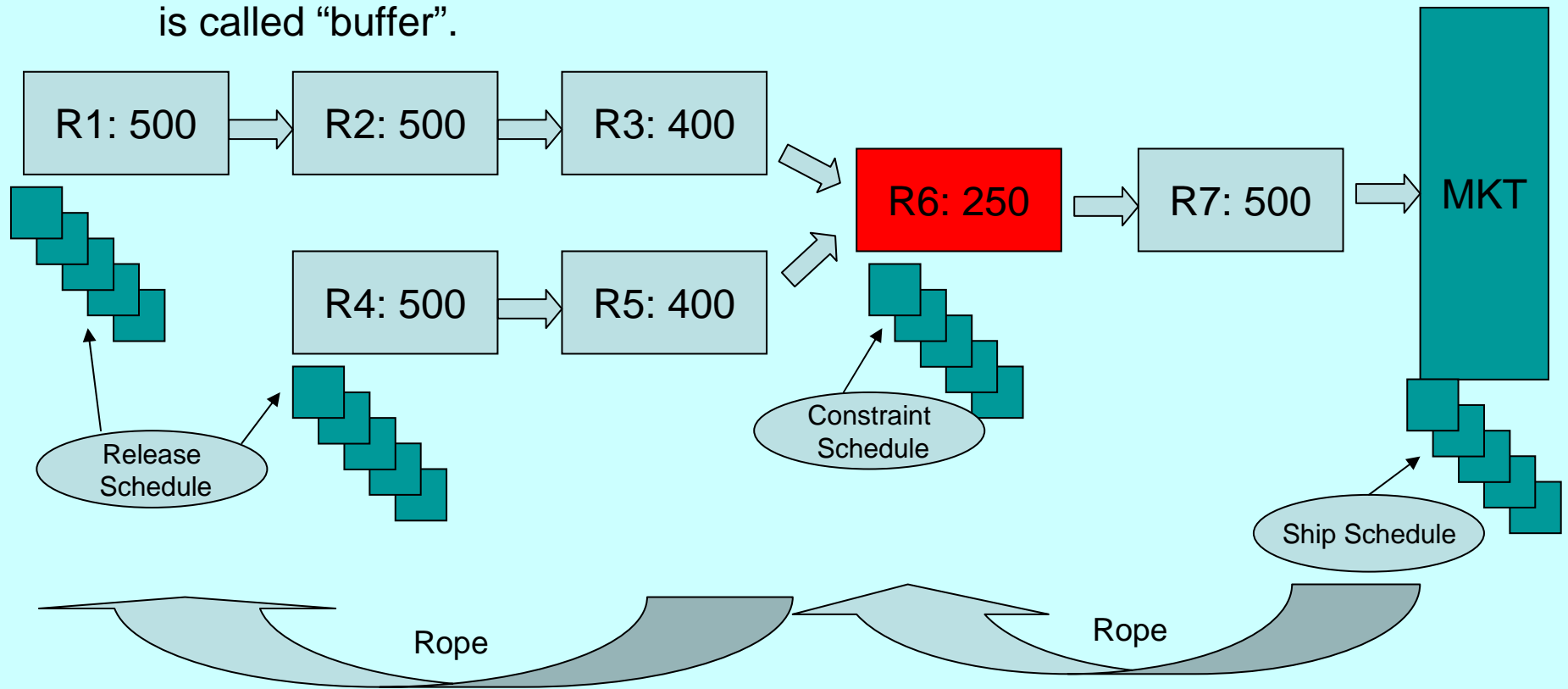
The schedule of material – the DRUM

The starting point is the ship schedule – all the orders due to be delivered each day: then due to accurate BOM and Routing the constraint schedule, and finally the release schedule of raw material and components for the final product, are created. We now have a properly developed Pull system.



The Rope

The rope is the mechanism by which the schedules are tied together, thus shipping is tied to the constraint, and the constraint tied to the release. The length of the rope is measured in time and is called “buffer”.

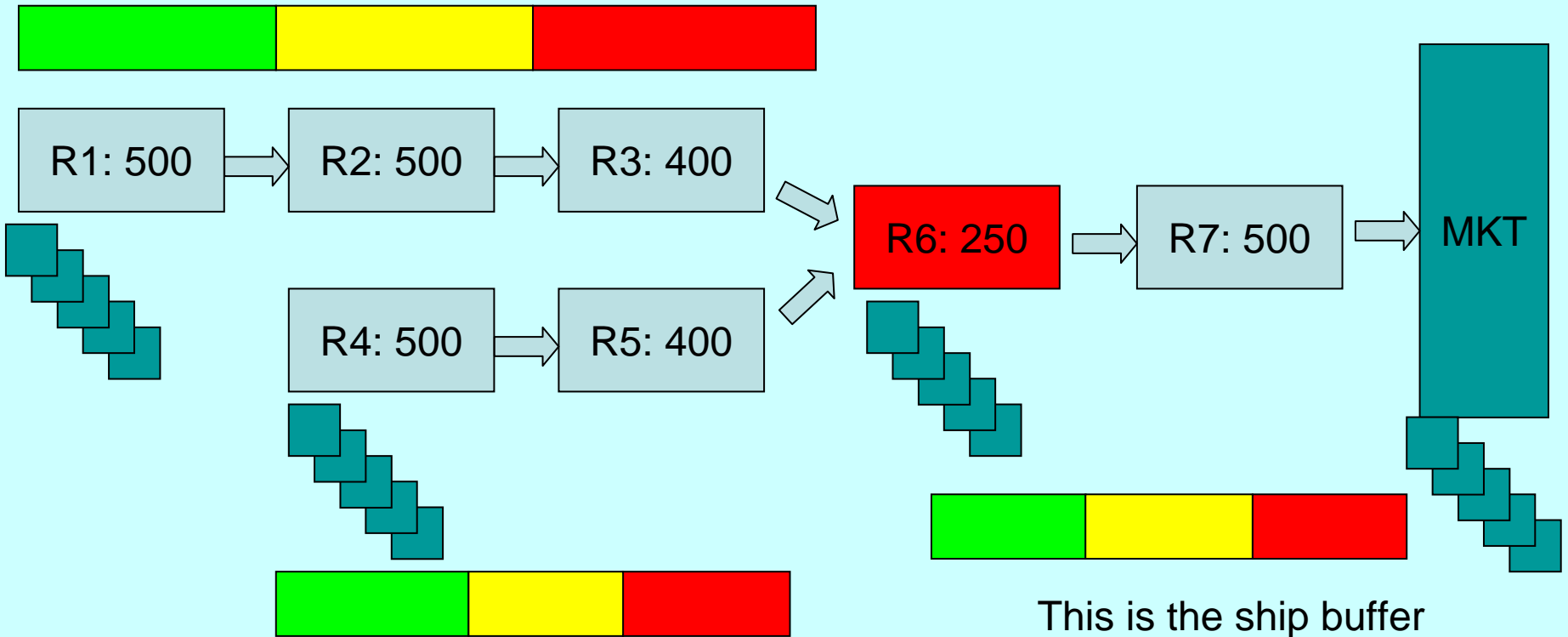


The Buffer

- ➔ This is measured in time and is designed to protect both the constraint, and the due date from problems within the operations environment
- ➔ There are three key buffers, only two in our example:
 - ⇒ Constraint buffer
 - ➔ Used to ensure that material has time to reach the constraint from the time of release
 - ⇒ Shipping Buffer
 - ➔ Used to ensure that material has time to reach the market OTIF after the constraint
 - ⇒ Assembly Buffer
 - ➔ Used if there is an assembly after the constraint fed by non-constraint resources

The Buffer

This is a constraint buffer



This is a constraint buffer

This is the ship buffer

Buffer Management

- ➔ Notice the three colours used within the buffer:
 - ➔ Green means that material is released and is likely to reach the destination (ship or constraint) on time
 - ➔ Yellow means that there has been a problem, material is late but not by much, and should still reach the destination on time
 - ➔ Red means that material has been held up for whatever reason and is likely to miss the destination time and thus has a high risk of being late to either the constraint and/or the market
- ➔ Thus the primary focal point of operations is any order that is currently in RED

Buffer Management and Lean

- ➔ Buffer violations are where material gets stuck for whatever reason
- ➔ Those violations that penetrate into Yellow and certainly into Red are those that demand the most attention.
- ➔ This is where we use the Lean tools and techniques, to create more capacity at the places where the violation takes place and thus enable a free flow to the constraint, and then to the market

Buffer Management and Improvement

- ➔ Once under control the level of buffer violations will reduce thus:
 - ⇒ We can reduce the overall time of the buffer thus reducing the overall lead time to market or..
 - ⇒ Increase the levels of sales to take up the slack in capacity that the buffer management has allowed
 - ⇒ At this point we are almost ready to elevate the constraint

Achieving TOC - Lean Status

- ➔ Pull System Scheduling
- ➔ Revenue Stream Mapping
- ➔ Set-Up reduction
 - ⇒ Driven by Buffer Management
- ➔ 5S/Visual Workplace/Production Led Maintenance
- ➔ Kaizen
 - ⇒ Driven by Buffer Management
- ➔ Addressing the seven primary causes of Waste
 - ⇒ Driven by Buffer Management
- ➔ Quality Systems
 - ⇒ Driven by Buffer Management
- ➔ Aligned decision-making can now be achieved through the buffer management and the reports generated.

Key Measurements within the TOC - Lean approach

- ⇒ Within the DBR approach key measurements are used to determine progress towards the goal of the company:
 - ⇒ **Throughput:** sales revenue less true variable cost
 - ⇒ **Investment:** cash tied up, typically material in raw, WIP or finished goods state
 - ⇒ **Operating Expense:** all the money that flows out of the company in terms of regular expenditure such as labour, rents etc

Other Measurements

- ⇒ In addition to the financial measurements already described there are others used to determine progress towards the goal of the company:
 - ⇒ **OTIF** (On-Time, In-Full) Delivery performance and the target is 100% with zero defect
 - ⇒ **PMROT** (Physical Material Released On Time) which is the measure of confidence that all the necessary material has been released in line with the schedule, including all design information, QA and so on.
 - ⇒ **Lead Time** which should be reducing as the buffer management identifies buffer violators and the various lean tools deal with them

Pull System Scheduling

⇒ Pull System Scheduling provides:

- ⇒ Shorter, more competitive response time to market
- ⇒ Excellent delivery performance and customer fulfilment rates
- ⇒ Lower inventory levels
- ⇒ Greater productivity
- ⇒ Less administration and control requirements
- ⇒ Company-wide employee engagement
- ⇒ Management by exception

Moving to the next level of performance

- ⇒ We now have control over operations
- ⇒ We now have focus across the whole of the revenue chain
- ⇒ We are now using Lean tools and techniques to properly support value flow and enable us to improve the quality of the process
- ⇒ We have put in place a real process of on-going improvement

Expediting

- ➔ Running pull scheduling will not resolve real problems in the plant
- ➔ We will still have :
 - ⇒ Breakdowns
 - ⇒ Shortages
 - ⇒ Scrap / Rework
 - ⇒ Absenteeism
 - ⇒ etc.
- ➔ This is where the combination of TOC, Lean and Six Sigma really delivers

Requirements to achieve a successful implementation

1. Management commitment (not involvement)
2. Understanding of cause and effect analysis tools
3. KISS
4. Clear communication and understanding of business strategy and business needs
5. Valid global operational measurements
6. Approach practically, not fanatically

Communicate Strategy

⇒ Determine the overall strategy of the business

⇒ For example:

- In six months position the company such that it achieves and maintains a growth rate of sales of current products of 20%/year
- Create a VMI capability within the supply chain
- In next fiscal year introduce new products that will increase sales by 15%

⇒ Identify the operational requirements necessary to achieve that strategy

⇒ For example:

- In Six Months Improve On-Time Delivery to 100% OTIF
- Aim for zero defect as a given
- Fast lead time to the market
- Fast Time-to-Market for new product development and launch

Valid Global Measurements

➔ Valid measurements:

- ⇒ Communicate
- ⇒ Evaluate
- ⇒ Anticipate
- ⇒ Not Conflicting

➔ Global: Measure the progress toward the goals of the entire operation

- ⇒ Throughput (T)
- ⇒ Investment (I)
- ⇒ Operating Expense (OE)
- ⇒ Profit = $T - OE$
- ⇒ ROI = $(T - OE) / I$
- ⇒ Productivity = T / OE

Determining our current position

⇒ Lean Scorecard

- ⇒ Designed to check *progress* towards lean initiative
- ⇒ Shows where you stand, compared to aggressive world-class goals
- ⇒ 80+% applicable to any mfg organization
 - Easily customizable
- ⇒ 56 total questions; multiple choice

Lean Scorecard Categories

1. Personnel & Training
2. Delivery, Lead-Time & Inventory
3. Layout, Flow, Handling & Scheduling
4. Processes & Operations
5. Preventive Maintenance
6. Supply Chain Management
7. Equipment Changeover/Set-Up
8. Quality
9. Metrics & Results

Lean Scorecard Sample Questions

⇒ Personnel & Training

⇒ What % of all employees have participated on improvement teams in the past 6 months?

⇒ Delivery, Lead-Time, and Inventory

⇒ What is your order fulfillment lead-time, compared to the industry average?

⇒ Flow, Layout, Handling, and Scheduling

⇒ What % of mfg process steps are organized in work cells, or situated so there is zero WIP between them?

⇒ Preventive Maintenance

⇒ What % of maintenance workload is spent on unplanned or emergency repairs?

Conclusions

- ⇒ Recent APICS article suggesting that the combination of TOC/Lean/Six Sigma (TLS) where out of 21 plants, the use of TLS led to a total of 89% of savings reported as against 4% for Lean on its own and 7% for Six Sigma (APICS May 2006)
- ⇒ TOC - Lean is a formidable partnership
- ⇒ Add to that mix the ability of sound quality systems to deliver zero defect and you have the most competitive platform there is
- ⇒ Now go and make money!

The Key Building Blocks

Process of on-going improvement

Business Strategy
Development

Visible
Management

Production Led
Maintenance

Quality
Management

Kaizen

Team
Dynamics

Five Steps of
Focusing

Pull Scheduling

Problem Solving Tools

5S
Organisation

Value Stream
Mapping

Set-Up
Reduction

Some final thoughts

- ⇒ There are, to my mind seven laws of constraint management that should be understood and applied:
 - ⇒ 1. Every organisation is a system comprising interdependent elements that form a revenue chain
 - ⇒ 2. The ability of the revenue chain to maximise performance is determined by the weakest link
 - ⇒ 3. The constraint is the primary location for both focus and leverage for the improvement of the overall performance of the system
 - ⇒ 4. Improving any link in the chain does not improve the overall performance of the chain

⇒ The remaining three laws are:

- ⇒ 5. Subordination to the constraint, in terms of the measurement system, the policies of the organisation, and the way in which people operate, is a fundamental requirement of managing the chain
- ⇒ 6. The management of the constraint, and the non-constraints, is dependent upon the use of an effective decision support system
- ⇒ 7. Variation in the system has most impact on the constraint

→ See Hutchin, T. 2002 Constraint Management in Manufacturing, optimising the Global Supply Chain published by Taylor and Francis. London

Further Information

Infor White Paper: A Lean Manufacturing Transformation

If you would like further information, join our new TOC-Lean forum to keep up to date with the latest information, or set up a visit from Ted Hutchin then contact:

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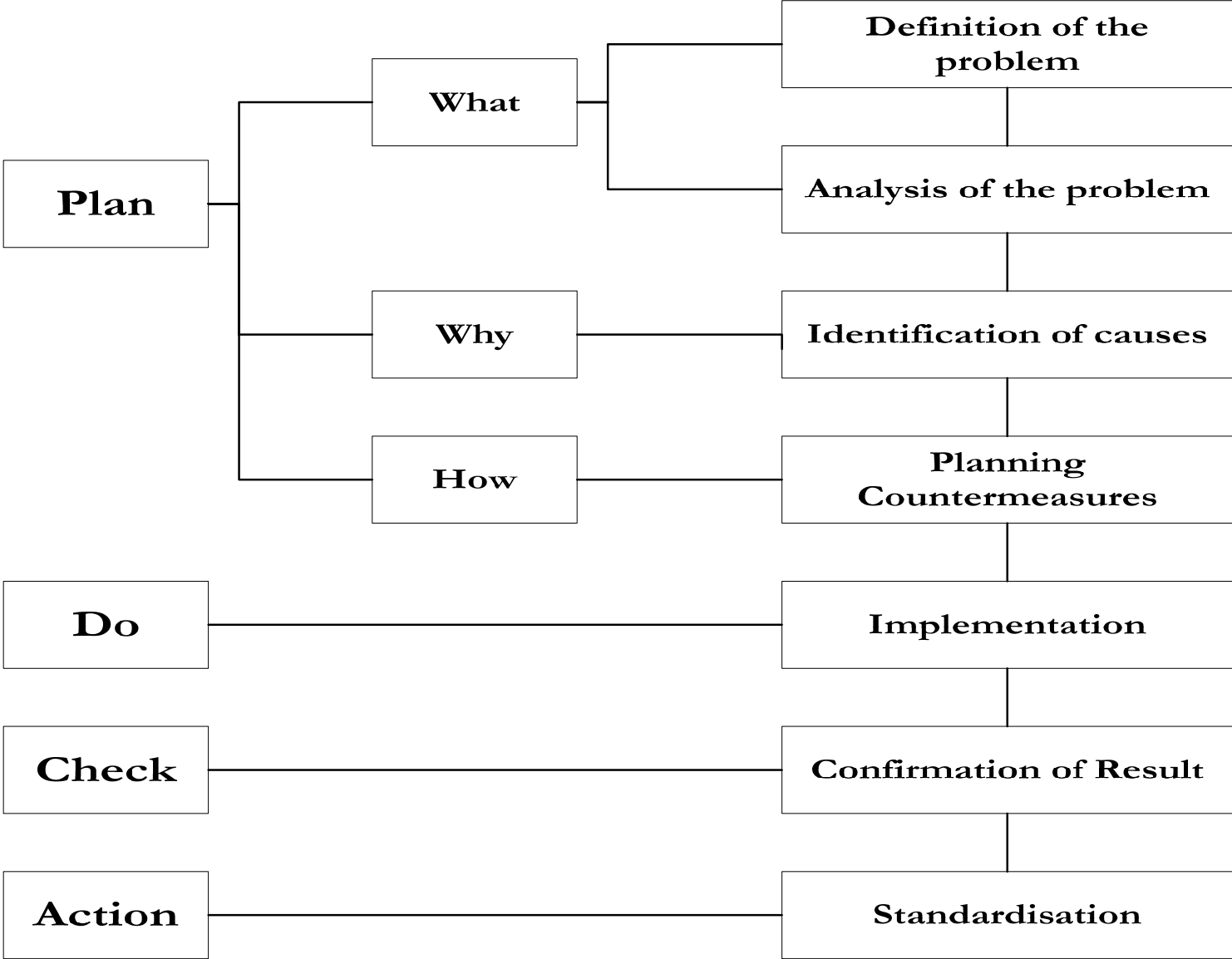
QUESTIONS?



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Appendix

Deming Applied within a Lean/TOC environment



- ➔ **Structure** – organisation is about separating the things which are necessary for the job from those which are not, and keeping the number of necessary ones as low as possible and at a convenient location
- ➔ **Systemise** – neatness is a study of efficiency. It is a question of how quickly can you get the things you need and how quickly can you put them away
- ➔ **Sanitise**- cleaning should be done by everyone in the organisation from Director to Janitor. While you are physically cleaning your areas your cleaning your mind as well
- ➔ **Standardise** – standardisation means continually and repeatedly maintaining your organisation, neatness and cleaning. Emphasis on Visual Management and 5S standardisation
- ➔ **Self-Discipline** – discipline means instilling the ability to do things the way they are supposed to be done. The emphasis is on creating a workplace with good work habits. Discipline is a process of repeating and practise

➔ *Progress that is not self-sustaining is not progress*

➔ The waste of

- ⇒ overproduction – making too much
- ⇒ waiting – ineffective use of time
- ⇒ transporting – excessive movement of product/inventory
- ⇒ inappropriate processing – the conflict between groups of machines vs one general machine
- ⇒ unnecessary inventory – too much inventory in the system
- ⇒ unnecessary motion – the level of movement operators have to do
- ⇒ defects – on both the product and the overall effectiveness of the production system

Addressing the primary types of waste

- ➔ *Waste of overproduction* – the root of many problems within manufacturing, making more than we need within the timescale
- ➔ *Waste of waiting* – how much time is taken up with material not moving when it could?
- ➔ *Waste of transporting* – how many times does material get handled when it needn't?

Types of waste ctd

- ➔ *Waste of inappropriate processing* – over-engineering springs to mind, using more than is necessary to achieve the objective
- ➔ *Waste of unnecessary inventory* – how much WIP do you have and what is the impact?

Types of waste ctd

- ➔ *Waste of unnecessary motions* – the application of sound ergonomics to manufacturing – this is also a key health and safety area
- ➔ *Waste of defects* – many companies today still measure quality in parts per hundred – yet world class companies measure in parts per million if not parts per billion!!