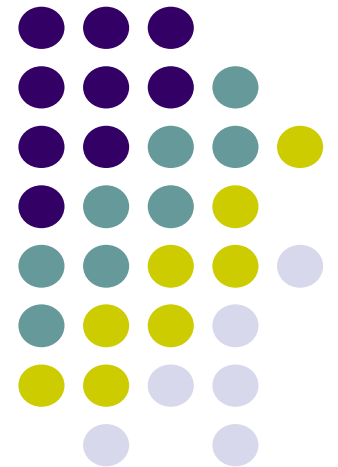
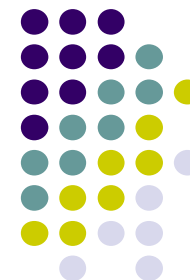


Lean Thinking and the Theory of Constraints

A Presentation for CIMA
9th April 2008

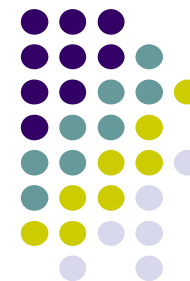
Presented by Ted Hutchin





The Lean Focus

- | View VALUE from the Customer's perspective
- | Get Value to FLOW through the system
- | PULL value from the customer back through the system
- | Continuously eliminate all WASTE in the flow



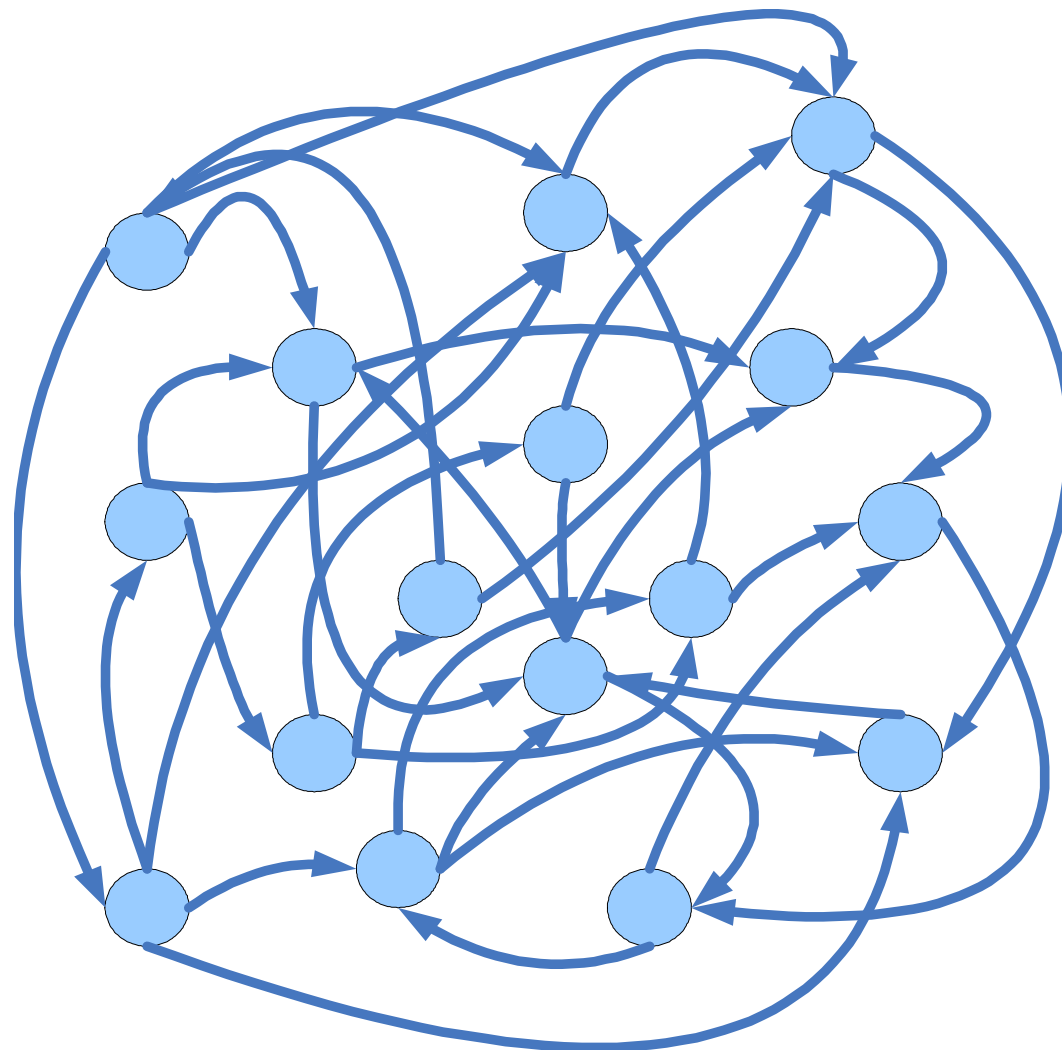
Lean – A huge success ?

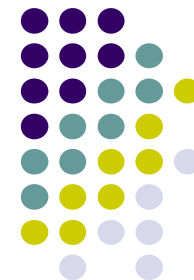
So why, with all these powerful tools, do we not universally see massive improvements to the bottom line from implementing Lean ?

(note the recent newsletters from Prof Dan Jones)



Businesses are Complex !!



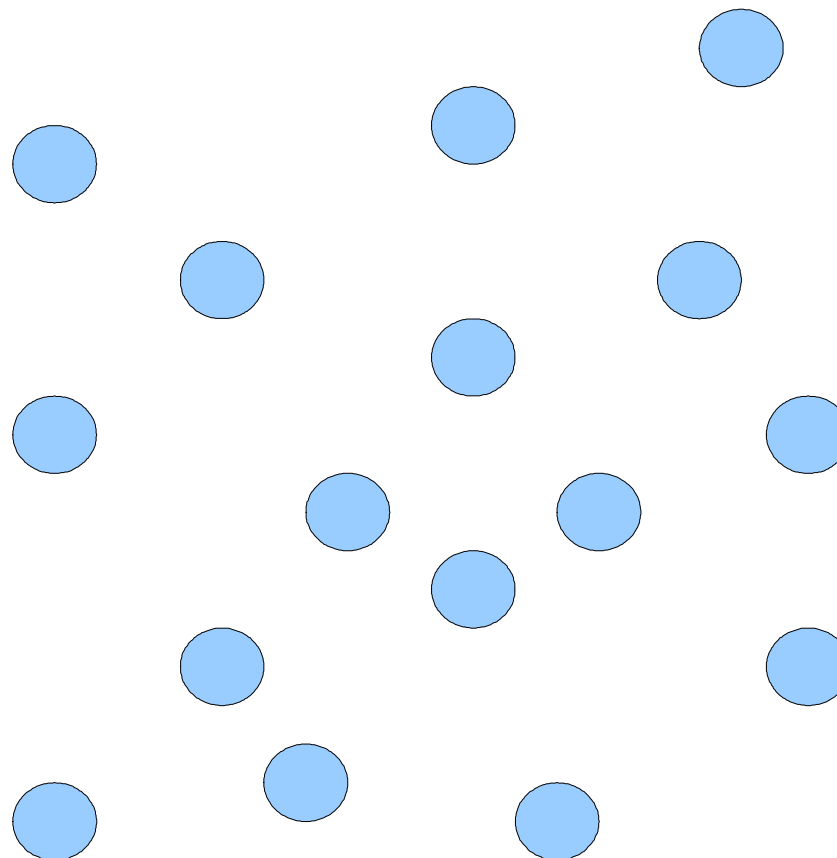


So....We simplify them !

Break things down systematically into smaller elements that we can control

The approach of :

- Management
- Accounting
- Lean

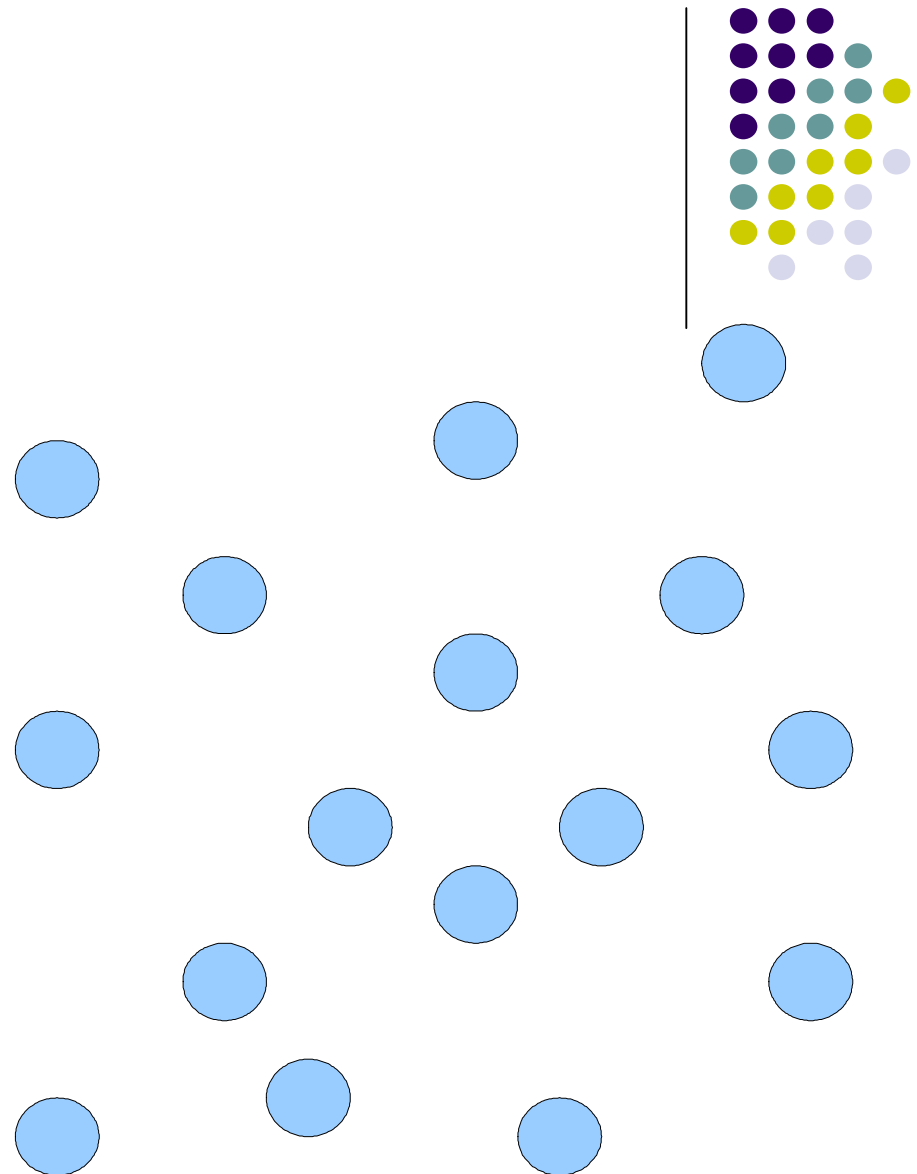


But with what effect ?

We have removed well over HALF of our system by making this simplification – the arrows

We are ignoring the INTERDEPENDENCIES in the system

We assume that the GLOBAL result will be the sum of all the LOCAL results from the elements





Implementing Lean - Traditionally

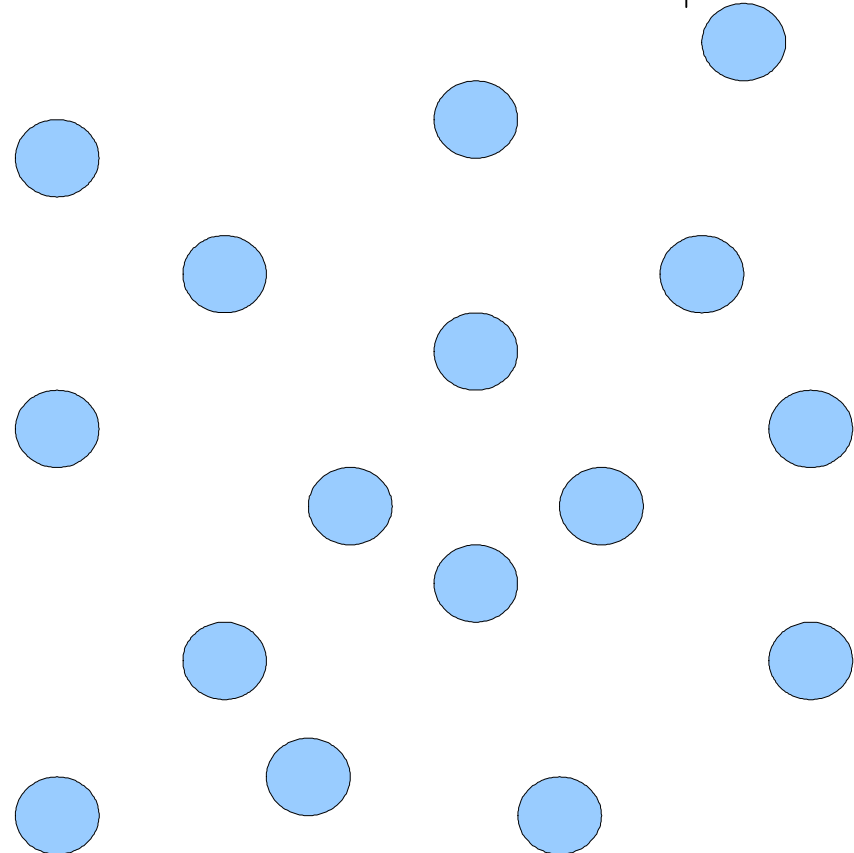
Let's start a programme to implement Lean

We'll train the managers from each section and some facilitators and they can all implement Lean projects in their areas

What is the biggest cost of Lean ?

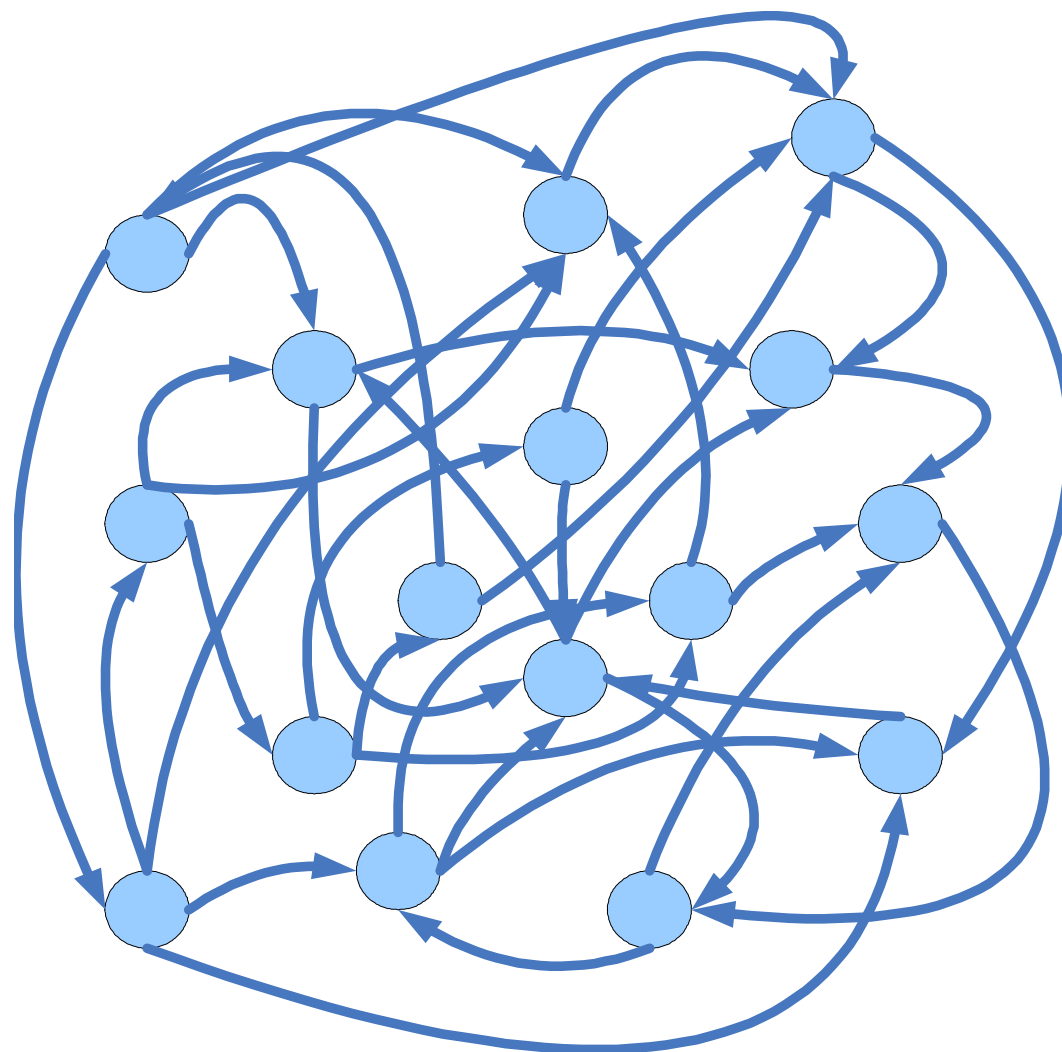
- TIME

Toyota started their Lean journey in 1950.....



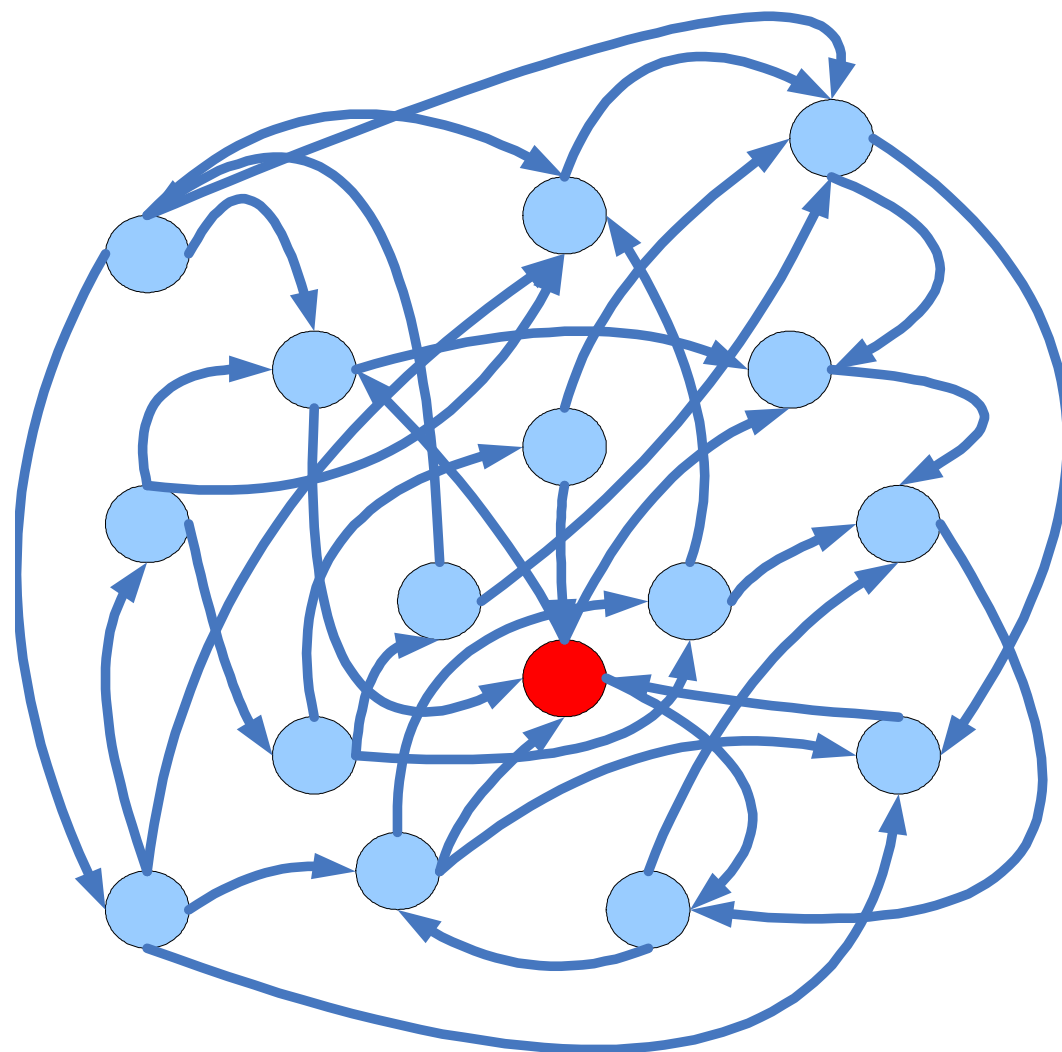


Is there a better way ?





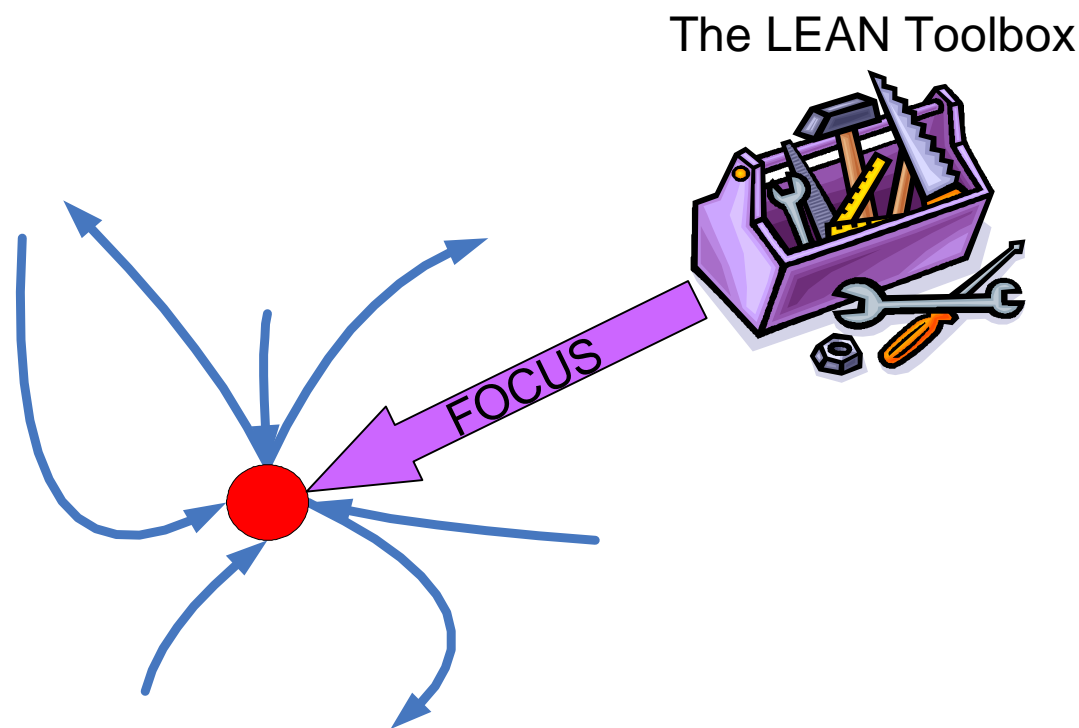
Find the Weakest Link in the System



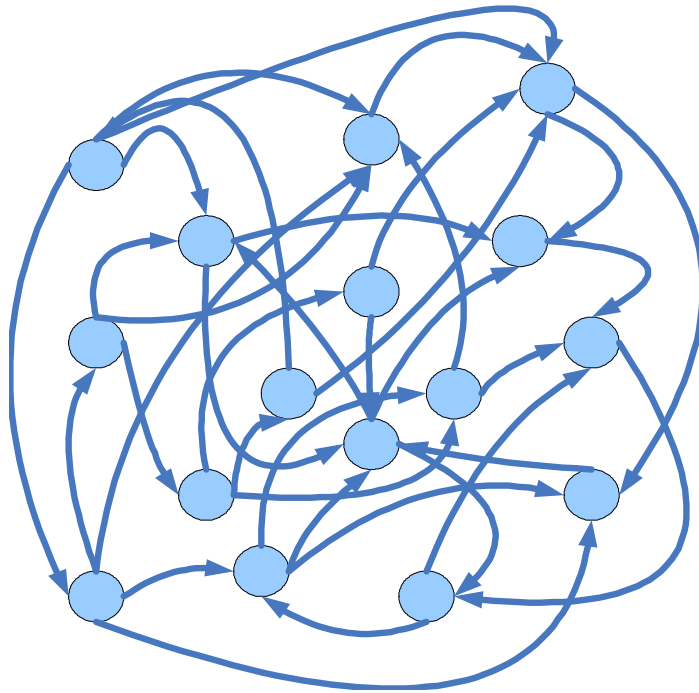


Focus on the Weakest Link

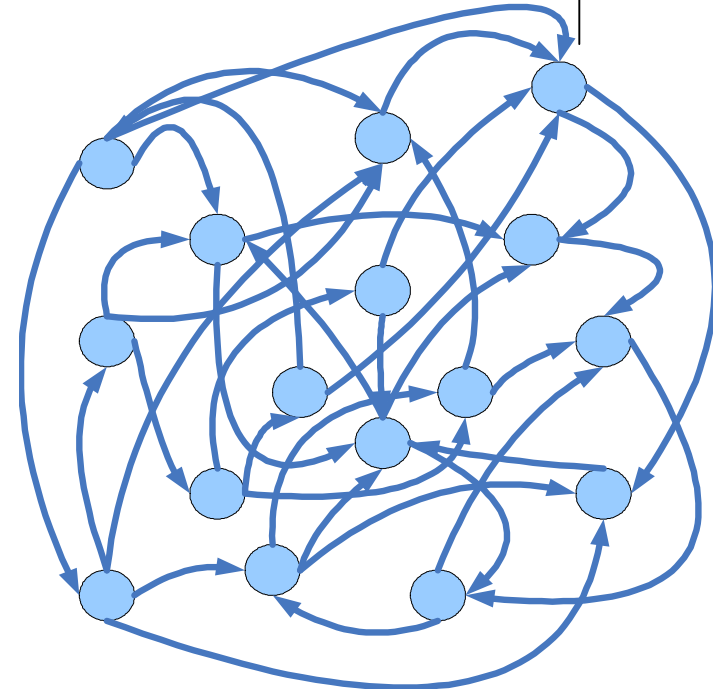
1. Find it (IDENTIFY)
2. Squeeze it (EXPLOIT)
3. Make the rest of the system support it (SUBORDINATE)
4. Then and only then, get more capacity (ELEVATE)
5. Check the weakest link has not moved (GO BACK TO STEP 1)



Contrast the Two Methods



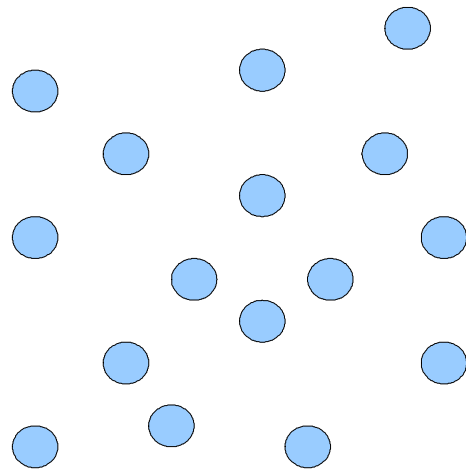
Lean



TOC

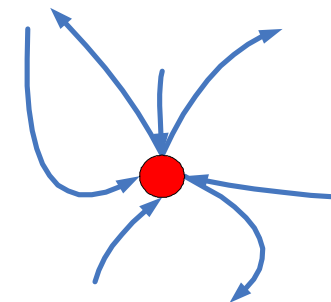


Contrast the Two Methods



Lean

Improve all elements of the system using Lean



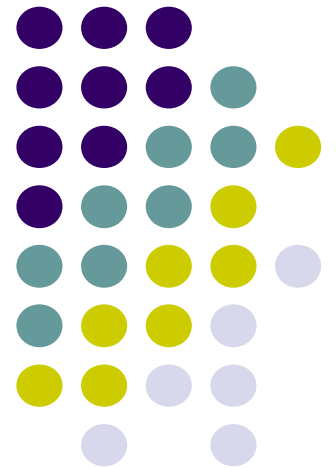
TOC

Focus all improvement only on the Constraint

| | | |
|-----------|----------------------------------|---|
| Time | Long | Short |
| Cost | High | Low |
| Execution | Slow | Fast |
| Results | Low rising to medium (if at all) | High rising to Huge Competitive Advantage |

Understanding the system

Using TOC to enable proper focus for the use of Lean tools and techniques starts here





What is the goal?

- | All companies are formed for a purpose, usually to make money, now and in the future, and to do so by continually satisfying the market
 - | Seems obvious but it is surprising how many companies take actions, implement strategies, buy machines and other services that do nothing to take the company closer to the goal
- | So that leads naturally to the next question



What are the key objectives?

- | Deliver...
 - | The right product
 - | At the right price
 - | At the right time
 - | Zero defect as a given

- | Better customer satisfaction than any competitor
- | Win business throughout the chosen market segment



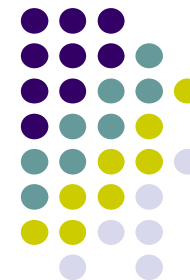
OK so how are we doing?

- | So are we making good profit on our current level of work?
- | Is our order book full?
- | Is our plant full of WIP trying to escape to a client?
- | Are we expediting most of the time?
- | Is our lead time too long for sales to keep existing and new clients on the hook?
- | Is our due date performance something we try to hide?
- | Is there room for improvement?

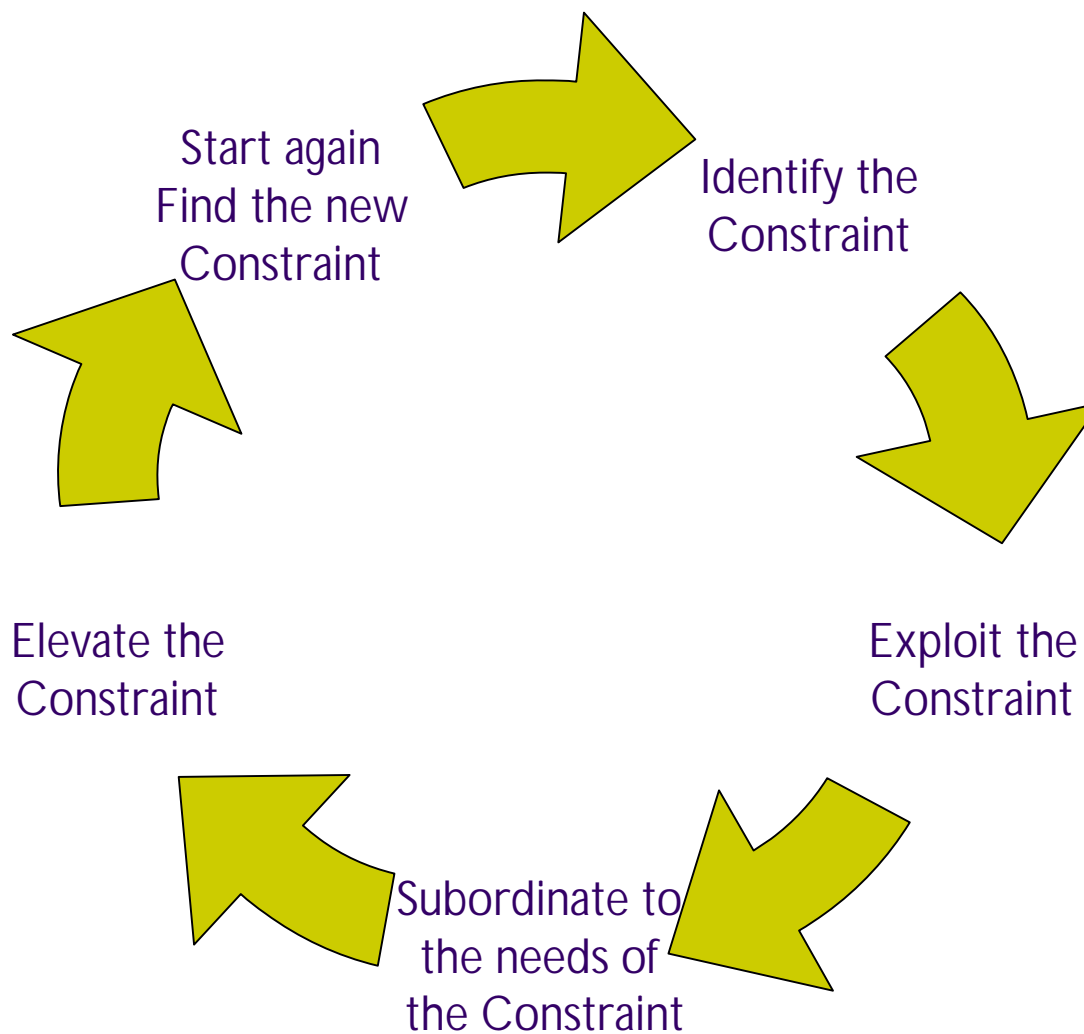


The notion of a constraint

- | If we are currently under-performing against the goal then there is a real problem within our company but.....
 - | Is it something physical like a machine, work centre, space or....
 - | Is it something less tangible such as the policies and procedures we have adopted to make the company more efficient, leaner, fitter.....



The Five Steps of Focusing





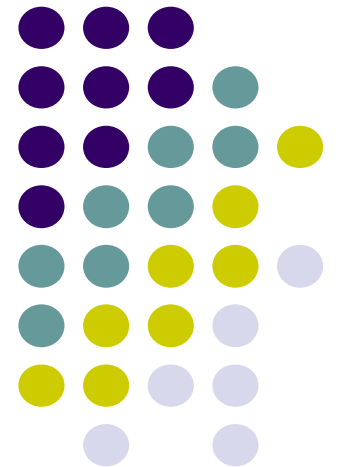
The five steps defined from *The Goal*

- I Identify the constraint
 - I 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
- I Exploit the constraint
 - I Once the constraint has been identified make it work, attack any waste, but make sure it is doing the right work
- I Subordinate to the constraint
 - I 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!
- I Elevate the constraint
 - I Once the constraint is under control and the organisation is stable it is possible to elevate the constraint, which often means...
- I Prevent inertia – go back to step one
 - I 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

Let's consider an example from the world of production

The solution described in the book *The Goal* and known as:

Drum – Buffer - Rope

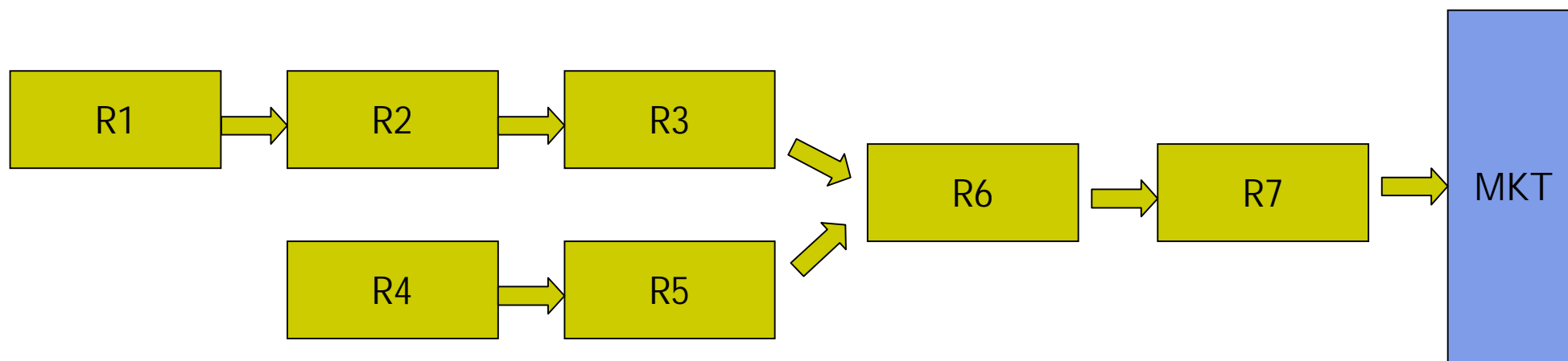




The basic flow of material in the chain

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

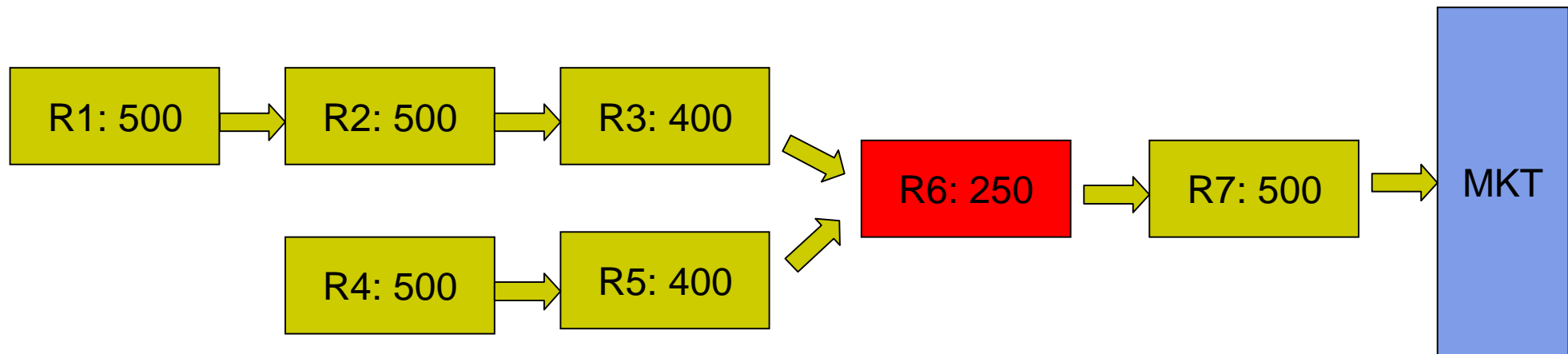
The intention is to surface the chain as it really is and the problems created





Finding the weakest link

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

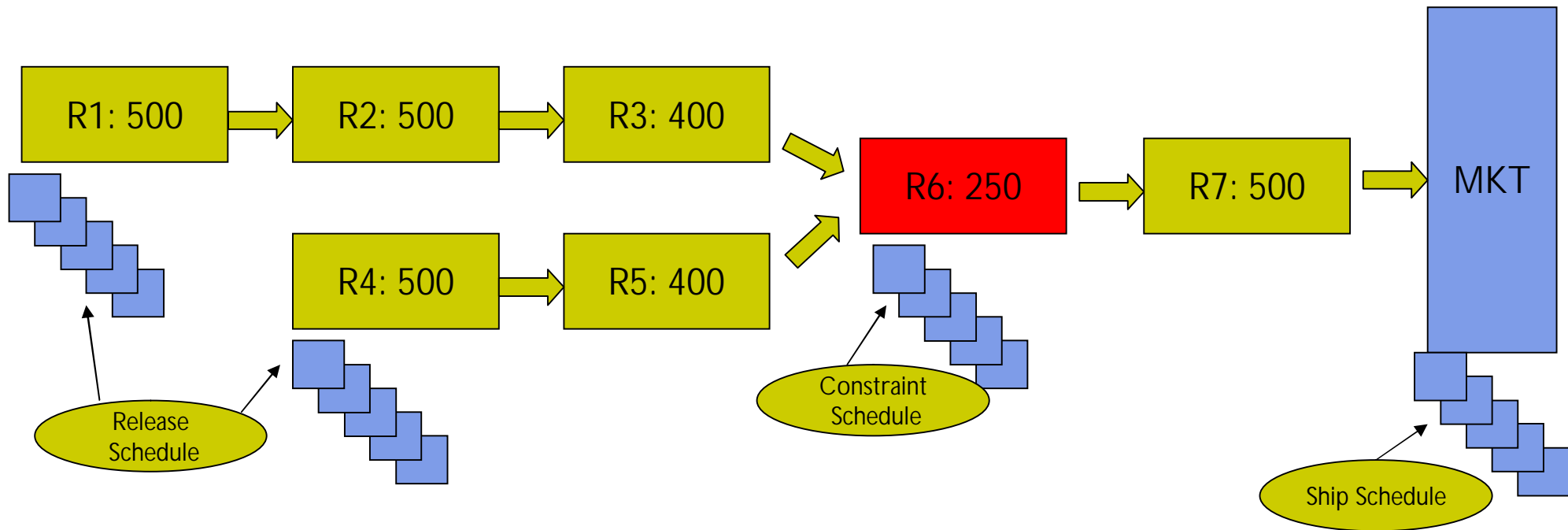


- Thus the number following the resource # shows the stated full capacity of each resource

The schedule of material – the DRUM



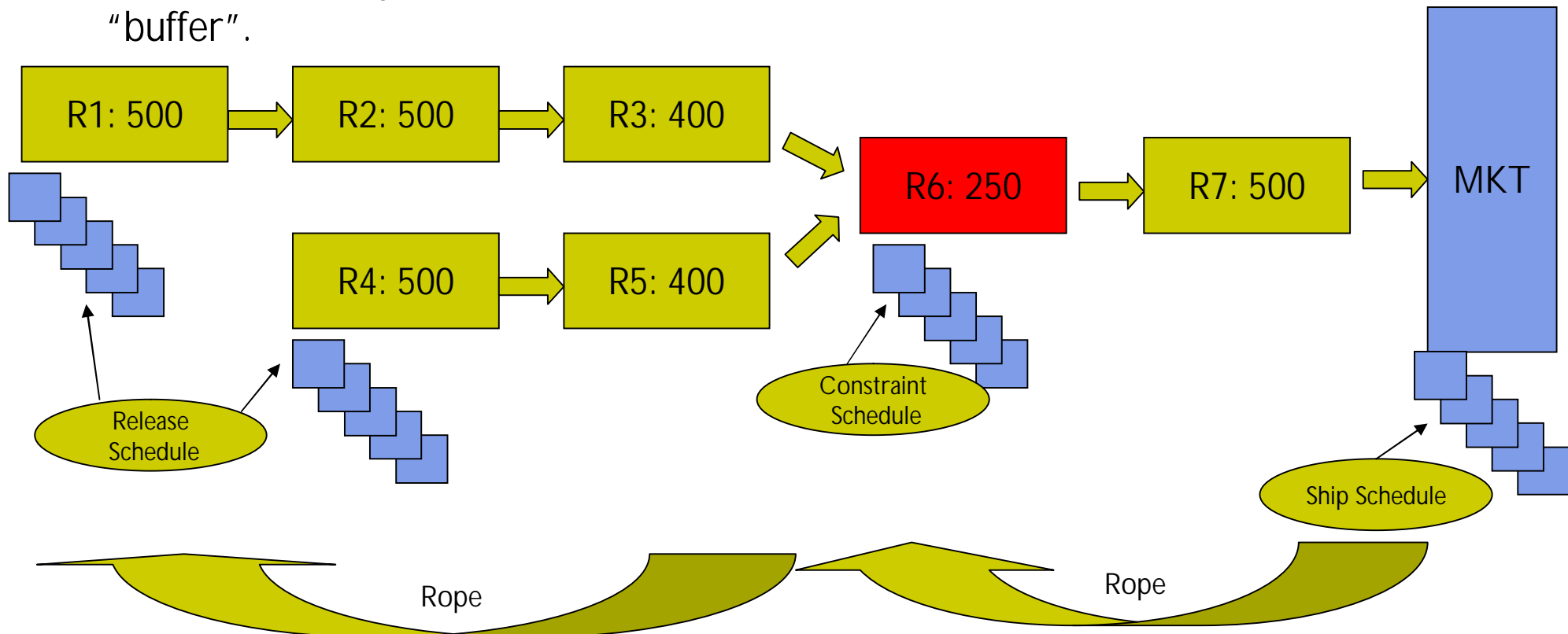
The starting point is the ship schedule – all the orders due to be delivered each day: then due to accurate BOM and Routing the constraint schedule, and finally the release schedule of raw material and components for the final product, are created

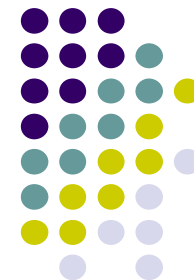


The Rope



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".





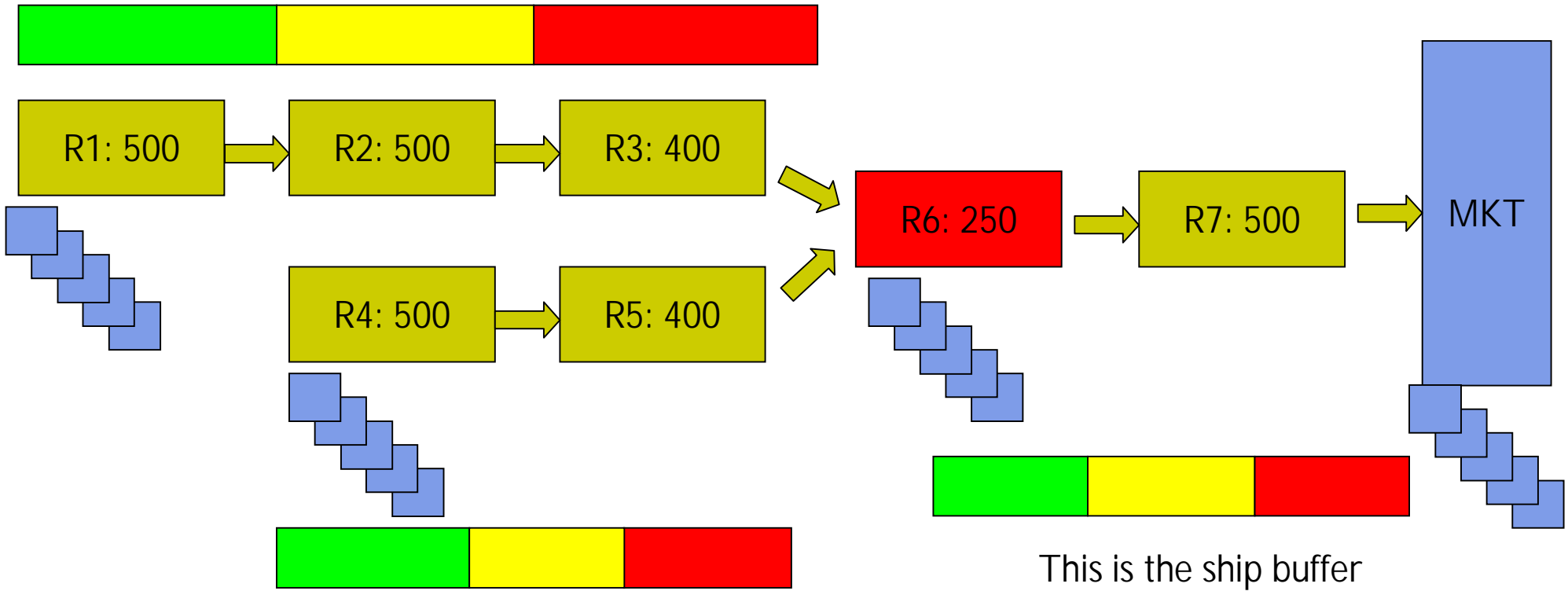
The Buffer

- | This is measured in time and is designed to protect both the constraint, and the due date from problems within the operations environment
- | In this example there are two key buffers:
 - | 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

The Buffer



This is a constraint buffer



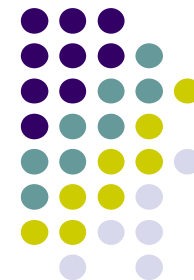
This is a constraint buffer

This is the ship buffer



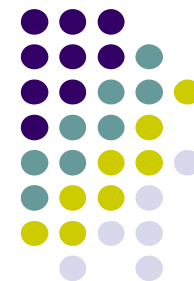
Buffer Management

- | 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

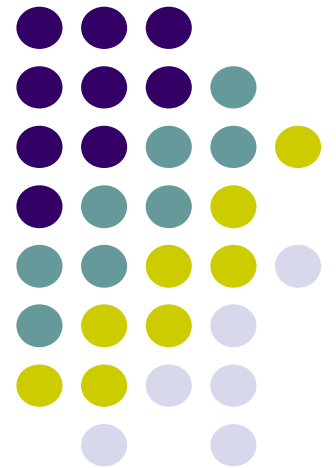


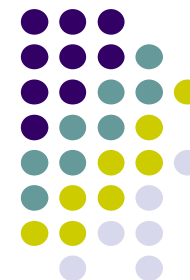
Buffer Management and Improvement

- | 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

Starting to change our reality!

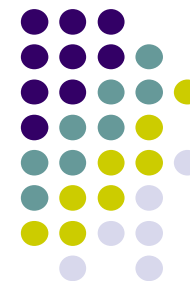
Applying the five steps of focusing





Applying DBR

- | The five steps of focusing form the core of our model at this stage
 - | Identify the constraint
 - | The constraint of production/operations is clearly determined
 - | Exploit the constraint
 - | The schedule of the constraint is created in line with orders and capacity
 - | Buffer sizes are determined and applied (Ship and Constraint)
 - | Prioritisation is done by Throughput/constraint minute
 - | Work rules for the shop floor are developed and implemented



Applying DBR

- | Subordinate to the constraint
 - | People work to the schedule – work rules for the non-constraint areas
 - | Prioritisation is done (after release) by buffer status (red zone penetration)
 - | Gating operation functions in line with the schedule
 - | Measure appropriate to the constraint operation, due date performance and lead-time reduction are in place and applied
 - § OTIF, MROT, DDP, Lead Time, T, I, OE and Defects
 - | Purchasing operate in line with the constraint schedule and buffer penetrations
 - | Material is released at the gating operation in line with the schedule
- | Elevate the constraint
 - | Move to the next, higher, level of performance and capacity
- | Prevent inertia – go back to step one



Expected results at this stage

- | Reduced lead time across all product ranges
- | Enhanced due date performance sustainable over time (> 95%)
- | Confidence in material release to support the schedule
- | Greater visibility as to buffer status
- | Greater control from and to the shop floor
- | More available capacity for sales
- | Enhanced bottom-line performance
- | Areas for improvement are determined by the buffer reports
- | The use of the Throughput Accounting to enhance decision-making throughout the plant



Key Measurements within the DBR/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
 - | MROT (Material Released On Time) – which is the measure of confidence that all the information and material is going to be ready for release at the PMROT date – this is the focal point for design, engineering and purchasing for example
 - | 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

TOC Financial Measurements



- | Throughput Accounting (for profit organisations)
 - | Throughput (T) - the rate at which the system generates money through sales ($Sr - TVC$)
 - | Investment (I) - the cash tied up in the system
 - | Operating Expenses (OE) - the cash required to turn I into T
 - | Net profit = $T - OE$
 - | ROI = $(T - OE) / I$
 - | Productivity = T / OE



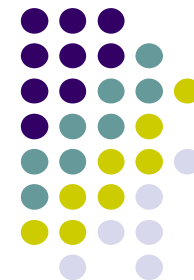
So what is the target?

- | Lead time – to be reduced
- | Due Date Performance – target is 100% defect free (On-Time, In-Full – OTIF)
- | Material released on time (MROT) – target is 100%
- | Physical Material released on time (PMROT) – target is 100%
- | Throughput \$days at zero
- | Inventory days to be at a minimum in line with the requirements of the shipping schedule
- | I – Investment – controlled
- | OE – Operating expense – controlled
- | T – Throughout (sales-raw material) - increased

Achieving Lean Status



- | Pull System Scheduling
 - | This is a DBR scheduling exercise
- | 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.



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
with DBR

Problem Solving Tools

5S
Organisation

Value Stream
Mapping

Set-Up
Reduction



Book list for further reading

- | Goldratt, E.M. and Cox, J. 1987 The Goal Revised Ed. North River Press MA
- | Goldratt, E.M. 1997 Critical Chain North River Press MA
- | Goldratt, E.M., Ptak, C. and Schragenheim, E. 2001 Necessary but not sufficient North River Press MA
- | Hutchin, T. 2001 Enterprise Focused Management: changing the face of project management Thomas Telford London
- | Hutchin, T. 2001 Unconstrained Organisations: managing sustainable change Thomas Telford London
- | Hutchin, T. 2002 Constraint Management within Manufacturing: optimising the global supply chain Taylor and Francis London
- | Umble, M.M. and Srikanth, M.L 1990 Synchronous Manufacturing APICS
- | Stein, R.E. 1996 Re-Engineering the Manufacturing System Dekker
- | Corbett, T. 1998 Throughput Accounting North River Press MA
- | Smith, D. 2000 The Measurement Nightmare St Lucie Press Boca Raton
- | Schragenheim, E. and Dettmer, H.W. 2001 Manufacturing at Warp Speed St Lucie Press Boca Raton



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