



# Addressing the “cash constraint”

*Throughput Accounting: an approach to  
making decisions*

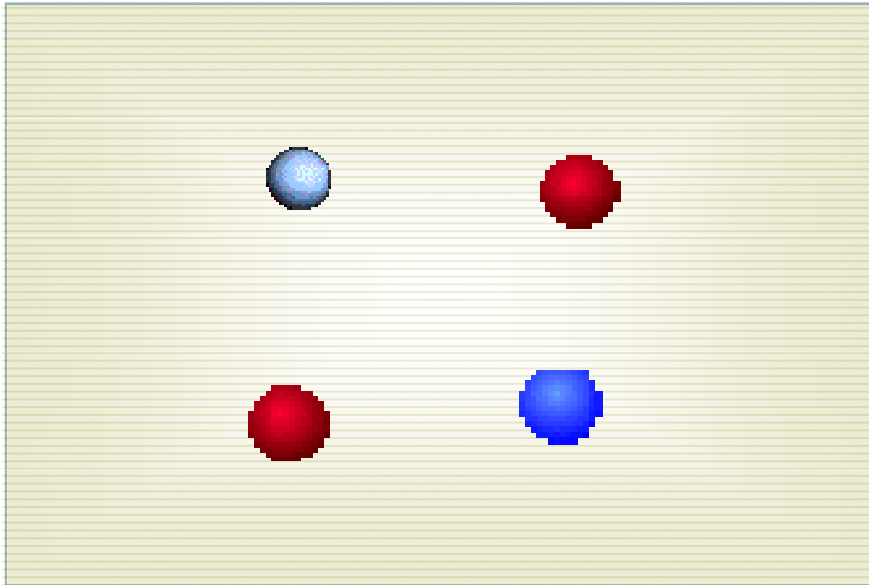
Presented by Dr Ted Hutchin  
TOC-Lean Institute



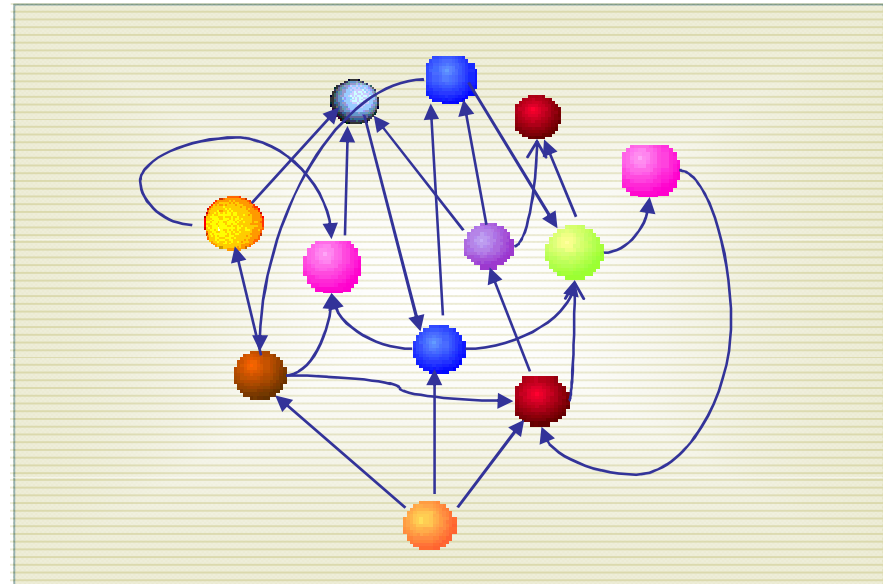


# So what do you think here?

**SYSTEM A**



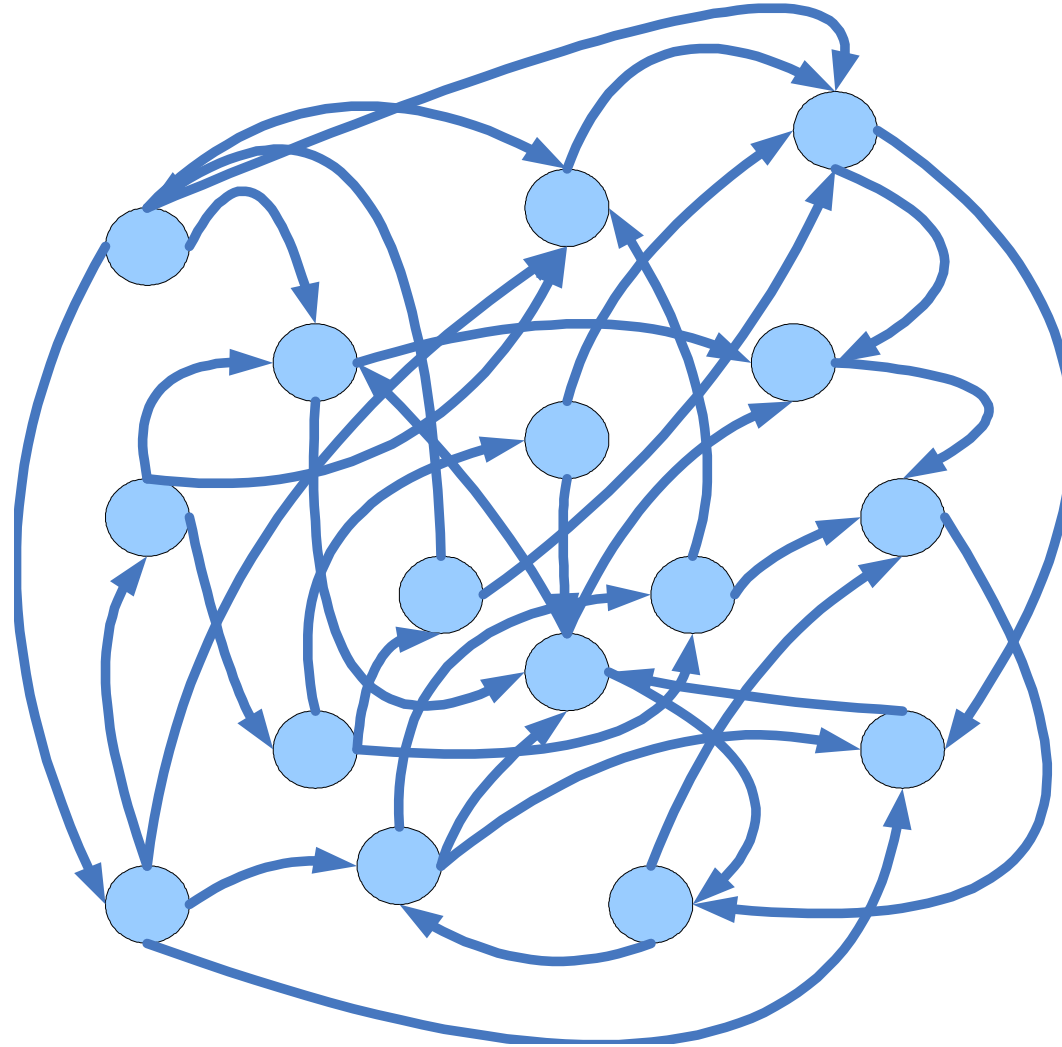
**SYSTEM B**



**Which system is more complex?**



# Businesses are Complex !!





# So....We simplify them !

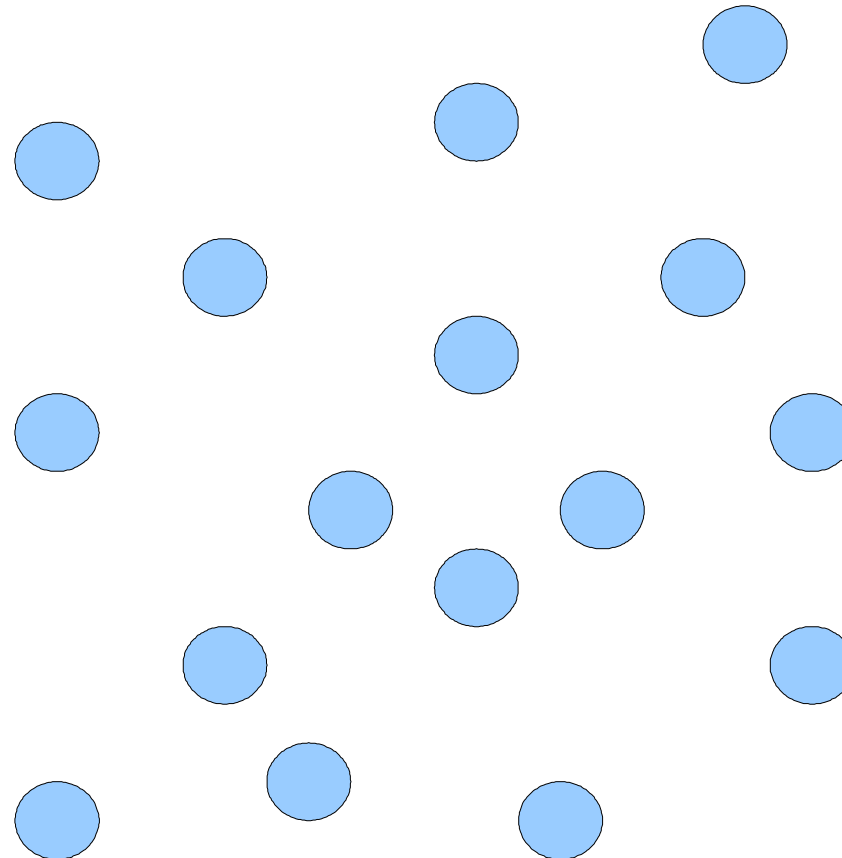
Break things down systematically into smaller elements that we can control

The approach of :

-Management

**-Accounting**

-Lean



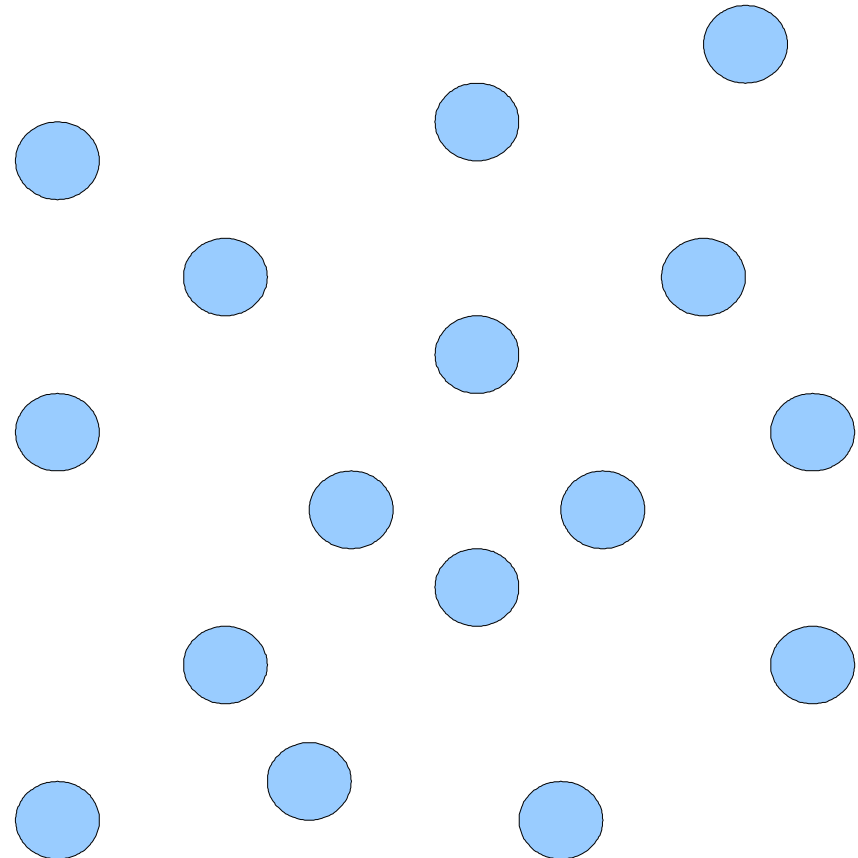


# But with what effect ?

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

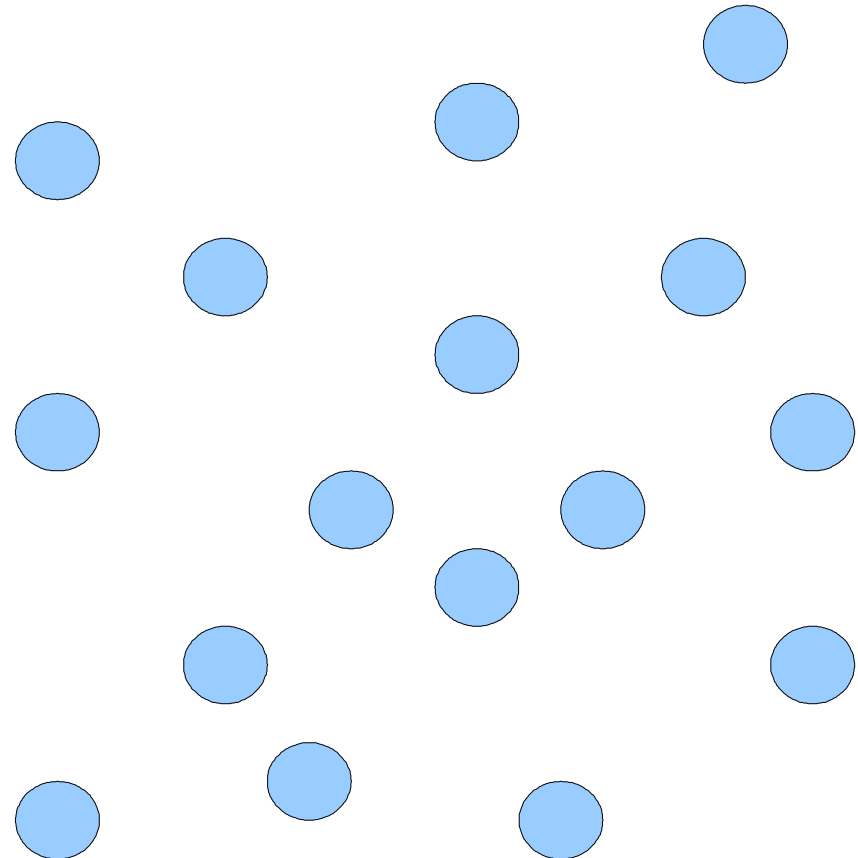
Let's start a programme to implement Lean

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

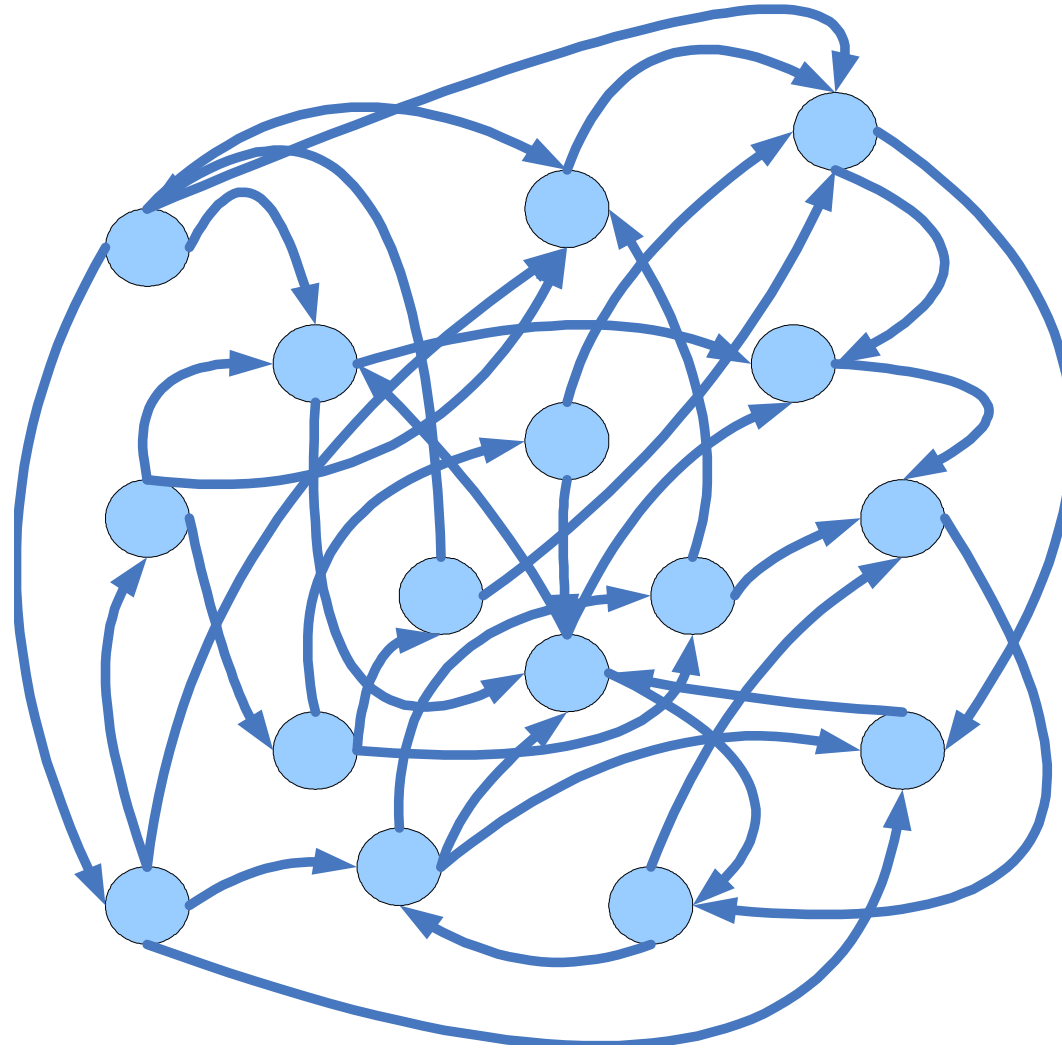
What is the biggest cost of Lean ?

- TIME

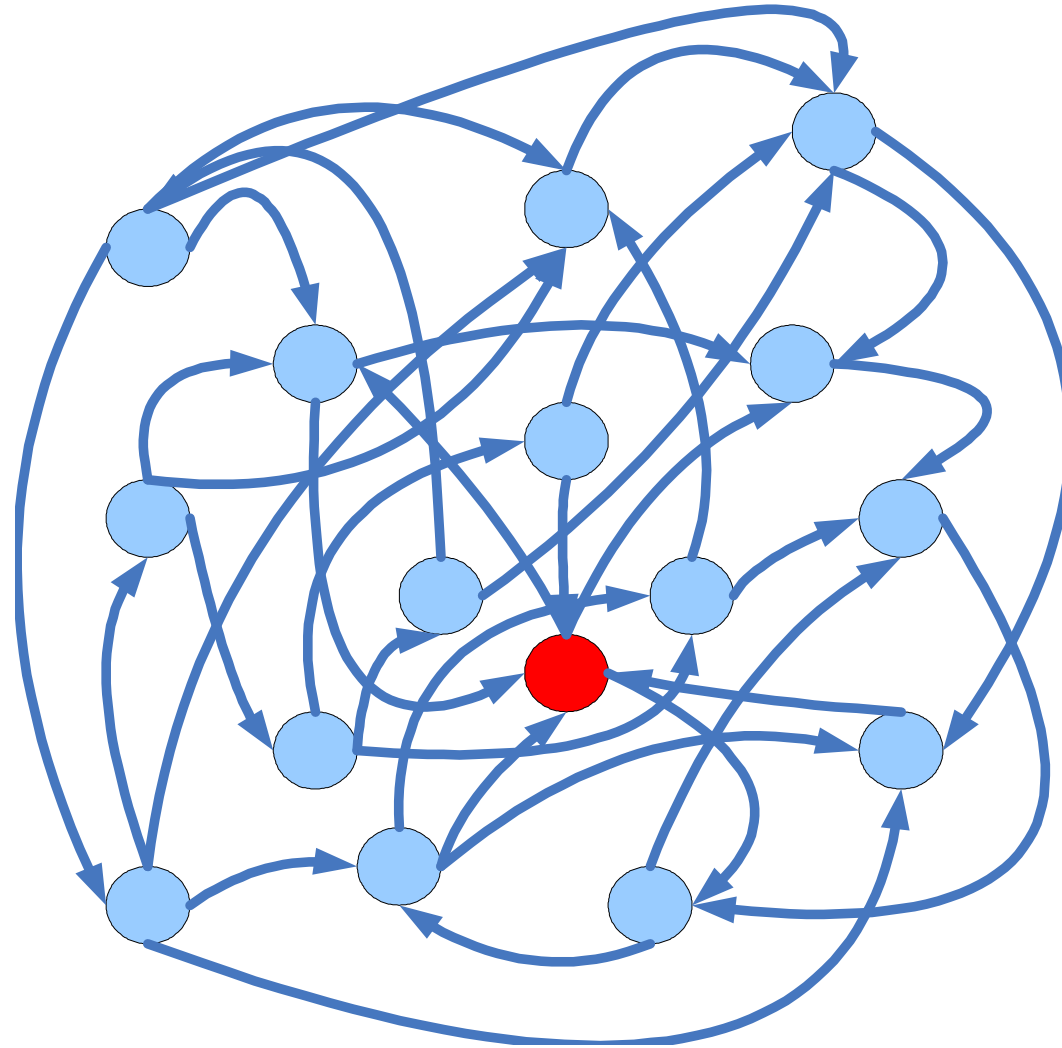
Toyota started their Lean journey in 1950.....



# Is there a better way ?



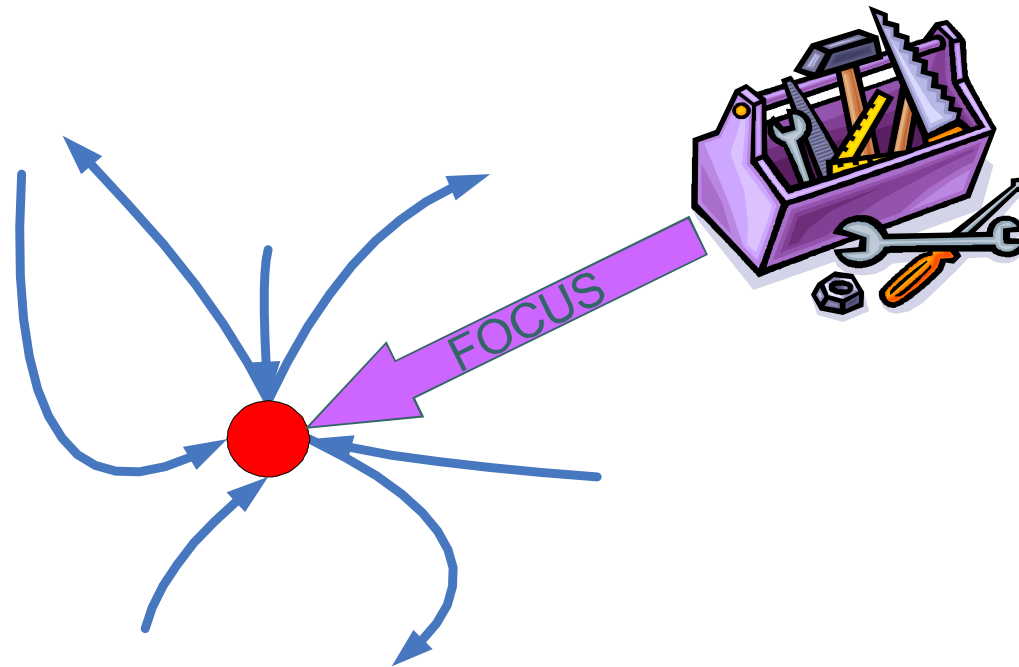
# Find the Weakest Link in the System



# 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)

The LEAN and DMAIC Toolbox





# Summary: The five steps of focusing

## ⌘ 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, attack any waste, but make sure it is doing the right work

## ⌘ 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!

## ⌘ 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 Goal

- ⌘ The main goal of a manufacturing company is to make money now and in the future.
- ⌘ All other goals are secondary, necessary yes, but still secondary
  - | *Such as satisfying the market (NAITF)*
  - | *And satisfying the team (NAITF)*
- ⌘ If you do not make money, you will not be in business much longer.



# Measures

- ⌘ We need measures to tell us how well we are doing in achieving the main goal.
- ⌘ An old process control maxim:
  - | “You can’t control what you can’t measure.”
- ⌘ If the goal is to make money, the measure must relate to a unit of currency.



# Common Measures

- ⌘ PROFIT - The amount of money generated beyond what was spent in a time period.
- ⌘ RETURN ON INVESTMENT (ROI) - The ratio of the PROFIT in a time period versus the amount of money invested in the company in order to generate that PROFIT.



# Primary Financial Measurements

- There are three universally accepted primary financial measurements, namely:

**Profit**

**Return  
On  
Investment**

**Cash Flow**



# Profit (P)

- ⌘ The success of any for - profit organisation as measured by its ability to generate Goal units can ultimately be expressed in terms of Money. i.e. the absolute measurement of how much profit is generated by the organisation.
- ⌘ So the First Prime Financial measurement is **Profitability.**
- ⌘ If I have two businesses and I make a profit of £100 in business A and £10,000 in business B then, on the face of it, business B would appear to be the better business, but is it?



# Return On Investment (ROI)

- ☞ In order to evaluate whether the profit made is acceptable we need a relative measurement which relates the profit made to the initial investment in the business.

## Return On Investment (ROI).

- ☞ If I invested £1,000 in business A and £1,000,000 in business B, which business is doing better?
- ☞ The **Return On Investment (ROI)** for business A is 10% and for business B it is only 1%.
- ☞ But this is not the full picture, there is another extremely important element, Cash Flow.



# Cash Flow

- ⌘ A business can be making huge profits yet still go out of business. How come?
- ⌘ Well if a business is, for instance, growing very rapidly then it will require more and more capital be invested in the business in order to meet the growing demand on its resources. The cash generated through normal operations may be insufficient to meet the capital requirements and the business may run out of cash.
- ⌘ A positive cash flow is therefore not a measurement as such but more of a necessary condition for survival in the long term.



# A Drawback

- ⌘ Neither PROFIT nor ROI as measures are particularly helpful in determining the impact of production decisions.
- ⌘ “If I decide to work overtime at that resource next week, what will it do to my PROFIT and ROI?”



# Two kinds of measurements

☞ Measurements can be divided into two broad categories, namely:

**Financial Measurements**

and

**Operational Measurements**

- ☞ The purpose of the two measurements is very different.
- ☞ Financial Results should reflect the sum of the outcome of management's efforts to run the organisation using the Operational Measurements.
- ☞ What happens when we use different operational measurements to drive decision-making and general behaviour in throughout our organisations?



# New Measures

- ⌘ Throughput (T) - all the incoming money a company generates *through sales* (selling price - raw material - outside service)
- ⌘ Inventory (I) - all the outgoing money that is *invested* in raw material, capital equipment, etc.
- ⌘ Operating Expense (OE) - all the outgoing money that is *spent* on utilities, labor, etc.



# Throughput Accounting Definitions

- ☞ *Profit* is defined as Throughput less Operating Expense.

$$P = T - OE$$

- ☞ *Throughput* is defined as Sales Revenue less Raw Material content, or more often today “total variable cost”.

$$(T = Sr - RMc)$$

- ☞ For service organizations Throughput is Sales Revenue less truly variable costs.
- ☞ Truly variable is defined as any cost that has a direct one-for-one change with volume.
- ☞ *Operating Expenses* is defined as the cash required to turn Investment (I) into Throughput (T).



# Throughput Accounting Definitions

- ⌚ *Return on Investment* is defined the rate at which a given investment generates profit.

$$\text{ROI} = (T - OE) / I$$

- ⌚ *Investment* is defined as the cash tied up in the business.
- ⌚ There is another TOC measurement which is handy to have - Productivity.
- ⌚ Productivity is defined as the rate at which Throughput is generated for a given amount of Operating Expense.

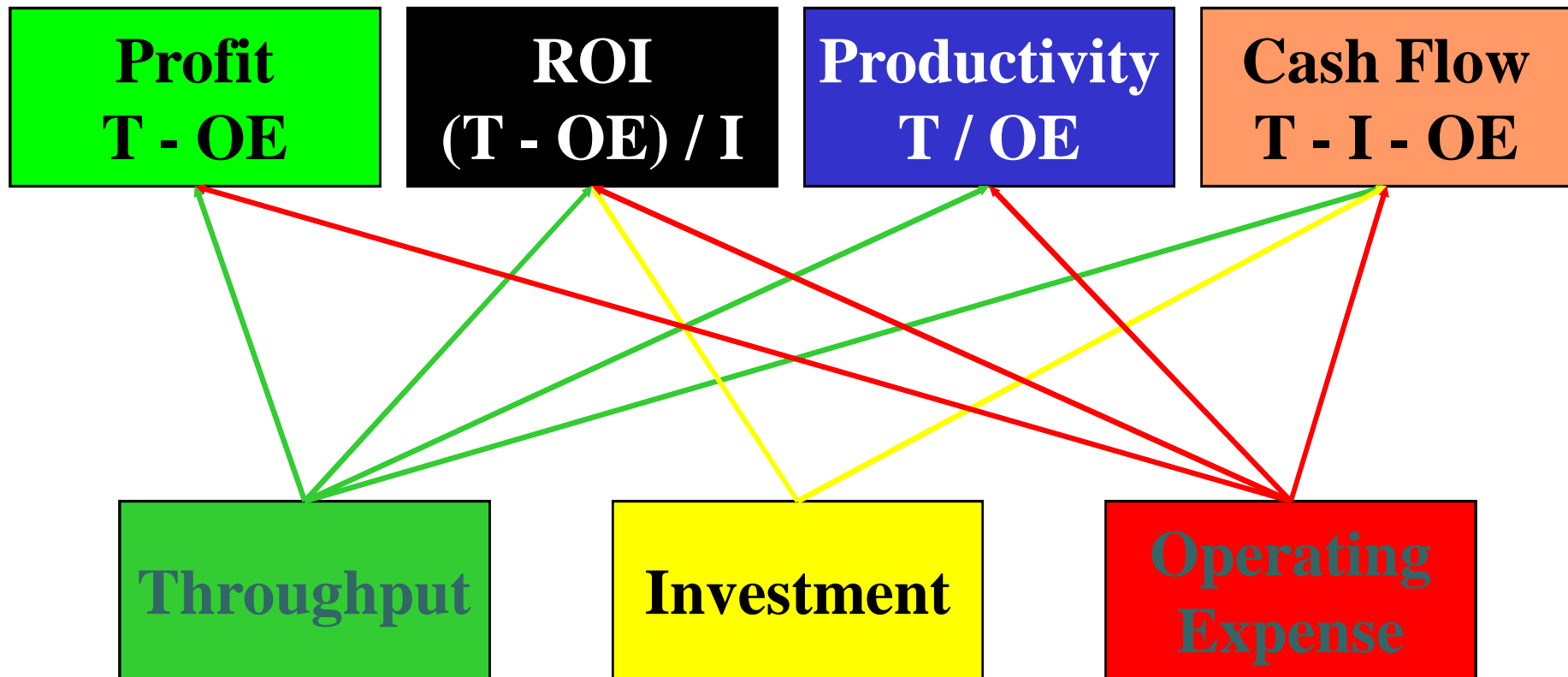
$$\text{Productivity} = T / OE$$



# Improving Our Organisation

- ☞ In order to improve our organisations in terms of the Prime Financial Measurements we aim to:
  - | Increase Profits
  - | Increase Return on Investment
  - | Increase Productivity
  - | Increase Cash Flow
- ☞ But in order to do that there are many things that we can do.
  - | Increase sales (Throughput),
  - | Decrease investment,
  - | Decrease operating expenses, etc
- ☞ We would like to have some way to focus our efforts through prioritising the alternatives.

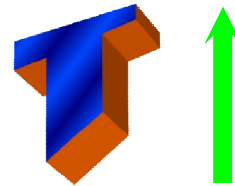
# Importance of T, I and OE in the Primary Measurements



# Throughput (T), Investment (I) & Operating Expense (OE)

- ⌘ We do not believe that anyone would disagree that for an organisation to be effective at reaching its Goal as measured by the Primary TA Measurements, the organisation must be good at:

- ¶ **Increasing Throughput,**



- **Reducing, at least in relative terms, the Investment in the organisation, and**



- **Reducing, again at least in relative terms, the Operating Expenses of the organisation.**





# T and OE – which is number 1?

- ⌚ It would appear that Throughput and Operating Expense have equal effect on the Primary Measurements, however let's honestly answer these questions:
  - ⌚ By how much can you cut costs?
    - | To Zero and then you do not have a business!
  - ⌚ By how much can you grow Throughput?
    - | Effectively, by an infinite amount!
- ⌚ This would appear to support our theory of exploiting and elevating the constraint in order to maximise flow.

# New measures relate to old

☞ PROFIT = T - OE

☞ ROI = (T - OE) / I

☞ *If we concentrated on improving just one measure to increase profit and ROI, we would want:*

- | Operating Expense(OE) to go

  - | DOWN

- | Inventory(I) to go

  - | DOWN

- | Throughput(T) to go

  - | UP



# Limitations

- ⌘ Of the three measures (T, I and OE), only THROUGHPUT can continually be moved in a direction that will result in increased PROFIT and ROI.
- ⌘ Yet, when a company is not making enough money (or losing too much money) and a new leader is appointed, which measure is typically targeted for change?
- ⌘ Operating Expense



# Today's Reality

- ⌘ It is easier in the short term to cut operating expense than to increase throughput.
- ⌘ Throughput is the result of everyone in the company working together to successfully deliver a quality product on time that some one is willing to pay for.
- ⌘ It is easier to “point and shoot” than to get everyone working together more successfully.



# Long Term Thinking

- ⌘ Cost-cutting is only a short-term tactical expediency.
- ⌘ As a long term strategy, focusing on throughput is the best way to continually increase the profitability and health of a manufacturing company.
- ⌘ But can we think systemically in order to achieve this?



# Measuring performance

Changes to the measurement system  
when using the TOC approach for  
operations – Drum Buffer Rope (DBR)





# Key measurements reminder

- ⌘ 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



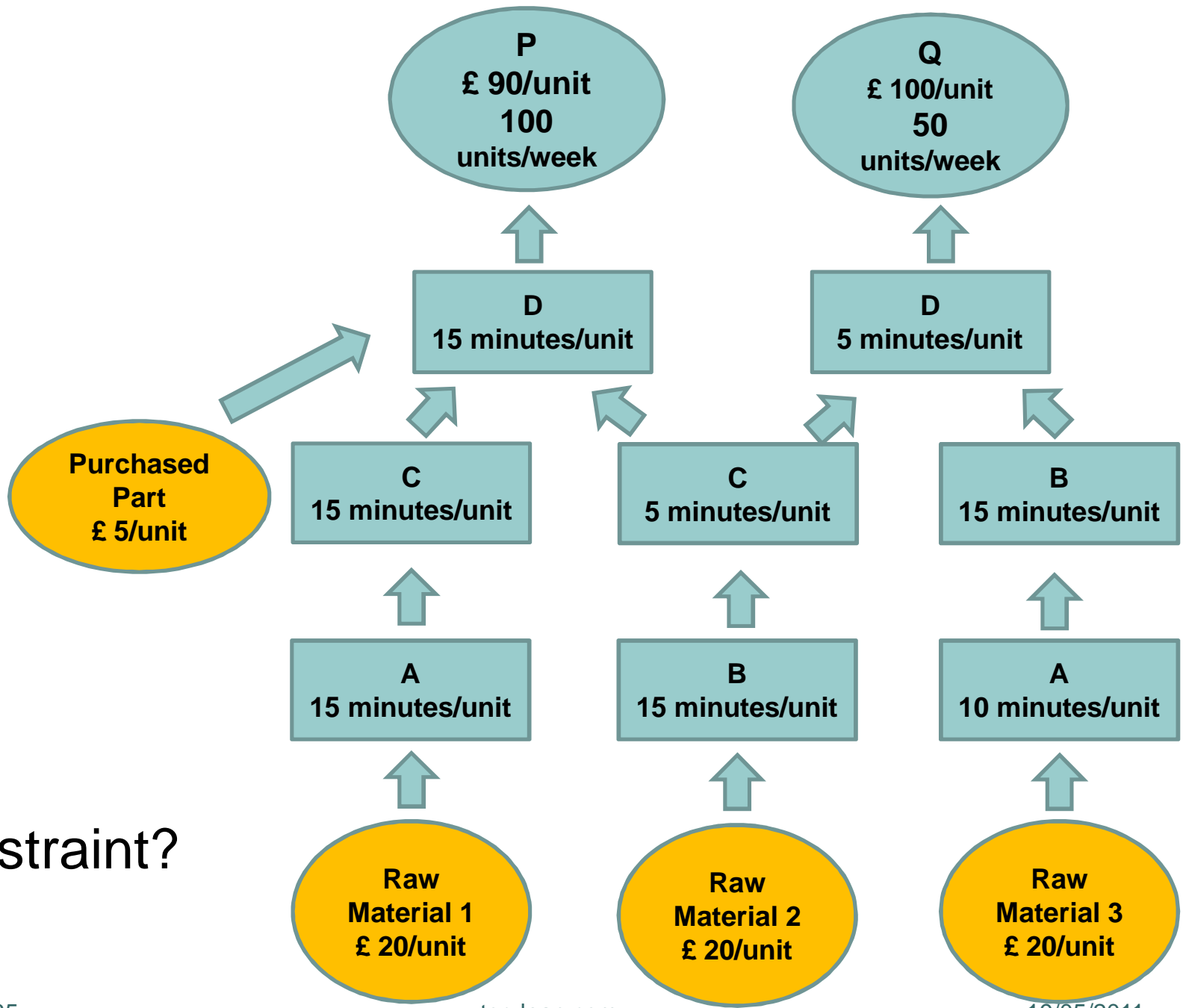
# Other Measurements

- ⌘ 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



# 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%
- ⌘ I – Investment – controlled
- ⌘ OE – Operating expense – controlled
- ⌘ T – Throughput (sales-raw material) - increased



# Cash Constraint?



# The basic parameters of the plant

- ⌚ The market demand for P is 100 units per week at a selling price of £ 90 per unit.
- ⌚ The market demand for Q is 50 units per week at a selling price of £ 100 per unit.
- ⌚ P is made by assembling one purchased component, one processed part from RM 1 and one processed part from RM2.
- ⌚ Q is made by assembling one processed part of RM 2 and one processed part of RM 3.
- ⌚ There are four workers in the plant
- ⌚ They work an 8 hour day and a five day week - without stopping!!
- ⌚ Operating expense for the plant per week is £ 6,000. This does not include any raw material purchased.
- ⌚ What is the maximum net profit (minimum loss) this company is capable of earning per week?



# Review

- ⌘ Throughput is a powerful measure of the contribution toward profit of a job or product.
- ⌘ Knowing where the bottleneck is going to be is a powerful piece of information. It helps qualify decisions that can impact the company profit.
- ⌘ “Throughput per bottleneck minute” is powerful because it tells us the relative contribution toward profit of a job or product.



# Questions?



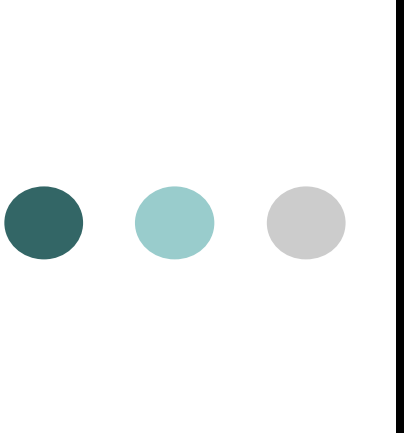
# Book list for further reading

- ☞ 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



# How to contact me

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# Appendices

# Calculating Throughput

- ⌘ We defined Throughput as Sales Revenue less Raw Material cost ( $T = Sr - RMc$ ).
- ⌘ What we are effectively saying is:
  - | Sales Revenue is Net Sales after all directly variable selling expenses such as commissions, packaging materials, shipping costs etc., and
  - | Raw Material cost is limited to only those costs which are absolutely, totally, 100%, directly variable with the quantity of services or products produced/sold . If you produce one more unit then the cost increases by one unit. If you do not produce a single unit there is no cost at all.
- ⌘ Raw Material costs do not include costs such as labour, unless labour is paid per piece.



# Calculating Operating Expenses

- ⌘ Operating expenses are all those period costs such as labour/wages, salaries, stationery, lubricants, power, fuel, transport etc., which although they may fluctuate to some degree with the level of activity, are by and large fixed period costs, at least in the short term.
- ⌘ Operating expenses include both cash items such as wages etc., and non cash items such as depreciation, bad debt provisions etc.



# Results of using the TOC approach – Three Case Studies

- ☞ Toyota Gosei Fluid Systems
- ☞ Delta Airlines
- ☞ US DoD



# Toyoda Gosei Fluid Systems

- ☪ Productivity increased by 20%
- ☪ Lead time down from 4 weeks to 2 days
- ☪ Response to Customer demand Pull within 1 hour of pull signal
- ☪ 100% on time delivery performance with less than 24 hours notice of pull signal
- ☪ Quality level down to 3 PPM (parts per million) reject level



# Delta Airlines

- ☪ Ran a 6-Sigma Programme (1999/2000)
- ☪ Could not service their own Delta internal demand for Engine repair/overhaul
- ☪ Delta went into Chapter 11 Bankruptcy
- ☪ In 2005 started with TOC
- ☪ Productivity up 25%
- ☪ Volume up 50%
- ☪ Costs down by 3%



# US Dept of Defense

- ⌘ Being applied over all Maintenance and Repair Operations (fixing the equipment)
- ⌘ Typical Productivity Gains – 25% to 40%
- ⌘ Equipment in for Maintenance down by as much as 50%
- ⌘ Around \$20 Billion of Equipment put back into service which would normally have been in for repair