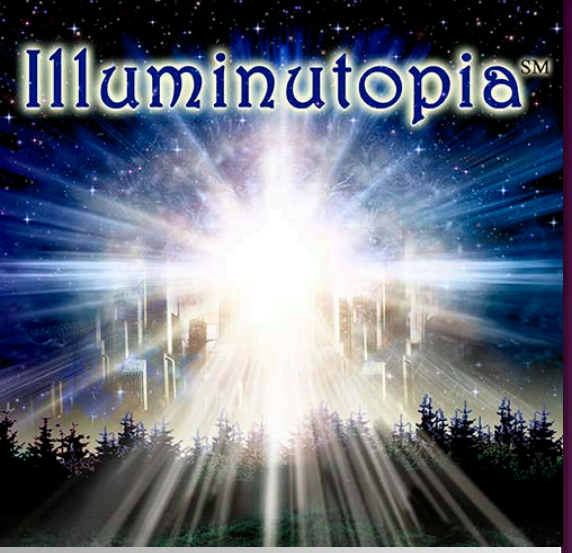

0 TO 60
INTRO TO OPERATIONS

TOCICO WEBINAR

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FIVE FOCUSING STEPS

1. Identify the system's constraint(s)
2. Decide how to exploit the system's constraint(s)
3. Subordinate everything else to the above decision
4. Elevate the system's constraint(s)
5. If in the previous steps a constraint has been broken, go back to step 1. Warning: do not allow inertia to cause a system's constraint.

1. IDENTIFY THE SYSTEM'S CONSTRAINT(S)

- The constraint is the weakest link in the chain, the factor that most limits throughput (T), the rate at which the organization generates 'goal units'
- Examples:
  - Supplies of raw materials
  - Person, department or machine
  - Market

2. EXPLOIT THE SYSTEM'S CONSTRAINT(S)

- Strengthen the weakest link by better using what is available (before providing more of what is lacking since this usually costs money)
- For example, make sure the resource's (i.e. machine) capacity is best utilized to generate T (working on the right things in the right sequence)

3. SUBORDINATE EVERYTHING ELSE TO THE ABOVE DECISION

Two different elements:

1. We should manage all non-constraint resources in a way that ensures that we can follow our decision to exploit our constraint (in order to protect throughput)
2. We should manage all non-constraint resources in a way that ensures they do not do more than is required for the constraint (in order to control costs)

4. ELEVATE THE SYSTEM'S CONSTRAINT(S)

- Strengthening the weakest link could be done by increasing its capacity (e.g. hiring more people, buying a new machine) elevating its performance to a higher level
- This is done in the fourth stage because
  - it usually involves a high cost
  - often exploitation of the constraint is sufficient

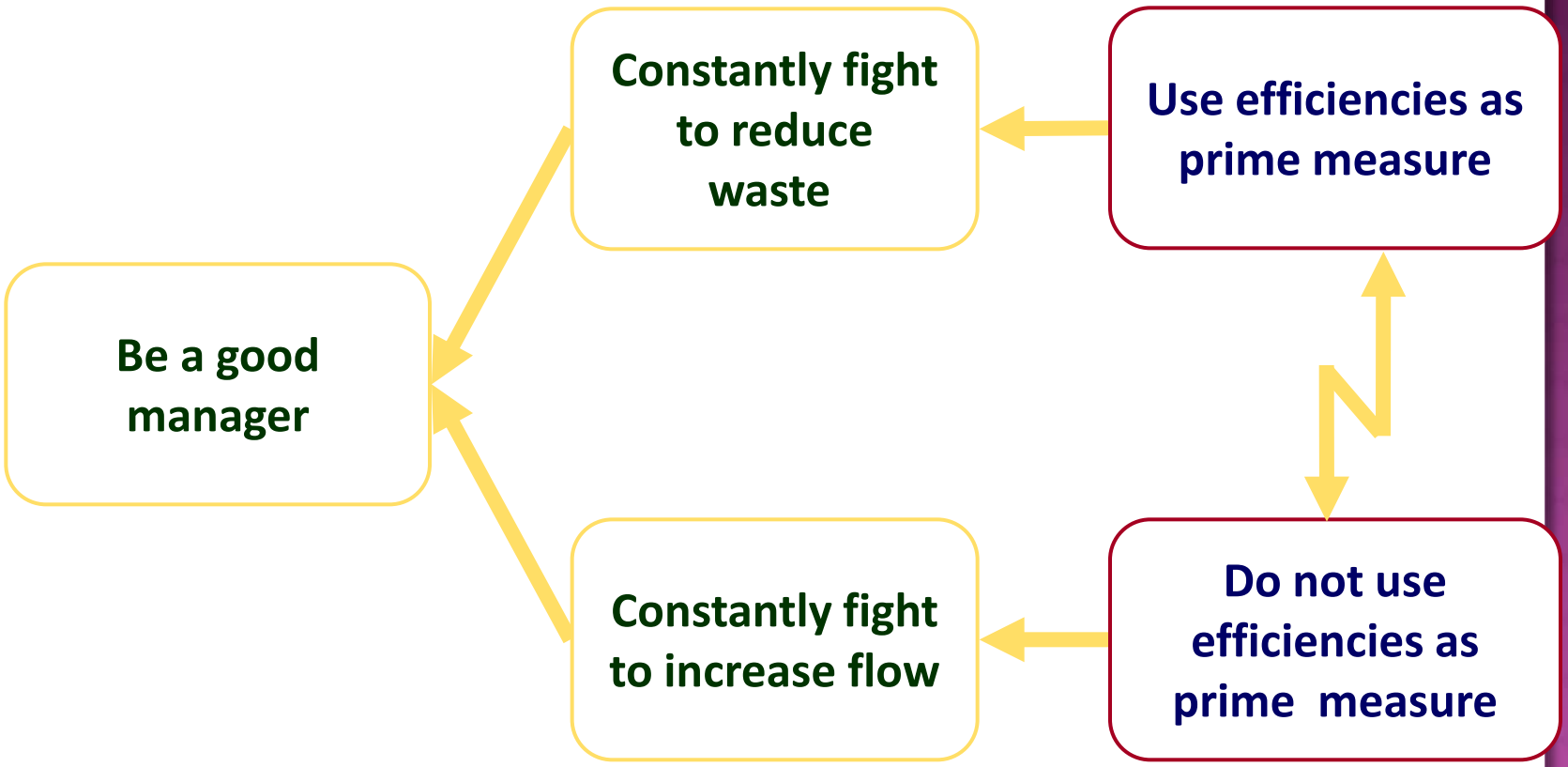
STEP 5 IF IN THE PREVIOUS STEPS, A CONSTRAINT HAS BEEN BROKEN, GO BACK TO STEP 1

- By strengthening a weakest link, it may not be the weakest link anymore
- We need to identify the new weakest link and re-examine all decisions regarding exploitation and subordination
- When the constraint shifts, a re-orientation of the entire company is required

ARE THESE COMPLAINTS TYPICAL?

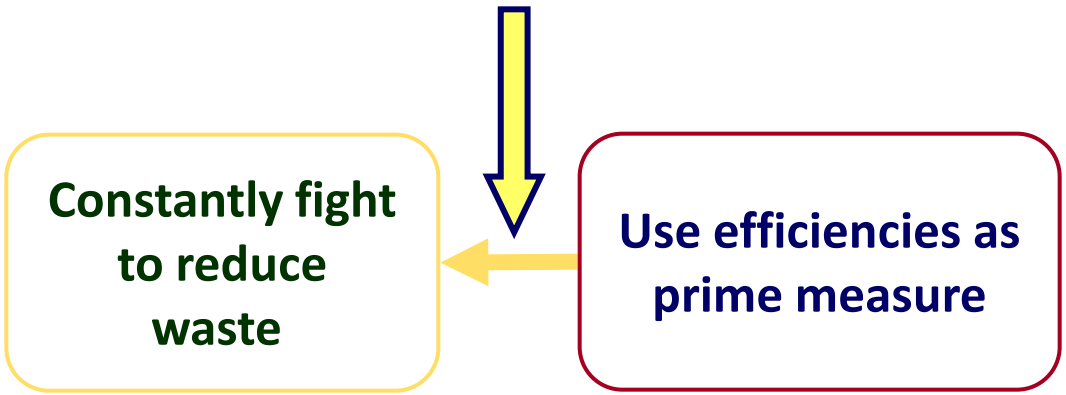
- Poor due-date performance
- Long lead times
- Too high inventories
- Long pay-back period
- Too many customer complaints
- Bad human relationships

CORE CONFLICT



THE ERRONEOUS ASSUMPTION (THE BLOCKING FACT)

A resource standing idle is a major waste



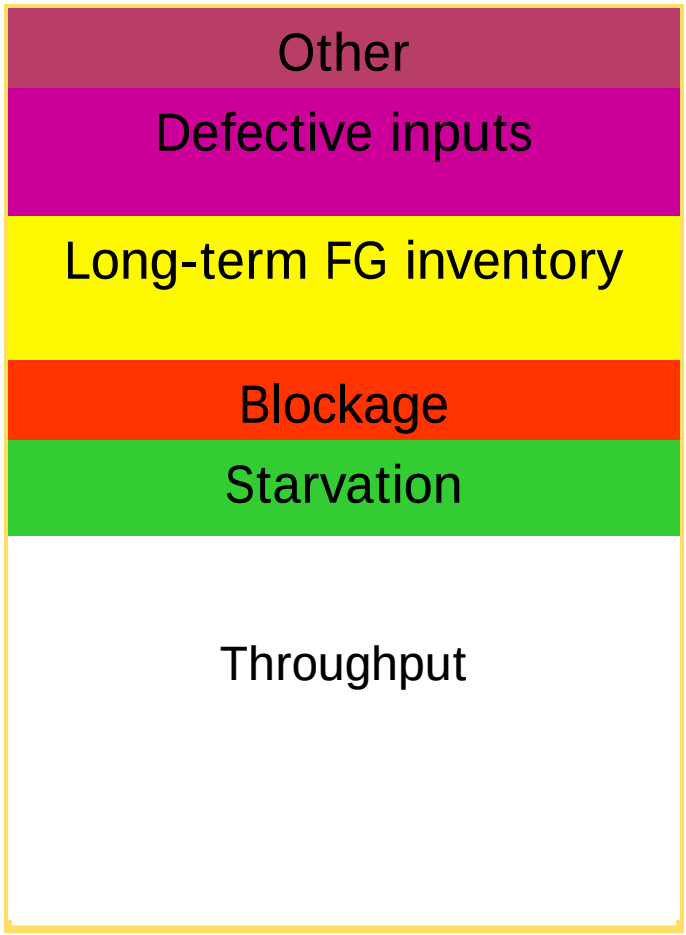
CRITERIA REQUIRED TO JUDGE ANY SOLUTION

- Significantly reduce (not increase) waste
- Significantly improve flow (throughput)
- Significantly improve DDP
- Significantly shorten production lead-time
- Expose significant excess capacity
- Enhance the effectiveness of improvement projects

HOW DO WE MANAGE OPERATIONS?

- Due to the lack the relevant data about the flow in the supply chain, we focused on ensuring that each resource (i.e. employee or machine) was productive.
- To do so, we ensured that resources were not idle and took actions to improve their productivity.
- As a result, resources may
  - pull ahead work that is faster to do
  - increase batch sizes to reduce setup times or costs and increase productivity (either by filling some orders earlier than planned and/or producing for finished good inventory)
  - sacrifice quality for speed
- Impact: increase in work in progress, missed due dates and long lead times.

Constraint/CCR Capacity



100%

50%

More/other reasons for lost capacity:

Setup

Planned maintenance

Breakdown

Non-value added time

Work that other resources can do

DRUM-BUFFER-ROPE

- Drum: schedule of work based on the constraint/CCR capacity and due dates
- Buffer: time needed to ensure that the due date is met and the constraint/CCR is not starved for work
- Rope: determines the release schedule of work
  - Scheduled time on CCR – buffer time, or
  - Due date to customer – buffer time (for work not processed by the constraint)

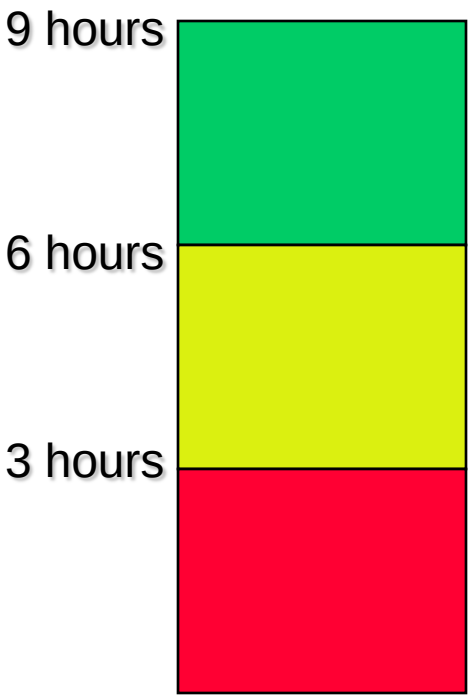
BUFFER TYPES

- Supply: ensure supplies/inputs arrive on time
- Constraint/Capacity Constraint Resource (CCR): ensure critical resource is kept busy since it determines throughput
- Assembly/Integration: Units processed on constraint/CCR do not wait to be completed after constraint/CCR (ensures flow)
- Shipping (Finished goods): protect due date from variability at or after constraint/CCR or entire process if unit is not processed by a constraint/CCR

BUFFER TYPES

- Space: placed directly after the constraint/CCR to ensure it is not blocked by problems downstream
- Time: Protect the throughput (due date and constraint/CCR) from internal issues
- Inventory/Stock: Stock is held as WIP or FG if the customer tolerance time is less than the processing lead time

BUFFER MANAGEMENT



The buffer is divided into three equal zones, thus dictating actions when there are holes:

Green: no action needed

Yellow: watch and plan

Red: expedite (this should not happen more than 5% of the time)

Resize the buffer as needed

Investigate and fix causes of buffer holes

4:11	Choking the Release
Necessary assumptions	Having too many orders on the shop floor masks priorities, promotes local optima behavior and therefore prolongs the lead-time and significantly disrupts due-date-performance (DDP).
Strategy	The shop floor is populated ONLY with orders that have to be filled within a predefined horizon.
Parallel assumptions	➢ In traditionally run plants touch time is a very small fraction (<10%) of the lead time. ➢ Vast experience shows that, in traditionally run plants, restricting the release of materials, to be just half the current lead time before the corresponding due date, leads only to good results and to no negative ramifications* (lead time shrinks to less than half, DDP improves considerably, throughput goes up and excess capacity is revealed). These results are achieved irrespective of whether or not a bottleneck exists. * *Except for environments which are dominated by heavily dependent set-up matrixes. Those environments have to be dealt in a different way.*
Tactic	For each product family, a buffer time is set to be equal to 50% of the current lead-time. Orders are released to the floor only buffer time before their committed due-date (excessive WIP is frozen until its time arrives according to the above rule). Sales people are **forbidden** from using the shorter lead times to get more sales.

4:12	Managing the priorities
Necessary assumptions	Hectic priorities (hot, red-hot and do-it-NOW) cause chaos on the floor. Even when material release is properly choked, not having a priority system can cause some orders to still be late.
Strategy	The shop floor is governed by a simple, yet robust, priority system.
Parallel assumptions	Vast experience has shown that Buffer Management* is a robust priority system that leads to even better DDP. **BM is setting priorities (three color code system) only according to the degree the buffer-time is consumed.*
Tactic	Buffer Management is the ONLY priority system used on the shop floor.

4:13	Dealing with CCR's
Necessary assumptions	In many plants there are Capacity Constraint Resources (CCR's) that prevent the attainment of 99% DDP.
Strategy	Orders are shipped on time (over 99%).
Parallel assumptions	➢ If a CCR exists work-in-process piles up in front of it. When materials release is restricted, the only work centers that have work-in-process piling up in front of them are the CCR's. ➢ In most of the cases additional capacity can be exposed by simple means like: - Ensuring that CCR's do not take lunch or shift-change breaks, - Offloading work from the CCR's to less "effective" work centers that have ample excess capacity, - Using LEAN techniques to shrink the set-up time on the CCR's, - Giving overtime approval for the CCR's, etc. *Note – In most cases the steps taken so far will be sufficient to prevent the CCR's from jeopardizing DDP, in those rare environments where CCR's still exist synchronizing sales with operations is essential, see step number 3:4*
Tactic	CCR's are identified and effectively removed. When DDP>99% is achieved, for a period of time equal to the production buffer time, the green light is given to sales. To prevent remerging of CCR's it is essential to move rapidly to implement step 3.4.

5FS APPLIED TO OPERATIONS

Identify the System's Constraint(s)

The constraint is the internal resource in operations that does not have enough capacity to meet demand or peak demand. (CCR)

Decide How to Exploit the System's Constraint(s)

Ensure the constraint's time is not wasted and that its time is used to generate more "goal units".

- The constraint only processes quality (non-defective) inputs.
- The constraint processes work that will generate short-term T.
- Reduce total setup time at the constraint (SMED, batches).
- Ensure that the constraint does not process work that could be completed by another resource.
- A space buffer is placed after the constraint to allow it to produce (prevent blockage).
- The constraint is not starved for work (adequately supplied).

5FS APPLIED TO OPERATIONS

Subordinate Everything Else to the Above Decision

- Reduce total setup time at the non-constraints that are close to becoming constraints.
- Resources providing inputs to the constraint keep it adequately supplied with work (ensuring that starvation does not occur or too much WIP).
- Work processed by the constraint does not wait to be completed to generate throughput.
- Cut batch sizes in half at non-constraints.
- The buffers protect timely completion of the work.
- Protective capacity is provided at non-constraints to keep the constraint supplied and process work after the constraint.

Elevate the System's Constraint(s) by further increasing the capacity of the constraint by hiring/buying more capacity.

If in the previous steps, a constraint has been broken, go back to step 1.

DBR AND BUFFER MANAGEMENT

- Implement synchronized processing of work using DBR
- Manage the buffers
- Focus improvement efforts at the resources that cause the most holes in the buffers
- Reduce buffer size
- Modification of other details for VATI

KEY INSIGHTS

- Throughput lost at the bottleneck is throughput lost for the entire system.
- Focusing on achieving efficiency everywhere can actual hurt throughput of the bottleneck (i.e. processing parts not needed for short-term throughput, processing defective inputs, starvation and blockage)
- Increasing non-productive time (idle time or increased number of setups) at the non-bottlenecks can help increase flow by reducing the processing lead time

KEY INSIGHTS (CONT'D)

- Statistical fluctuations (variability) at processing steps do not average out in operations because the processing steps are dependent
- We can provide sufficient protection in buffers (strategic placement of safety) to ensure due dates are met
- Buffer management provides us with an effective mechanism for knowing when corrective action is needed and helps us to identity the cause of the buffer consumption to take action to ensure the cause is addressed (prevent future problems)

TYPICAL DBR RESULTS

- Significantly reduced Processing Lead Time
- Increased Throughput significantly using the same resources (due to improved utilization of our capability/capacity)
- Significantly improved quality
- Much less expediting (only when required by Buffer Management)
- Improved employee satisfaction due to less stress and more empowerment
- WIP typically reduced significantly (FG inventory is usually reduced as well)
- Improved due date performance

ABOUT THE PRESENTER

Lisa A. Ferguson, PhD, is the founder and CEO of Illuminutopia, an organization that is focused on "Illuminating the way to utopia for individuals, organizations and society" (www.illuminutopia.com). Dr. Ferguson is the author of the chapter on Strategy and Tactic trees in the *Theory of Constraints Handbook*. Professor Ferguson has taught several programs on how to write S&T trees. She is currently working on completing her book on writing S&T trees, which will be published in 2013. Until June 2008, Dr. Ferguson spent a year working one-on-one with Dr. Eli Goldratt, the founder of the Theory of Constraints (TOC), while learning how to write. Professor Ferguson has trained TOC Experts and Supply Chain Logistics implementers in India, Japan and the U.S. as a faculty member of Goldratt Schools. Professor Ferguson has a PhD in Business (in Operations Management) and an MBA. Dr. Ferguson taught operations management full-time at a university for 10 years. Dr. Ferguson was a TOCICO board member from 2008 to 2011 and is TOCICO certified in Supply Chain Logistics, the Thinking Processes and Critical Chain Project Management.