It’s just common sense, right? So why is it so uncommon?

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The theory of constraints (TOC)

- Originator: Dr. Eliyahu Goldratt (1947-2011)
- Origins in the hard sciences (physics)
- Aims to continually achieve more of the goal of a system
Five Focusing Steps (5FS)

1. **IDENTIFY** the system’s constraint(s)
2. **Decide** how to **EXPLOIT** the system’s constraint(s)
3. **SUBORDINATE** everything else to the above decisions.
4. **ELEVATE** the system’s constraints.
5. If the constraint has been broken, **GO BACK** to step 1

*A Process of Ongoing Improvement*
Manufacturing
Cutting

Printing

Sewing

Finishing
Step 1. **Identify** the system’s constraint
Step 2: **Decide how to Exploit** the Constraint

- Use constraint effectively
  - make the right products
  - most efficiently

So...

- Avoid wasting time on the constraint
- Make only what’s needed
Step 3: **Subordinate** everything else to those decisions

- Borrow workers from elsewhere
- Set up ‘off line’

- Make sure Cutting cuts only to customer demand
Step 4: **Elevate** the constraint

- No big investment – just some custom made racks!

Step 5: **Go back** to Step 1

- Do not let inertia become the system constraint!
Second constraint: sewing
And then ...

After

1. printing
2. sewing

tackled the next constraints in turn:

3. inventory
4. marketing
5. cut planning
6. quality .....
After applying 5FS at Expozay

- Sales up 80% in 3 years
- Inventory down 13% in 8 mths
  - WIP down from 30k to 4k
- Operating expenses steady

- Quality, flexibility, responsiveness, and due date performance all improved
- Faster quotes for delivery dates

“Chaos was replaced by order”
Tony Alvos, Managing Director, Expozay International.
Key lessons from The Goal

A chain is only as strong as its weakest link!
Gould’s Fine Foods

• **Situation:**
  - Two product lines:  
    Sausages and Hams
  - Shared production resources
  - Couldn’t meet demand
  - High unplanned overtime
Process Flowchart

Raw Materials

Mixing Ham

Mixing Sausage

Filling

Cooking

Chilling

Pack and Despatch

Demands:

Ham (1000 kg batch): 8

Sausage (350 kg batch): 20 (batches/wk)
How to set priorities?

• TOC Product Mix Heuristic

<table>
<thead>
<tr>
<th></th>
<th>Hams</th>
<th>Sausages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Profit</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Time on Constraint (Filler hrs/batch)</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td><strong>Gross Profit per Constraint Hour</strong></td>
<td>$\frac{6}{8} = 0.75$</td>
<td>1</td>
</tr>
</tbody>
</table>
Goulds Fine Foods - Results

Results

• Improved productivity:
  • Throughput improved by 70%
  • Unplanned overtime slashed
• Allowed Goulds to supply the market demand and increase profits without extra staff or capital

Research spinoffs

Synergies between Linear Programming and TOC’s 5 Focusing Steps
Impacts of applying The Goal and 5FS Evidence from the international literature

- Published papers and books up to late 1990’s
- 100 case studies, no failures reported
- Large measurable improvements from TOC
  - (better than from other methods)
  - eg 75% reduction in Lead time, 50% in Inventory!
Improvements using TOC (Medians)

- Revenue Increase: 39%
- Lead Time Reduction: 75%
- Due Date Performance Improvement: 50%
- Cycle Time Reduction: 66%
- Throughput Increase: 65%
- Inventory Reduction: 50%
- Profitability Increase: 100%
Impacts of applying The Goal and 5FS
Evidence from the international literature

**Observations:**

- Some BIG companies achieved BIG results
- Having already used other methods
- Worth sharing?!
- Most applications used only part of TOC
TOC Thinking Processes
It’s Not Luck

• How to develop solutions

• Via a change process...
Key Questions to Guide Change ... ... and TOC Thinking Tools

1. Why change?
   - Goal Tree
   - Lists of Undesirable Effects

2. What to change?
   - Current Reality Tree
   - Evaporating Cloud

3. What to change to?
   - Evaporating Cloud
   - Future Reality Tree
   - Negative Branch Reservation

4. How to cause the change?
   - Prerequisite Tree/ IO Map
   - Transition Tree
   - Strategy & Tactics Tree

5. How to sustain the change?
   - Using the right measures;
   - Repeat?
Simplicity in complexity

“*The whole is greater than the sum of its parts*”
Some Local Applications of the Thinking Processes

- Banking
  - “TOC provided framework and tool kit to help manage and lead a major bank merger, harnessing resistance to change” Steve Forgeson, Area Manager, Westpac

- Manufacturing:
  - “Led to fundamental shift in the way we think, unlocked potential we never realised we had.” Lawrie Evans, Managing Director, Astra Print
  - Milk products (Fonterra)

- Regulatory issues: electricity, telecoms, education
- Resource management: water, biofuels
- Health: Hospitals, elder care, smoking, ...
- Distribution networks
- Projects
Water
– the case of Kāpiti district

• Finding a solution using TOC’s Evaporating Cloud

Ensure secure water supply

Have sufficient water to meet demand

Invest in more storage capacity

Live within our means

Not invest in storage capacity
Managers want to adopt new method of data verification in new EHR.

Clinicians want to retain current method of data verification in the EHR.

Clinicians must have 100% accurate patient information.

Managers want to adopt new method of data verification in new EHR.

The Hospital must operate efficiently & provide quality patient care.

Managers must have new EHR on time & within budget.

Doctors must make treatment decisions that exceed contract volumes.

Doctors must schedule appointments.

The Hospital must deliver the best treatment for patients.

UDE: the over-delivery of services that are not funded.

Nurses must only provide treatment within contract volumes.

Doctors must be able to demand how resources are allocated.

Management must allocate all resources.

Doctors must be able to demand how resources are allocated.

Nurses are well trained and work within resources.

Clinicians must have 100% accurate patient information.

The Hospital must operate efficiently & provide quality patient care.

The Hospital must deliver the best treatment for patients.

UDE: the over-delivery of services that are not funded.

Pharmacy must respond quickly to demands

Pharmacy staff must be prioritised to work in production unit.

Hospital pharmacy must provide timely and excellent service to all patients.

Pharmacy staff must be rostered in medicines information.

UDE: bottlenecks in pharmacy production, high workloads causing staff dissatisfaction

Pharmacy staff must have job satisfaction.

Doctors must make treatment decisions that exceed contract volumes.

Doctors must schedule appointments.

The Hospital must deliver the best treatment for patients.

UDE: clinicians do not support new verification system.

Managers must have new EHR on time & within budget.

Managers want to adopt new method of data verification in new EHR.

The Hospital must operate efficiently & provide quality patient care.

Clinicians must have 100% accurate patient information.

The Hospital must provide best treatment outcomes for patients.

The Hospital must provide best quality care.

The hospital must provide best quality care.

The hospital must operate within its resources.

The hospital must provide best quality care.

Combined Evaporating Cloud

Healthcare – hospital

Individual Evaporating Cloud

UDE: The Hospital does not consistently deliver best quality care.

UDE: the over-delivery of services that are not funded.

UDE: bottlenecks in pharmacy production, high workloads causing staff dissatisfaction

UDE: clinicians do not support new verification system.
What to change?
- core conflict

The hospital must provide best quality care

Doctors must provide best treatment outcomes for patients.

DOCTORS must decide how resources are allocated.

The hospital must operate within its resources.

MANAGEMENT must allocate all resources.
Back in the hospital pharmacy

Problem symptoms:

• Long **waiting times** for patients in cancer centre
• Fluctuating workload
  • Idle time and **overtime**
• Increasing **stress levels** for staff
Problematic situation

Dr writes prescription

If OK – Dr confirms prescription

Pharmacy makes drugs

Deliver to Patient

Wait for blood test results

Nurse overtime

Nurses busy with waiting patients

Long wait times

Large queue
What to change to? *Pilot solution*

- Dr writes prescription
- Pharmacy makes drugs *immediately*
- Check blood test results
- Deliver to Patient
- Minimal wait times
- Short queue
- Nurse workload ↓
Impact on Waiting Times

Average Overall Patient Waiting Times Pre and Post Project

Pre Project (n = 62) | Post Project (n = 14)
129 mins | 20 mins
Impact on Staff Overtime

- **Nursing staff**: Pre Project 61 mins, Post Project 22.8 mins
- **Pharmacist**: Pre Project 8.5 mins, Post Project 8.5 mins
- **Technician**: Pre Project 8.5 mins, Post Project 0 mins
- **Assistant**: Pre Project 0.5 mins, Post Project 0 mins
Impact on Wastage Cost (% Total Expenditure)

- Pre Pilot: 0%
- Pilot: 4%
- Confirmation of high cost drugs: 2%
- Two Tier Confirmation: 1%
What to change to? *Win-win solution*

Dr writes prescription

Pharmacy makes **Low cost High volume drugs immediately**

Pharmacy waits for Confirmation for **High cost, low volume drugs**

Wait for blood test results

Check blood test results

Minimal wait times

Short queue

Nurse workload ↓

Deliver to Patient

☺

☺
Education

• TOC for Education – worldwide movement
• At Victoria:
  • Setting up ‘Assurance of Learning’ processes
  • Designing and implementing new policies/operations
  • Regulatory issues: tuition fees/institutional funding
  • Strategic issues: inter-school organisational structure
  • Improving student research thesis completion
  • Improving teaching and learning experiences
An Academic’s Dilemma?

Key Questions:

• How can we spend more time on teaching AND publish good articles?
• How can we spend more time on research AND have a satisfying teaching experience?
Goldratt’s tenets

"I smile and start to count on my fingers:

1. people are good
2. every conflict can be removed
3. every situation, no matter how complex it initially looks, is exceedingly simple
4. every situation can be substantially improved; even the sky is not the limit
5. every person can reach a full life
6. there is always a win-win solution

Shall I continue to count?"

Further Reading

- Dettmer, The Logical Thinking Process
- Scheinkopf, Thinking for a change
- Yean, Thinking Smart
- Ronen, Focused operations management for ... health services organizations, Jossey Bass (2006)
- Papers on cases referred to in this talk available on request.