Theory of Constraints

NDTA – USTRANSCOM FALL MEETING 2018



Agenda

- Introduction to Theory of Constraints (TOC)
- 5 Focusing Steps
- Principles of Flow
- Case Studies



Theory Of Constraints

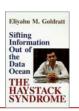


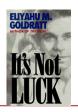
- Invented by Dr. Eliyahu Goldratt
- Aims to continually achieve more of the goal of a system
- Derived from the hard sciences (physics)

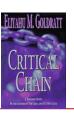
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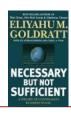


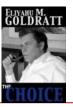














1970's

1980's

1990's

2000's

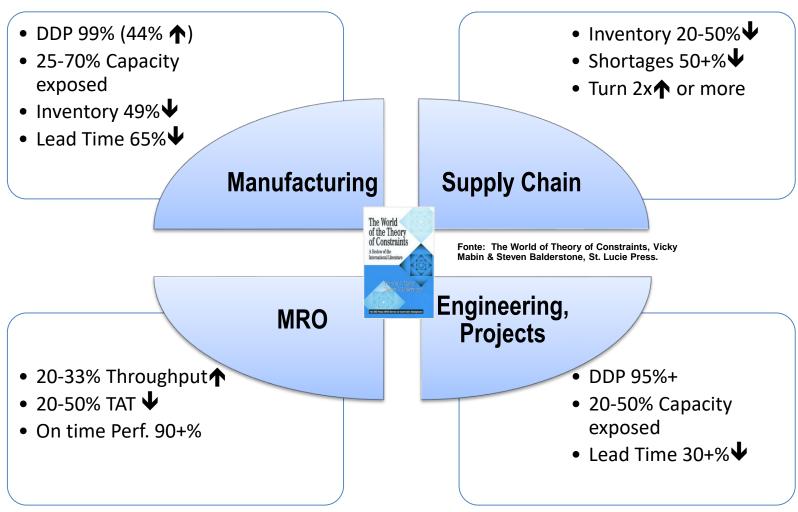
2010's

Supply Chains Distribution

Sales Projects & Strategy & Holistic Retail



Typical Results from TOC Implementations



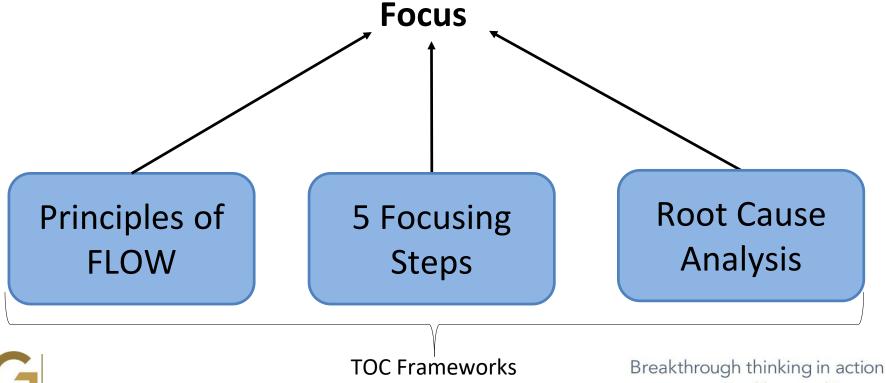


TOC = FOCUS

"If I'll need to choose one word to explain what TOC is all about it will be FOCUS."



Dr. Eli Goldratt

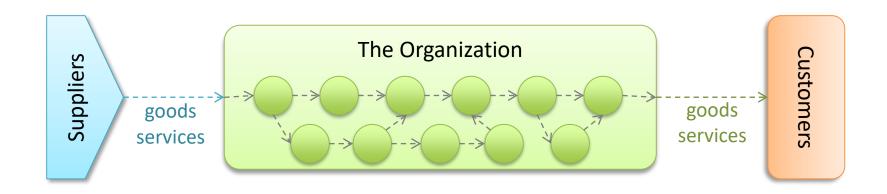




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Every Organization is a System...

.... With Dependencies & Variability



What limits the system's performance relative to its goal?



Constraint

The factor that limits a system's performance relative to its goal.

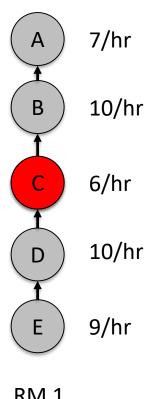


5 FOCUSING STEPS



Identify the constraint

- What is output of this factory?
- Which machine determines the output?



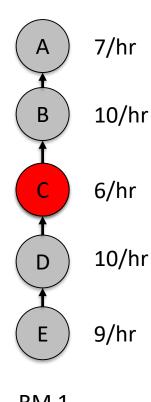
RM₁



Exploit the constraint?

Demand is 24 Red and 24 Blue

- What happens if the machine C breaks down?
- What happens if some other machine breaks down?
- Where should we test for quality?
- What happens if machine C produces only Red widgets?

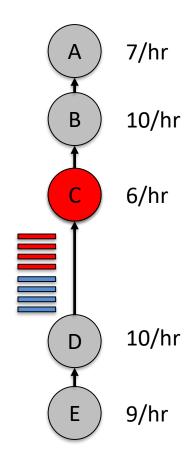


RM₁

Exploit the constraint?

Demand is 24 Red and 24 Blue

- How do we protect the constraint from disruptions?
- What else can we do to protect output at the constraint?
- What if demand is not fixed at 24 red and 24 blue?
 What if it is dynamic?



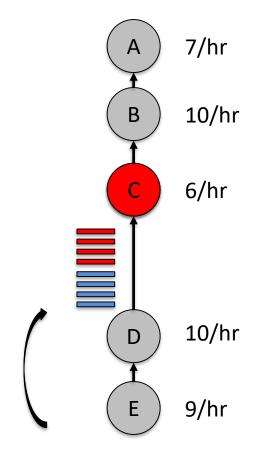
RM 1
Breakthrough thinking in action
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Subordinate to the Constraint

- What if E tries to produce 9/hr?
- What if D and B are measured to efficiency?
- How do we stop all other machines from "over" production?

Market Demand X Red, Y Blue



RM 1
Breakthrough thinking in action
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TOC's 5 Focusing Steps

- 1. Identify the constraint
- 2. Exploit the constraint
- 3. Subordinate everything else to the constraint
- 4. Elevate the constraint
- 5. Go back to Step 1 (don't allow Inertia to set in)



PRINCIPLES OF FLOW



TOC for Operations

Improving **FLOW** is the Primary Goal of Operations

Dr. Goldratt

TOC acknowledges that UNCERTAINTIES & VARIABILITY are intrinsic in all operations



Exercise

Α	1	\wedge
В	1 2	
С	3	
B C D	4	$\tilde{\wedge}$
E F	5	
F	6	
G	7	$\check{\wedge}$
Н	8	\Box
1	9	
J	10	$\check{\wedge}$
K	11	一
L M	12	$\overline{\bigcirc}$
M	13	$\check{\triangle}$
N	14	
0	15	$\overline{\bigcirc}$
N O P Q	16	\triangle
Q	17	
R	18	\bigcirc
S	19	\triangle
Т	20	
U	21	\bigcirc
V	22	\triangle
R S T U V W X Y	23	
X	24	\bigcirc
	25	\triangle
Z	26	

A B C D E F G H I J K L M	1	
N O	14	
P	16 <u>\(\tilde{\Delta} \)</u>	
Q	17 	
R	18 🔘	
S	19 🛆	
Т	20	
U	21	
V	22 <u>\(\times \) \(\times \)</u>	
W	23 🗀	
X	24	
Υ	25	
Z	²⁶ reakthrough thinking in action	1



Missed
Commitments
(Delays)

Tasks take longer, Productivity is low Pressure to Release work earlier to meet deadlines

OVER-PRODUCTION SPIRAL

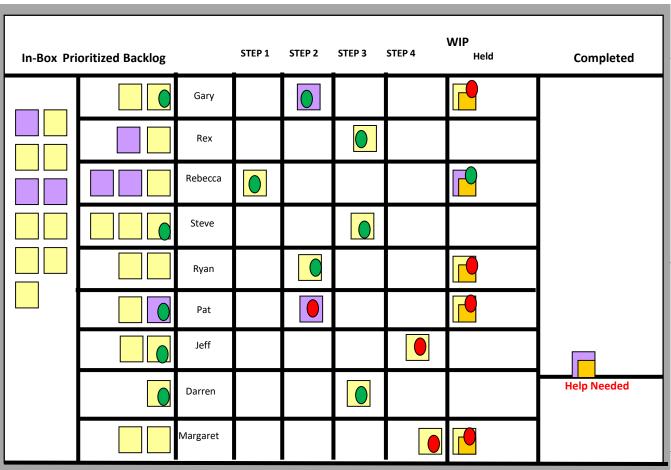
Priority juggling, multitasking, spreading thin

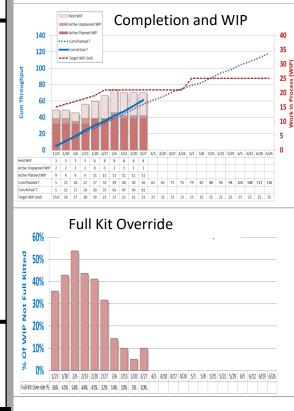
Work piles up & waits for resources



hinking in action

WIP Control





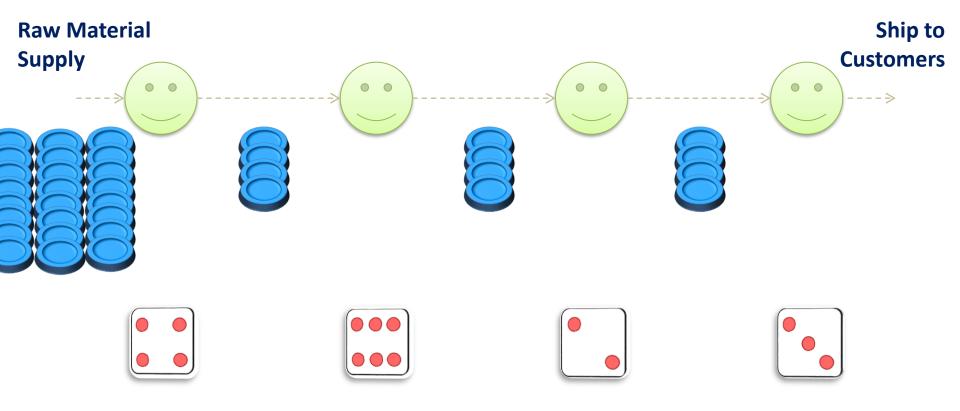


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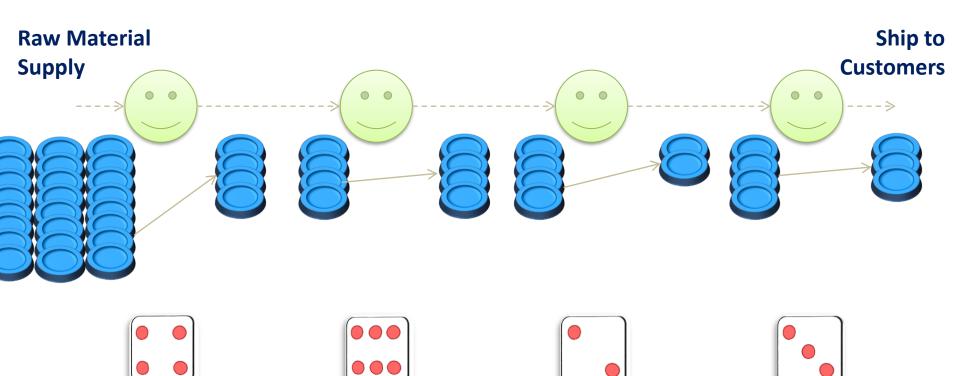
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Setup



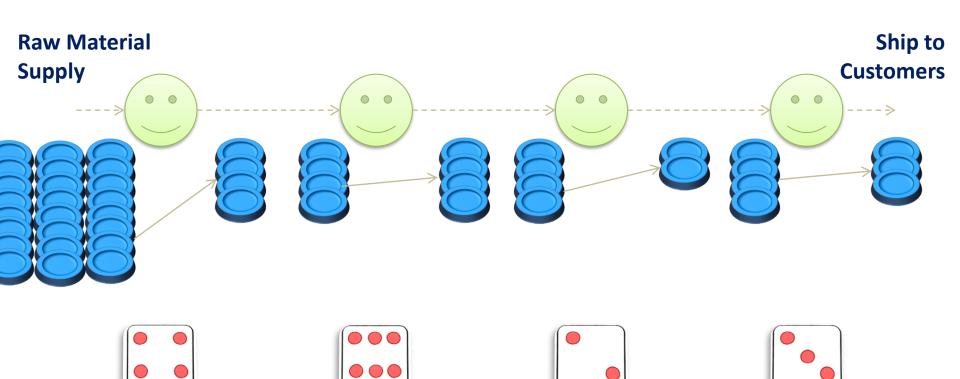


First Day Simulation



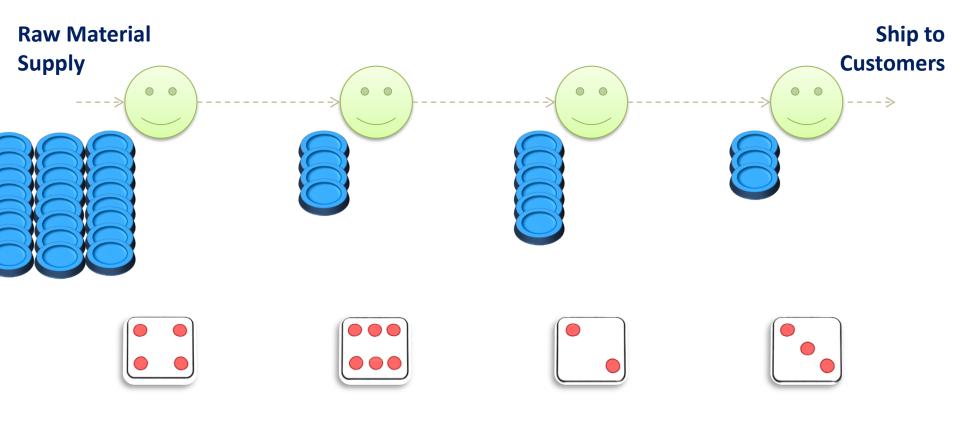


What Day One Looks Like "Real Time"





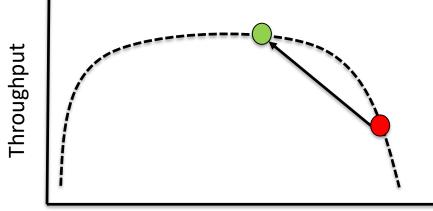
Beginning of Day 2





TOC's Principles of Flow

- Improving FLOW is a primary objective of operations.
- This primary objective should be translated into a practical mechanism that guides the operation when NOT to produce → (i.e. how to maintain Low WIP)
- Local efficiencies must be abolished
- A focusing process to balance flow must be in place

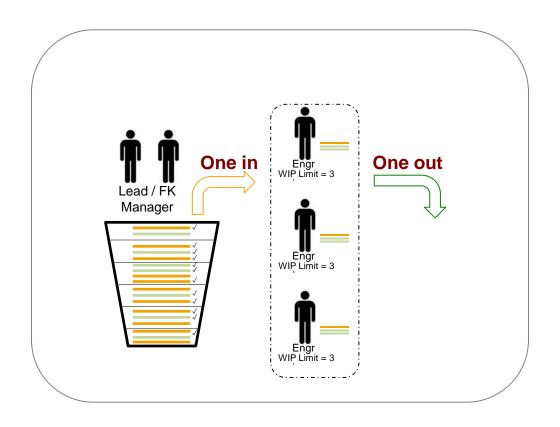


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Backup

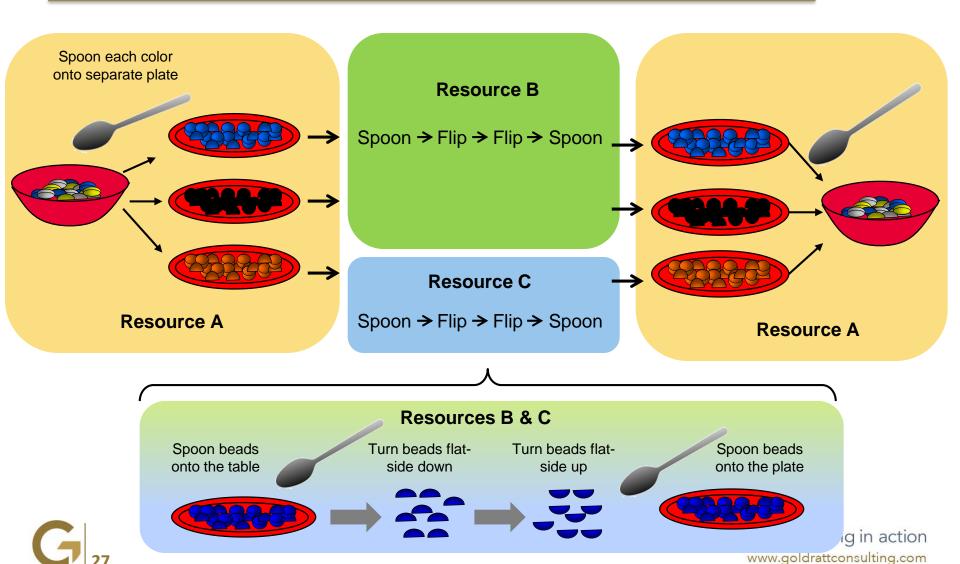


WIP Control



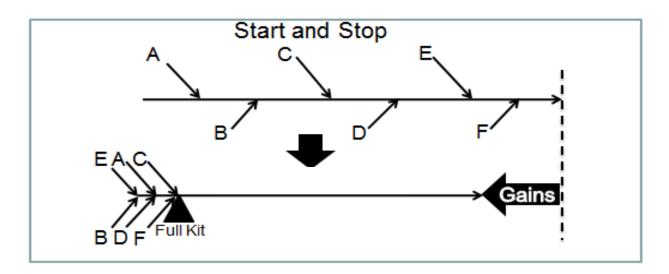


Bead Simulation



Full Kit

 Ensure full preparation of parts, work package, tech. documents, troubleshooting history etc. for the scheduled aircraft





Case Study – Delta Air Lines



Challenging Basic Assumptions

The earlier we start, the sooner we will finish

The better the worker/ work center efficiency, the higher the throughput

