

TOC & The Essence of Management

David Updegrove

Principal, Afinitus Group, LLC

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A Generation in TOC

- A different approach
- Share my personal discoveries
- Hope that you share my conclusion – TOC is the essence of (good) management
- Encourage innovation in TOC
- Address the difficulty in “selling” TOC
- Subtopics: DBR & S-DBR, Critical Chain, The Thinking Process and the S&T trees

The “Natural” Aspect of TOC

- The natural aspect of TOC sets it apart from other methodologies
- Sometimes called “Common Sense”
- 1986 – 1990 Boeing Microelectronics
- “Necessity is the mother of invention”
- Very poor performance, very unhappy management
- An idea

The Five Focusing Steps of TOC

1. **Identify** the system constraint
2. Decide how to **Exploit** the system constraint(s)
3. **Subordinate** everything else to the above decision
4. **Elevate** the system constraint(s)
5. **Go back** to Step 1. Do not let inertia set in

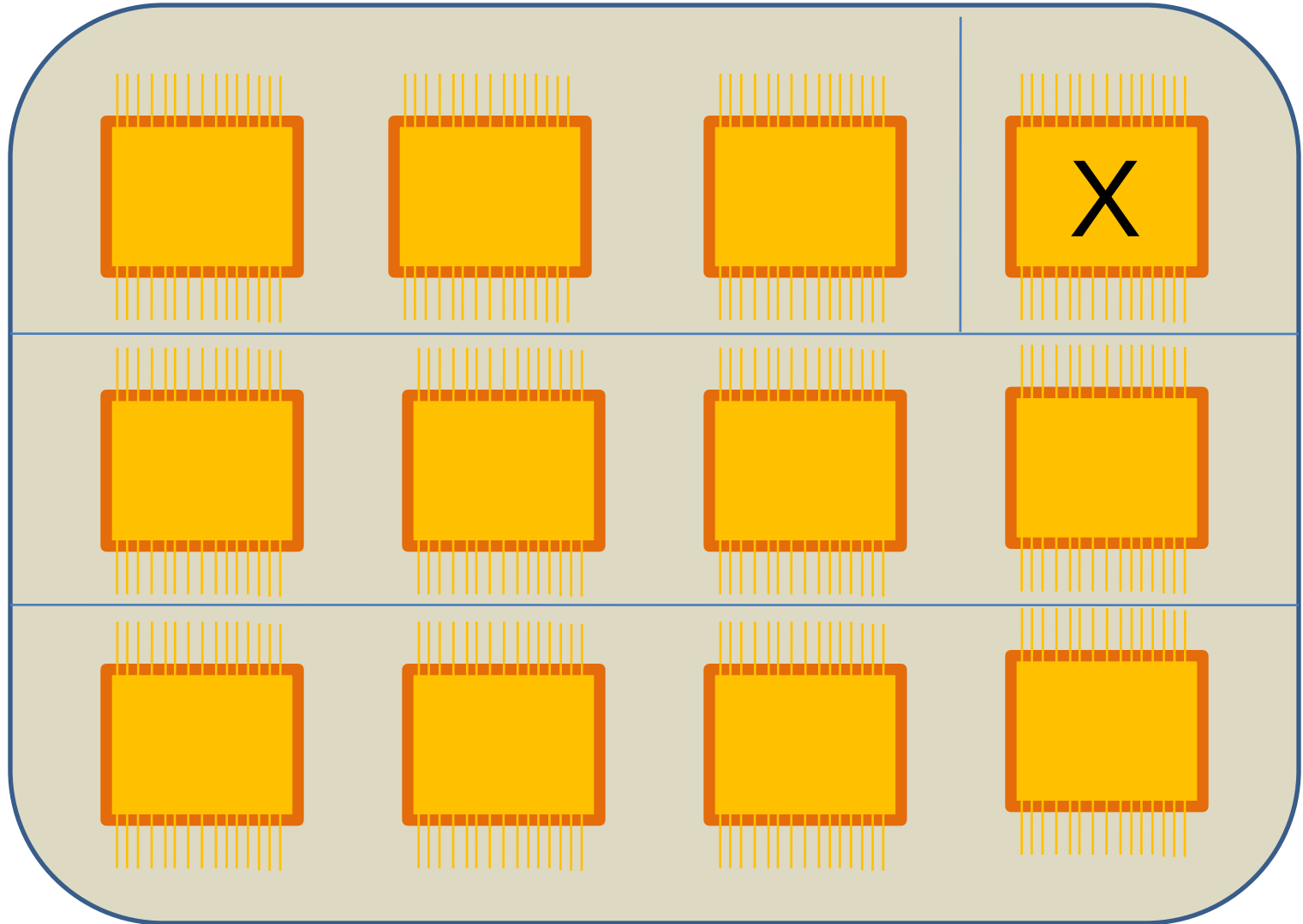
First DBR Implementation – Results

- Quoted Lead time
 - Before: 54+ working days
 - After: 23 working days
- Parts in process
 - Before: 5800
 - After: 1600

Surprises

- Quality went up
 - First pass electrical inspection went from 79% to 94.8%
 - First pass visual inspection improved by similar numbers
- Costs went down
 - Charged cost of labor decreased by 67.5%!

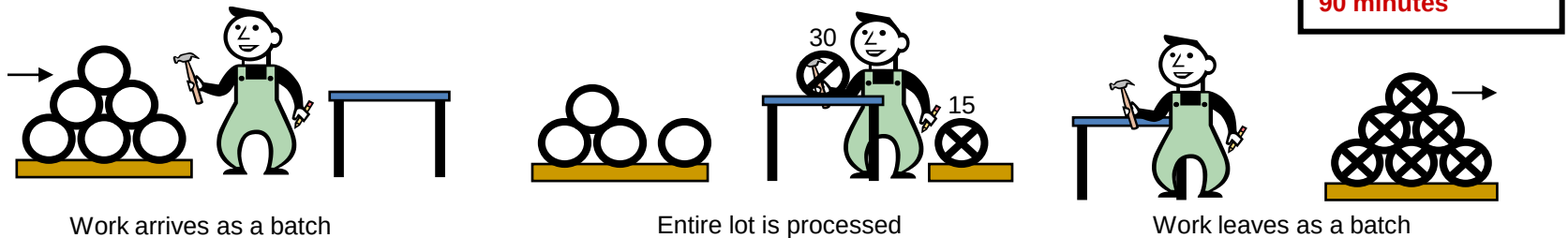
Batching (Hello cost world!)



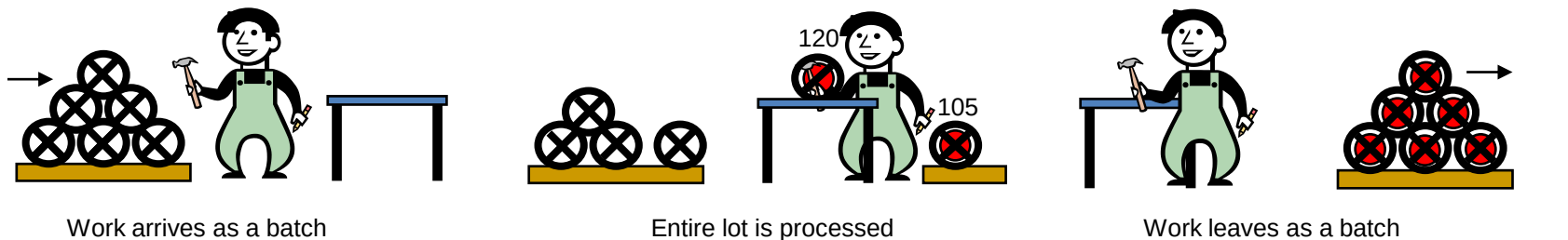
Negative Effects of Batching

- Note : Each operation averages 15 minutes of touch time

Operation # 1



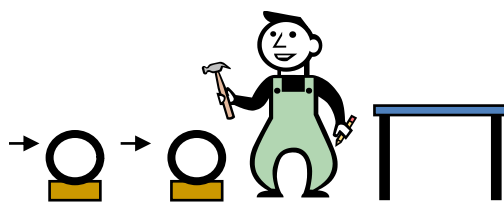
Operation # 2



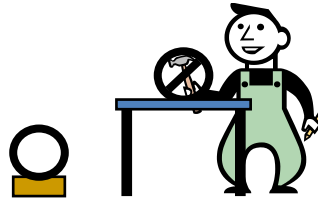
Positive Effect of Not Batching

- Note : Each operation averages 15 minutes of touch time

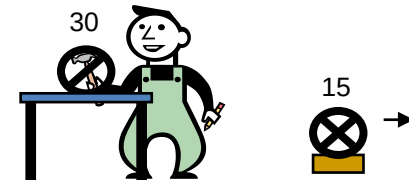
Operation # 1



Work arrives in small batches

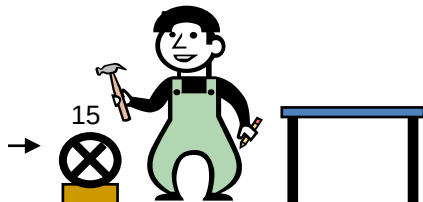


One part is processed

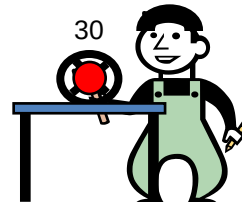


One part is moved

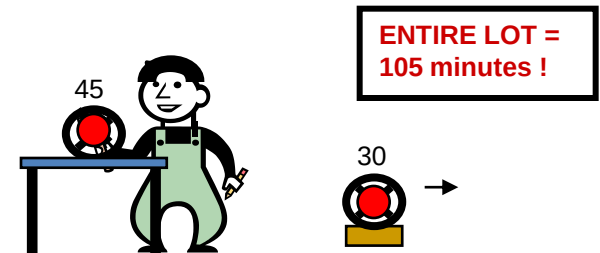
Operation # 2



One part is received



One part is processed



One part is moved

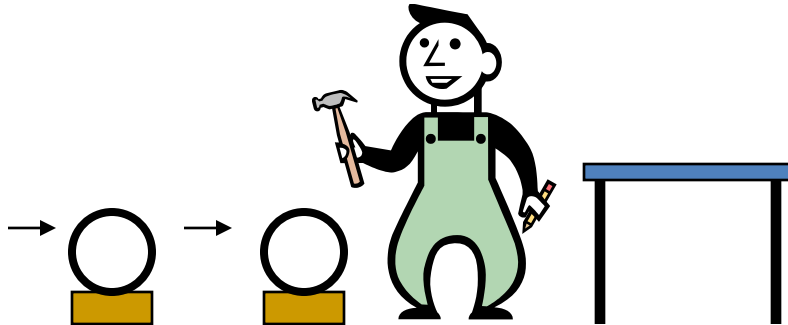
Impact of Batching

Note : Each operation averages 15 minutes of touch time

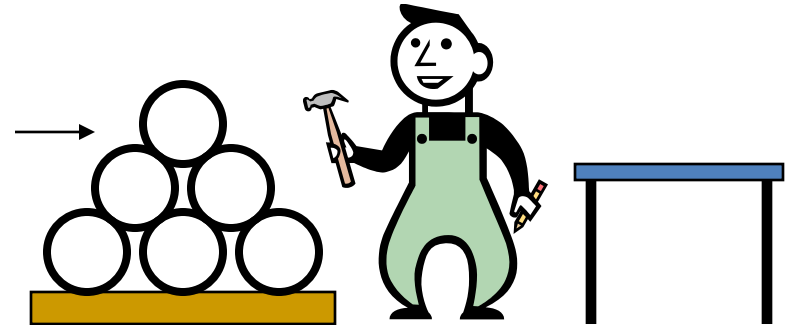
Number of Operations	Time With Batching	Time Without Batching
1	90	90
2	180	105
3	270	120
4	360	135
5	450	150
6	540	165
7	630	180
8	720	195
9	810	210
10	900	225

“ Personal ” Batches – Hidden Danger !

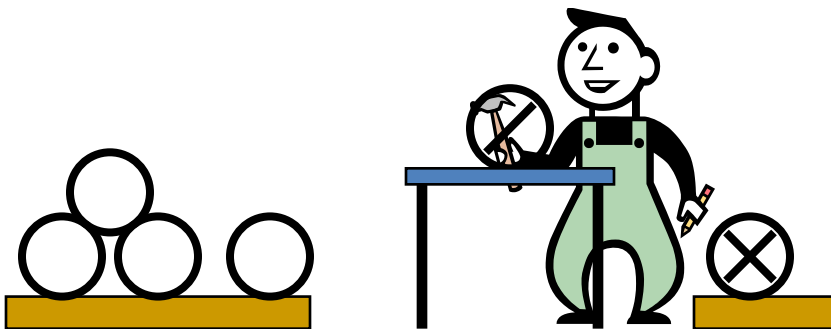
1 Work arrives in small batches



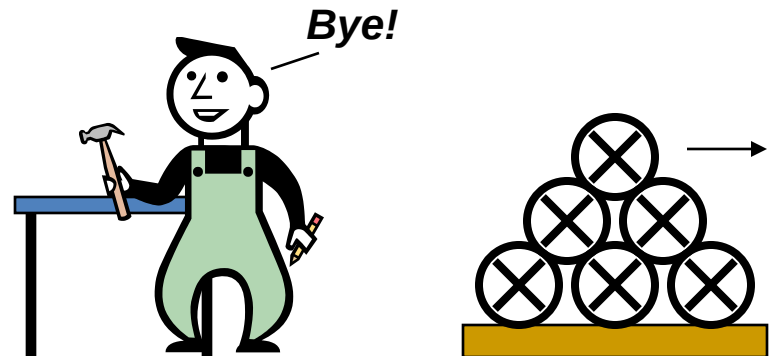
2 Worker builds batch for “efficiency”



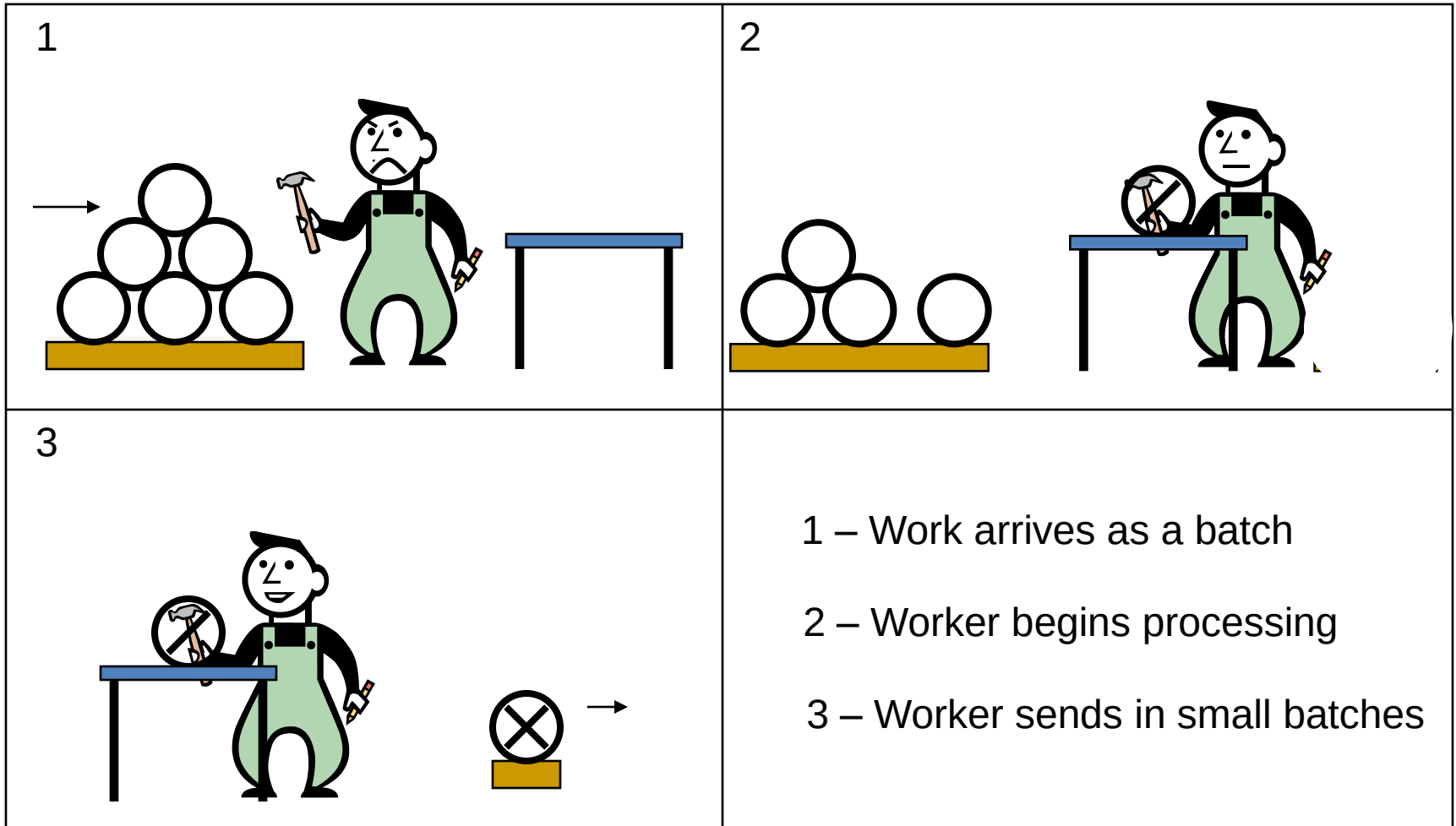
3 Large number of parts processed



4 Work leaves, usually as a batch



What To Do When You Receive A Batch



Key Learning & Surprises

- Key learnings: The concept behind Drum-Buffer-Rope is natural and universal; batching is devastating to flow time
- Surprises: TOC reduces cost, increased quality, as by-products

Applying TOC To The Organization

- The Five Focusing Steps and the TOC Thinking Process (to be discussed later) are the foundation used to develop all present and future applications of TOC
- Since every imaginable type of system and subsystem are governed by constraints, these tools can be utilized to create breakthrough solutions and develop robust strategic and tactical plans
- Since each application deals with the leverage points of the system, significant improvement can be expected regardless of the industry, product, or process

Growing at Boeing

- Followed Microelectronics success with a similar success at Printed Circuit Board fabrication (modified DBR concept for the environment)
- Worked in various environments, became an internal TOC consultant / trainer
- Example of a machine shop
- The amazing Sheet Metal Center
- My “Glorious Failure”

Key Learning & Surprises

- Key learning: Classic DBR is not necessary in all production environments
- Surprises: Even huge, historic, and great companies do the stupidest things; make a better case, and get official buy-in

Becoming a Consultant

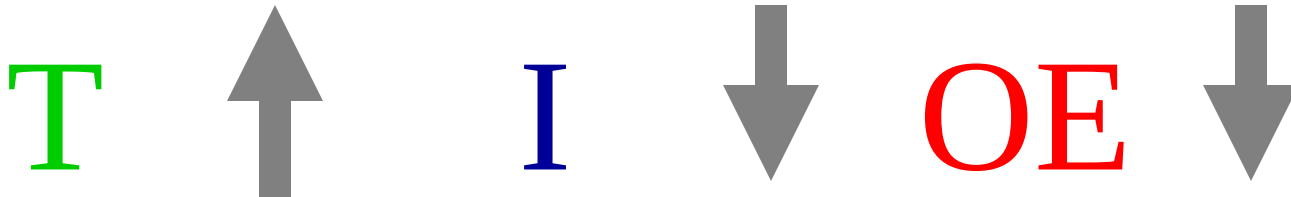
- Discovered Project Management
- Disillusioned with Boeing
- Left Boeing February 3, 2000, joined Maxager Technology February 7
- Experienced the dot-com bust from the inside
- But got great experience

Key Learning & Surprises

- Key learning: What throughput accounting really is, and what it is not
- Surprises: Most organizations do not have a true, physical, internal constraint

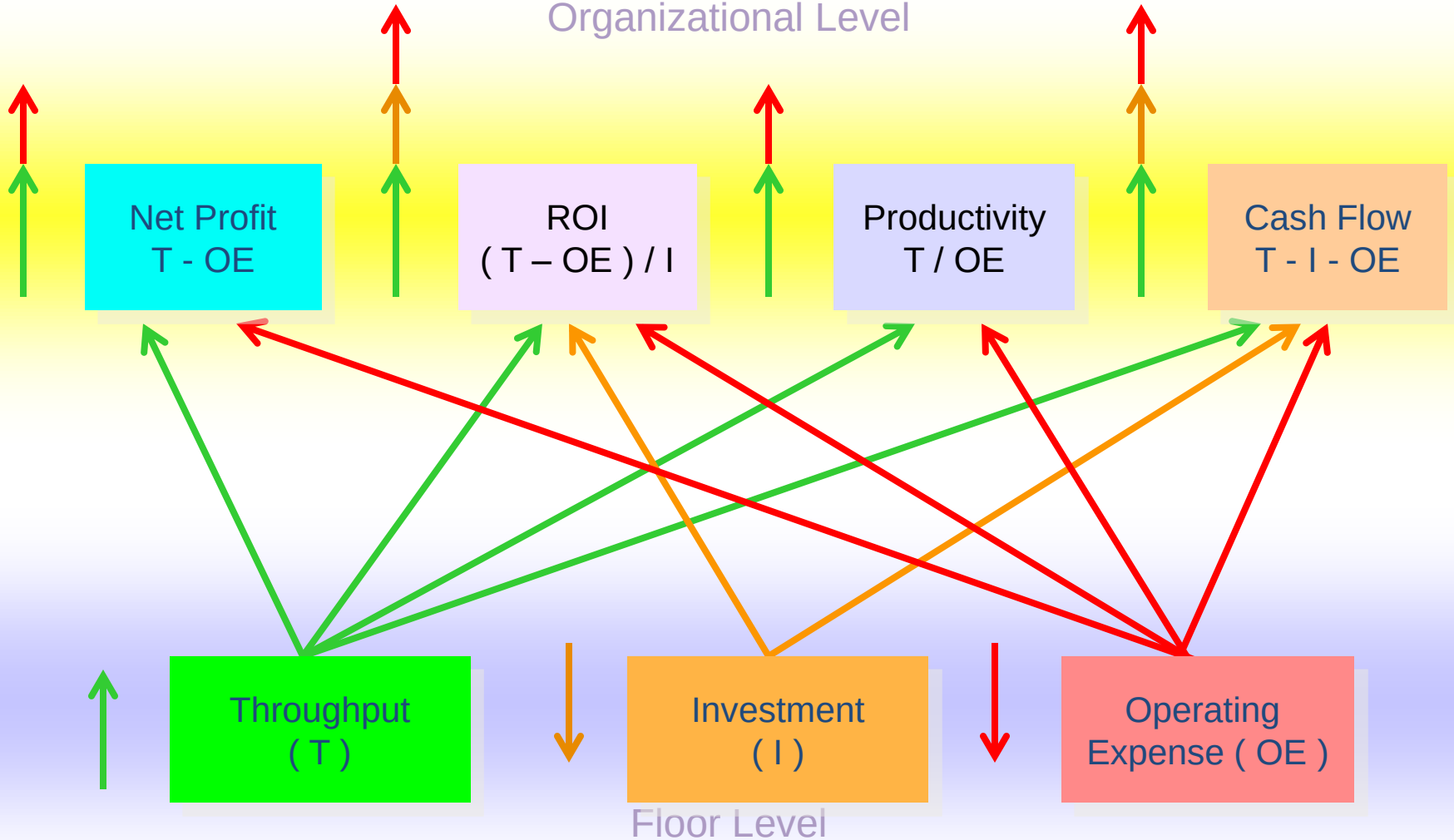
TOC Metrics

- Throughput (T) – The *rate* at which system generates money through sales
- Investment (I) – All the money the system invests in purchasing things the system intends to sell
- Operating Expense (OE) – Money the system spends in turning Inventory into Throughput



TOC Financial Metrics

Organizational Level



Decision Support

- Will my decision increase the throughput of the system?
- Will my decision decrease the organization's investment in the system?
- Will my decision reduce the operating expense of the system?
- What if this decision increases throughput, but also requires an increase investment, and / or operating expenses?

Throughput Accounting

Money Spent

Investment

Current Assets

Fixed Assets

Operating Expense

Supplies

Utilities

Depreciation

Travel

Freight

Training

Labor

Benefits

Maintenance

Scrap

Individual products not
burdened with conversion
costs

Budgeted and measured as
actual, NOT variances to
standards

Money Earned

Throughput

Product Sales

Service Sales

Sales \$ - truly variable
cost of sales

Throughput Accounting

- Major Premise :
 - Does not assign costs to an individual product, and
 - Treats traditional ' variable expenses ' as fixed (for example direct labor)
- Systemic approach with transactions :
 - Decided at the boundary of the organization
 - Recorded when they cross the boundary of the organization

Throughput Accounting Benefits

- One common Metric set
- Simple / easy to understand
- Concentrates on :
 - Throughput
 - Expense drivers
- Links all activities and functions to the financial goals

Throughput Accounting Benefits

- Allows for direct manufacturing departments to be held accountable to a spending plan
- Visibility to losses is raised in the organization
- Implementing Throughput Accounting creates an atmosphere conducive to other elements of TOC being successfully implemented and sustained
- Relevant measurements at each organizational level are linked to the organization's strategy and plans

A World of Experience

- Pre-Maxager: Inventory Control, Production Control, Industrial Engineering, Microelectronics, Printed Circuit Boards, Composites, Sheet Metal, Extrusion, Machined parts, sub-assembly and major assembly
- Maxager: Semiconductors, Printed Circuit Assemblies, die-casting, metallic injection molding, steel production, joist production, paper products, LCD production
- Post-Maxager: MRO – Trucks, tanks, helicopters, airplanes, submarines; ceramics, software development, Public Works construction, truck body manufacturing, flex circuits, cable, oil & gas
- And more I've forgotten for today

Life As An Independent Consultant – But First, Simplified Drum - Buffer - Rope

- Classic Drum - Buffer - Rope is applicable when a true, physical constraint exists on the shop floor
- It also can be used successfully where resources are operating near capacity, but are not actually constraining throughput
- Even with resources that are historically overloaded, most bottlenecks can be broken by using the Five Focusing Steps

Simplified Drum - Buffer - Rope

- In reality, most apparent constraints are caused by our **policies**, which are manifesting themselves physically
- If we can remove the policy constraints and resolve capacity issues, we can look at DBR in a new way

Simplified Drum - Buffer - Rope Basics

- The market (customer demand) is **almost always** a major constraint of any production system
- If market demand is the actual constraint, the drum schedule should be based on a Master Production Schedule that we create
- Rather than subordinating to a resource, we will instead *subordinate to and buffer customer demand*
- We must monitor fluctuating market demand and balance our internal resource **capacities**
- **Rising market demand will eventually cause an internal constraint**

The Buffer in S - DBR

- The buffer in S-DBR is a liberal estimation of the lead - time from raw material release to shipping; it contains :
 - Actual processing time (Set Up and Run)
 - Transportation time
 - Reduced Queue Time – less Queue Time overall than in conventional systems, but still enough to help protect against “ Murphy ”
- Buffers are used to overcome *common* delays; for more serious disruptions, we need something more

Buffer Management in S - DBR

- Buffer management is a control mechanism-- its objective is to alert us when **due dates are threatened**
- When an order is not complete a set time before the Due Date, it is considered “ **almost late** ” and should be investigated immediately !
- Buffer Management can also be used to insure that the buffer itself is about the right size
- It is effective even when data is inaccurate
- When many “ almost late ” orders are appearing - there is a threat to the stability of the whole system

Determining Original Buffer Sizes

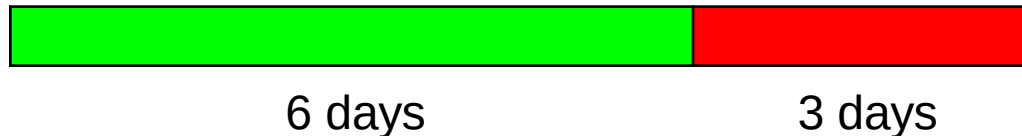
Start with the existing lead time (e.g. 12 days)



Cut lead time by 25-30 % (e.g. to 9 days)



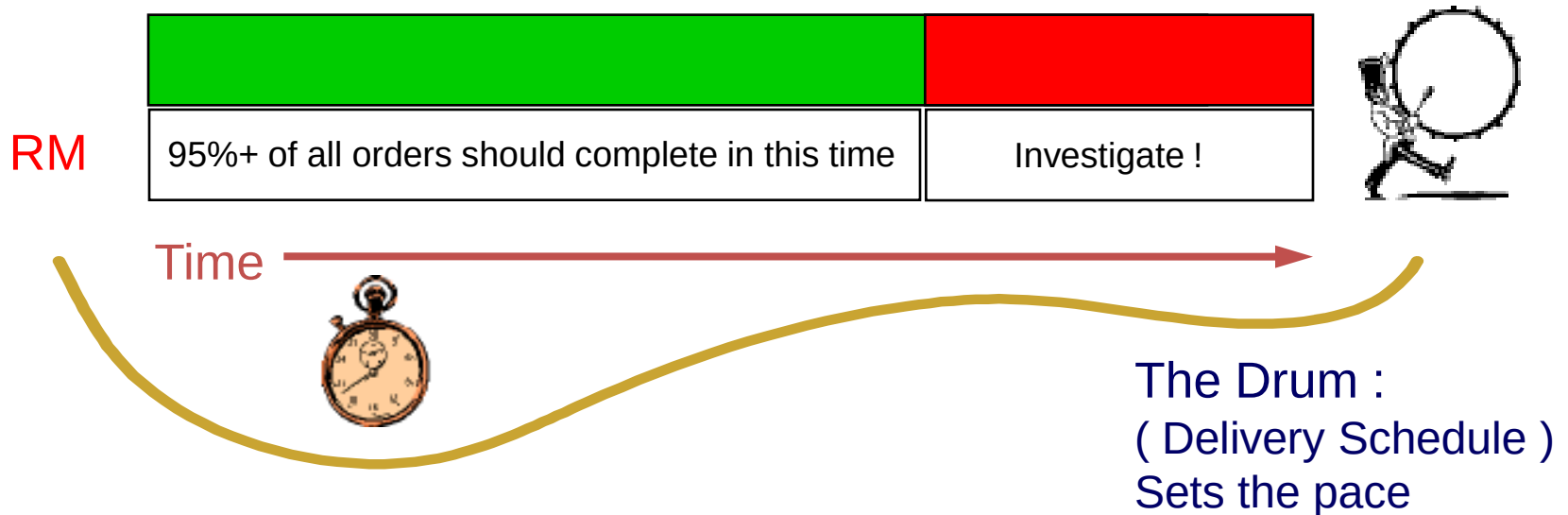
Make the final 1/3 of lead time the emergency zone



- “ Touch Time ” should fit completely within the emergency zone
- Given smaller batch sizes and lower WIP levels, > 95 % of all orders should complete within the Green Zone (6 days)

S - DBR and Buffer Management

The Buffer : Protects against variation and uncertainty



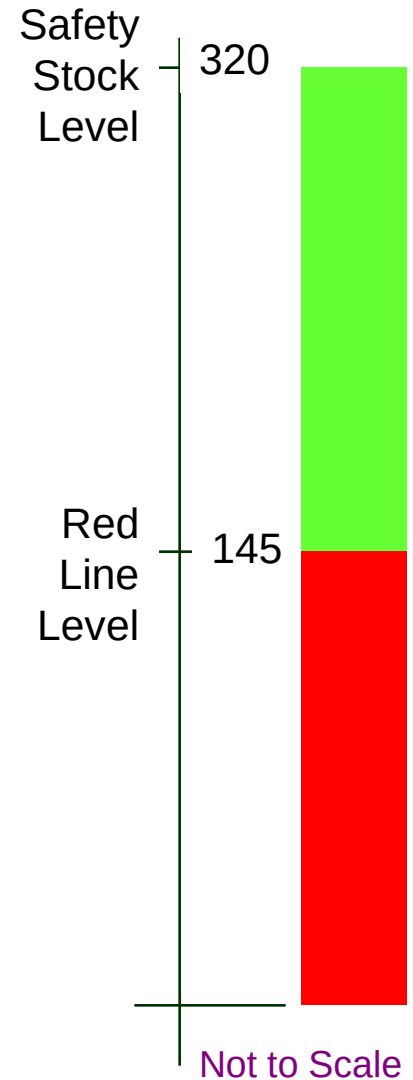
The Rope, Schedule : Signals Raw Material release “ pulls ” in accordance with drum beat

Safety Stock & Emergency Stock

- Throughout the simulations we have assumed that Raw Materials are available either because we have :
 - Processed refurbished materials in a timely manner, or because
 - New Raw Materials are in stock
- Stock Outs, whether from internal refurbished or new externally acquired, cannot be tolerated if we hope to meet our schedules
- So we need to protect ourselves with a Raw Material Stock

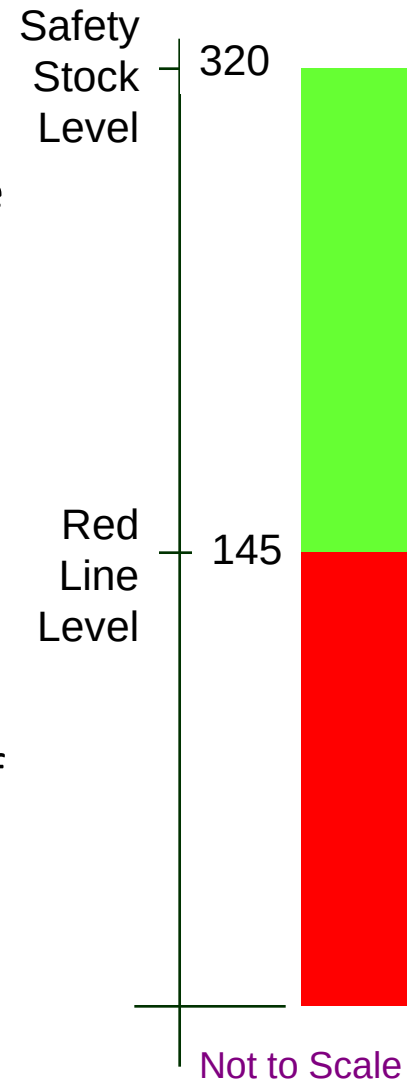
Safety Stock & Emergency Stock

- Raw Material, if acquired new and external to the organization, must be stocked as follows :
 - The level of stock is set by determining for how long a period we need to maintain stock
 - Setting a warning device to tell us when the threat of stock exhaustion is real while consumption continues; this warning device is called the 'Red Line Level' for Raw Materials
 - We immediately **investigate** and **possibly** re - order when we reach the Red Line Level



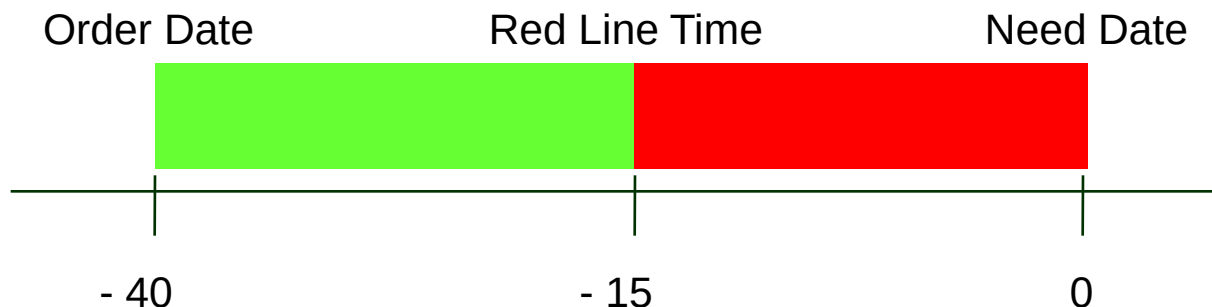
Safety Stock & Emergency Stock

- One key principle however :
 - *Optimally* we order stock on a one for one basis as we consume it in the green zone :
 - Consume one → Order one
 - Consume ten → Order ten
 - We DO NOT collect up a batch before ordering
 - We will **investigate** immediately Red Zone incursion of the Stock Buffer and **possibly** re - order a significant quantity



Red Line Time

- Another type of Buffer may be required :
 - When inventory accuracy is unreliable due to data systems, vendors, no cycle counting, etc we may employ a Red Line Time Buffer
 - The Red Line Time Buffer signals us to verify material is in hand at a predetermined interval prior to need date



Not to Scale

Safety Stock & Emergency Stock

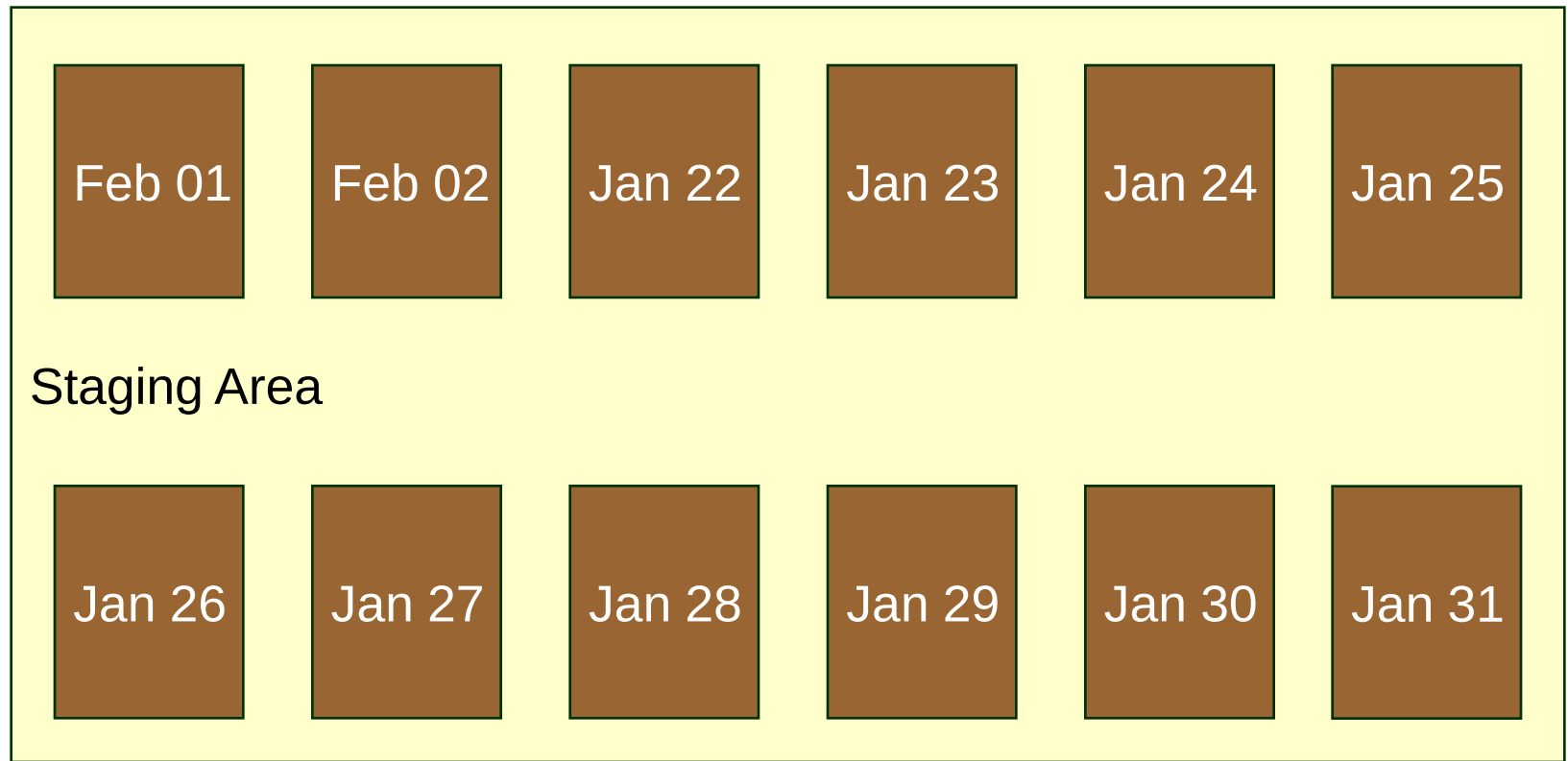
- As mentioned earlier one of the assumptions was that we have processed refurbished materials in a timely manner which infers that we finish within the :
 - Project Buffers (meaning we must release the project on the correct date - we already have that covered), and
 - Shipping Buffers, meaning we must release our work on the correct date also
- We'll have a multitude of items in flow via Shipping Buffers at any time; so we'll need tight control over material release - but how ?

Staging Area

- Experience has shown that a Staging Area is required, and works well for work which is to be re-furbished, provided it is :
 - Physically secured (locked down)
 - Identified / Tagged
 - Correctly Packaged or / and Palletted
 - Released on the appropriate Material Release Date
 - Movements are properly transacted in MRP II

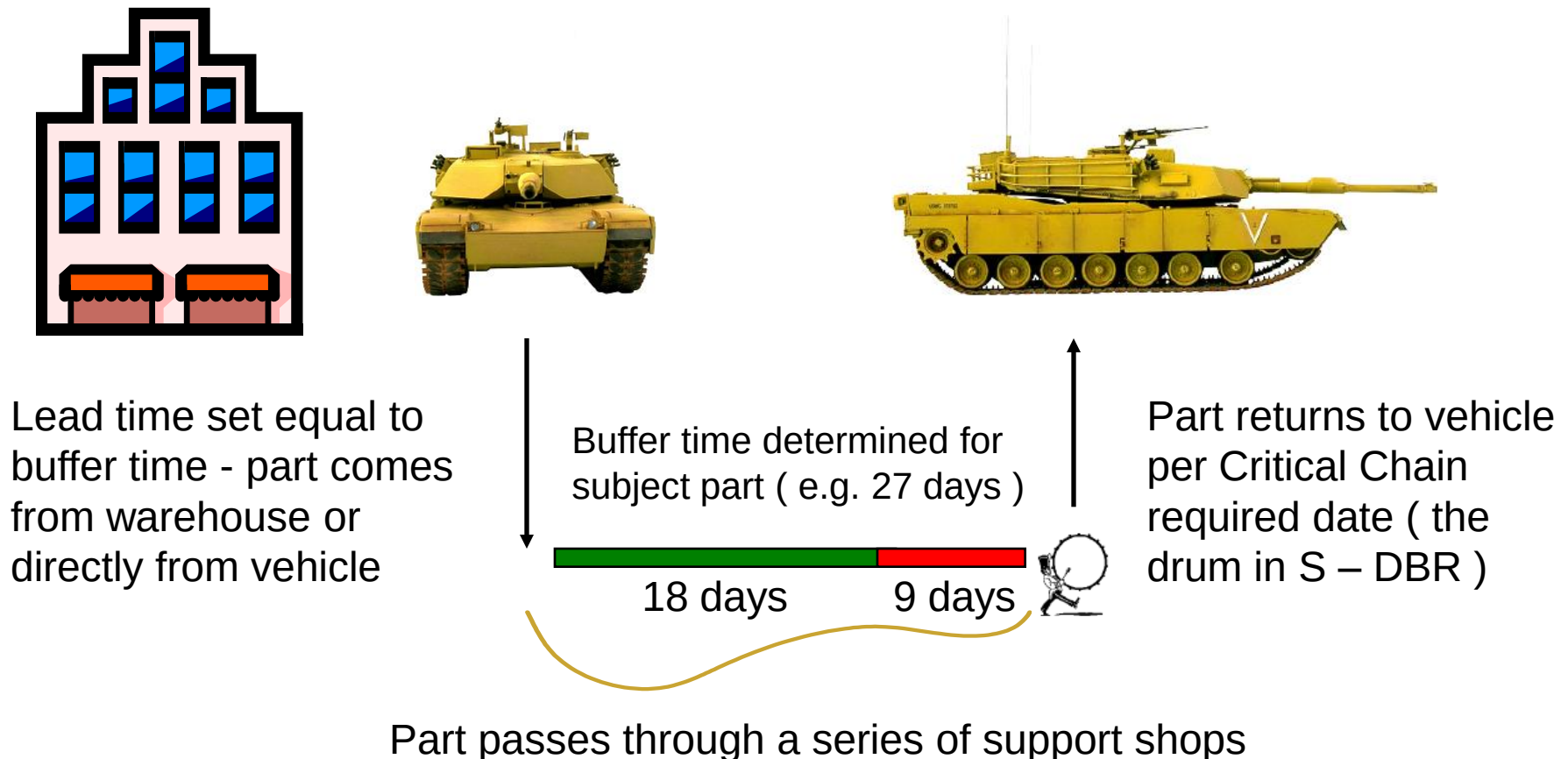
Work to Refurbished Staging Area

- Different layouts will work; the key is to segregate work by release date and NOT release those materials until the morning of that day

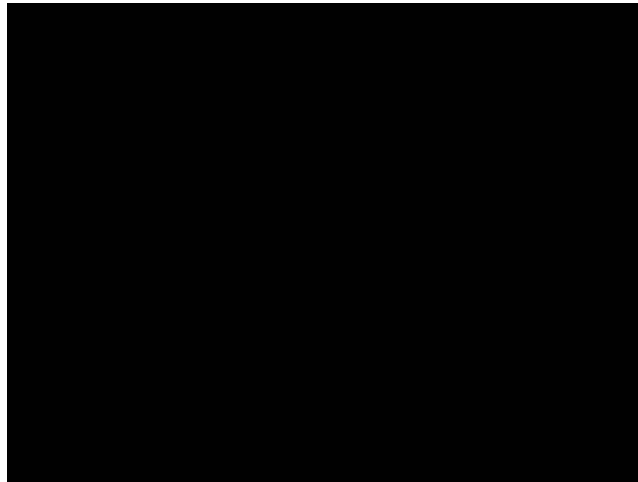


Materials to be Released on Each Day

Putting It All Together – The Marines – Albany, Georgia Maintenance Center S - DBR in Support of Critical Chain - MRO



Albany Maintenance Center Results



Albany Maintenance Center Results

System	FY-04	FY-07	Reduction (Days)
MK-48	100 (138-38)	38 (68-30)	62 (62%)
MK-15 Trailer	71 (133-62)	5 (41-36)	66 (93%)
MK-17 Trailer	53 (105-52)	10 (47-37)	43 (81%)
M970 Refueler	86 (136-50)	4 (73-69)	82 (95%)
M149A2 Water Trailer	49 (65-16)	19 (38-19)	30 (62%)
M88 Tank Retriever	89 (235-146)	31 (129-98)	58 (65%)

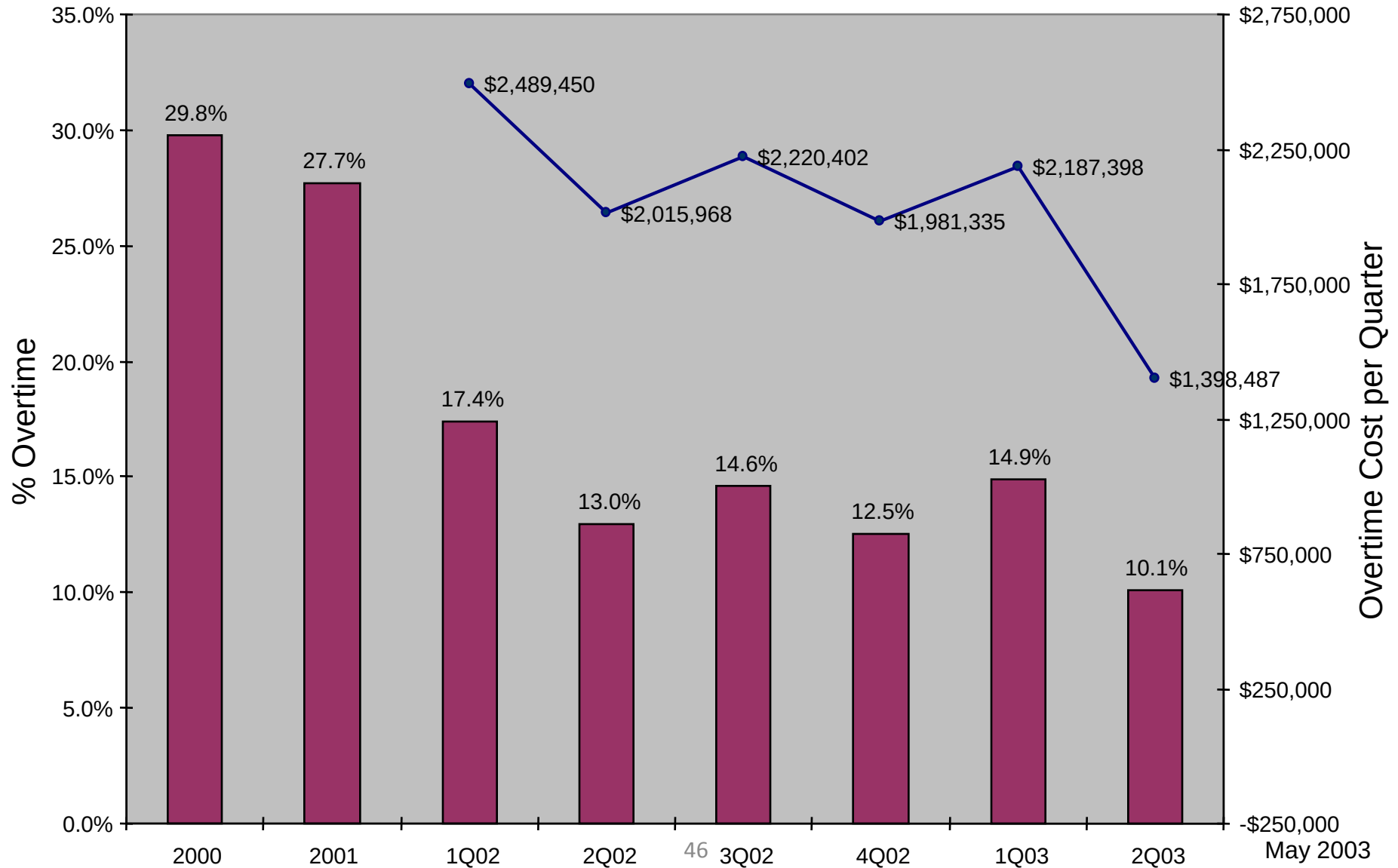
Key Learning & Surprises

- Key learning: Even large, multi-faceted organizations can be synchronized and improved
- Surprises: The operation who fully adopts TOC will benefit far more than those who compromise

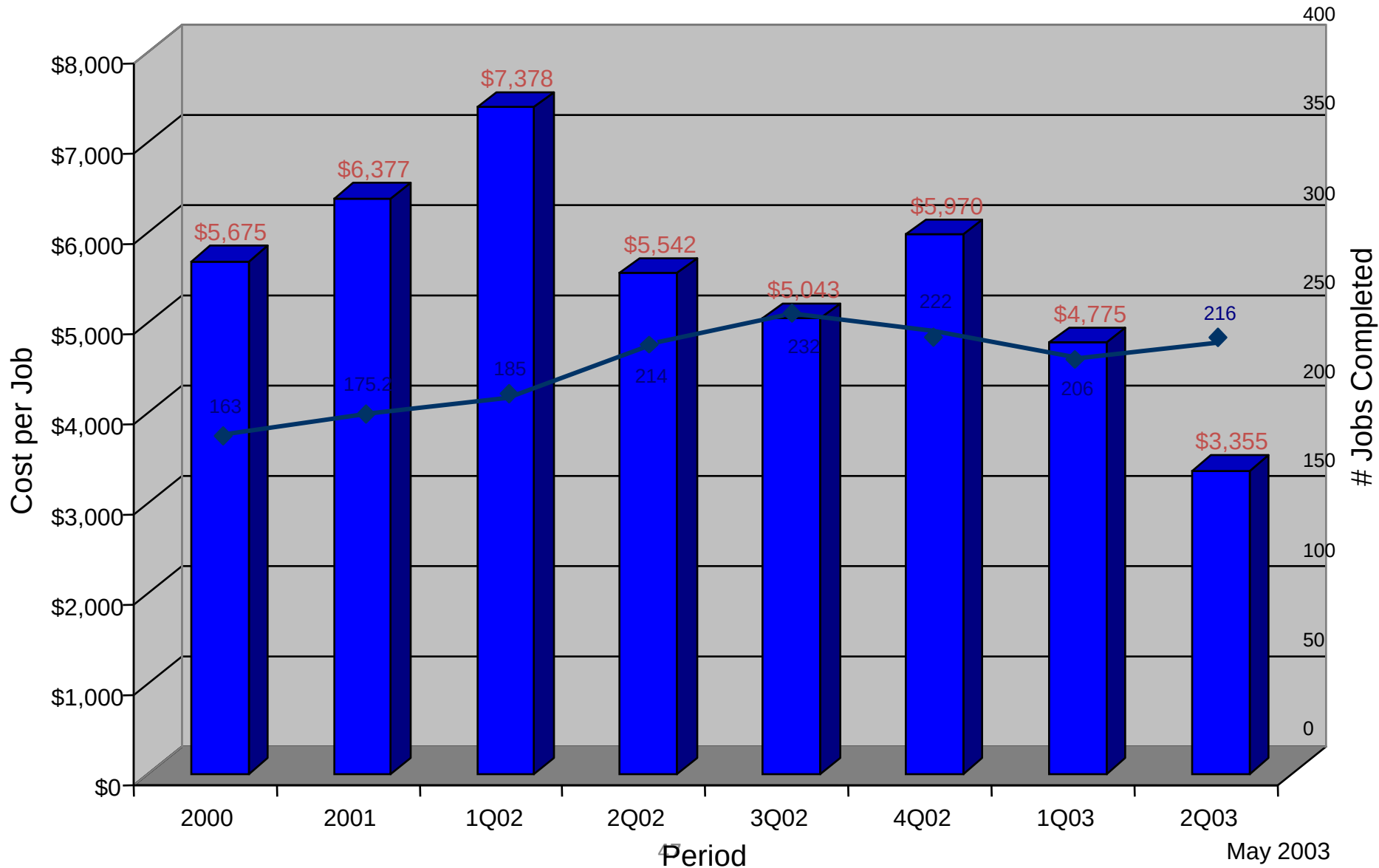
More Adventures in MRO

- Helicopters & Airplanes
- Nuclear Submarines at Pearl Harbor and beyond
- But we're different...
- Pearl Harbor results

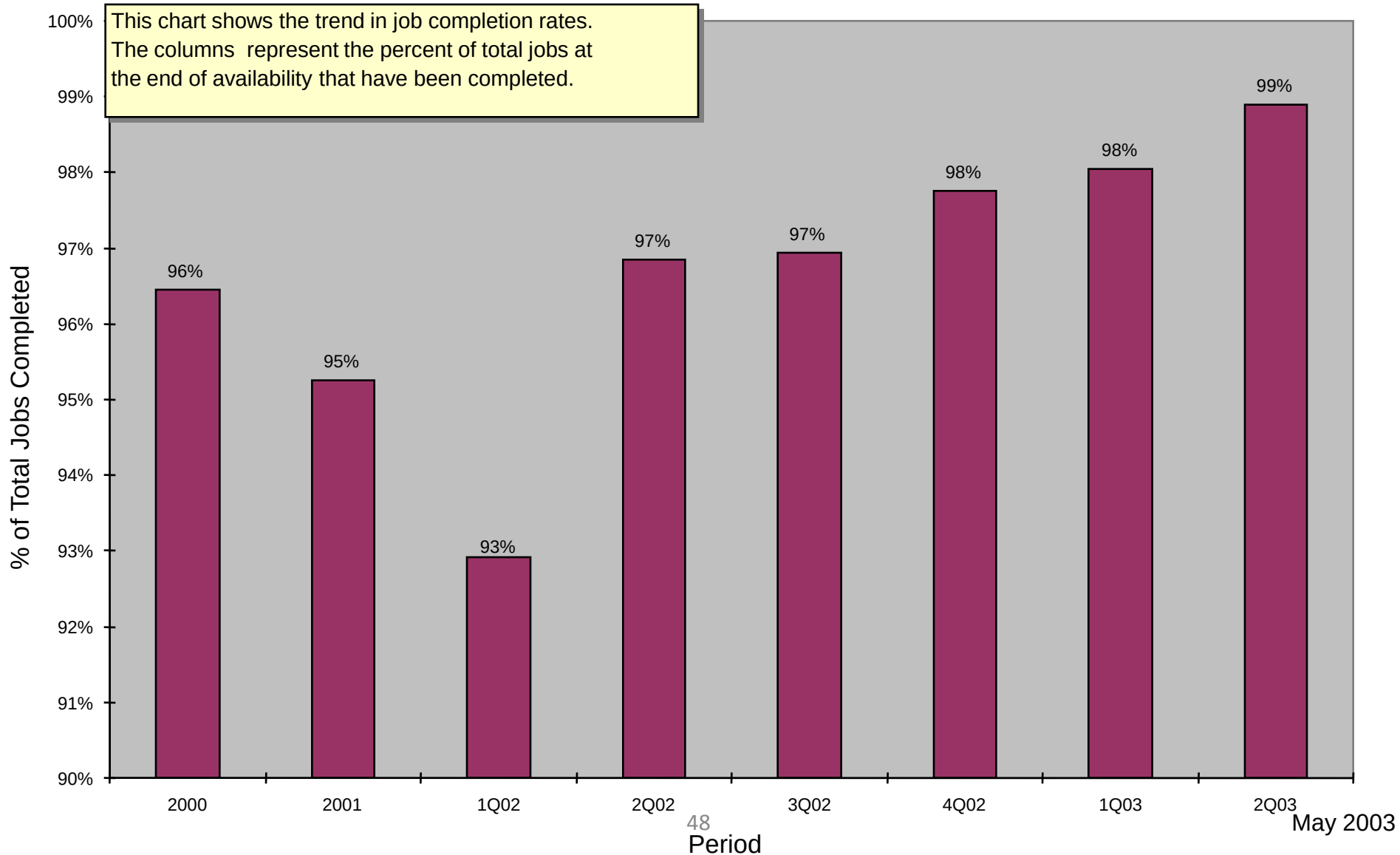
Focused Use of Overtime



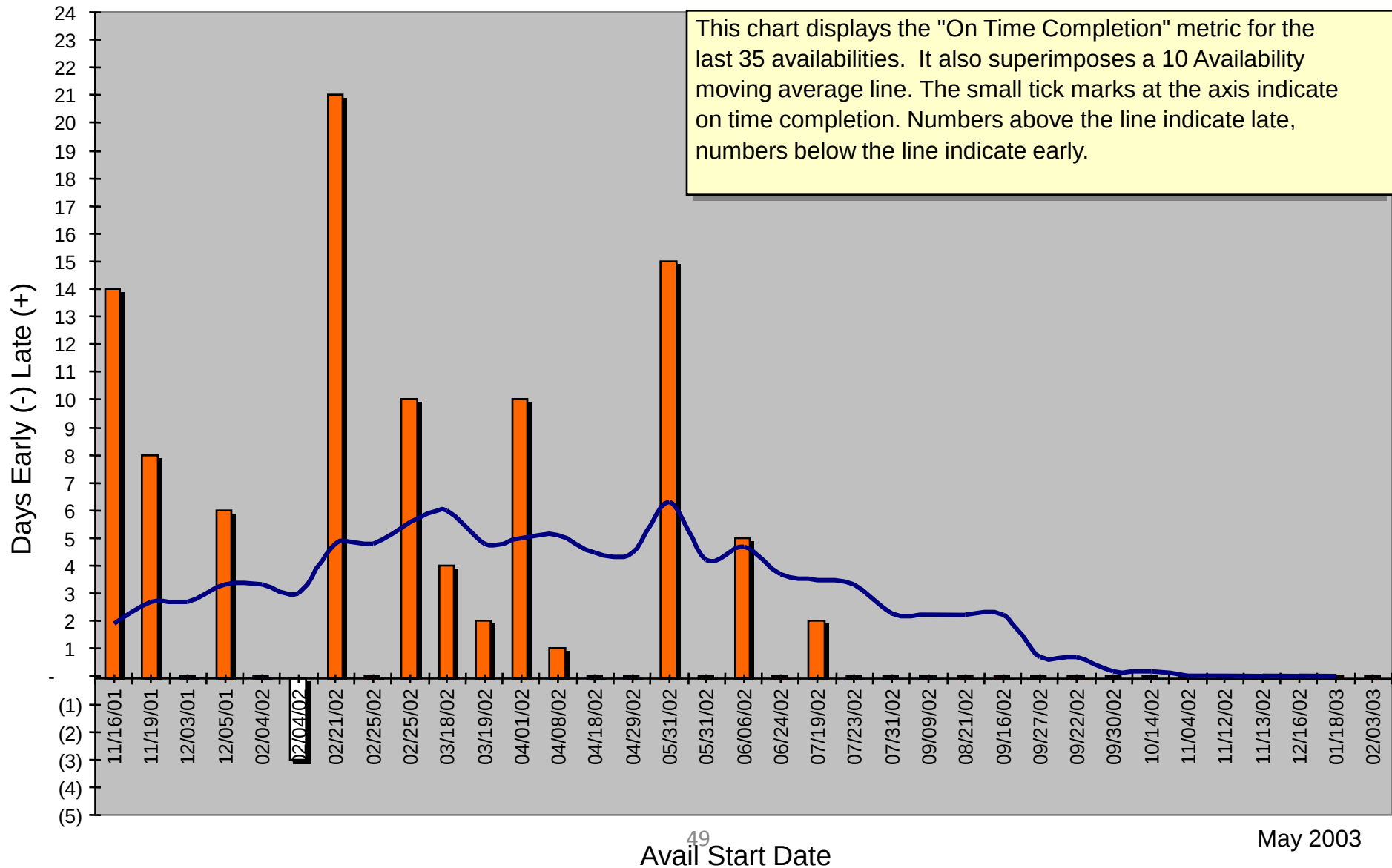
Reduced Cost Per Job



Improved Job Completion Rate

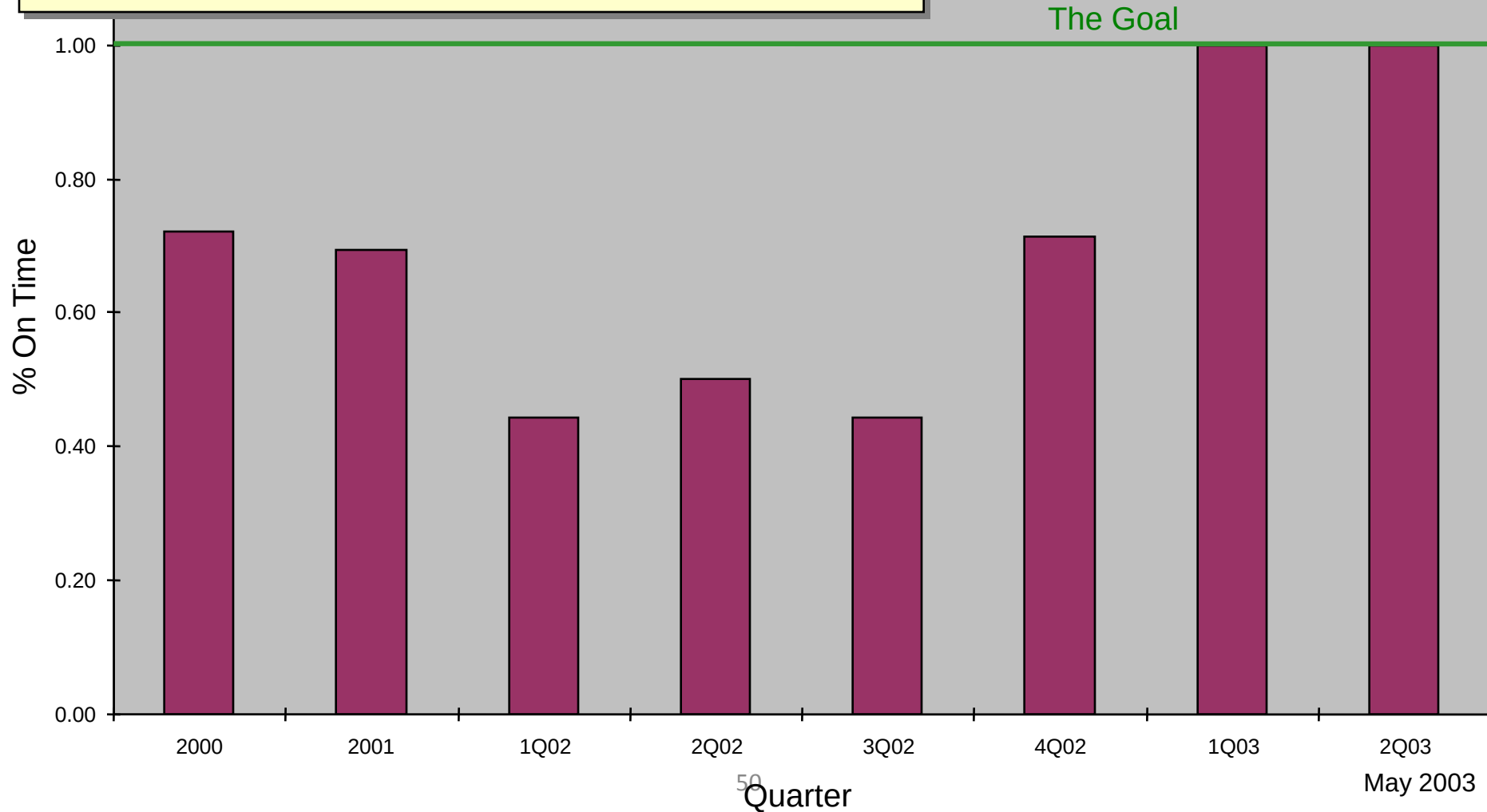


On Time Completion

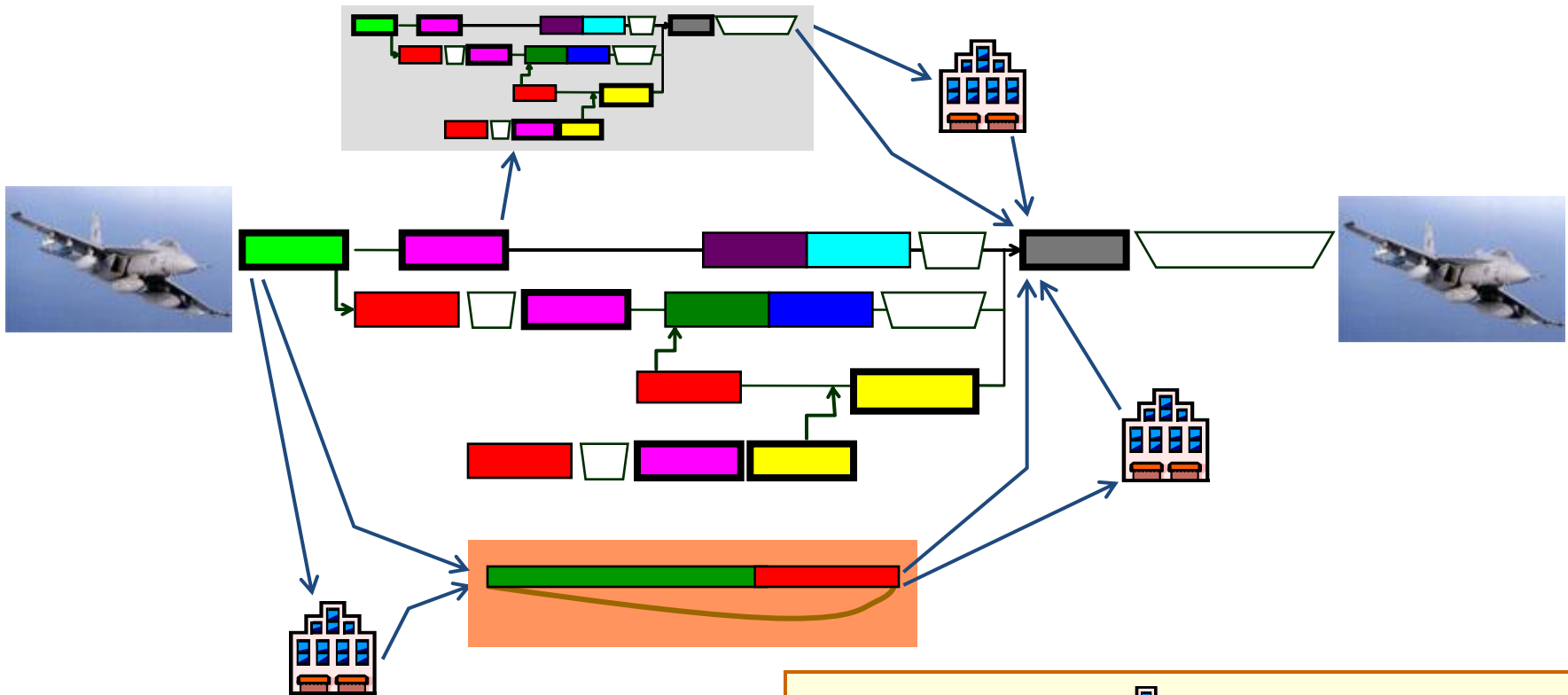


Improved Schedule Adherence

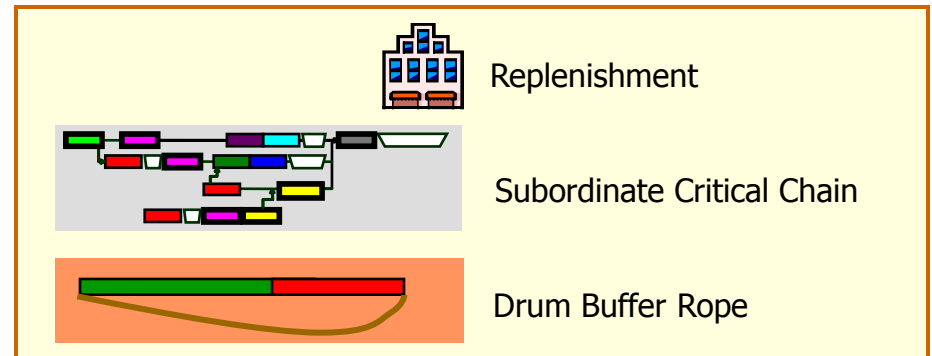
This chart displays the "On Time Completion" metric. The ratio is the total number "On Time" versus the total completed. (This is the equivalent of the Schedule Indicator in the DMOIs.)



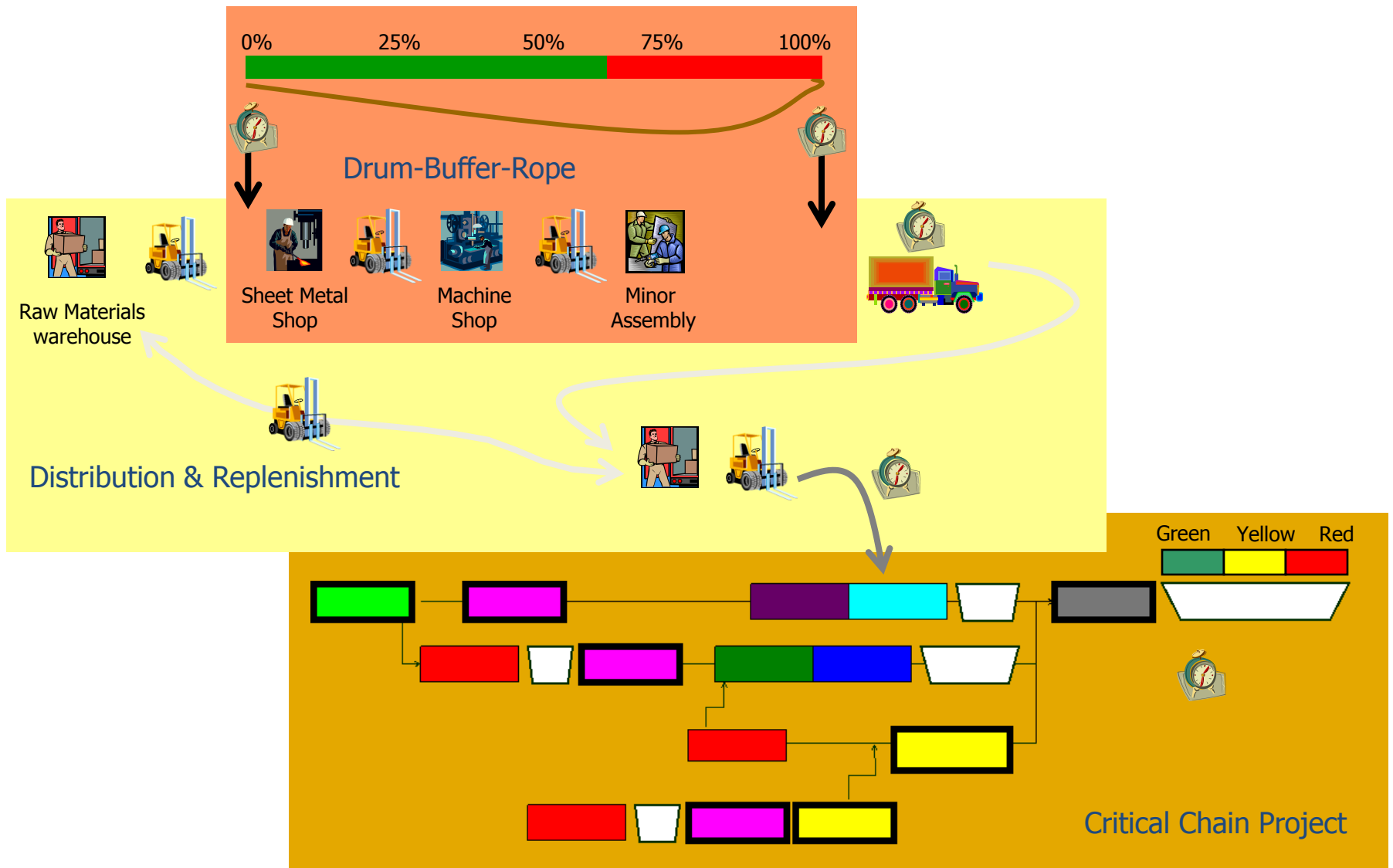
Synchronized Solutions – MRO View



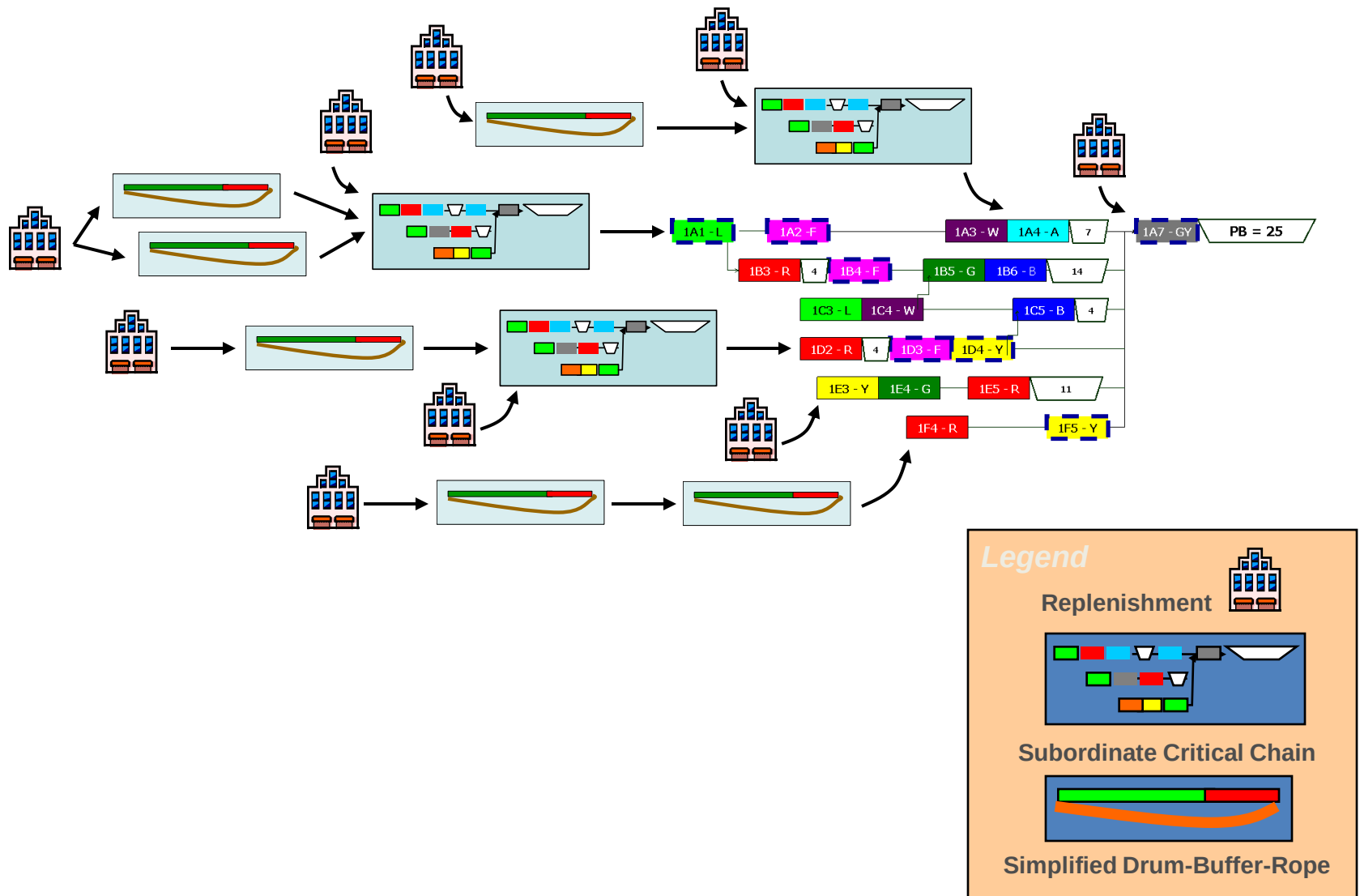
- This scenario repeats and overlaps as multiple units are processed



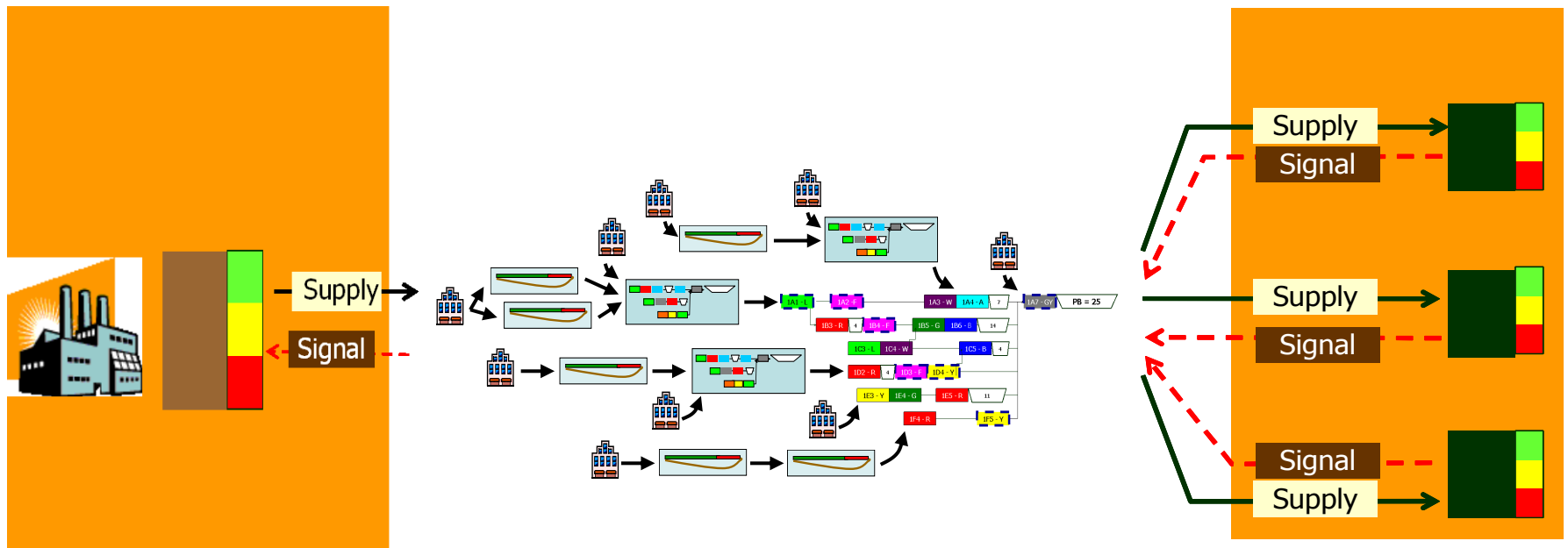
Synchronized Solutions – Project View



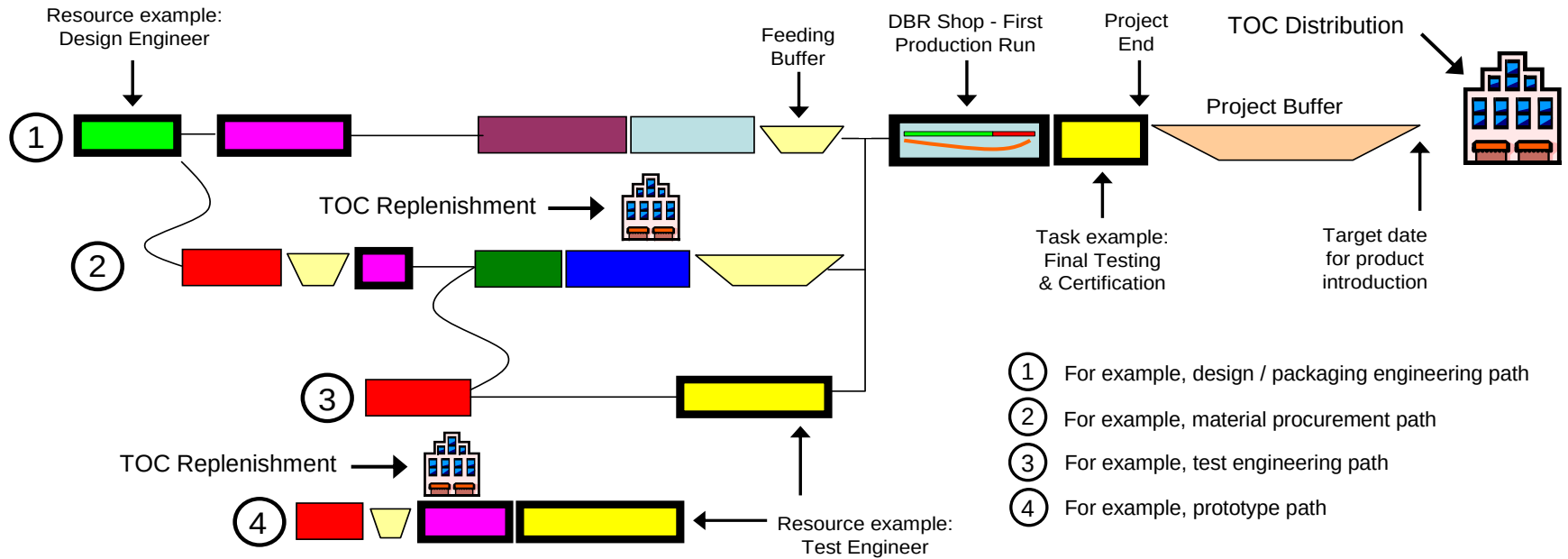
Synchronized Solutions – Enterprise View



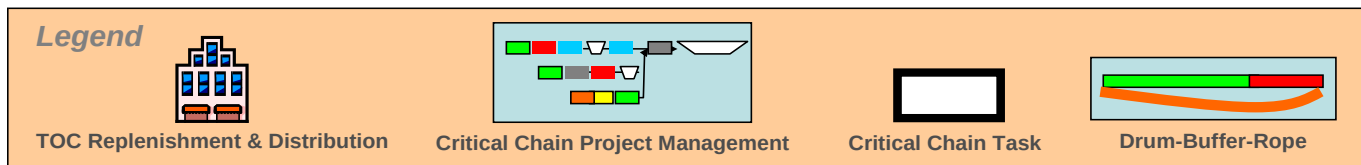
Synchronized Solutions - Supply Chain View



For new product development ...



Notes: Notional only. Not to scale. Each rectangle represents a task. Each color represents a resource.



Synchronizing the TOC Solutions

- Maximum on-time delivery supply chain-wide
- Minimum practical inventory levels supply chain-wide
- Improves upon current level of performance
- Brings together proven TOC solutions
- Synchronizes the selected system (scalable)

More Adventures in Project Management

- June, 2003
- August, 2004

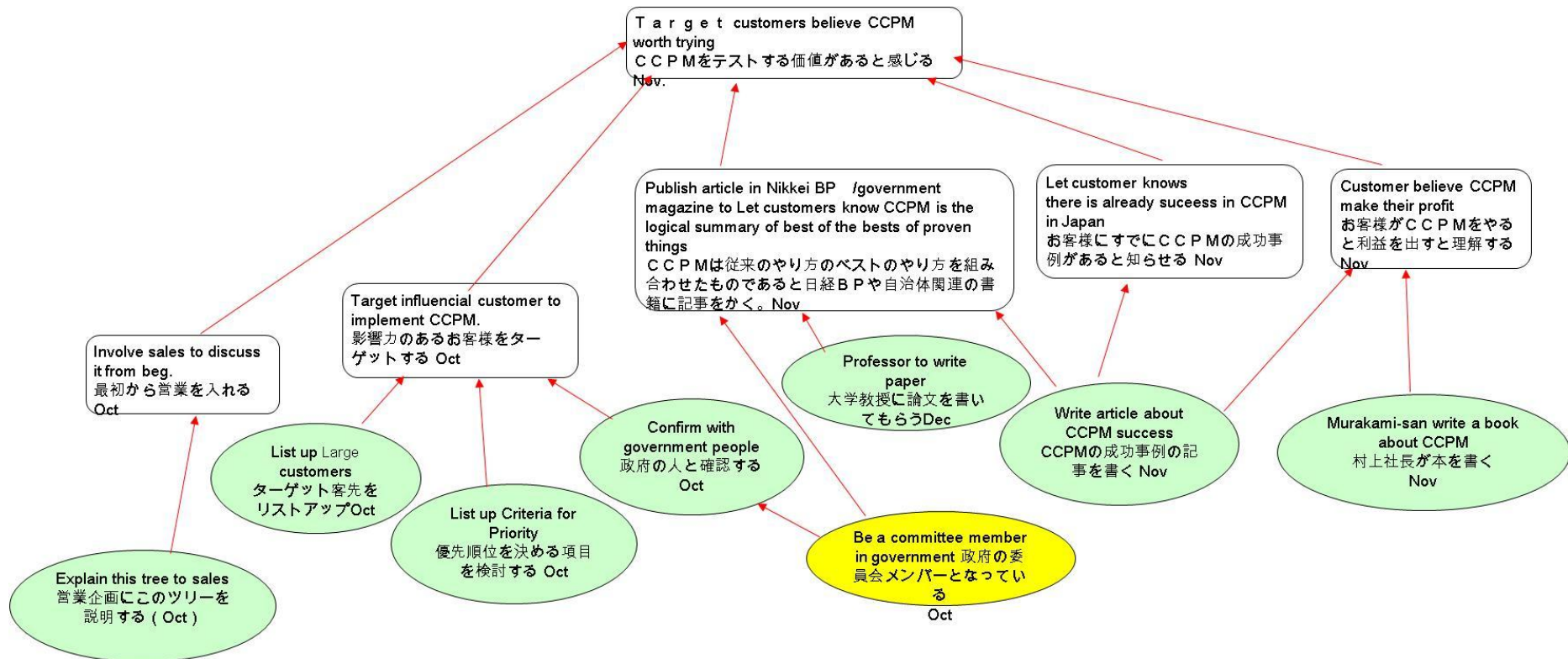
Two Dilemmas, One Solution

- Yuji Kishira's dilemma
 - Market saturation of flagship product
 - Government spending cut by half
 - Small and medium sized companies struggling to survive, many failing
- Japan's public works construction dilemma
 - Spiraling costs
 - Unhappy public
 - Late projects cost lives

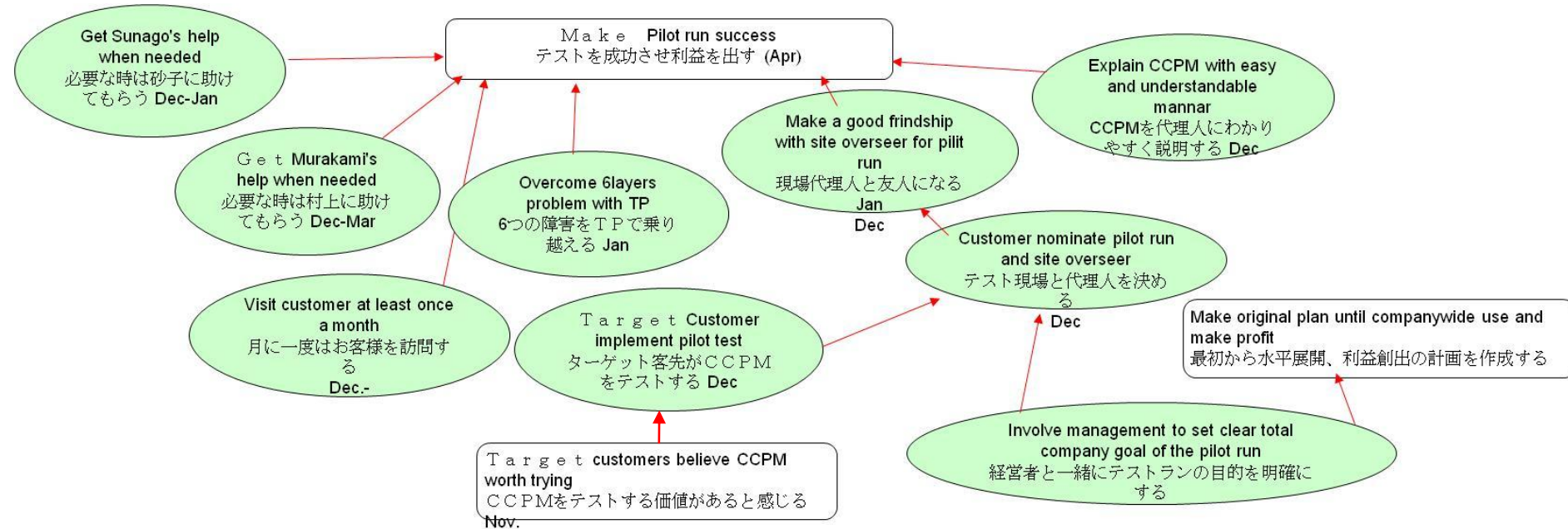
Juji and Dave Make a Plan

- CCPM can be the solution to both dilemmas
- Mr. Kishira and I created a detailed plan
- He was uniquely positioned to influence both worlds
- The plan involved both construction companies and government, focusing on Win-Win-Win
- He chose and negotiated with one of his clients to be a test case
- Began a discourse with government officials

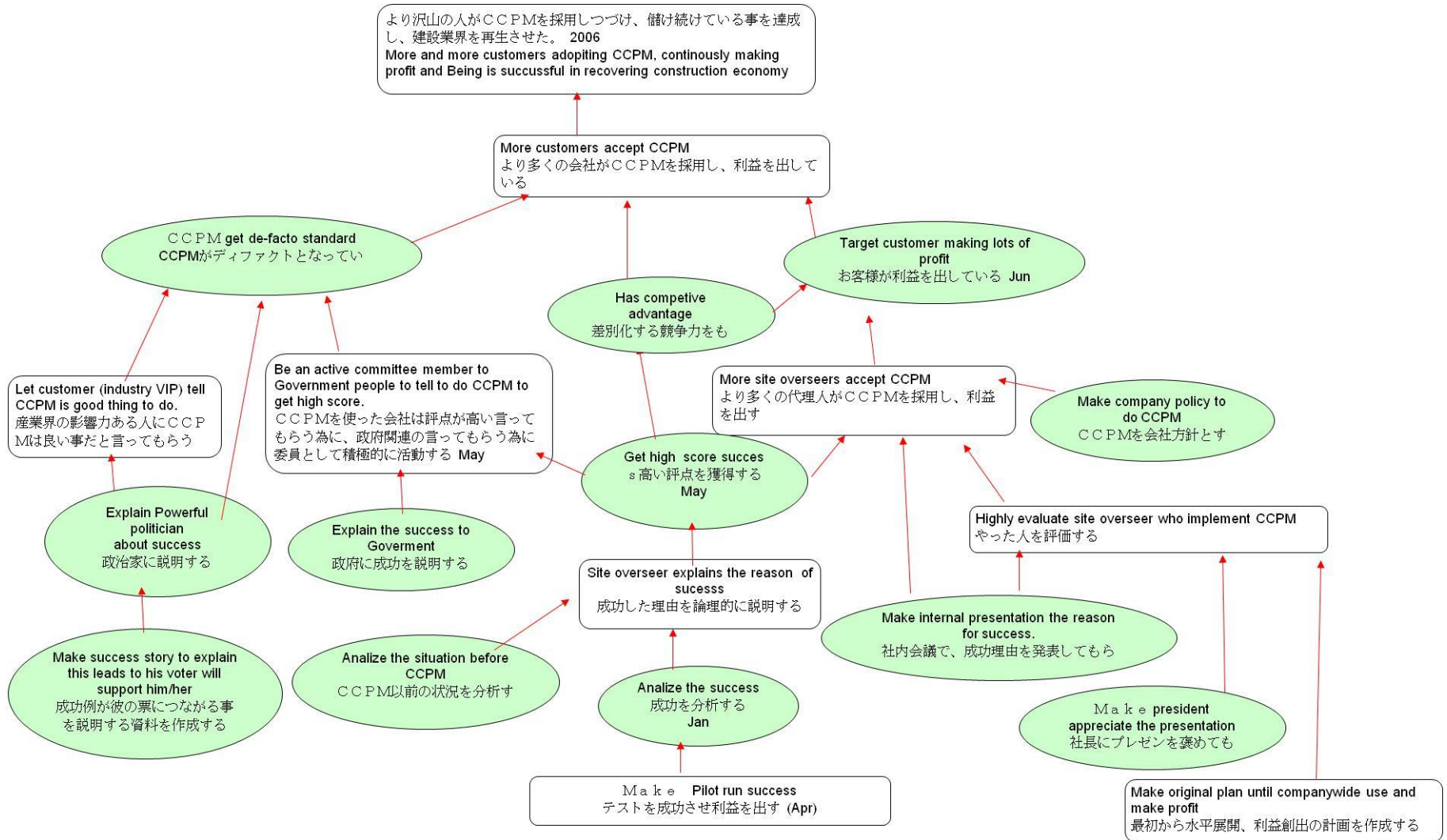
The “Roadmap” – Prerequisite Tree



The “Roadmap” – Prerequisite Tree



The “Roadmap” – Prerequisite Tree



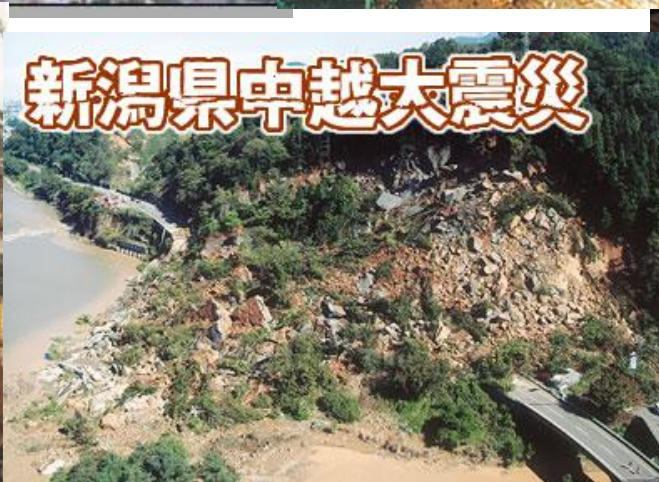
Top Level Objective

More and more customers adopting CCPM,
continuously making profit and **Being is successful**
in recovering construction economy

CCPM Training – The Software Company First

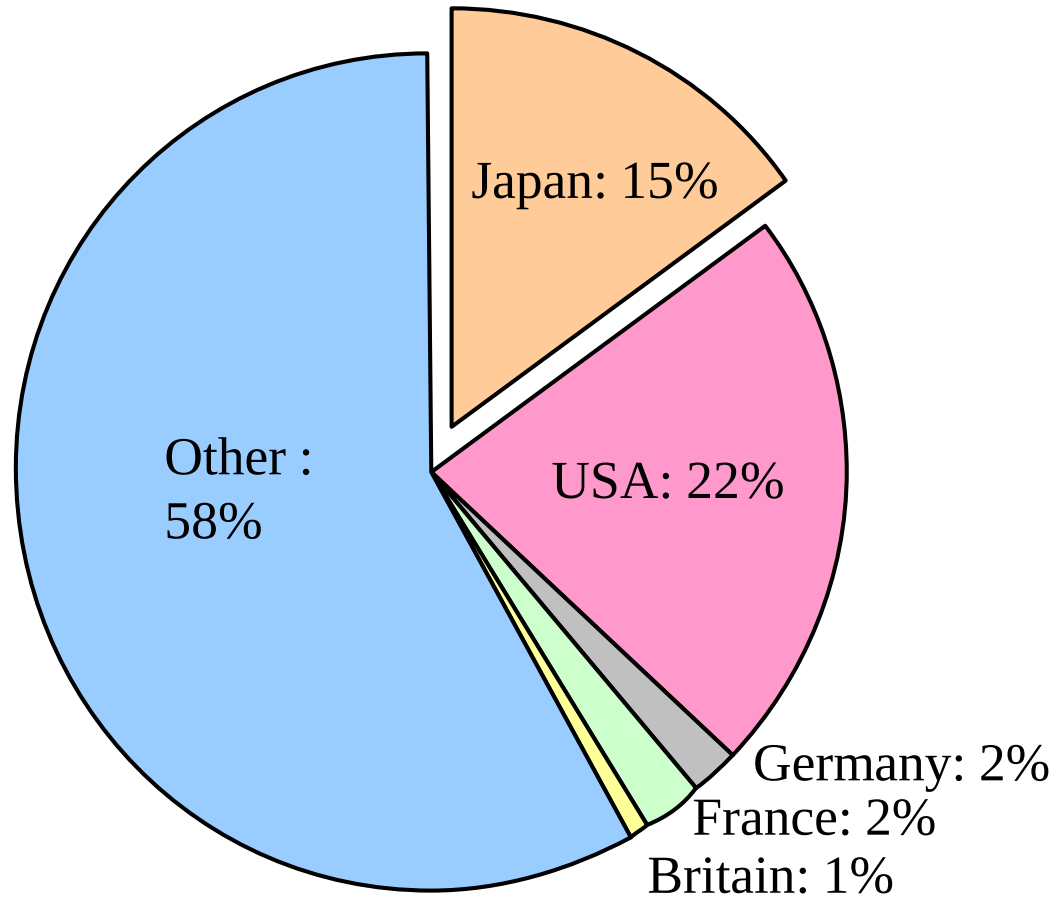


Continuing natural disasters



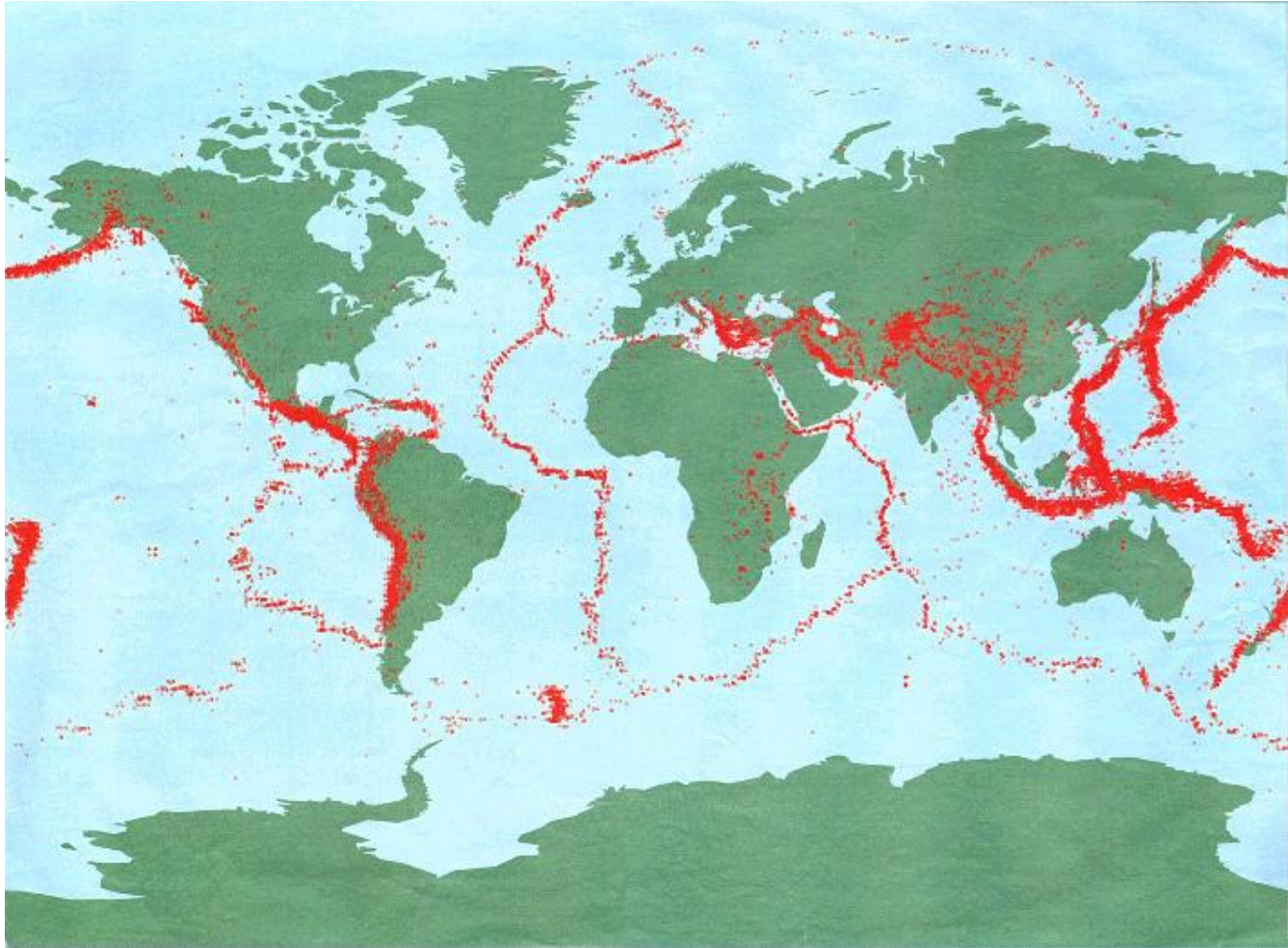
Ratio of amount of natural disaster damage

(1970 - 2004)



Japan - Only 0.25% of geographic area of the world accounting for 15% of the amount of the world of the natural disaster damage

World Earthquake Distribution Chart



(1985-1994) M4 or more and 100km in depth Asa of hypocenter

From Ministry of Land, Infrastructure and Transportation material

High Construction Costs In A Poor Economy

- Japan is an earthquake large country, and the measures cost is necessary.



Pier of Hanshin Expressway



Charles de Gaulle Airport
Pier on access road

In the majority of regions in France, there is no necessity for seismic design.

From the Ministry of Land, Infrastructure and Transport material

First Critical Chain Implementation



Young foreman



Pilot Project Results

Letter of thanks 2005/11/25..

Lastly, we were able to make a higher profit than in the original plan. I feel that the approach of the government supervisor was different from projects in the past; he acted in a way so as to allow construction to proceed smoothly. Or rather, I should say that it made me feel as though he himself was carrying out the project together with us as a team. It became a wonderful construction work where quick responses and good communication enabled good quality work to be completed much earlier than original plan, which pleased the local residents. Everyone who worked on the site felt a sense of satisfaction. I would like to express my heart-felt appreciation.

November 25, 2005

Shinji Hirogami, Sunagogumi Corporation

TOC Critical Chain in Japan

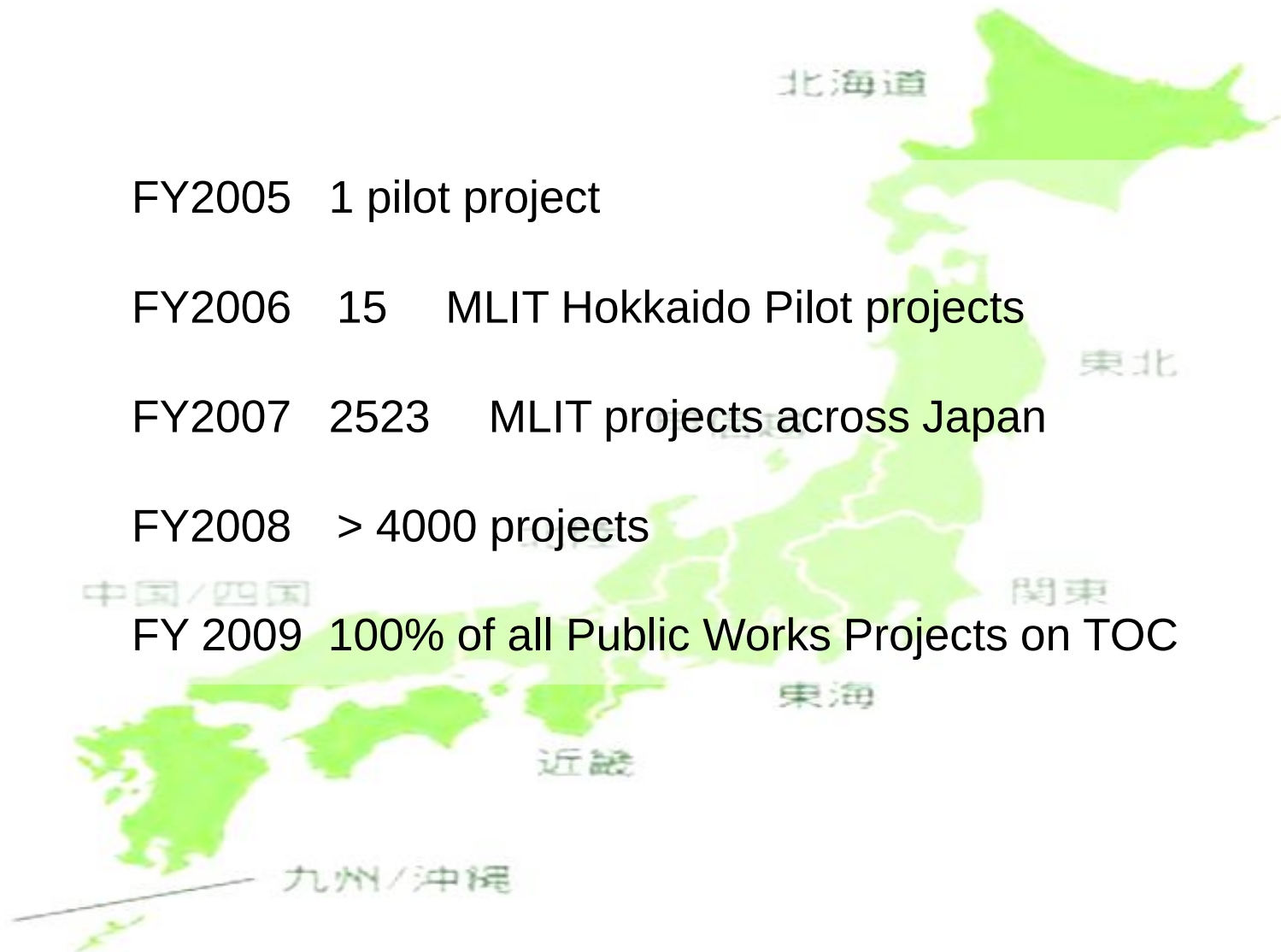
FY2005 1 pilot project

FY2006 15 MLIT Hokkaido Pilot projects

FY2007 2523 MLIT projects across Japan

FY2008 > 4000 projects

FY 2009 100% of all Public Works Projects on TOC



November 26, 2008



Key Learning & Surprises

- Key learning: Anything is possible
- Surprises: Even the government can be helpful

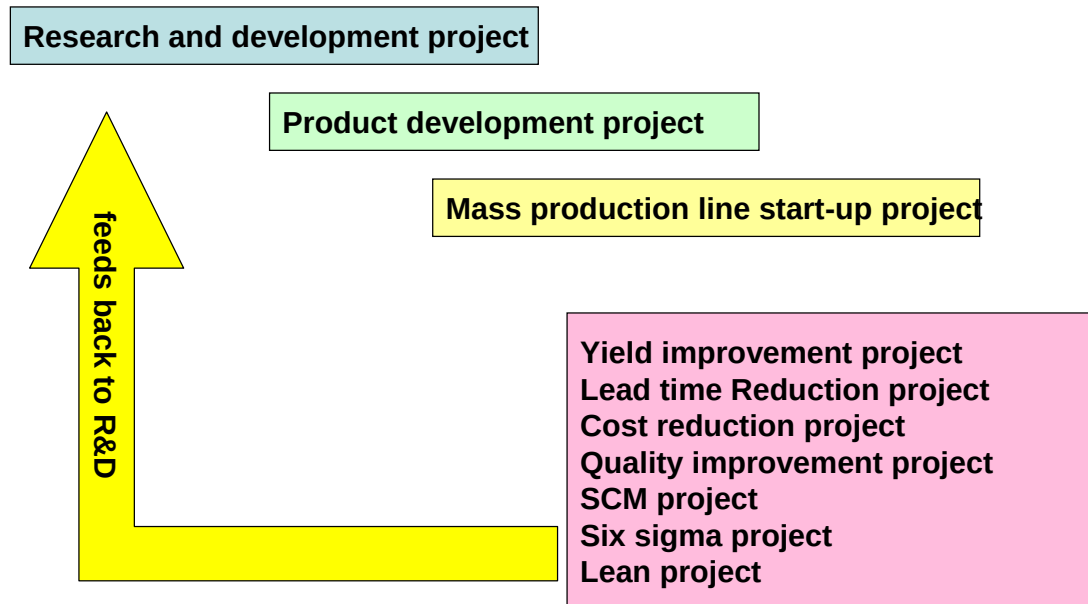
Critical Chain saves 30,000 lives



Holistic Project Management

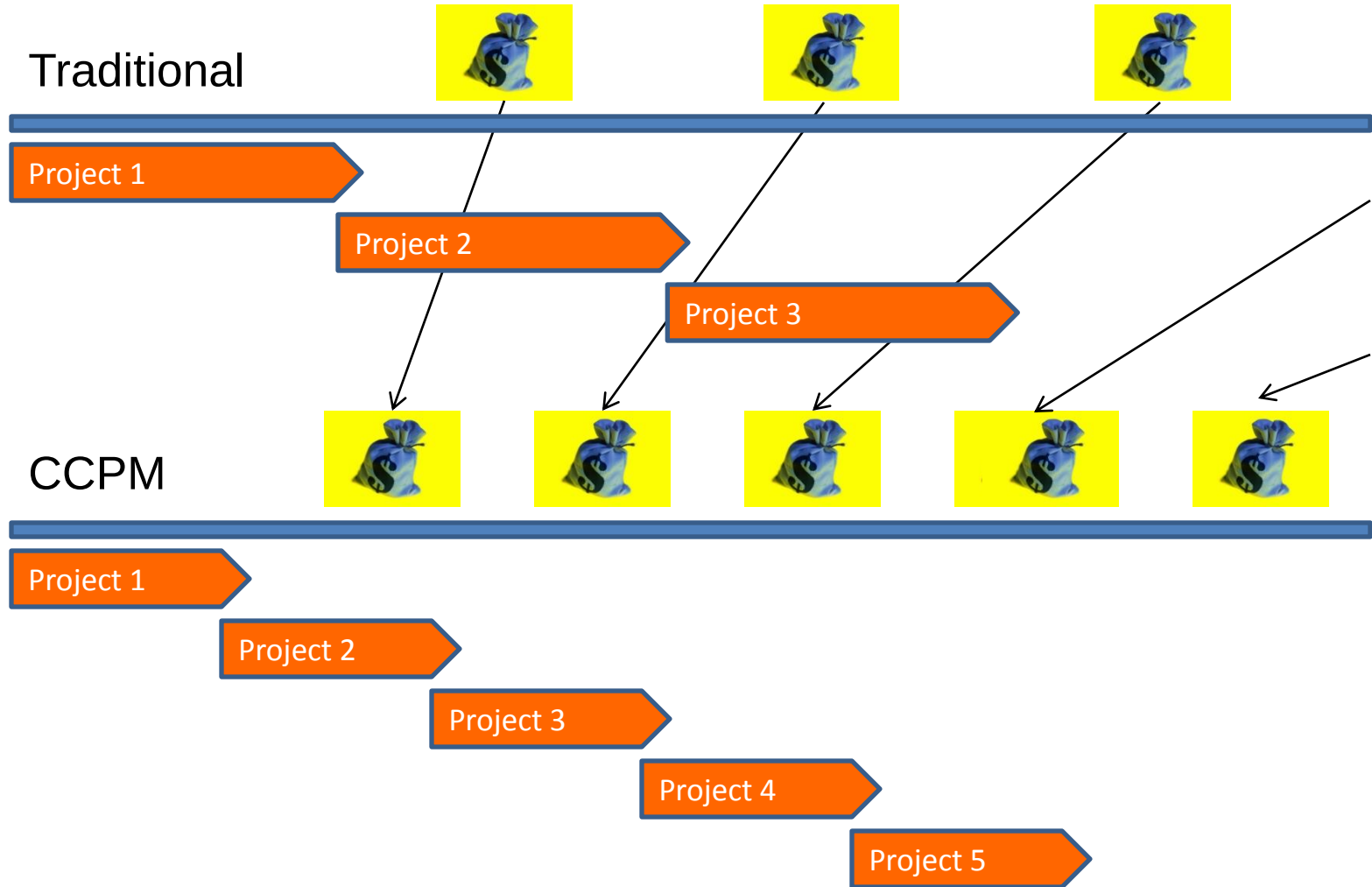
- It can be said that the definition of successful management is the continuous successful execution of projects

Even in manufacturing companies, projects are everywhere



- Successful project execution = the successful company

Greater Flow, Shorter Durations



Viable Visions and the S&T Trees

- 1999
- Viable Vision Reservations
- S&T Tree improvements
- The S&T Tree is not Holy
 - Inertia – make to availability
 - Invention of new TOC Solutions

TOC : The Essence of Management

- Given that constraints are inherent in all systems
- And that managing these constraints is an imperative
- And that successful management can be defined as the successful continuous execution of projects
- And that managing money is most effective when counted and measured as close to cash as possible

Then, the Theory of Constraints is much more than just
another improvement methodology

It is itself *The Essence of Management*

TOC : The Essence of Management

- Managing Constraints
- Managing Projects
- Managing Money

Inventing New Applications – The Concept of Flow

1. Improving flow (or equivalently lead time) is a primary objective of operations
2. This primary objective should be translated into a practical mechanism that guides the operation when not to produce (prevents overproduction)
3. Local efficiencies must be abolished
4. A focusing process to balance flow must be in place

Personal Growth

- Reality is simple
- Any conflict can be removed
- People are good (resistance to change is a misunderstanding)