Low Volume, High Variety Production, No Problem for Lean

By Kim Dixon

Technical Change Associates, Inc.

Kim Dixon

- **34 Years' Experience**
- **Expertise**
  - Kaizen Events
  - Manufacturing Strategic Planning
  - Facilities Planning
  - Manufacturing Engineering
  - Six Sigma
  - Project Management
  - 5S Housekeeping
- **Experience**
  - Project Coordinator
  - Manager-Manufacturing Engineering
  - Supervisor-Process Engineer
  - Production Manager
  - Sr. Manufacturing Engineer
- **B.S., Manufacturing Engineering**
- **Senior Member, SME**

Workshop Objectives

- Show how Lean tools can de adapted to drive improvement in a custom (low volume, high variety) environment

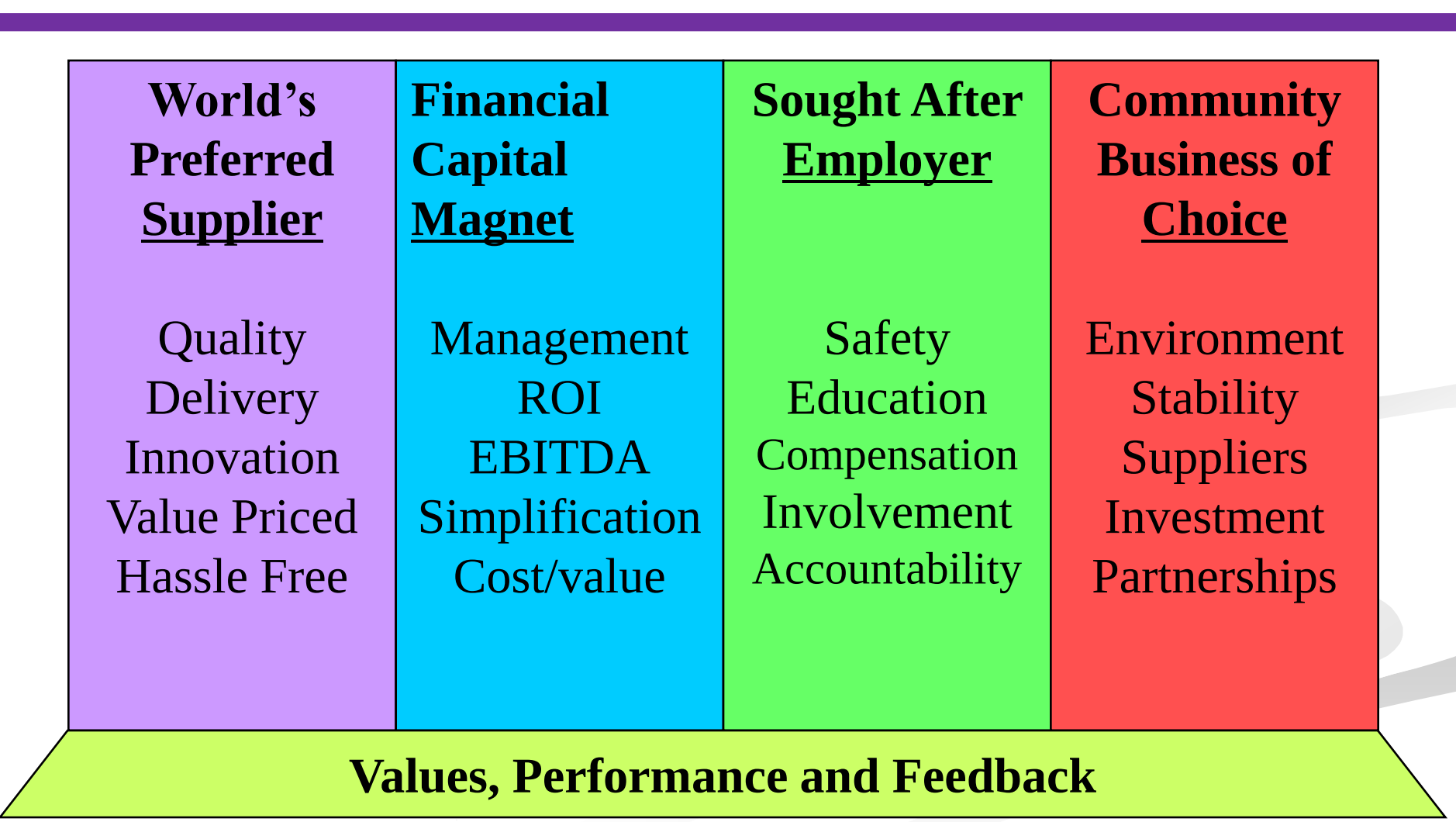
- Send you away with some specific ideas on how to employ in your company the concepts and principles that we discuss

Assumptions

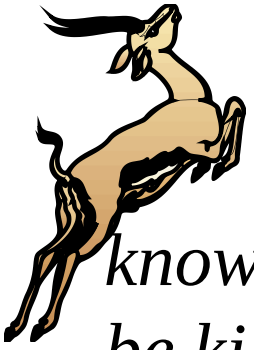
- We are people, not rabbits or alligators!
- Silence means non-involvement
- This is a “can do” group
- Everyone present is committed to learning how to develop a WCE
- “Show me” is a healthy attitude – ask questions
- We are all learners (facilitators included)

World Class Enterprise Overview

What Is World Class?

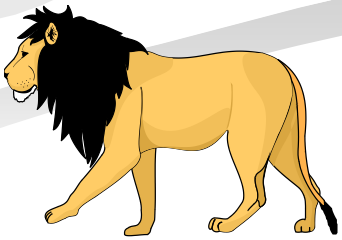


WCE is Market Driven



Every morning in Africa, a Gazelle wakes up. It knows it must run faster than the fastest lion or it will be killed. Every morning a lion wakes up. It knows it must outrun the slowest gazelle or it will starve to death.

It doesn't matter whether you are a lion or a gazelle - when the sun comes up, you had better be running.



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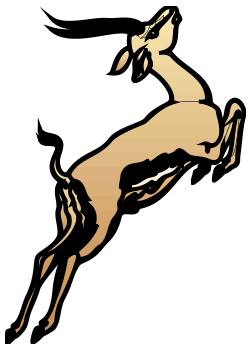
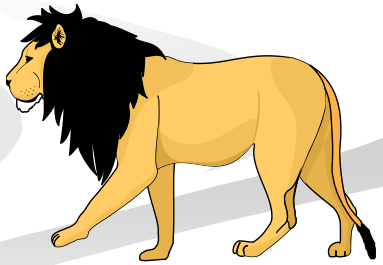


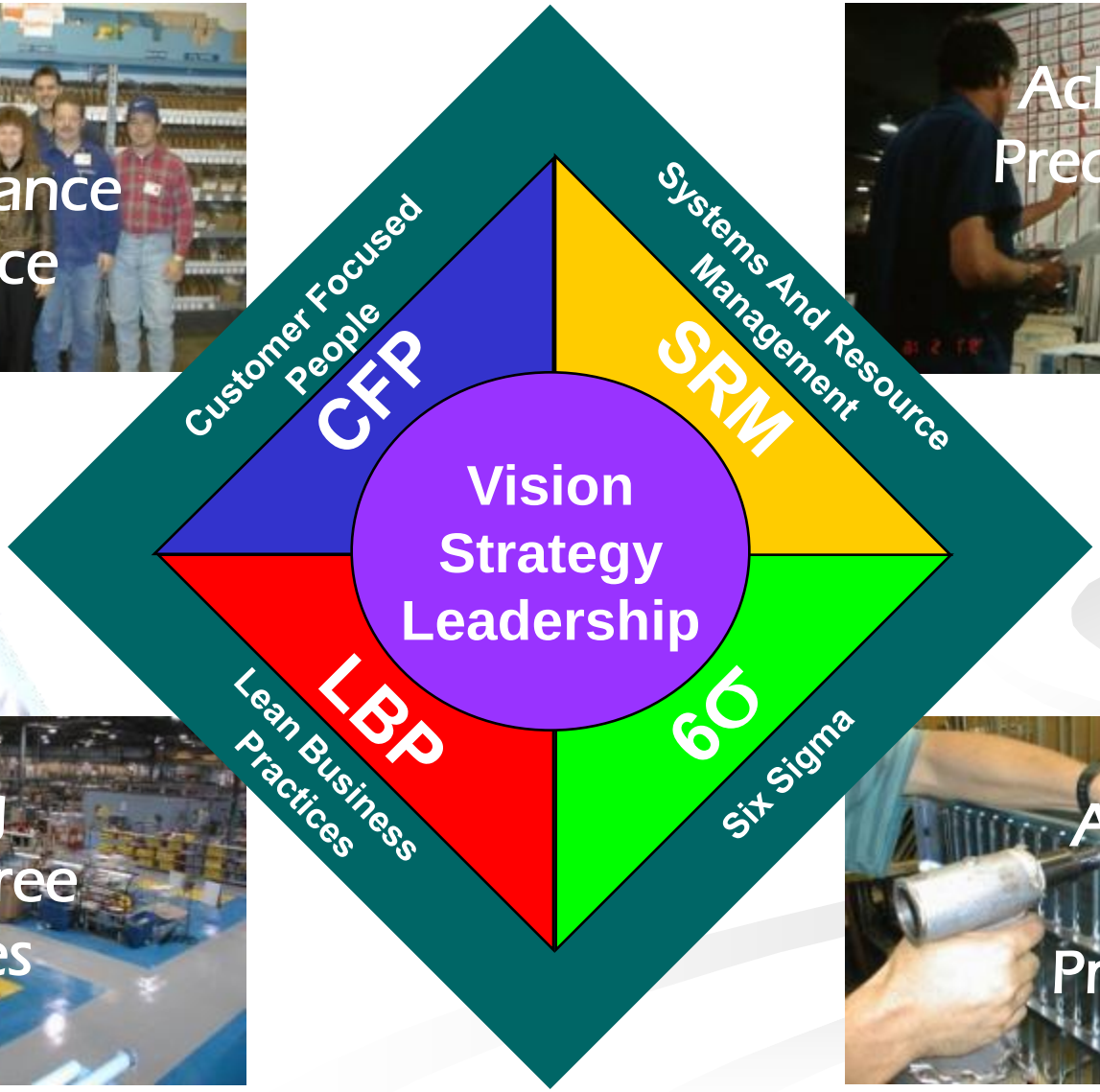
Not only running……..



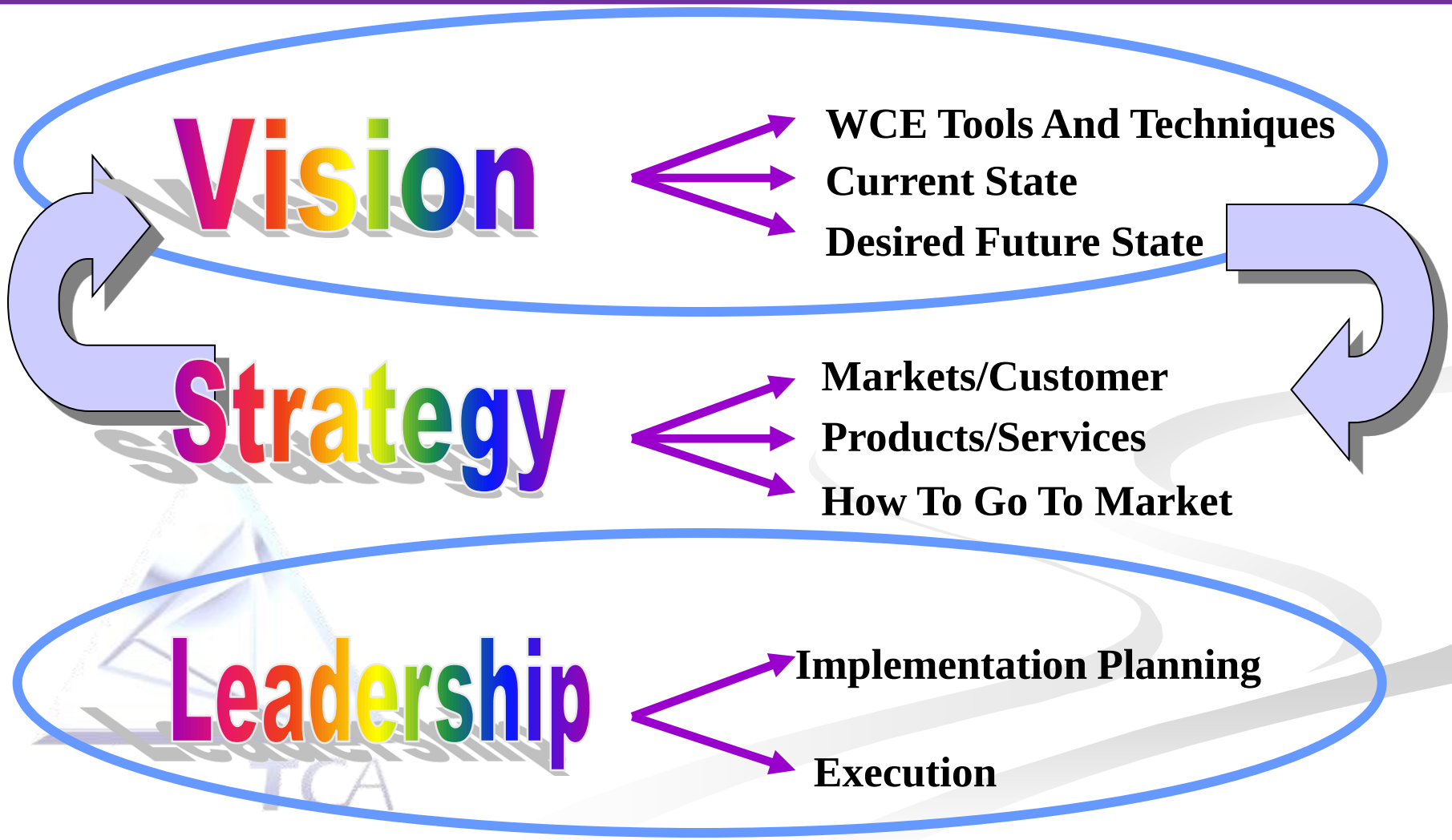
But in the right direction !

Your Journey to World Class

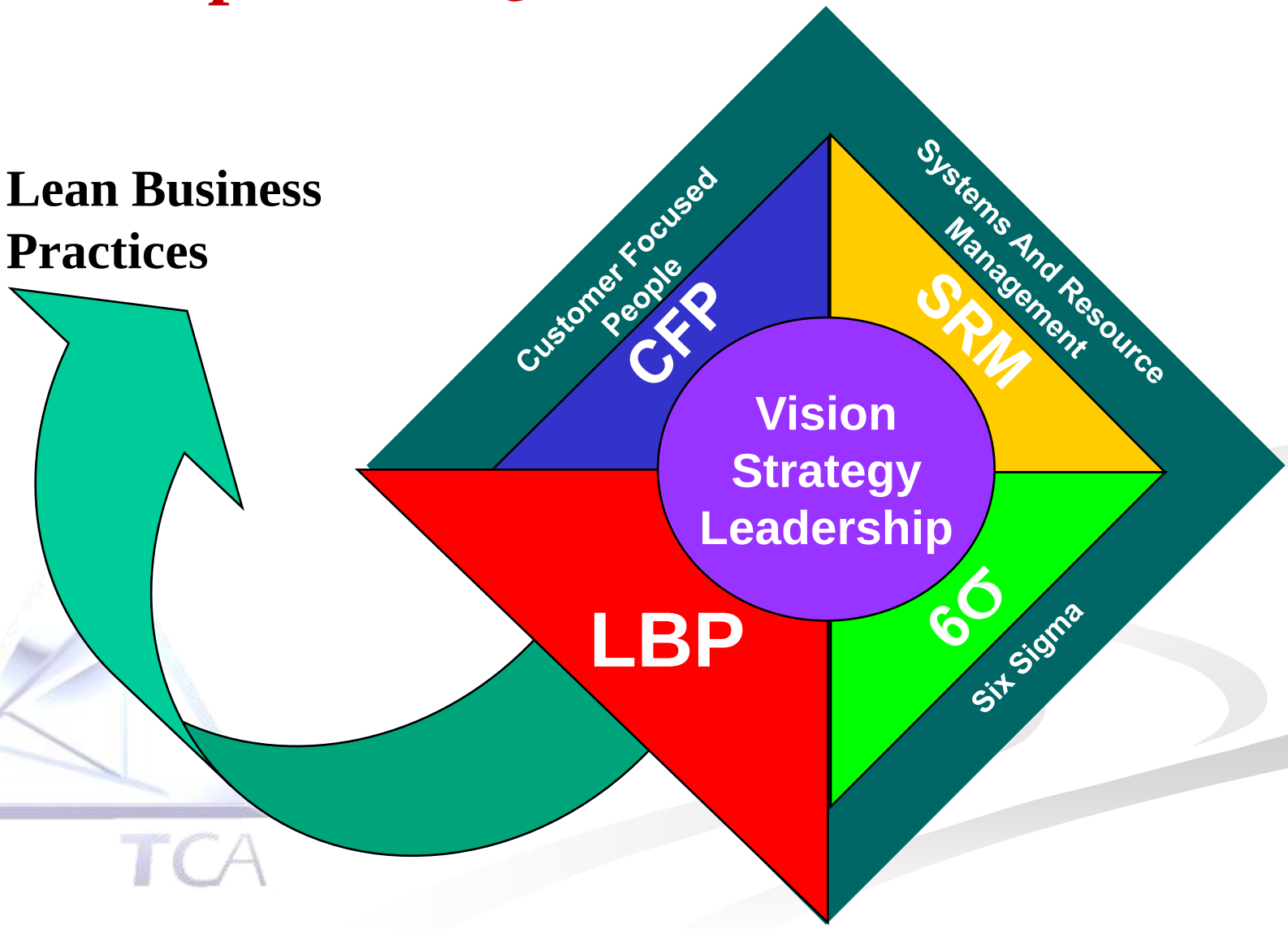
The Competition Quad



Core Of The Competition Quad



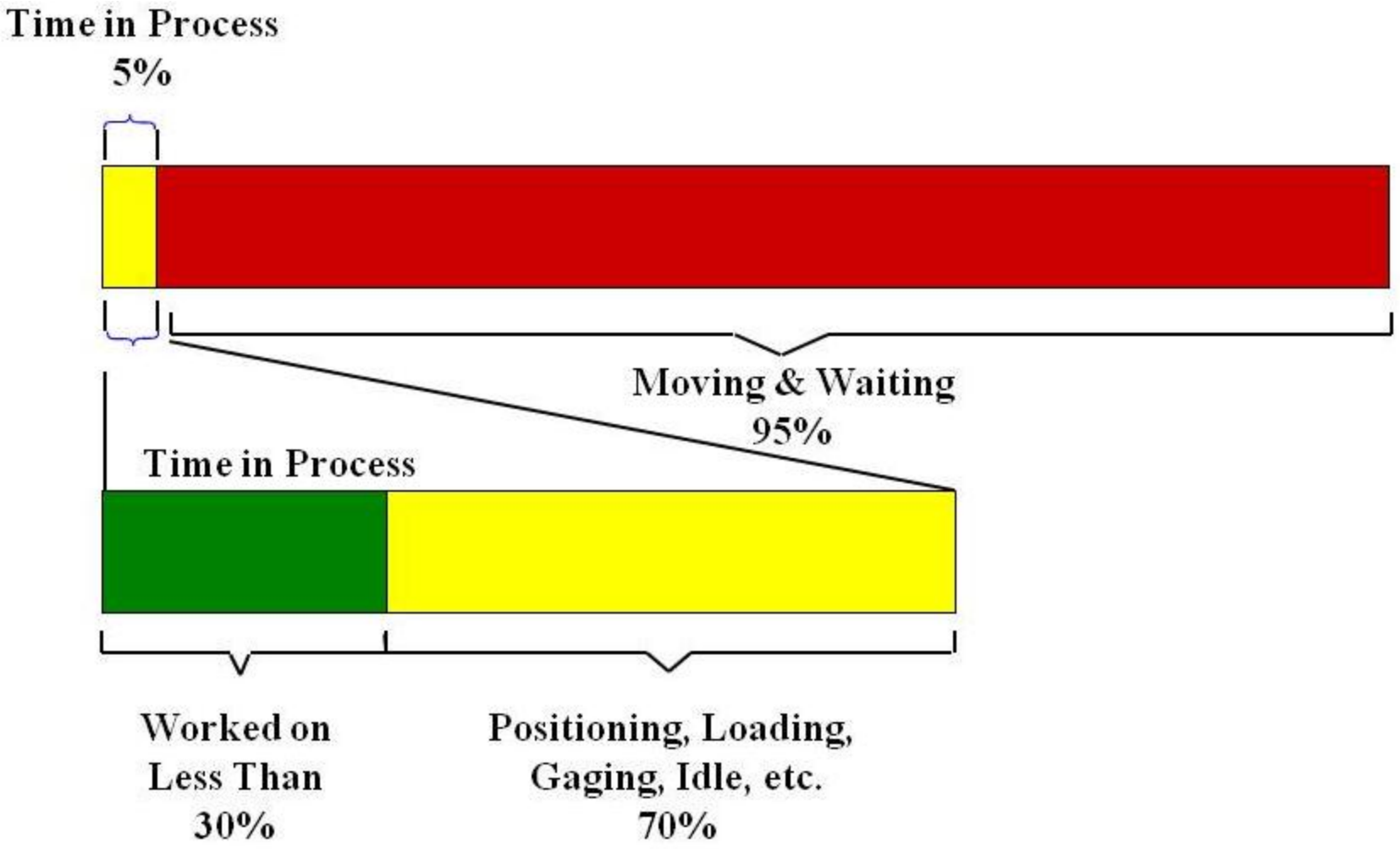
The Competition Quad

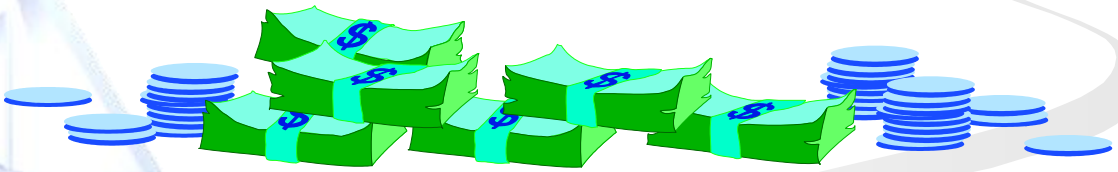


Waste Reduction

Is the Key to Improvement

The Lead Time Dilemma





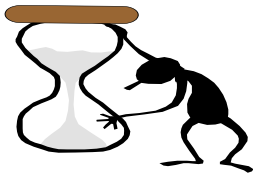
Definitions

- Value added
  - Any activity that increases the market form or function of the product or service
    - These are things the customer is willing to pay for
- Non-value added
  - Any activity that does not add market form or function or is not necessary
    - These activities should be eliminated, simplified, reduced or integrated
- Non-value added, but necessary
  - Activities that are mandated by customer or regulatory requirements or technology constraints

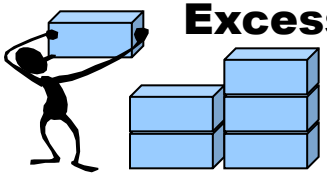
The Eight Deadly Wastes

Over Production

Transportation



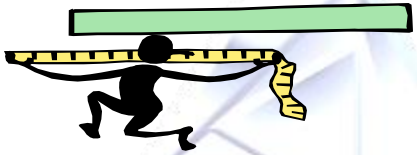
Waiting



Excess Inventory

Unused Employee Creativity

Unnecessary



Unnecessary Processing

Non-conformities

8 Wastes

Can You Find Examples of the "Eight Wastes" in YOUR Work Area?

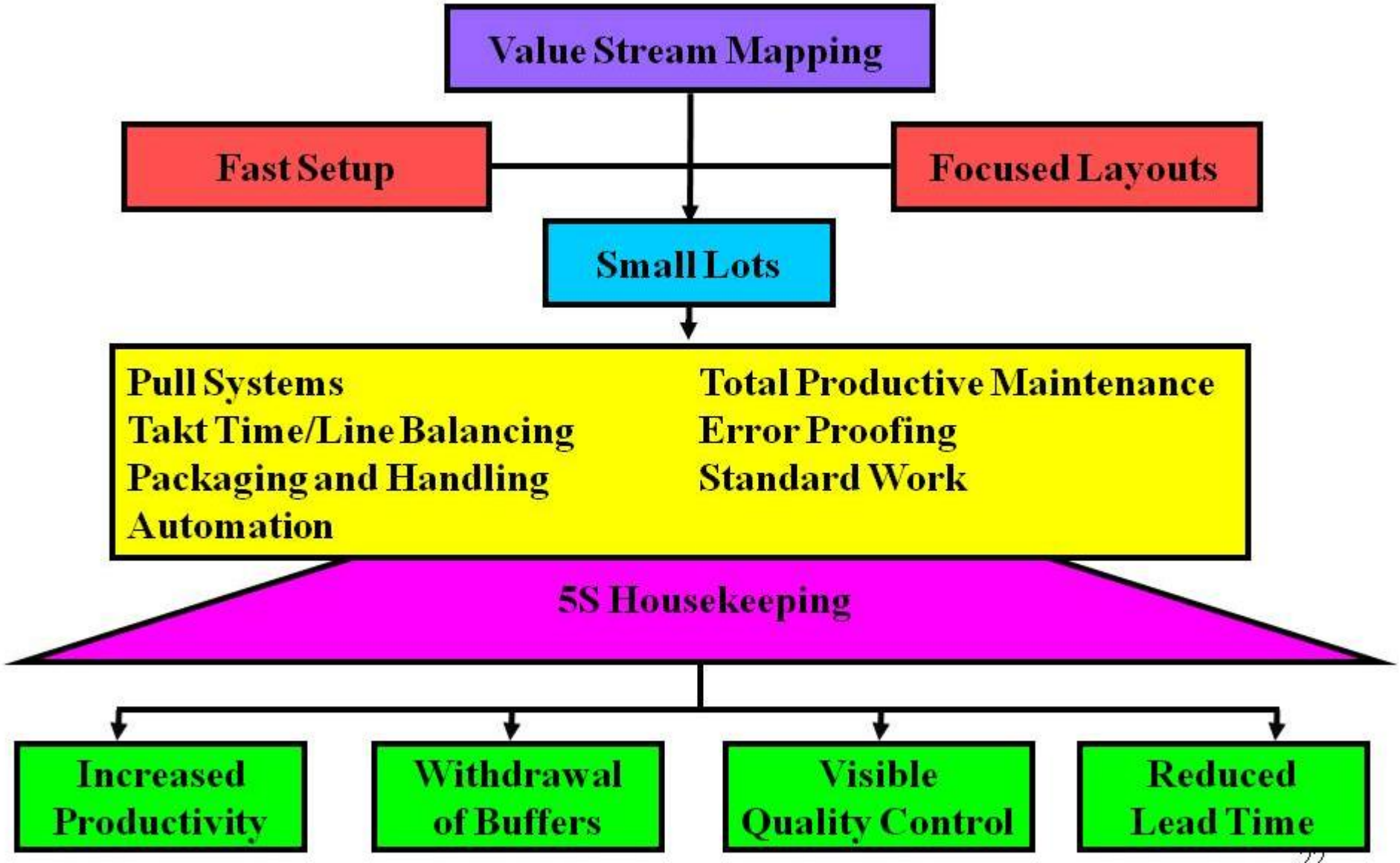
Cycle Time

"One of the most noteworthy accomplishments in keeping the price of Ford products low is the gradual shortening of the production cycle. The longer an article is in the process of manufacture and the more it is moved about, the greater is its ultimate cost."

Henry Ford, 1926

Lean Business Overview

Lean Overview



The Origins of JIT

The Origins Of Lean

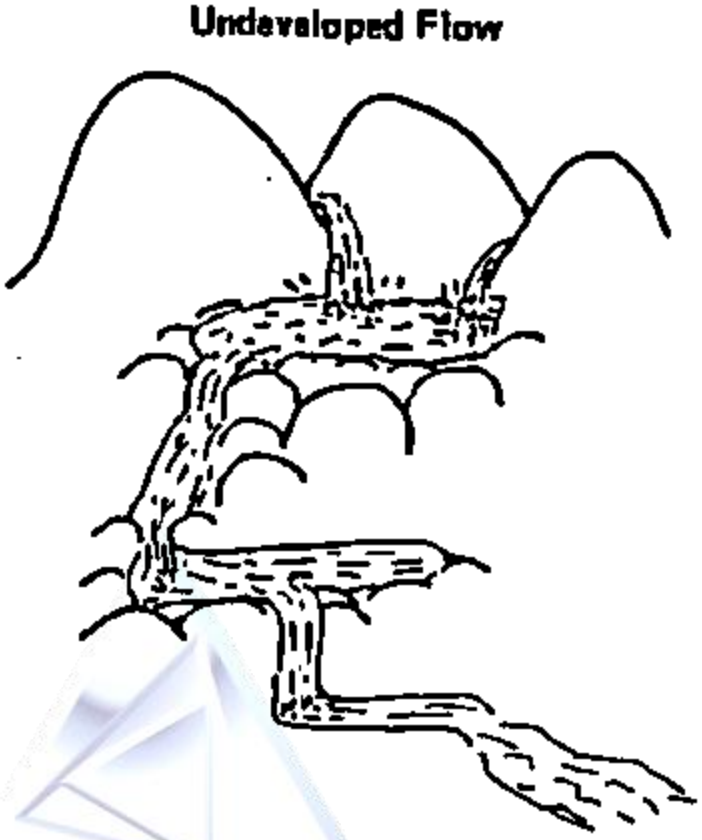
	Pre-Industrial 1890	Mass 1920	Lean 1980
People	• Craftsmen perform all aspects of task • Self-taught or apprenticeship training	• Employees contribute minimally to total product • Training for limited skills • Management makes decisions	• Clusters of employees working in teams • Extensive, continuing training
Product	• Customized, non-standard products • Variation in quality	• Standardized, focused on volume not quality	• Focus on internal/ external customer
Work Environment	• Independence, discretion • Variety of skills • Responsibility	• Limited skills and knowledge • Repetitive, mind-numbing work • Little discretion, simplified tasks	• Some discretion, group effectiveness, empowerment, team accountability, work cells

Lean: A Working Definition

A Structured (Disciplined) Manufacturing Approach
Focused on …
Enabling smaller Lots, More Frequent Deliveries
and…
Greater Quality, Productivity and Competitiveness
Through…

Systematic
Elimination of All Waste !

Developed Flow Is Less Disruptive



Source: Suzaki. The New Manufacturing Challenge

Custom

What is Custom?

MTS	ATO	MTO	ETO
End item is stocked in finished goods	"Pinch point" subassemblies are stocked in process	No finished goods nor subassemblies are stocked	No finished goods nor subassemblies are stocked
All raw material and components are stocked	All raw material and components are stocked	Possibly some raw material or components are not stocked	One or more raw material or components are not stocked
Engineering is complete	Engineering is complete, configuration may need specification	Minor one-off engineering may be required	Significant engineering is required

What is Custom? (cont)

- Tell us about your operations

Operational Excellence

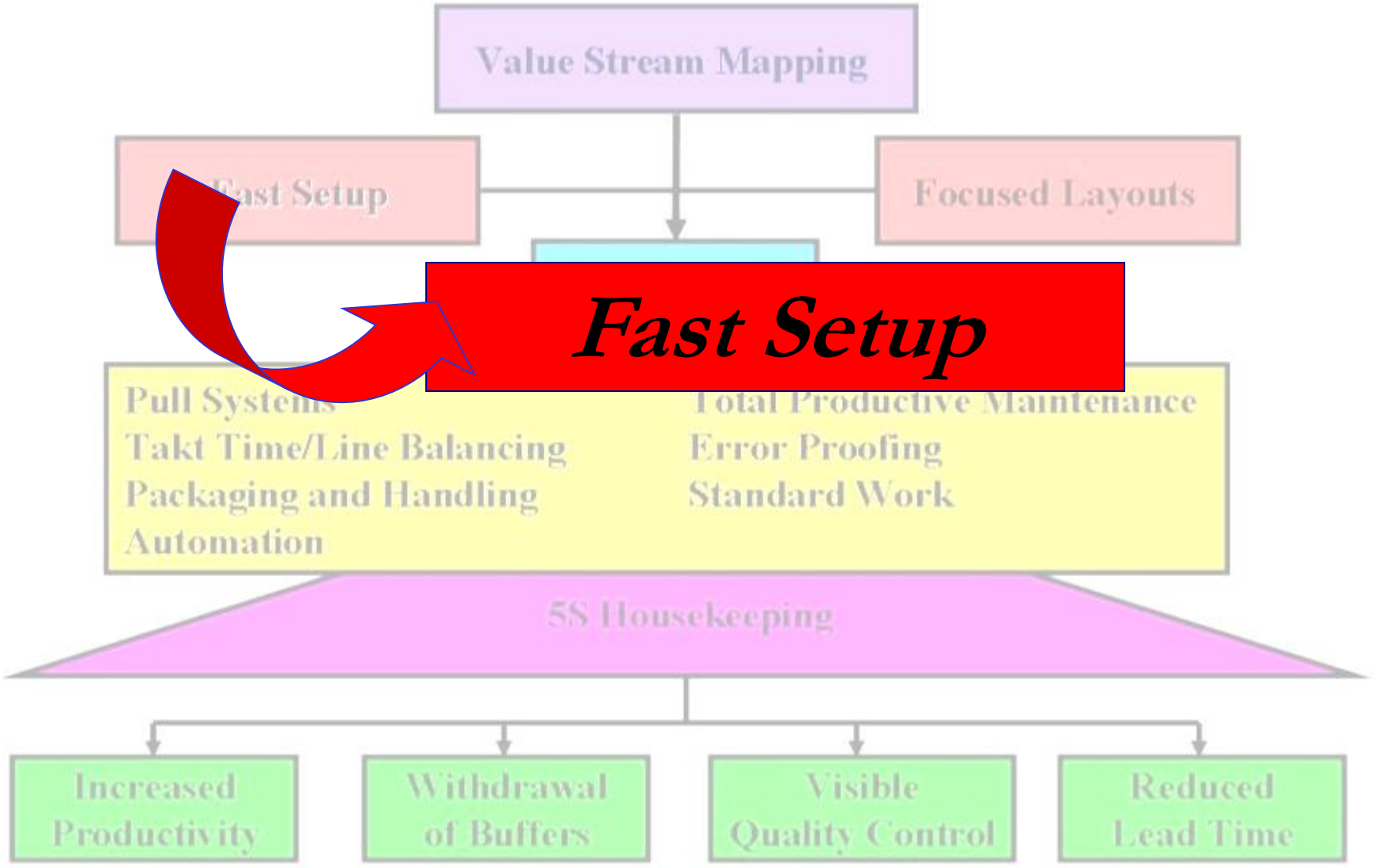
Factoids

- Lean evolved in repetitive manufacturing environments
  - Re: "The Toyota Production System"
- Custom manufacturers have viewed Lean with some skepticism from the beginning
- We (consultants) have not done well in illustrating the applications of Lean in your situation

Custom Adaptations

Lean Tool	Basic Purpose	Custom Manufacturing Application
Value Stream Mapping	Identify Part/Product Families and Related Processes, "See Waste"	Critical Focus on Front- end Processes
Fast Setup	Enable Flexibility and Small Lots, Regain Capacity	Constraint Resources are Key
Focused Layouts	Physically Isolate Value Streams, Recreate the "Mom and Pop" Shop	Some Monuments May Remain-- Virtual Cells and "Cell-for-a-Day"
Small Lots	Reduce Queuing, Provide Flexibility	Cost Effective Handling of One-off Quantities, mixed model cells
Pull Systems	Flawless Replenishment With Minimum Queues	Oueue Limiters and Pull to Time Slots
Takt Time/Line Balancing	On-time Delivery With Maximum Productivity	May Use Variations; Earned Hour Run Rates--Load Balancing
Packaging and Handling	Support of Waste Free Processes	May be Less Important
Standard Work	Institute Best Practices/Minimize Variation	Must Include Front-end Processes
Preventive Maintenance	Minimize Queuing and Other Waste Due to Breakdowns	A Dominant Tool, Especially in Capital Intensive Environment
Error Proofing	Minimize Queuing and Other Waste Due to Quality Problems	Major Focus on Front-end Processes
5S Housekeeping	Support of Waste Free Processes	Another Dominant Tool-- Office and Shop
Automation	Provide Breakthrough Productivity Improvement	Some Opportunities -- But Risk the Loss of Flexibility

Lean Overview – Fast Setup



Setup Reduction

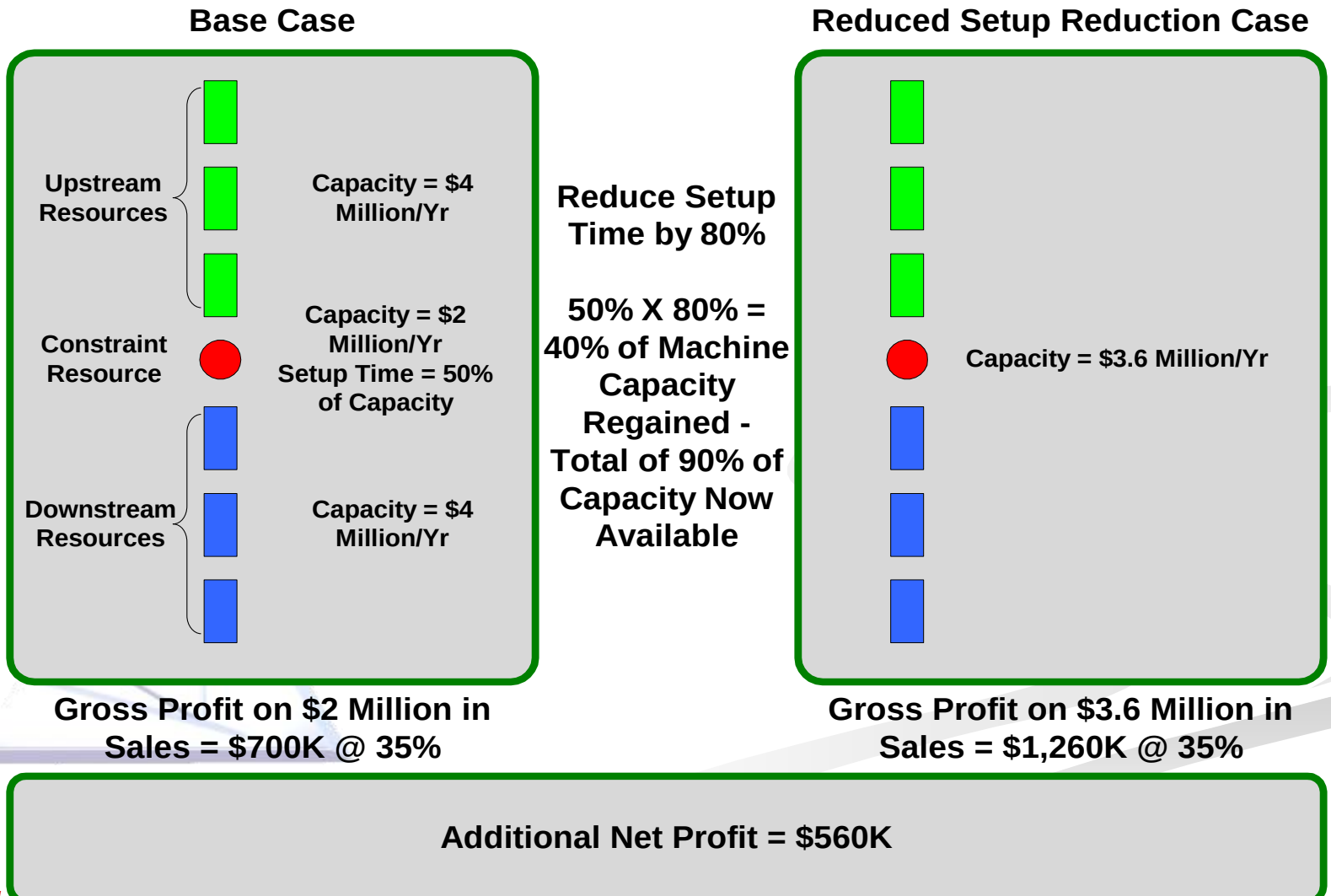
Setup Time: A Definition

- The time between critical steps of the service or maintenance process led by the mechanics, offset by the non value added steps to prepare the task!!!!!

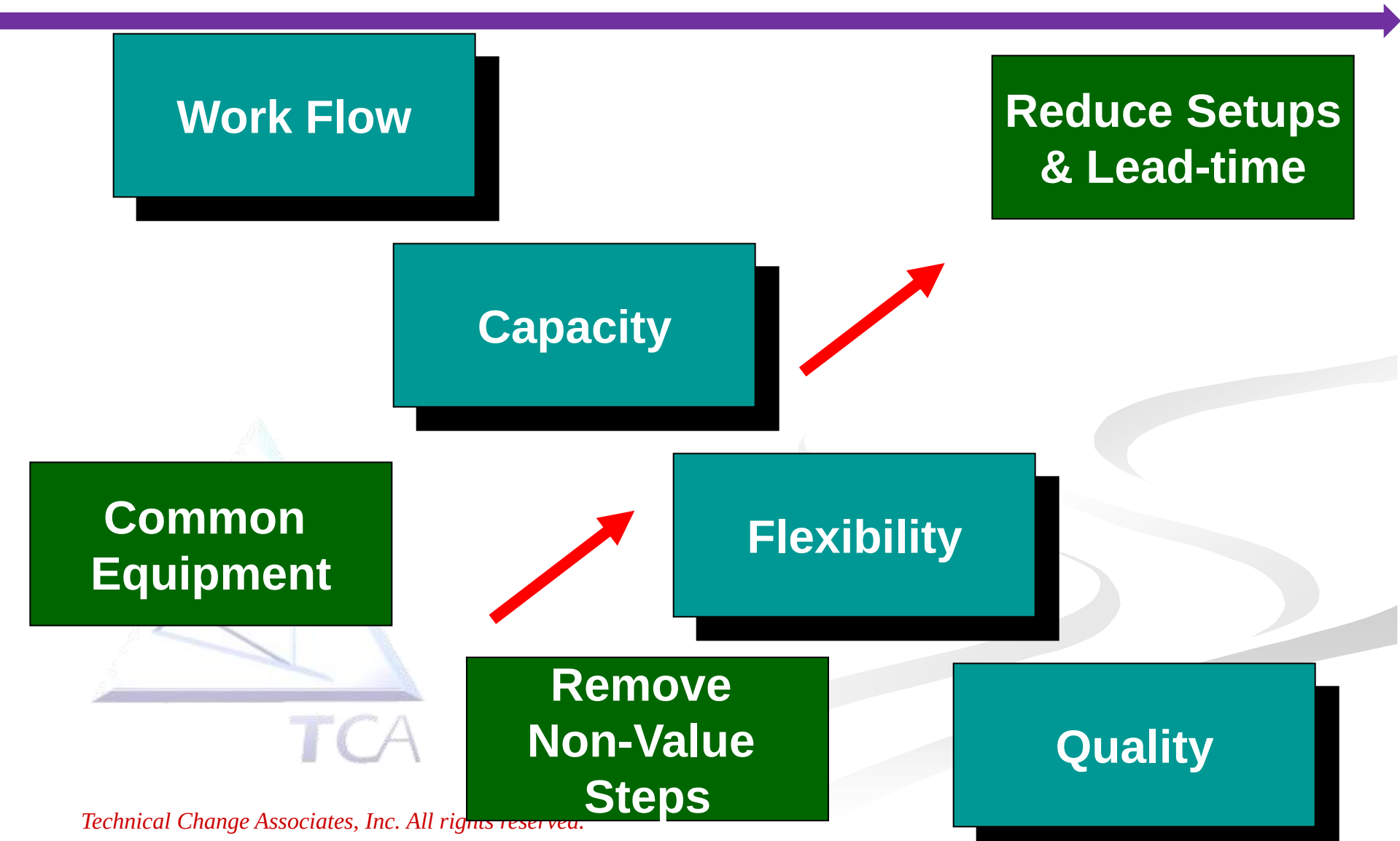
Setup Time: A Definition (cont)

- Unlike manufacturing, which is based on predictable processes, the Service business is very dynamic, variability and change are always in flux
- Efficiency is created by identifying the common servicing elements by using common equipment

The True Economics of Setup Reduction



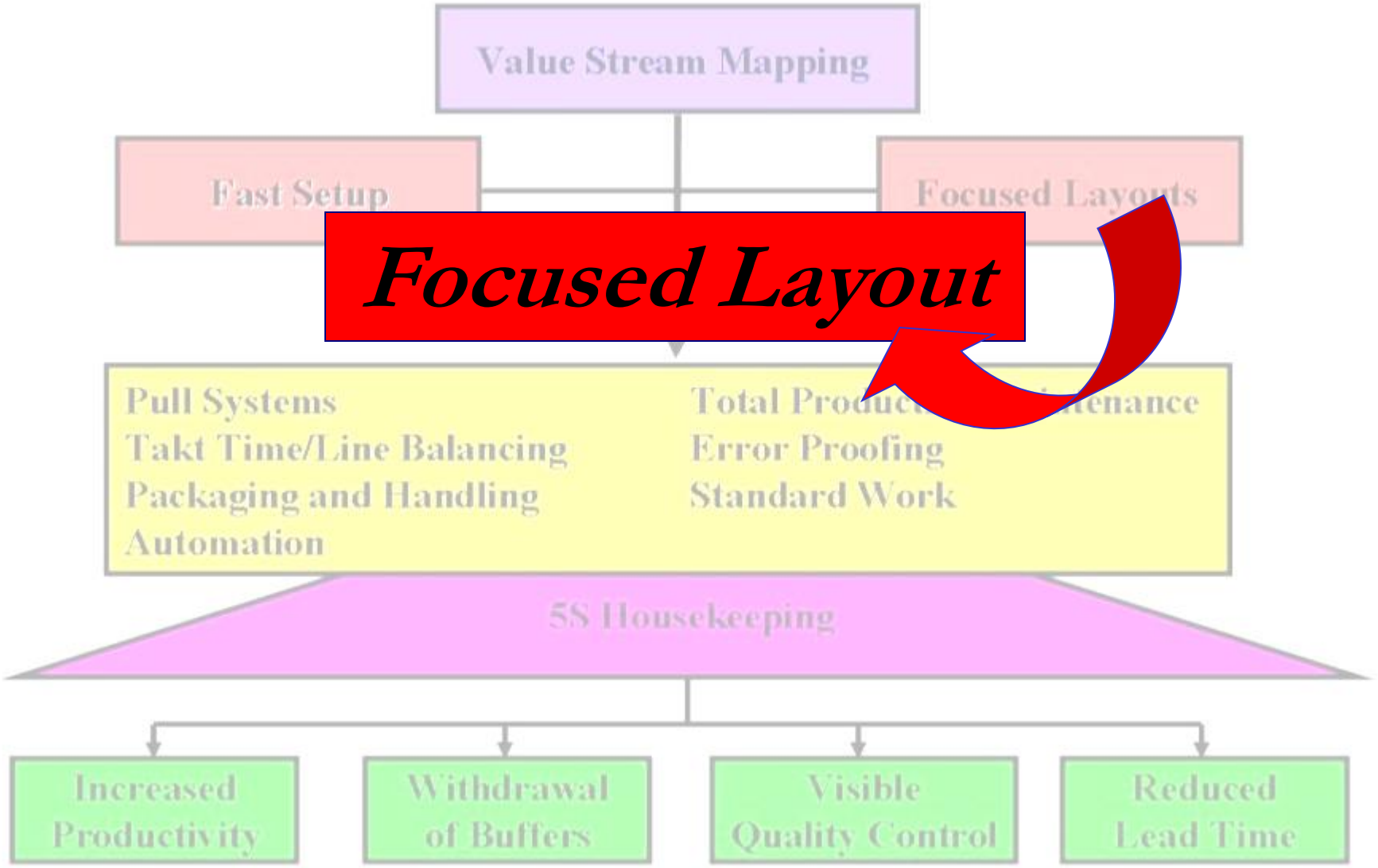
Why Setup Reduction?



Setup Reduction

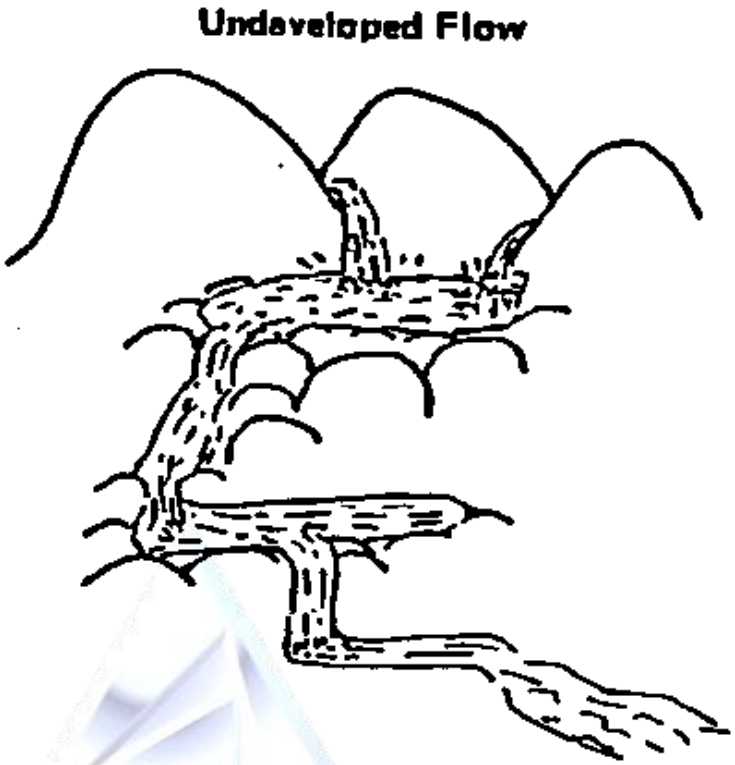
- *Setup Reduction is not just for manufacturing!*
  - Administration
  - Order Entry
  - Intellectual Setup
  - Finance
  - Engineering
  - Purchasing Materials

Lean Overview - Focused Layout



Plant Design for Lean

Developed Flow Is Less Disruptive

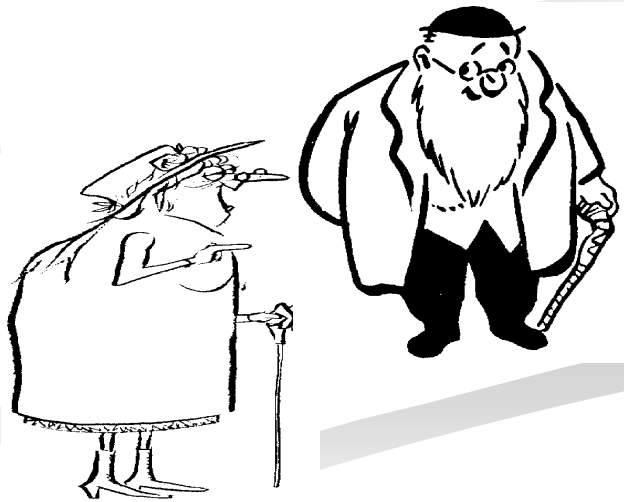


Source: Suzaki. The New Manufacturing Challenge

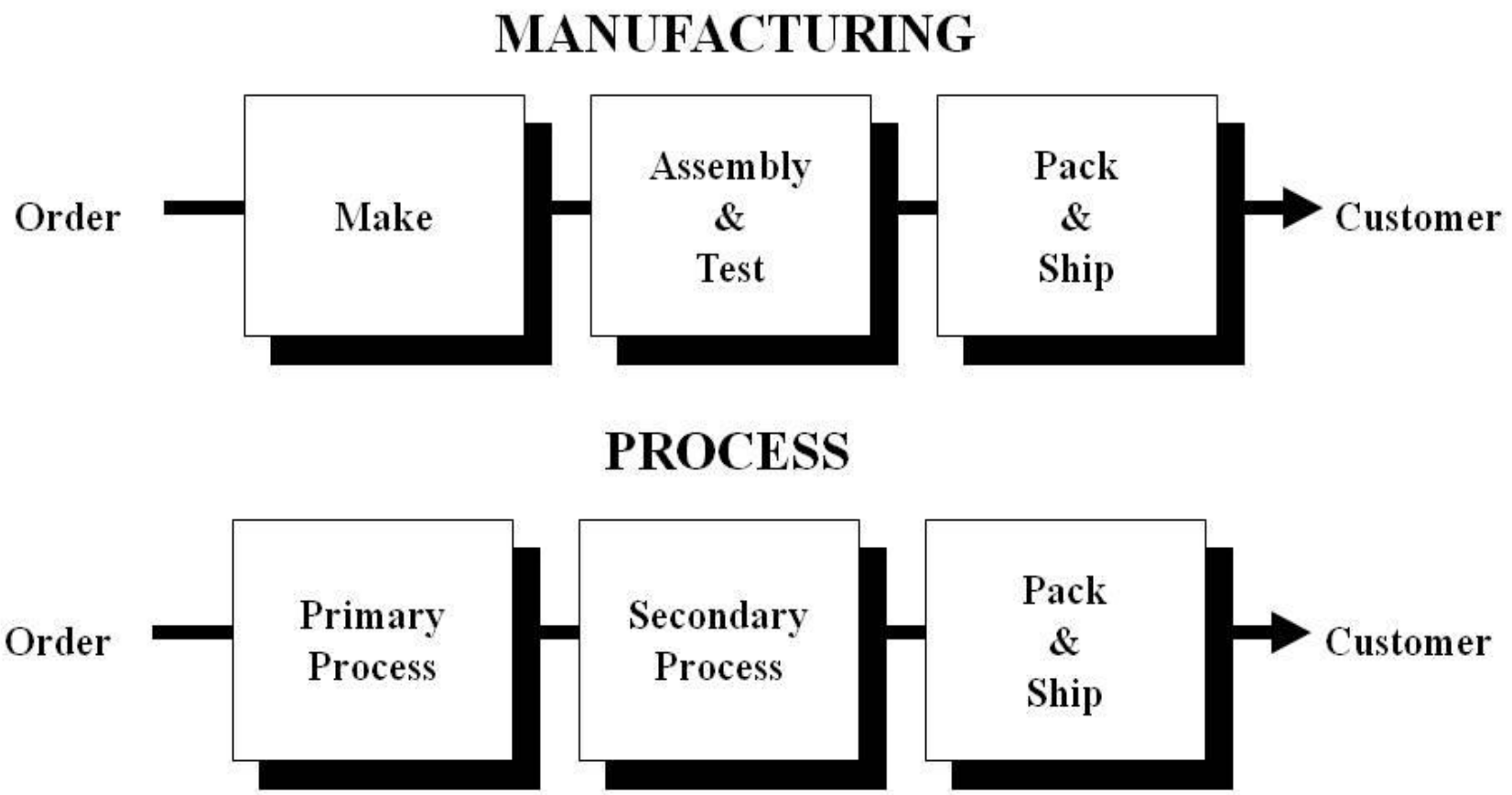
Cellular Manufacturing

Mom And Pop Shop Demonstration

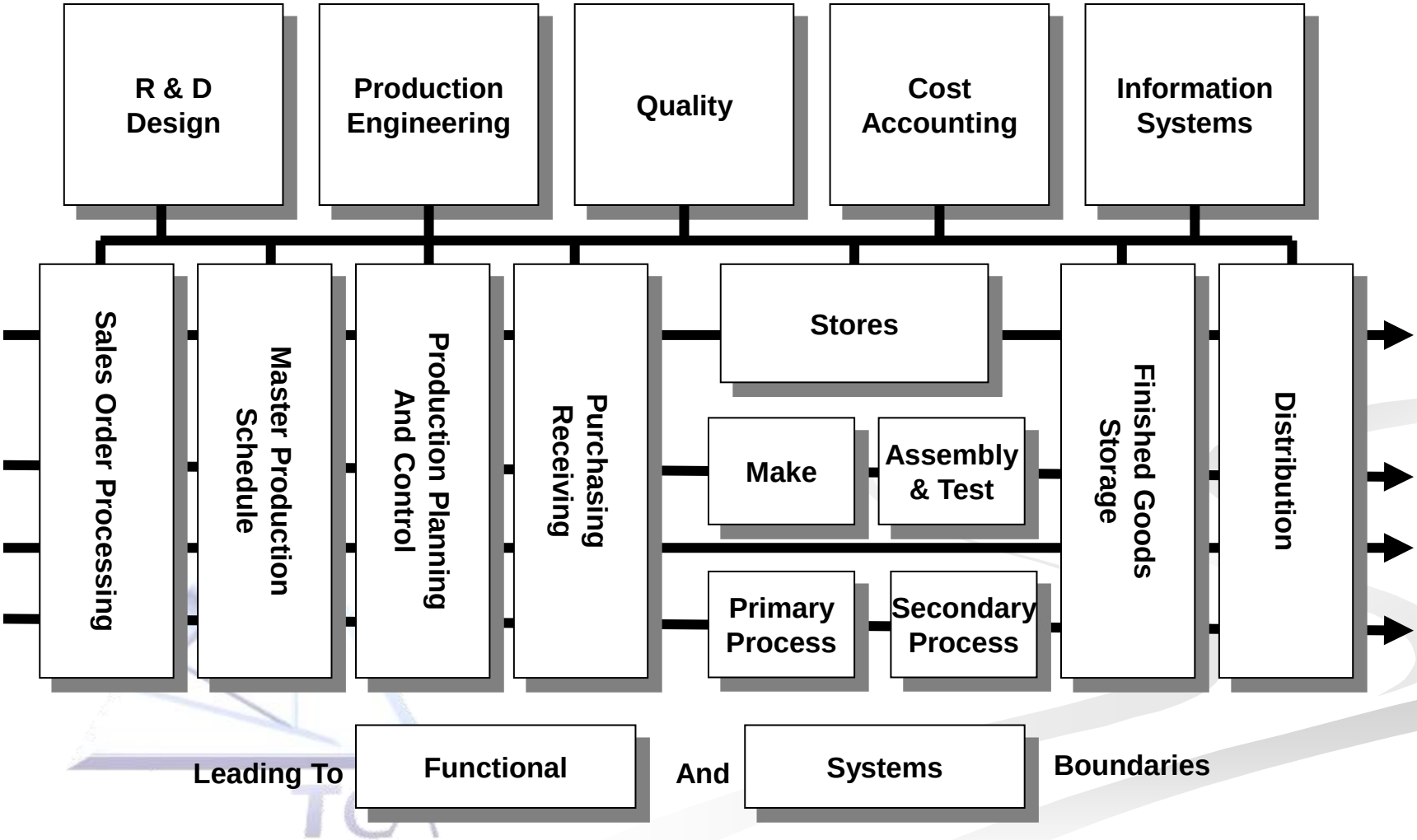
- Recreate the Mom and Pop shop through cellular layout and related accountabilities
- Main point
  - Properly designed cells ***recreate*** the mom and pop shop with all of its characteristics
  - But with refinements!



We Have Taken A Simple Process...



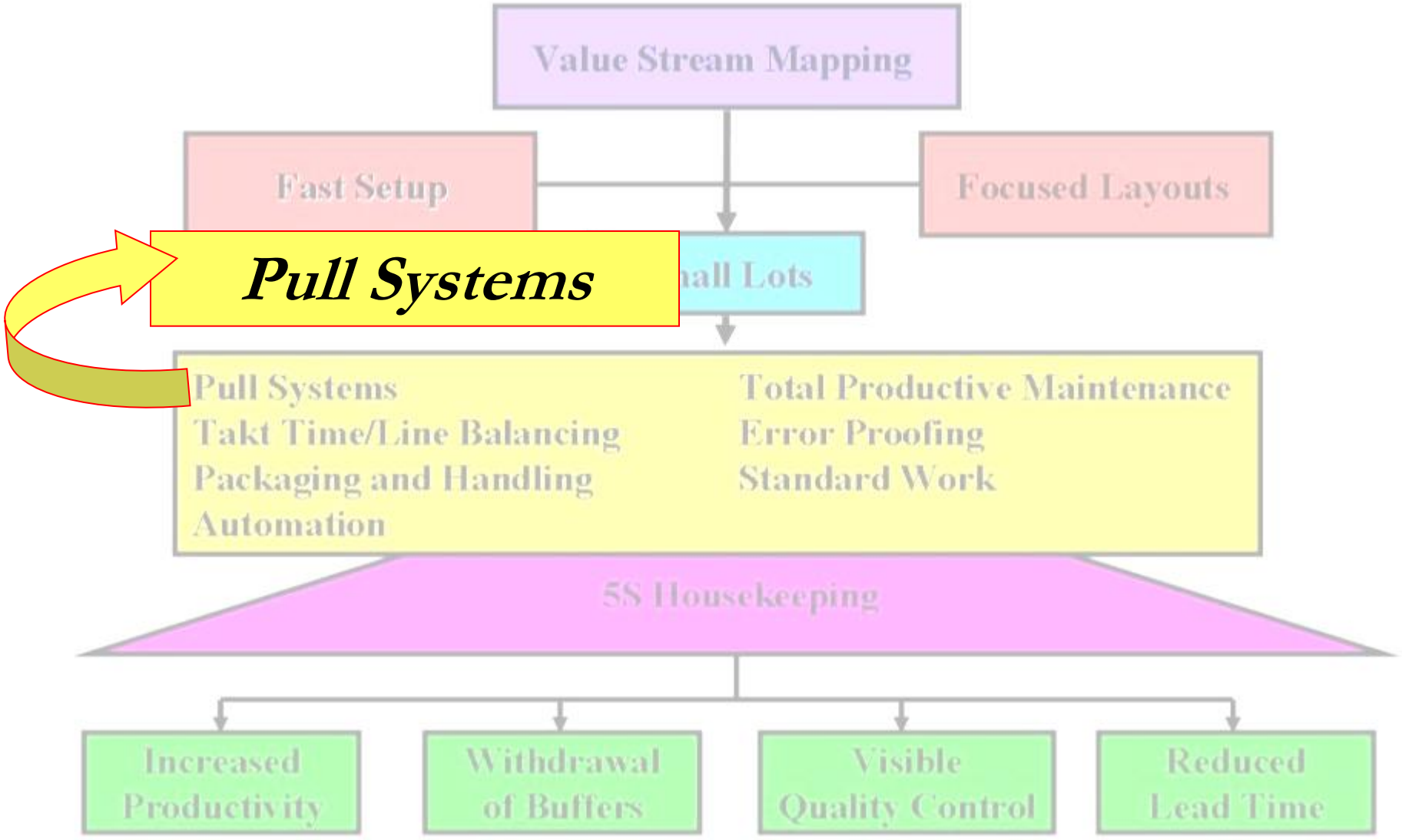
...And Complicated It!



The Golden Rules of Flow

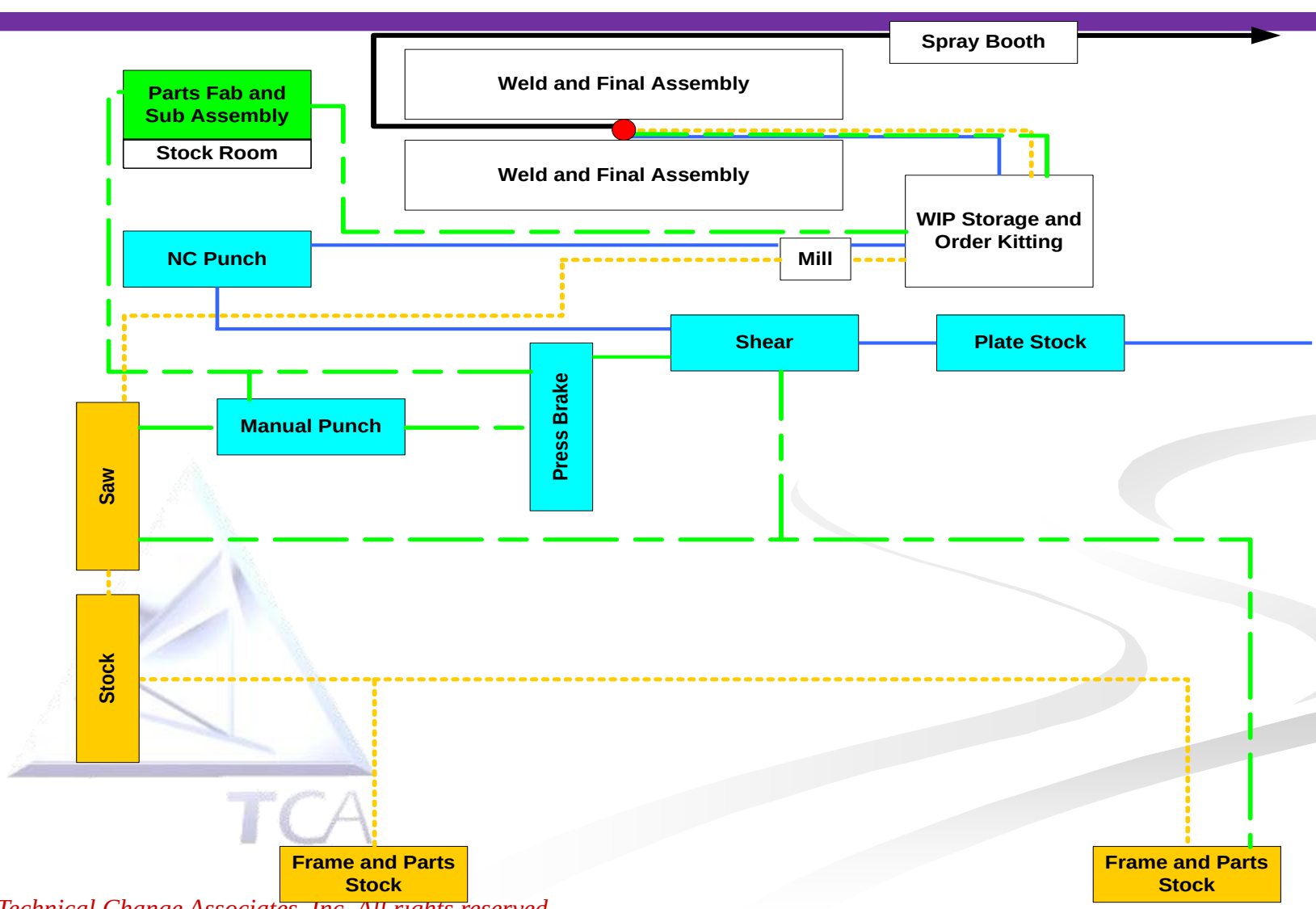
1. If you touch it, finish it!
2. Flow one piece at a time
3. Flow in one direction
4. Never pass on defective work
5. Balance each task to the Takt time

Lean Overview – Pull Systems

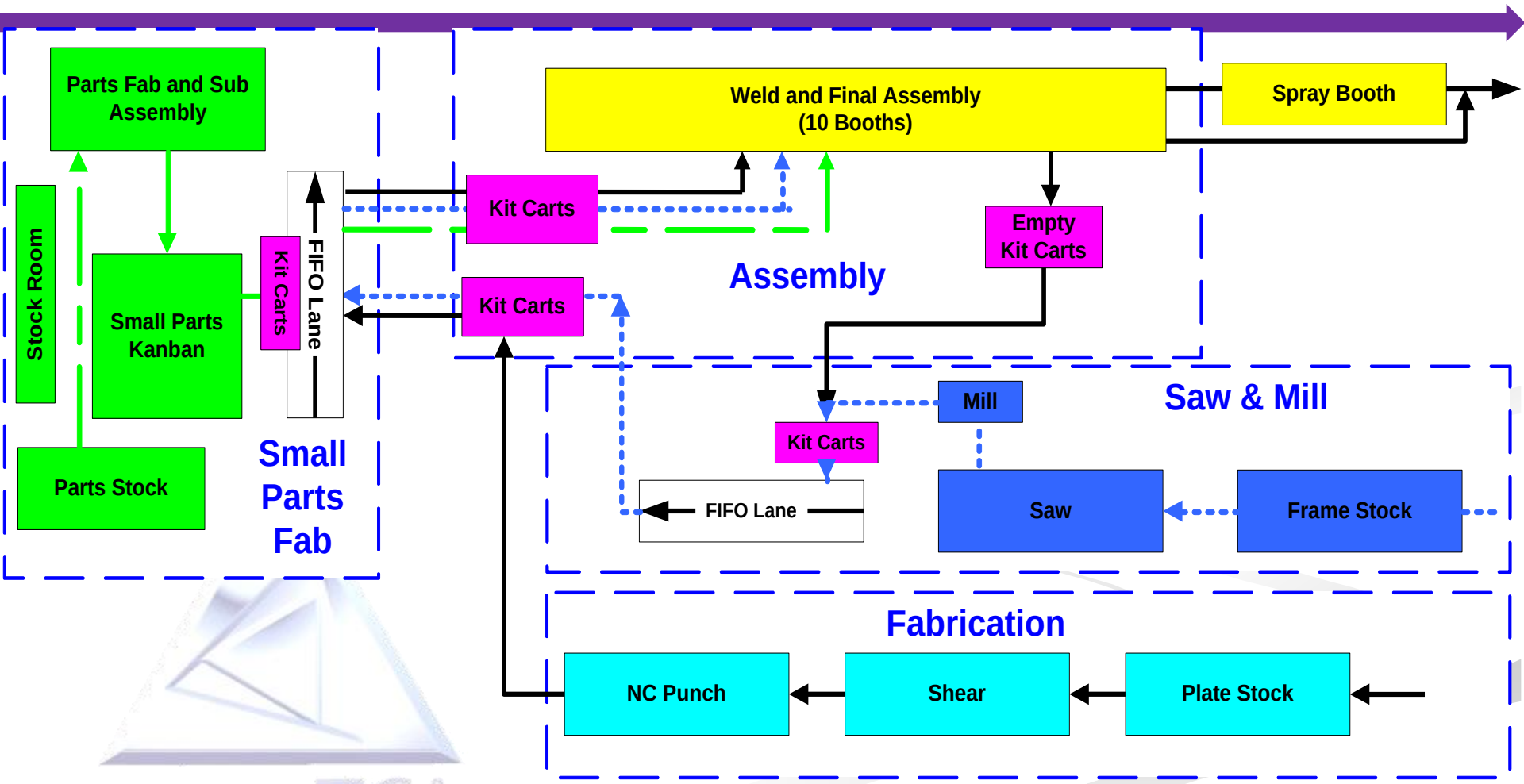


Pull Systems

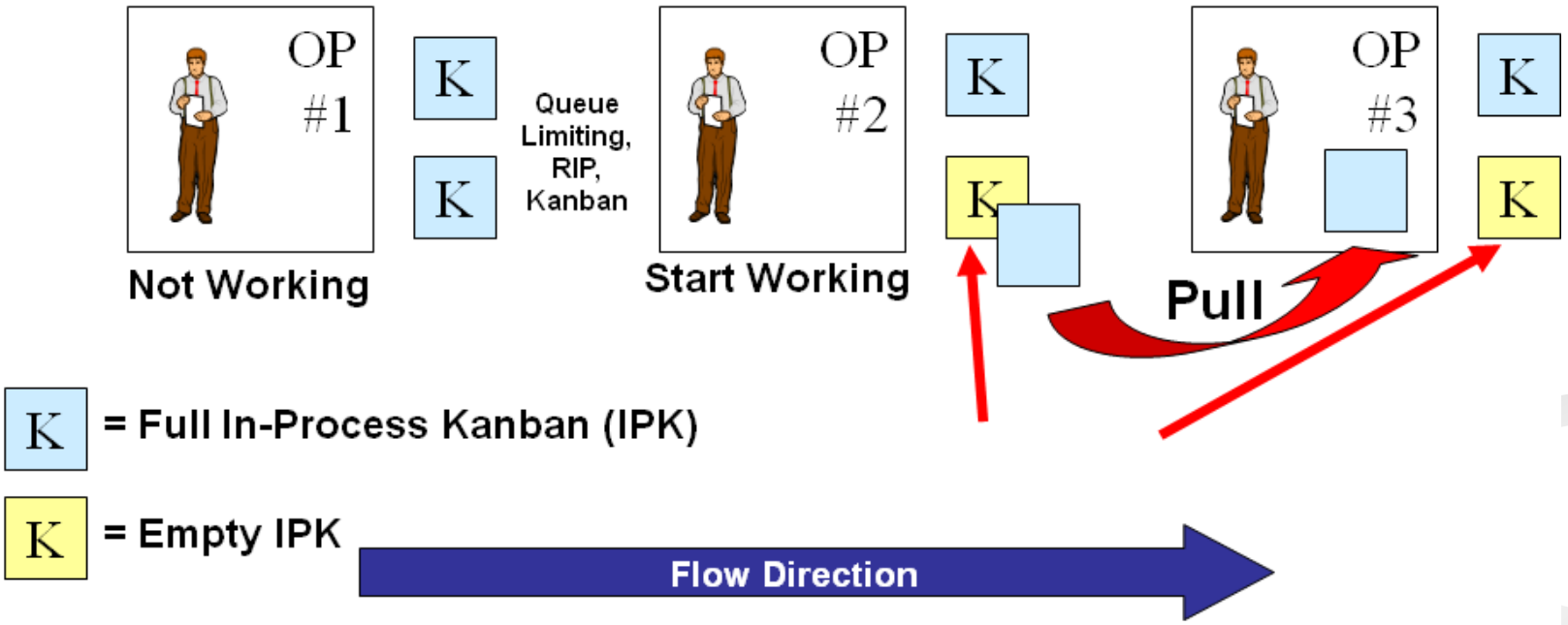
Traditional Layout



Lean/Cellular Layout

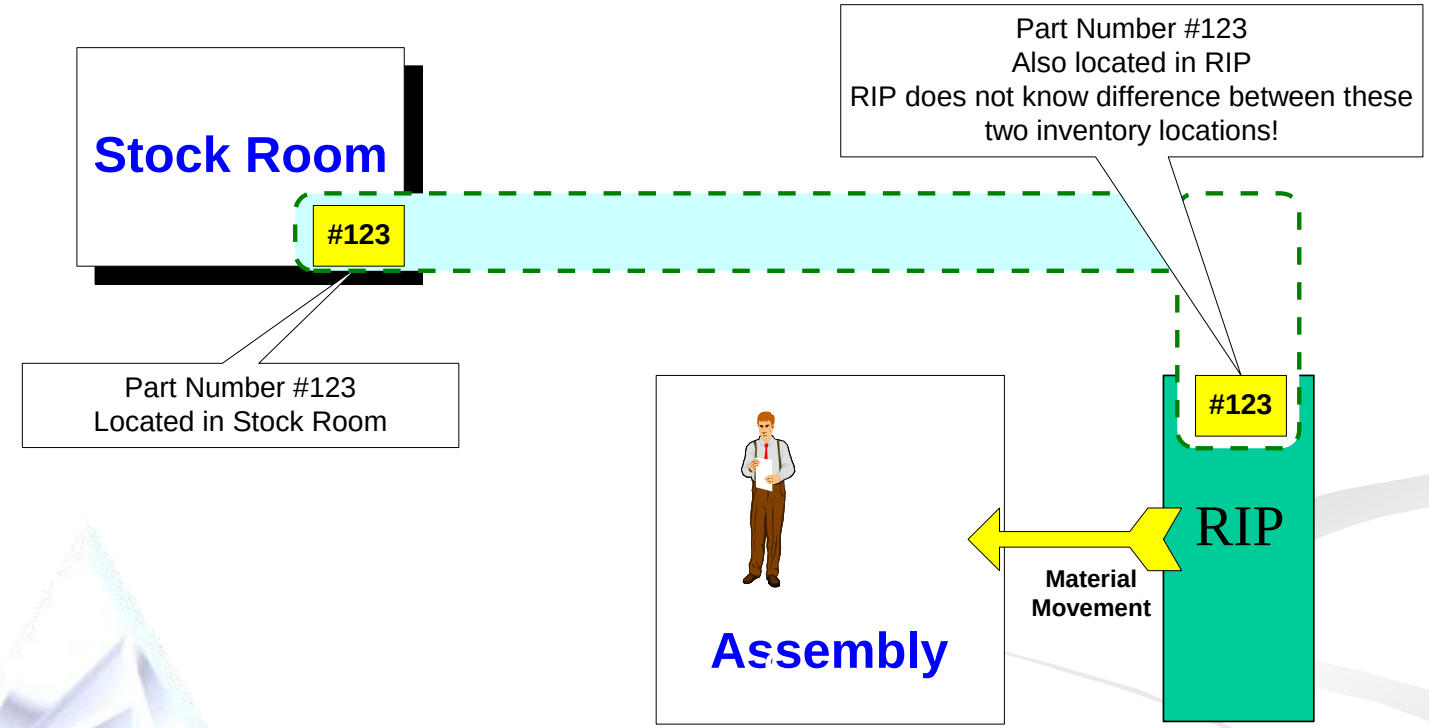


Demand Pull System



FIFO = IPK = Queue Limiter

RIP Stock Example



RIP is also knows as:
Supermarket or Point of Use (POU)

RIP =
Raw In Place

Why Pull Systems?

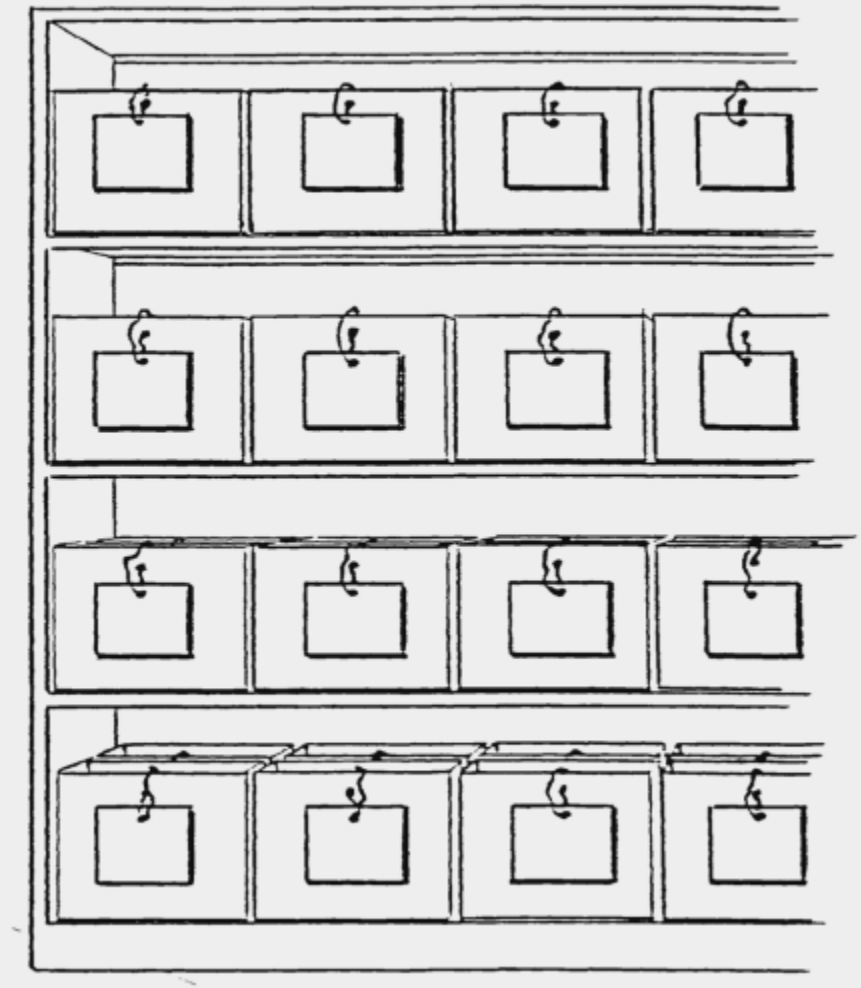
- Answers questions:
  - What part number do we do next?
  - How many should we make?
  - When should we do them?
  - Where should we deliver them?
- Links upstream replenishments to market demand
  - Keep them in “sync”
- Limits queuing (overproduction)
- Provides triggers for:
  - Line balancing
  - Cell work scheduling

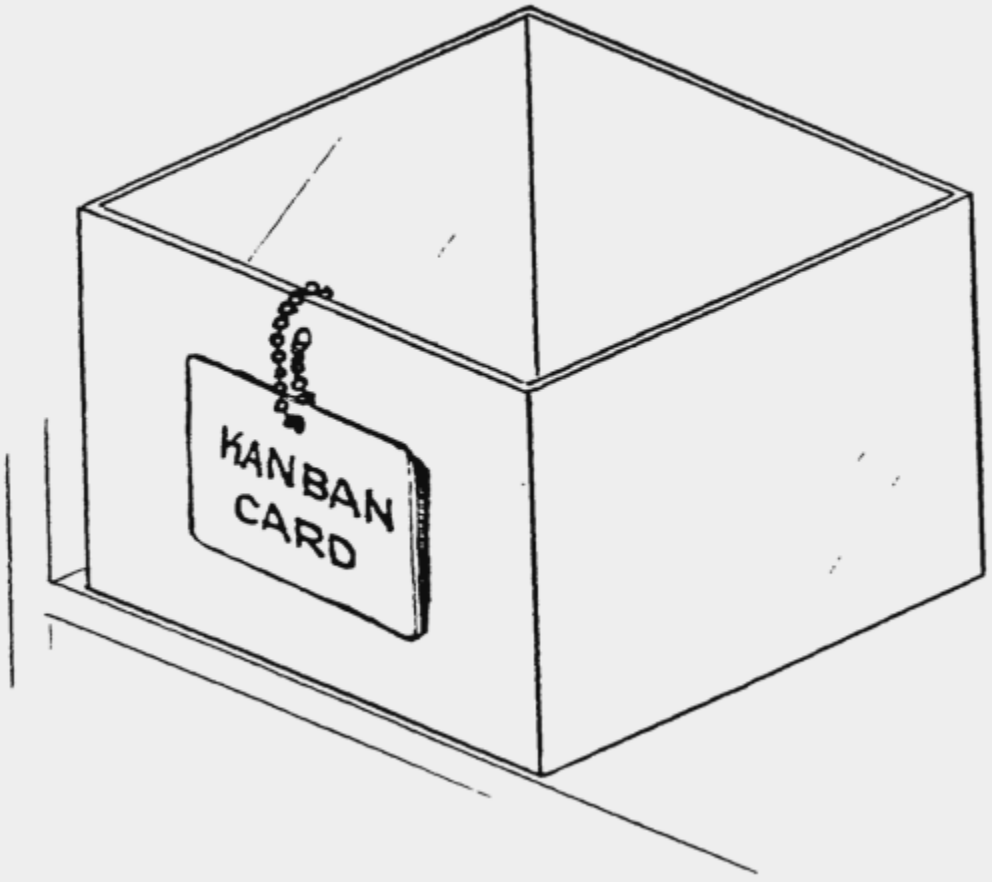
Definitions

Pull System is a method for scheduling production at the end of the process. "Upstream" processes supply each "downstream" user based on what parts are actually being consumed.

Kanban is the Japanese word for "signal," and is a signal to do work or to make product. It is an "execution" technique for a pull system.

Small Parts Kanban





Variations On Pull Systems

- Dual card w/RIP locations
- Single card w/RIP locations
- Empty containers (no cards)
- Two-bin
- Min/max
- “Bread-man”
- FIFO lanes/queue limiters/Kanbans
- And…
  - Versions where cards or container are replaced by ***electronic*** Kanban signals

Water Spider - "Mizu Sumashi"

Water Spider –"Mizu Sumashi" - An insect that whirls on the surface of the water very quickly.

In the lean factory, water spiders are the people who service work locations with parts or materials. They replenish point of use supplies, such as drill bits, and enable the production worker to only "add value." That is, "they keep the surgeon at the table."

Water Spiders are assigned any number of value added and non-value added but necessary tasks to provide required support.

Parts Provisioning Alternatives

- Build Just-in-Time
  - No WIP
  - Always the first choice
- Broadcast Schedule
  - Time slotted kanban
  - Not MRP
- Point of Use “Kits”
  - RIP (not WIP) inventory locations
  - Replenished with pull signals going into a stockroom or an in-house producer or vendor

Parts Provisioning Alternatives (cont)

- Local Stockroom or “Supermarket”
  - Kits pulled by water spiders and delivered just-in-time
  - Locations replenished with pull signals
- Many Variations Within These Basic Approaches!

Case Study

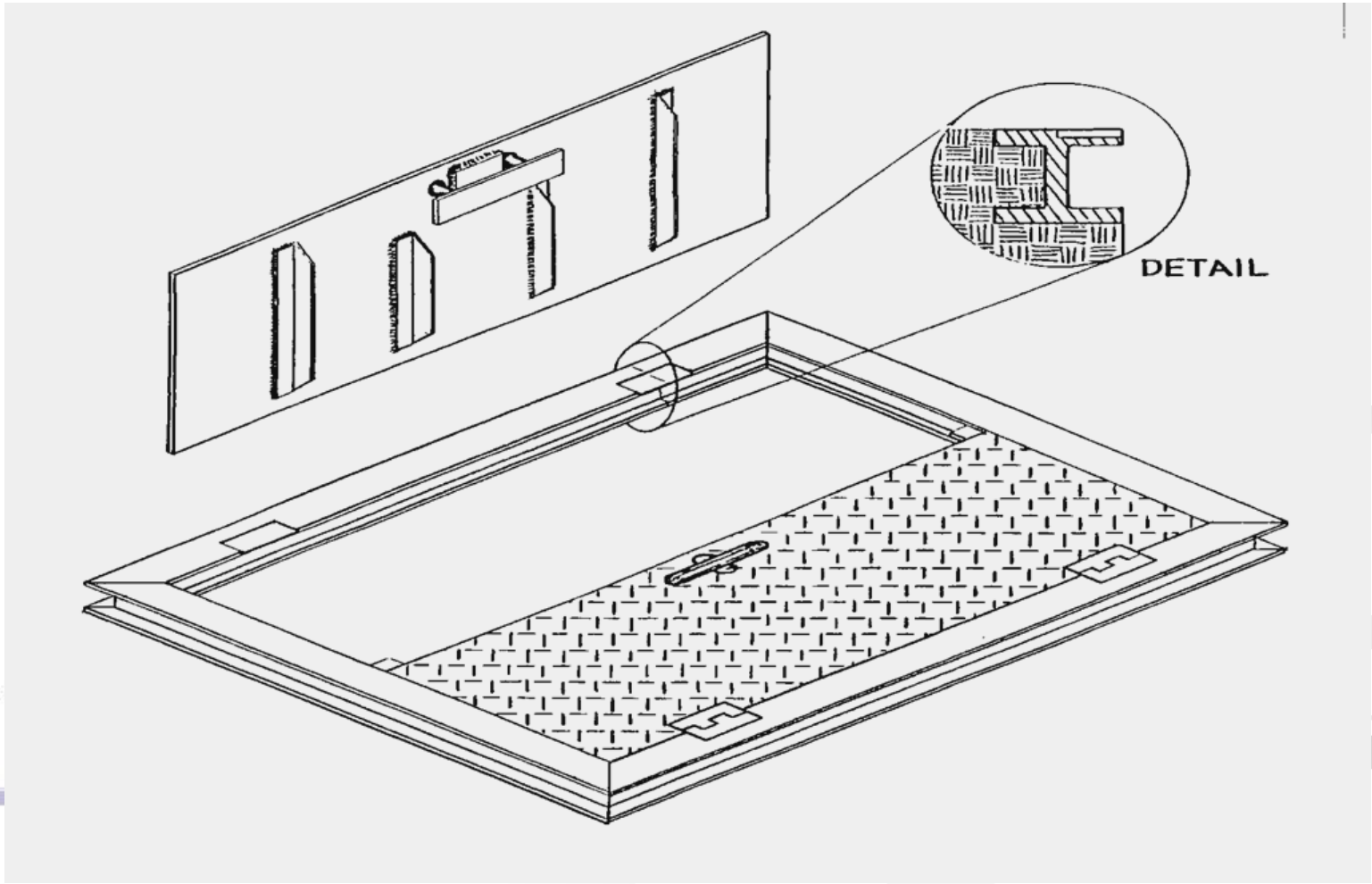
Panterra, Inc.

Background

- Panterra is a $60 million producer of underground storm and sanitary sewer infrastructure
  - Pre-cast concrete manholes
  - Concrete Pipe
  - Pump Stations
  - Cast Iron gratings and manhole covers
  - And…

Fabricated Aluminum Hatch Doors

Hatch Door Characteristics



Hatch Door Characteristics (cont)

- Options
  - Length and width (2’x4’ to 8’x10’)
  - Extrusion dimensions
  - Locks
  - Hold-open devices
  - Reinforcement
  - Finishes
- Number of combinations approaches infinity

Industry Norms

- Very price competitive
- Fast delivery a must
  - Industry standard was two weeks, but still a problem
- Stocking not an option (MTO) due to custom design requirements

The Opportunity

- Panterra management believed that market share would increase substantially if
  - Lead time could be cut to one week
  - Price could be reduced by 5-10%

Project Objectives

- Double market share from 6% to 12%
- Reduce lead time to 1 week, including ship time
  - 1.5 day shop throughput
  - .5 day engineering/order entry lead time
- Reduce WIP by 50%
- Improve productivity by 40% plus

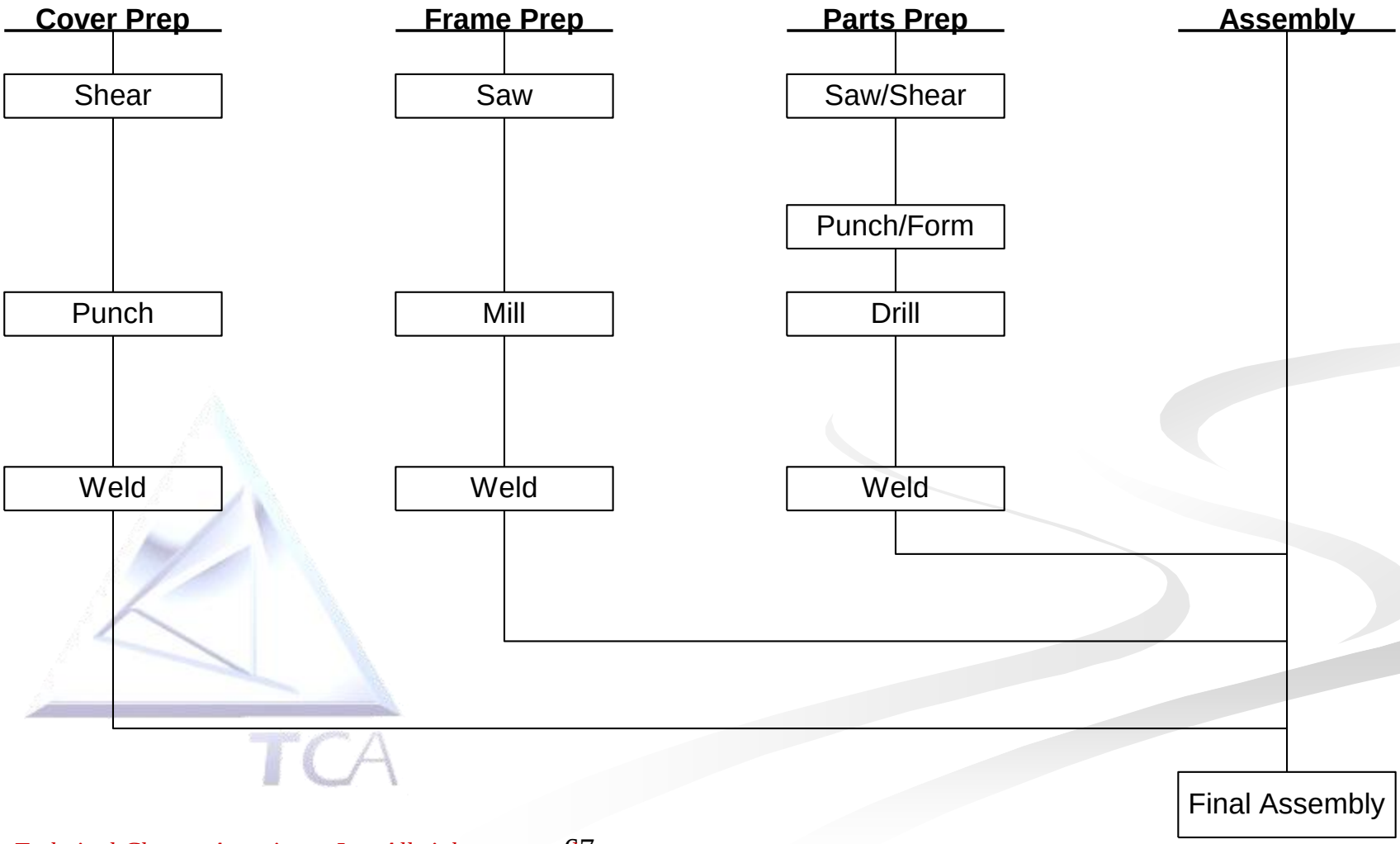
Project Approach

- Team comprised of the natural work group and a TCA facilitator
- Team trained in Lean principals and well supported by management Steering Team
- Carefully structured project plan
- Four-month schedule

Team Focus

- Reducing / Eliminating Setup Time
- The Layout
- Material Provisions
  - Demand Pull System in a MTO environment

Door Fabrication Process



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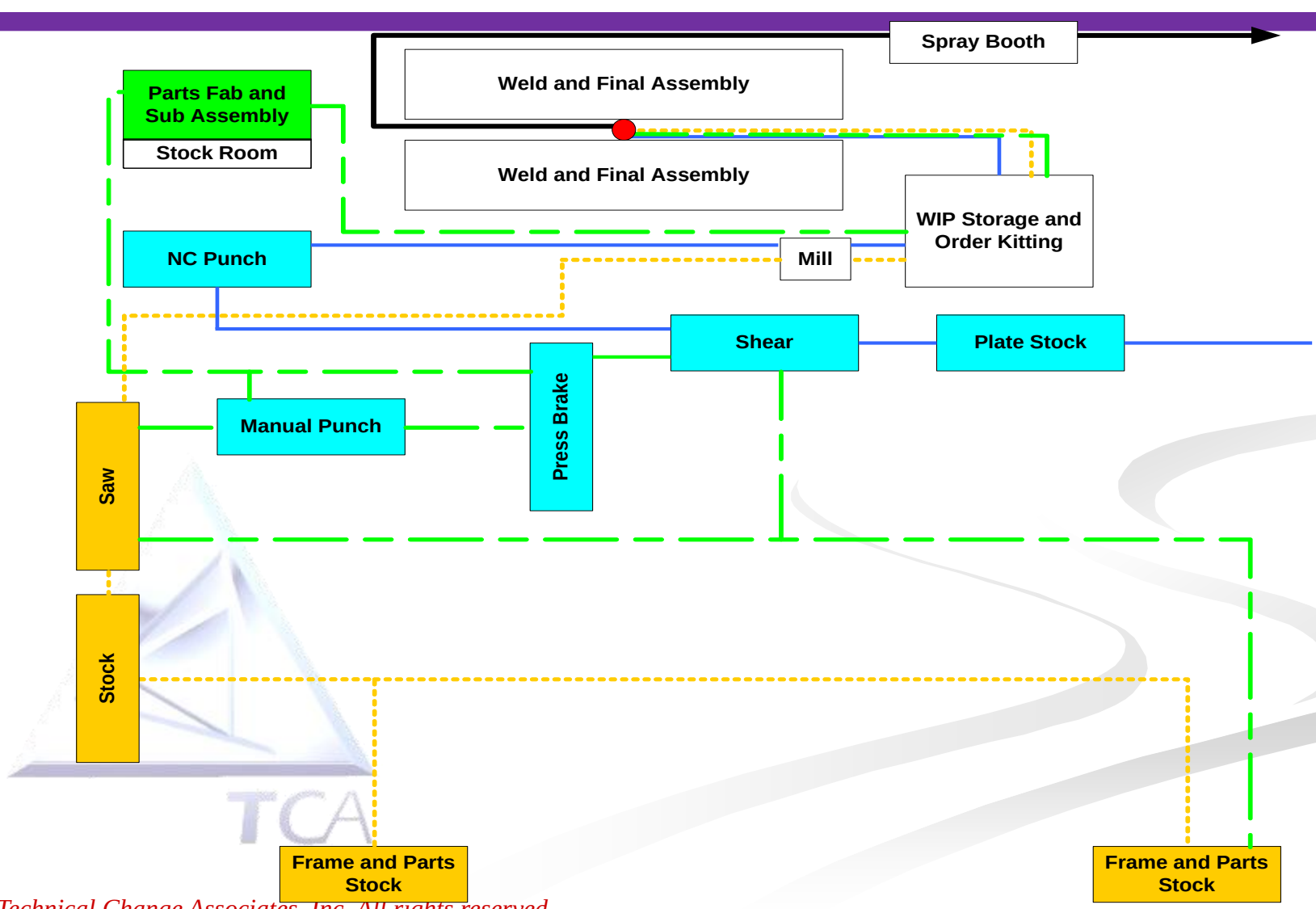

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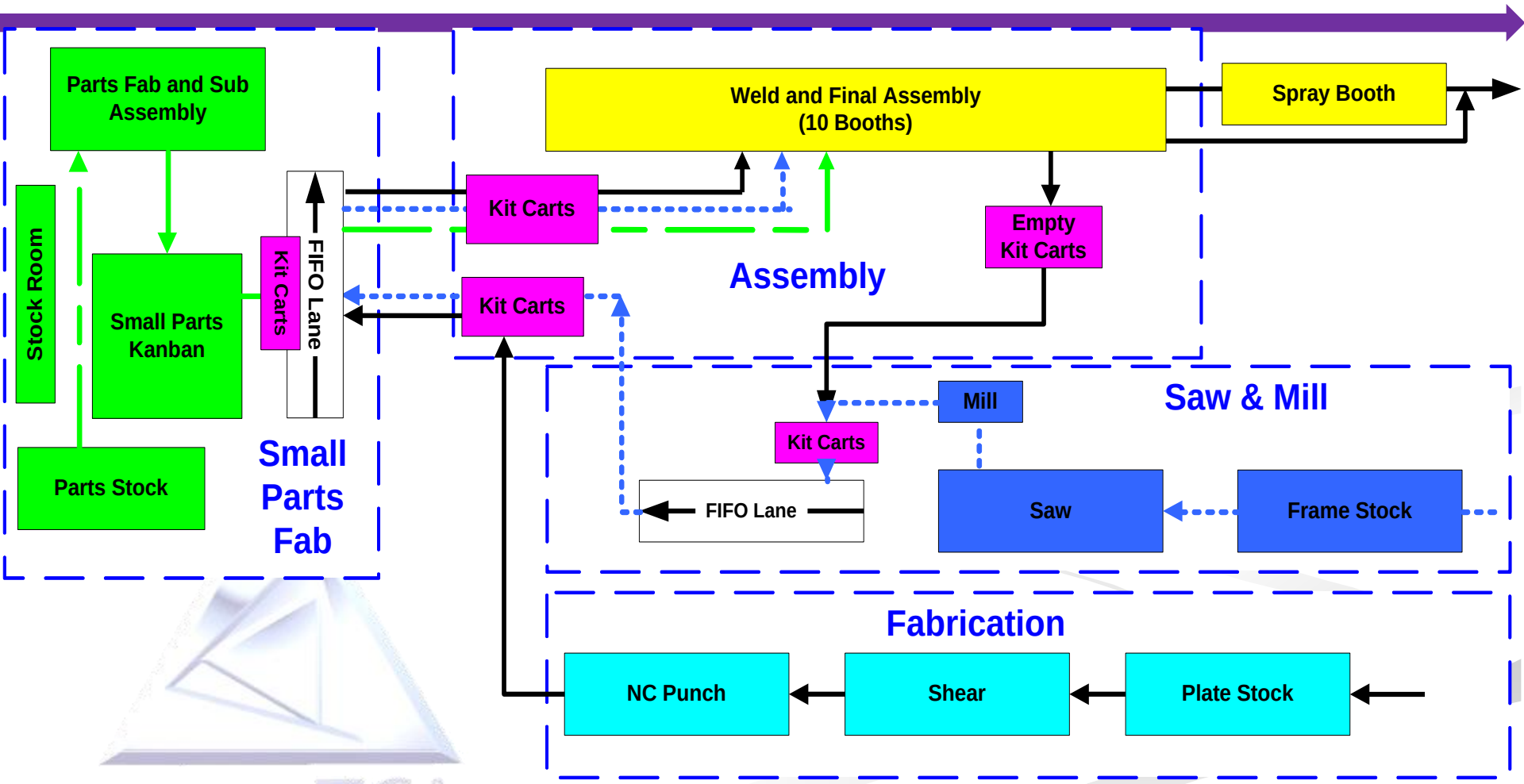

Project Results

Performance Metric	Pre-Lean Performance	Lean Performance	Original Objective	Percent Improvement
Throughput Time	3-5 Days	.8 Days	1.5 Days	- 80%
WIP Level	$28,000	$7,000	$14,000	- 75%
Labor Productivity	2.1 Doors Per Employee Per Day	3.2 Doors Per Employee Per Day	3.0 Doors Per Employee Per Day	+ 52%
Space Productivity	.0043 Doors Per Square Foot Per Day	.0059 Doors Per Square Foot Per Day	.0054 Doors Per Square Foot Per Day	+ 37%

Project Results (cont)

- Annual Cost Savings
  - Labor $202,000
  - Inventory Carrying Costs 4,000
  - Floor Space 6,000

- Total Savings $212,000

Project Results (cont)

- Based on 5,000 doors per year

  $212,000 ÷ 5,000 = $42.40 per door
  Average door price = $545.89
  Potential price reduction to customers:
  $42.40 ÷ $545.89 = 7.8%

- Strategy: Pass on 6%, keep 1.8%

Project Results (cont)

- Market share effect (snap shot)

  From 5-6% to 10-12%
  $2.0 to $2.3 million in added sales
  $700,000 to $800,000 in added gross profit

- Implementation cost less than $50,000

Payback = 15:1!

Conclusions

- Lean works in a custom manufacturing environment
- Applications will require determination and imagination
- The natural work group is a fantastic resource
- The effort must impact the market place
  - Performance and cost improvement

The Look of Excellence

Excellence Again

Again...

And again...

It Takes 43 Muscles to Frown and 17 to Smile, But it Doesn't take Any to Just Sit There with a Dumb Look on Your Face.

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