



November 14-17, 2011

McCormick Place
Chicago, IL

DEMAND PULL IN THE FABRICATION JOB SHOP



By Timothy Winder
Technical Change Associates, Inc.

WELCOME



Timothy W. Winder, CPIM

29 Years' Experience

- ❖ Lean Business Consultant
 - Sales & Operations Planning (S&OP)
 - Materials Management
 - Production Management
 - Business Systems
 - Warehouse Design and Management
 - Material Logistics
 - Inventory Control
 - Performance Measurement
- ❖ APICS Certified
- ❖ MBA









Introductions

 Who I am, what I do

 What I want to get from this workshop






Workshop Objectives

-  To add to a base of knowledge that will help drive a World Class/Lean enterprise competitive advantage
-  To understand the four elements of a World Class Enterprise (WCE) strategy in terms of the competition quad
-  To know how pull systems contribute to World Class performance
-  To see clearly how pull techniques can support different material replenishment requirements
-  To persuade you that pull systems really can work in a job shop
-  To provide enough information to allow you to initiate a pull systems effort in your company

Agenda

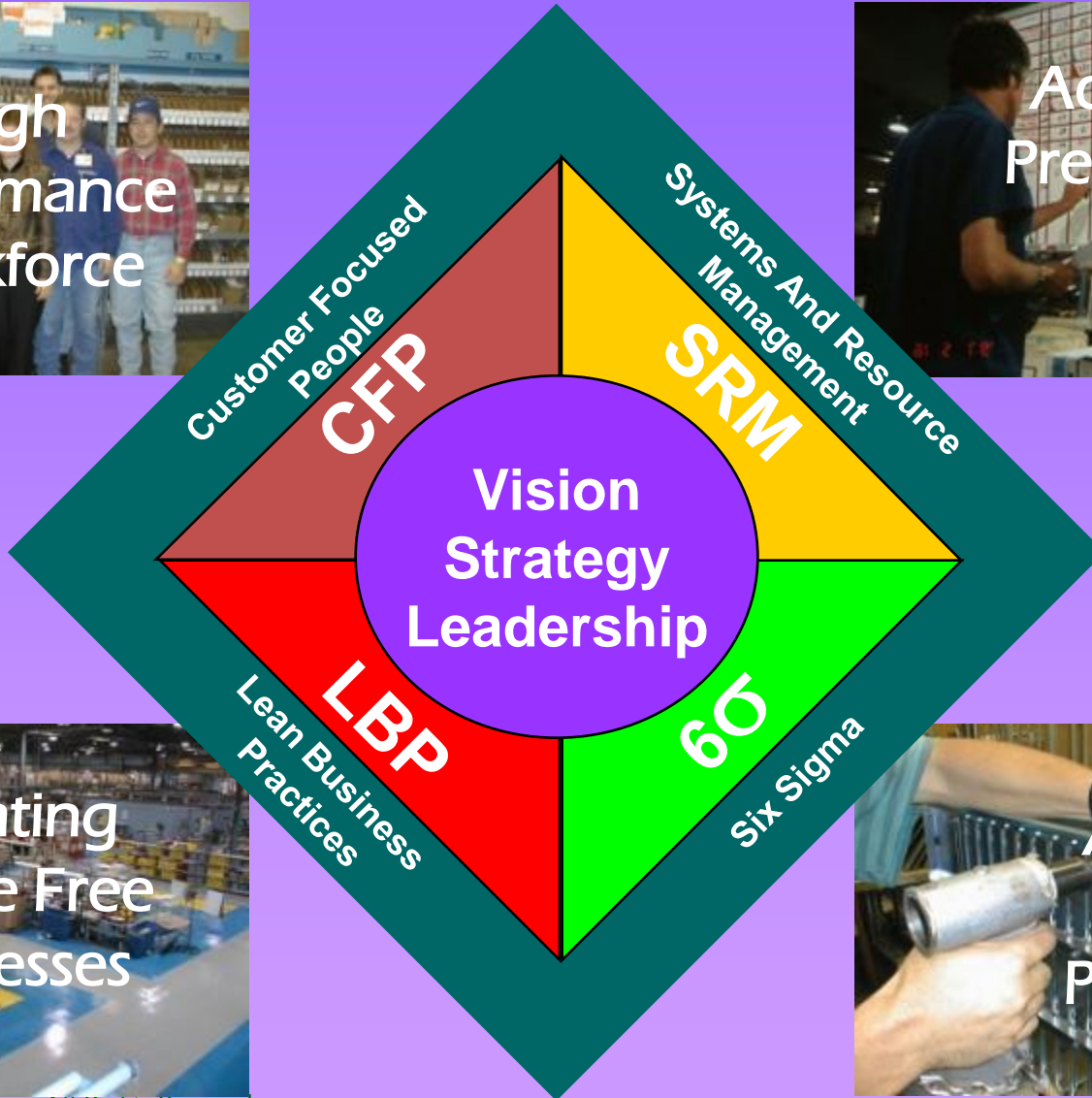
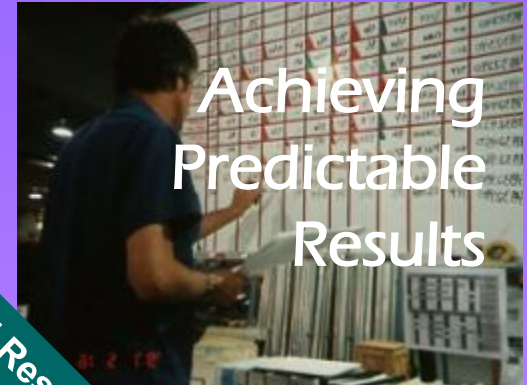
-  Introduction
-  Objectives
-  Agenda
-  World Class Enterprise Overview
-  Lean Tools Overview
-  Demand Pull Techniques
 - ❖ True Demand Pull
 - ❖ Queue Limiters
-  Demand Analysis
 - ❖ Product/Quantity Curves
 - ❖ Degree of Repetition
 - ❖ Seasonality and Spikes

-  Creating the Shop Model
 - ❖ Part/Product Families
 - ❖ Transaction Points / Systems Interfaces
 - ❖ FIFO Lanes or IPK's (In Process Kanbans)
-  Selecting and Applying the Tools
 - ❖ Part Personalities
 - ❖ Pull or Push/Pull?
 - ❖ Doing the Math (Kanban sizing)
-  Implementation
 - ❖ A Case History

A faint, light blue outline of a world map is centered in the background of the slide. The map shows the continents and major islands.

WORLD CLASS ENTERPRISE OVERVIEW

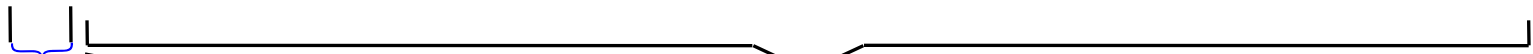
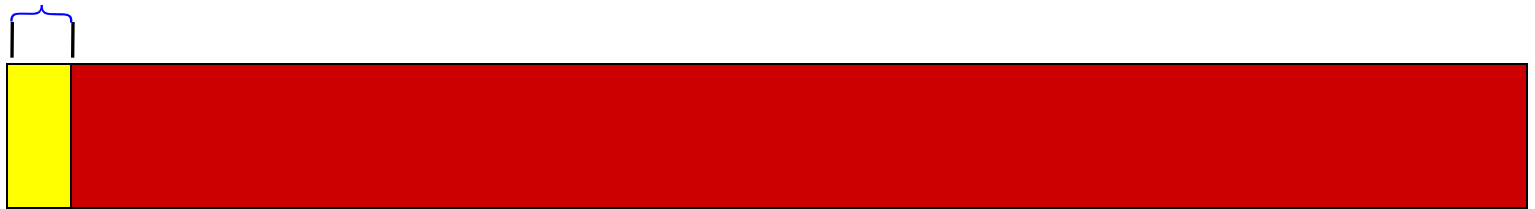
THE COMPETITION QUAD



The Lead Time Dilemma

TIME IN PROCESS

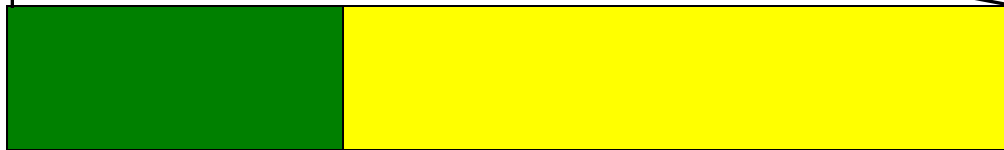
5%



MOVING & WAITING

95%

TIME IN PROCESS



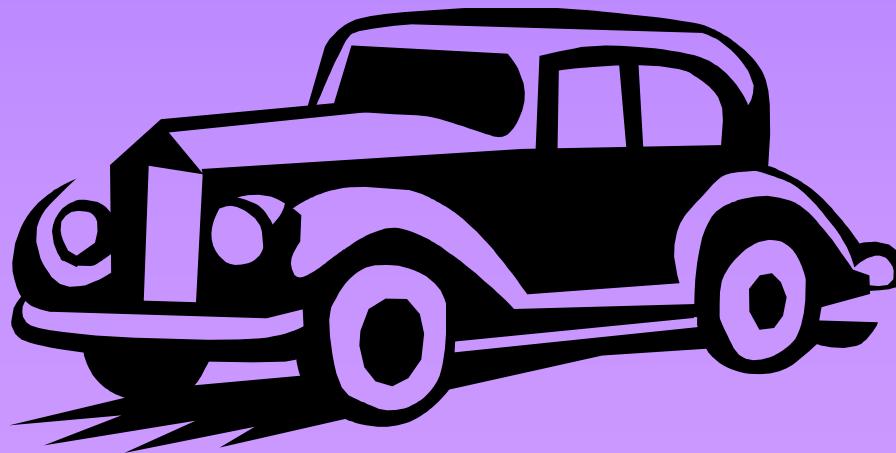
*WORKED ON
LESS THAN
30%*

*POSITIONING, LOADING,
GAGING, IDLE, ETC.
70%*

CYCLE TIME

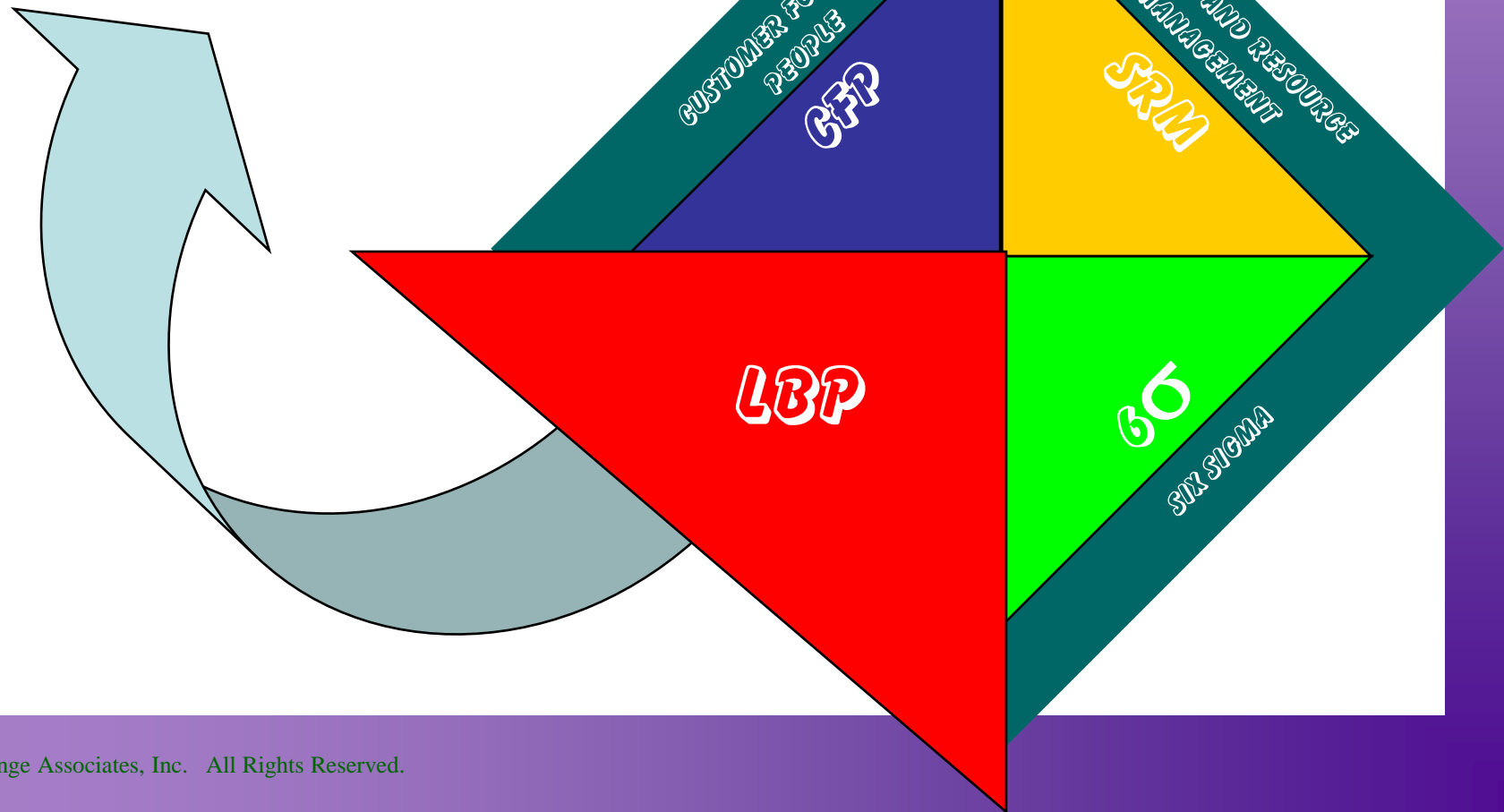
“One of the most noteworthy accomplishments in keeping the price of Ford products low is the gradual shortening of the production cycle. The longer an article is in the process of manufacture and the more it is moved about, the greater is its ultimate cost.”

Henry Ford, 1926



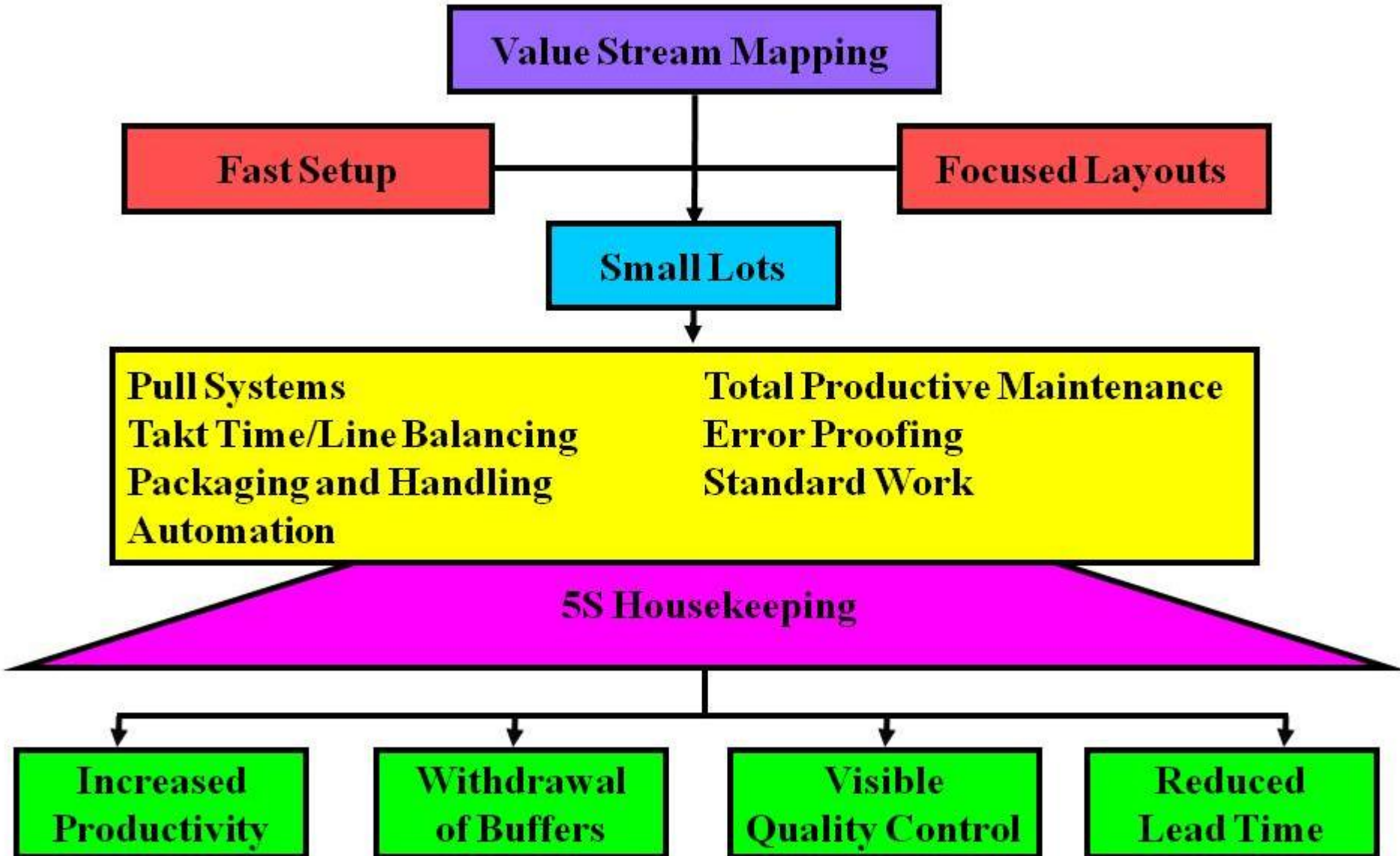
The Competition Quad

**Lean Business
Practices**





LEAN OVERVIEW



Definitions



Takt time

- ❖ The pace of production required by the customer
 - Equation: $\text{Time Available} / \text{Sold Units} = \text{Takt Time}$



Cycle time

- ❖ The current pace of production, measured as the time from completion of one unit to completion of a second unit

Definitions (cont)

- ▲ TCA | **Lead time or throughput time**
 - ❖ Total elapsed time from the start of a process to the end (Sometimes called throughput time)
 - ❖ The boundaries of the process may be very broad (e.g. receipt of order to delivery) or may be defined more narrowly

- ▲ TCA | **Processing time**
 - ❖ The actual value-added component of lead time

Lean: A Working Definition

A Structured (Disciplined) Manufacturing Approach

Focused on ...

Enabling smaller Lots, More Frequent Deliveries

and...

Greater Quality, Productivity and Competitiveness

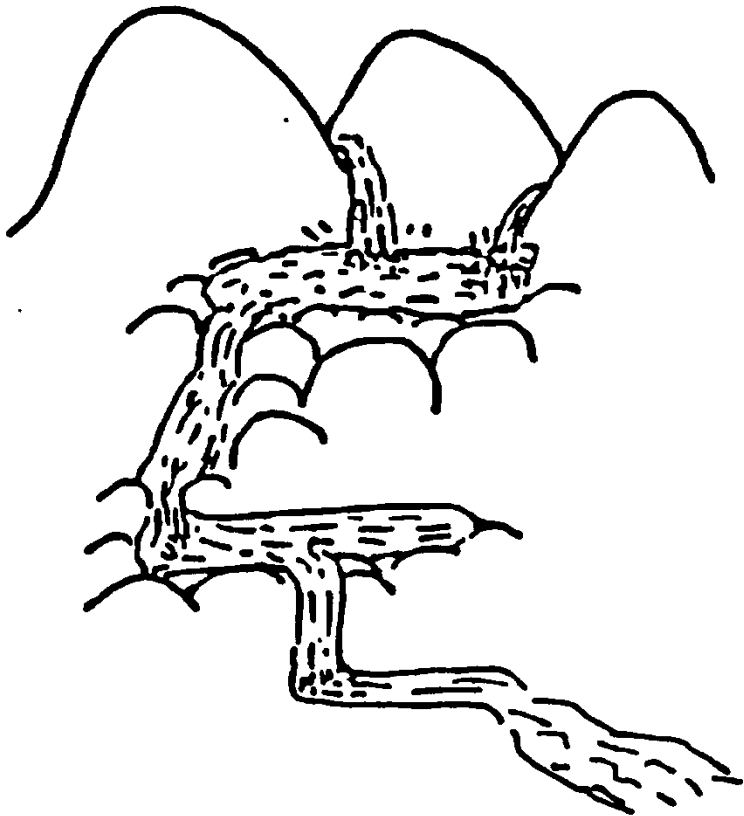
Through...

SYSTEMATIC

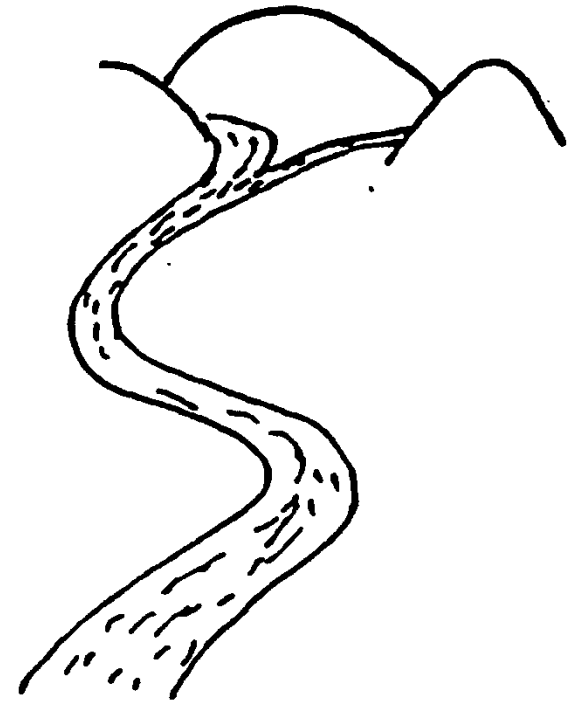
ELIMINATION OF ALL WASTE !

DEVELOPED FLOW IS LESS DISRUPTIVE

Undeveloped Flow



Developed Flow

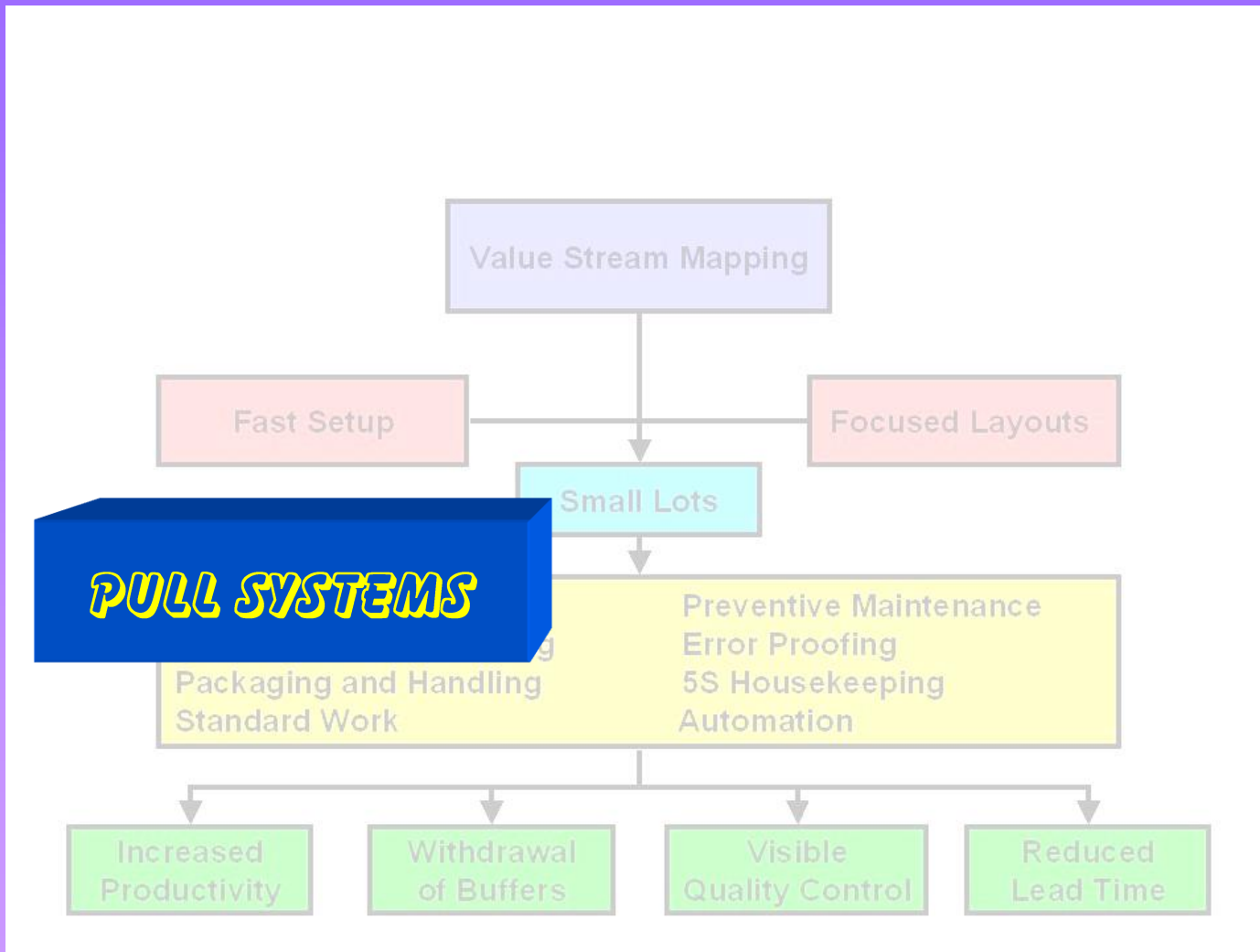


SOURCE: SUZAKI. THE NEW MANUFACTURING CHALLENGE



DEMAND PULL TECHNIQUES



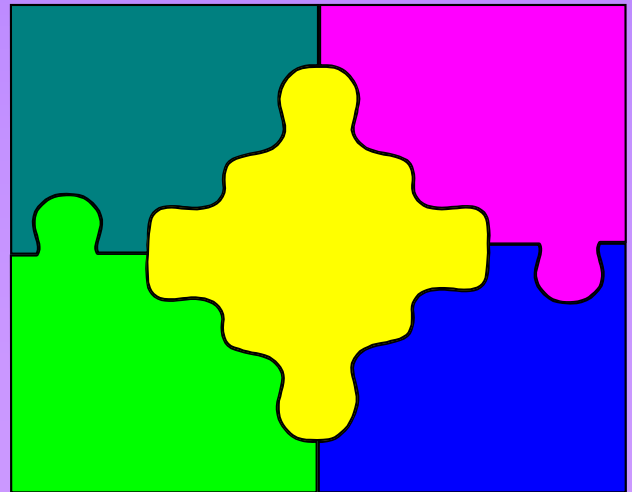
LEAN MANUFACTURING OVERVIEW



Key Point

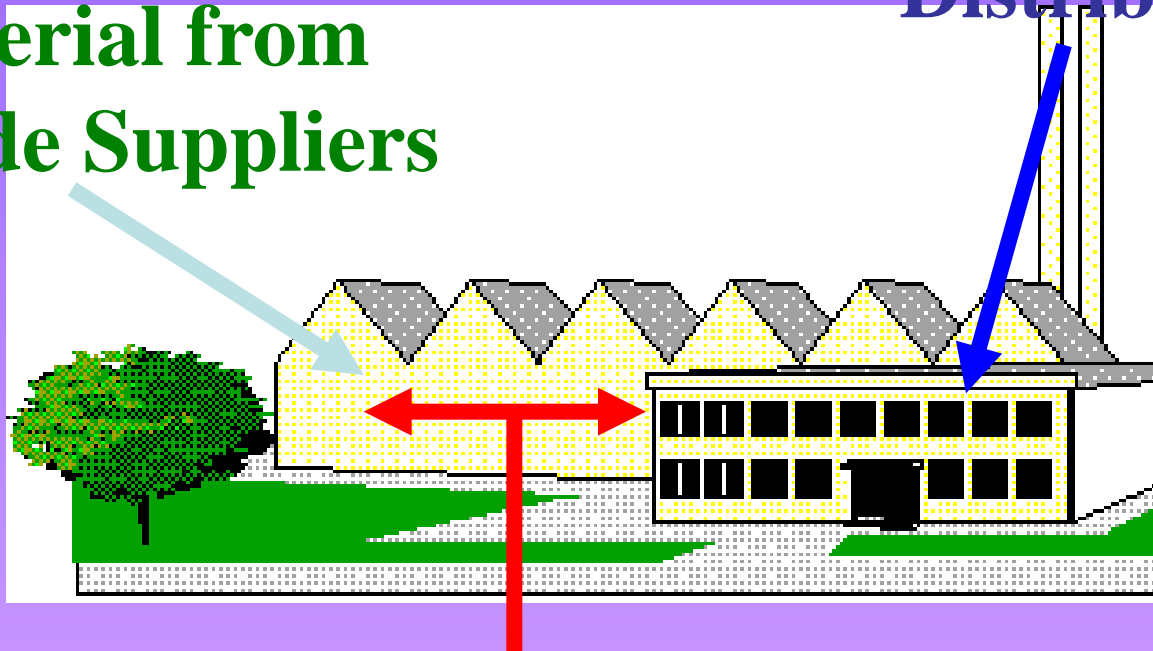
-  Pull systems are Lean techniques that we often use in combination with computer-based systems to better manage materials and processes (resources)
-  We will discuss pull systems in the context of the Lean tool kit and as an approach to sound materials management practices

MATERIAL REPLENISHMENT STRATEGIES

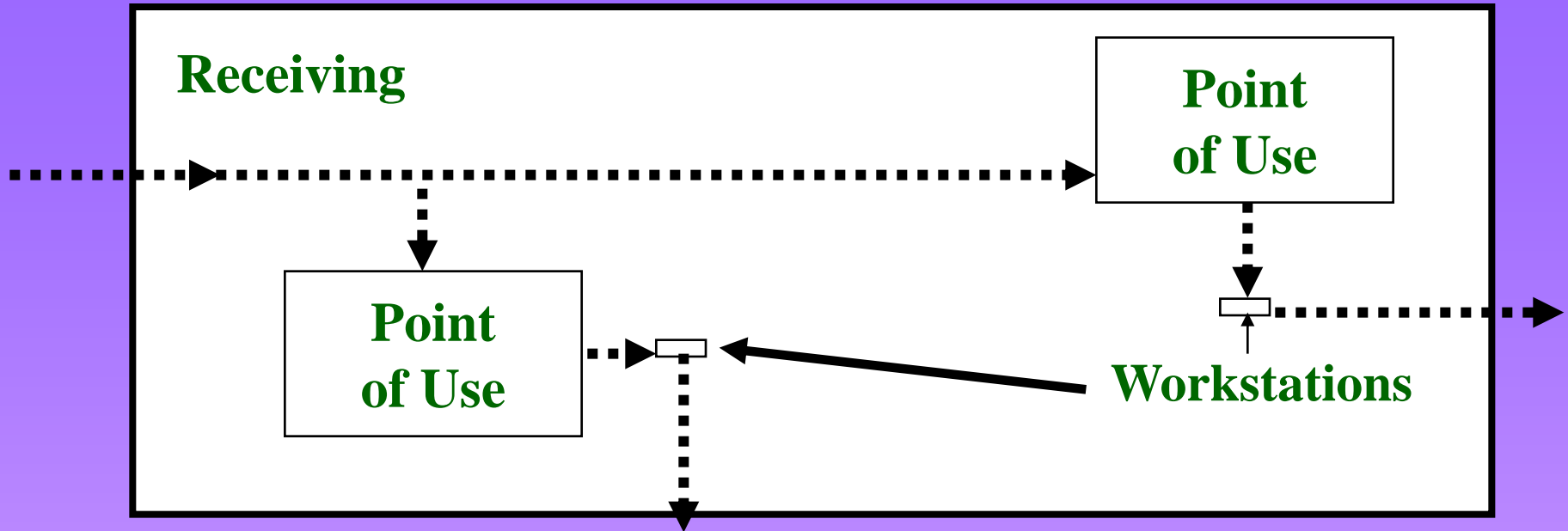


**Material from
Outside Suppliers**

**Finished Goods
Distribution**



**Internally Produced
Parts and Assemblies**



**Where do transactions occur?
Where are on-hand balances maintained?
How many locations for the same part?
What is the material flow?**

Locations must be PRECISE!

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!

Replenishment Options

Material Requirements Planning

❖ (MRP – Dependent)

Order Point

Two Bin

Surveillance

INDEPENDENT

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.

Why Pull Systems?

Answers questions:

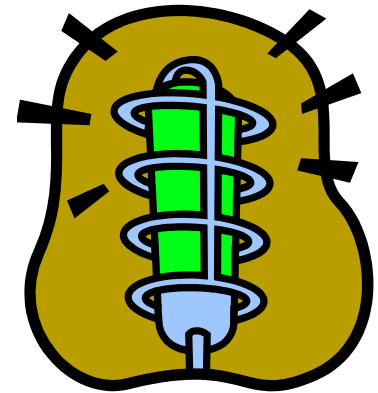
- ❖ What do we do next?
- ❖ How many should we make?

Link upstream replenishments to market demand

- ❖ Keep them in “sync”

Limits queuing

Provides visual triggers for line balancing



Variations On Pull Systems

- ▲ TCA Dual card w/RIP locations
- ▲ TCA Single card w/RIP locations
- ▲ TCA Empty containers (no cards)
- ▲ TCA Two-bin
- ▲ TCA Min/max
- ▲ TCA “Bread-man” (surveillance)
- ▲ TCA Physical Kanban (spot on table or floor)
- ▲ TCA And...
 - ❖ Versions where cards or containers are replaced by electronic Kanban signals



Replenishment Options

Material Requirements Planning

❖ (MRP – Dependent)

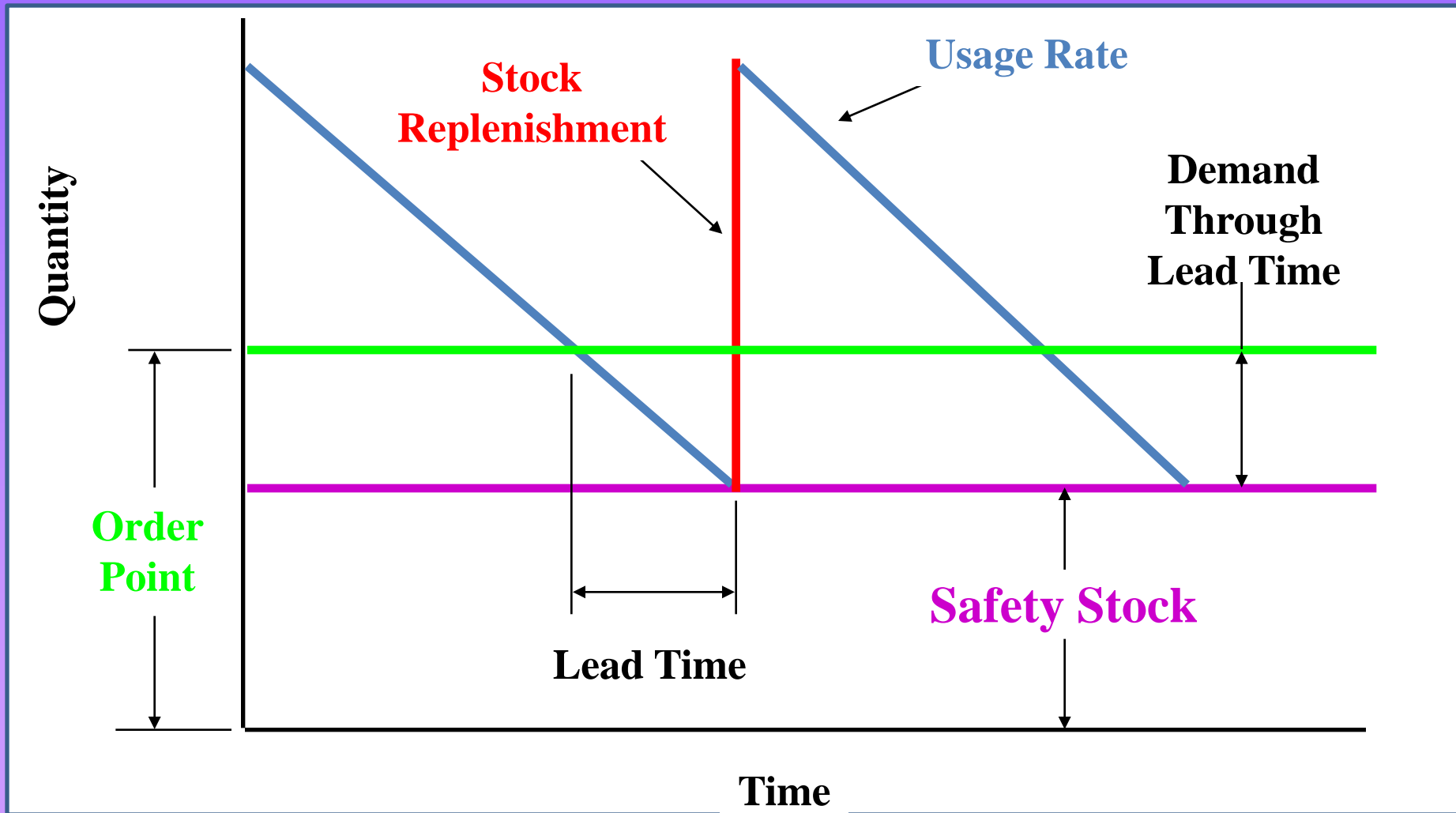
Order Point

Two Bin

Surveillance

INDEPENDENT

INDEPENDENT DEMAND MODEL (TRUE DEMAND PULL)



Kanban Sizing Formula



The number of Kanban locations/signals can be calculated as follows

$$\gg Y = D(KP + KW + X) / A$$

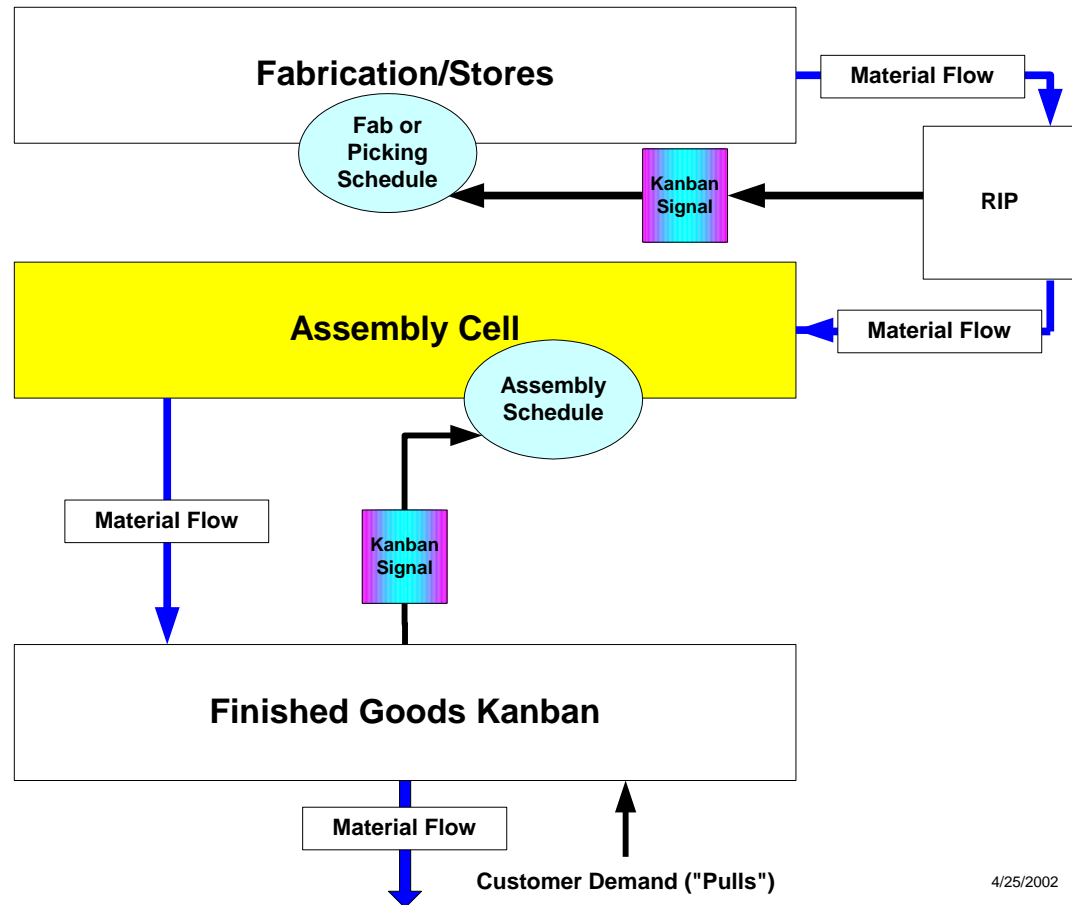
- Y = Number of Kanban locations/signals needed
- D = Demand per unit of time (daily quantity)
- KP = Kanban processing time (usually 2 days)
- KW = Kanban waiting time (expressed in days)
- X = Safety stock allowance (specified in days)
- A = Container or Kanban quantity (specified)



Note: Lead time = KP + KW

DEMAND PULL EXAMPLE

Demand Pull System - Assembly/Packaging



4/25/2002

Supplier Surveillance



Requirements:

Supplier agreement

Precise locations

Clear labeling

Bin quantities

Box sizes

Planner accountability

No P.O.'s

Supplier periodically checks the bins and replenishes to the given bin quantity.

SUPPLIER SURVEILLANCE

Can You Use This Technique ?

Company Surveillance System



Requirements:

- Parts list
- Bin sequenced
- Visual monitoring
- Daily/weekly
- Precise locations
- Clearly labeled
- Bin Quantities
- Box sizes
- Planner accountability

“Water Spider” periodically checks the bins and replenishes to the given bin quantity.



COMPANY SURVEILLANCE SYSTEM

Company Surveillance System

 Why do we use this technique?

 Will it work for you?

TWO-BIN REPLENISHMENT



**RACK
&
ROLL**

KANBAN REPLENISHMENT

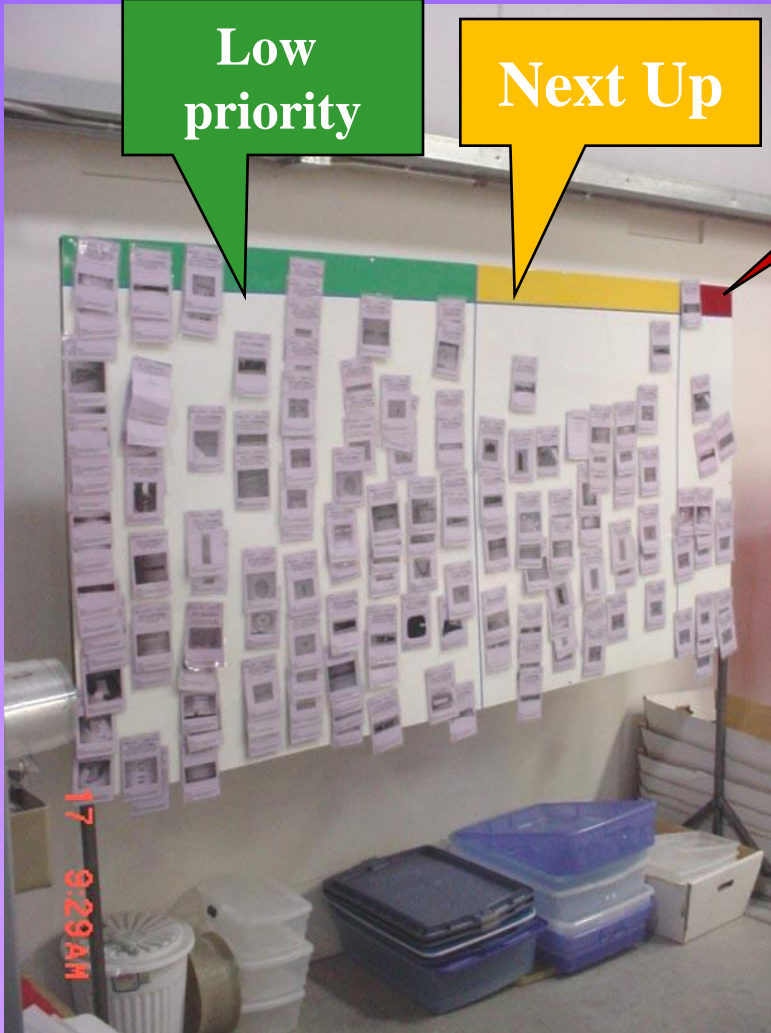


AIRCRAFT PARTS APPLICATION

Low
priority

Next Up

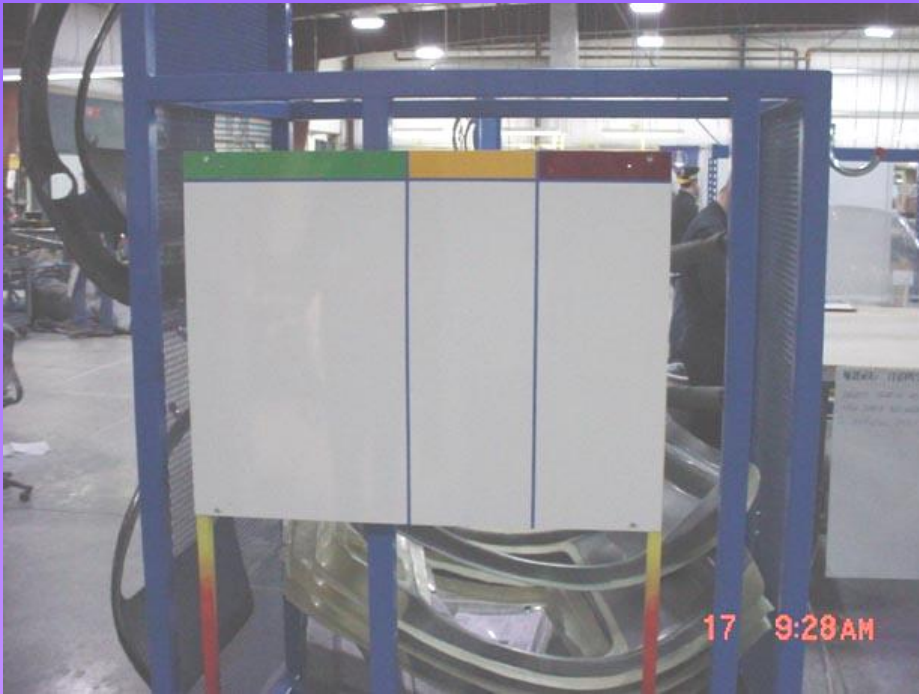
Hot!



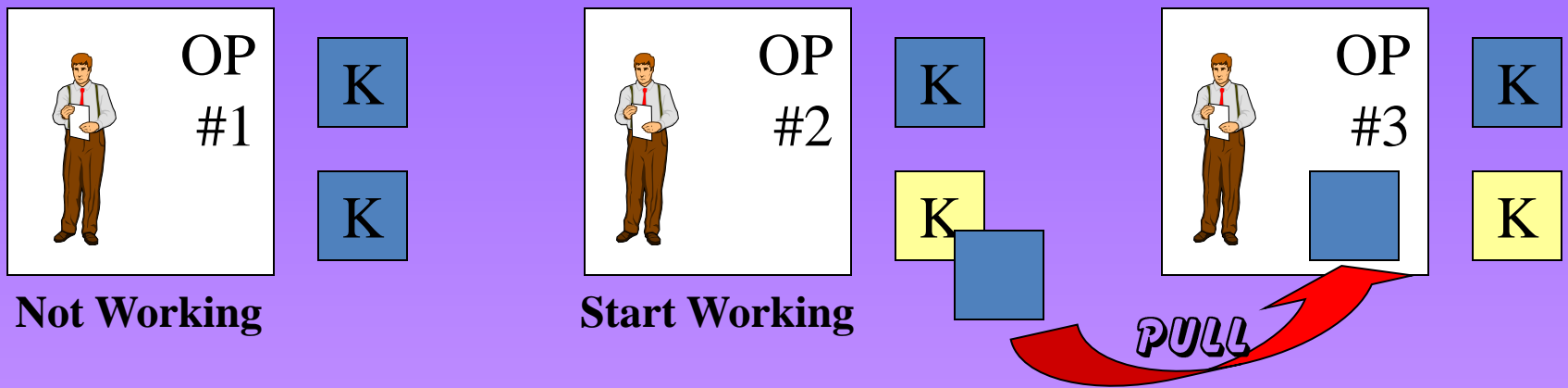
AIRCRAFT PARTS APPLICATION



AIRCRAFT PARTS APPLICATION



IN PROCESS KANBAN (IPK OR QUEUE LIMITERS)



K = Full IPK

K = Empty IPK

Signal to Work



QUEUE LIMITER EXAMPLE



Genlyte-Thomas Group

QUEUE LIMITER EXAMPLE



Solar Turbines

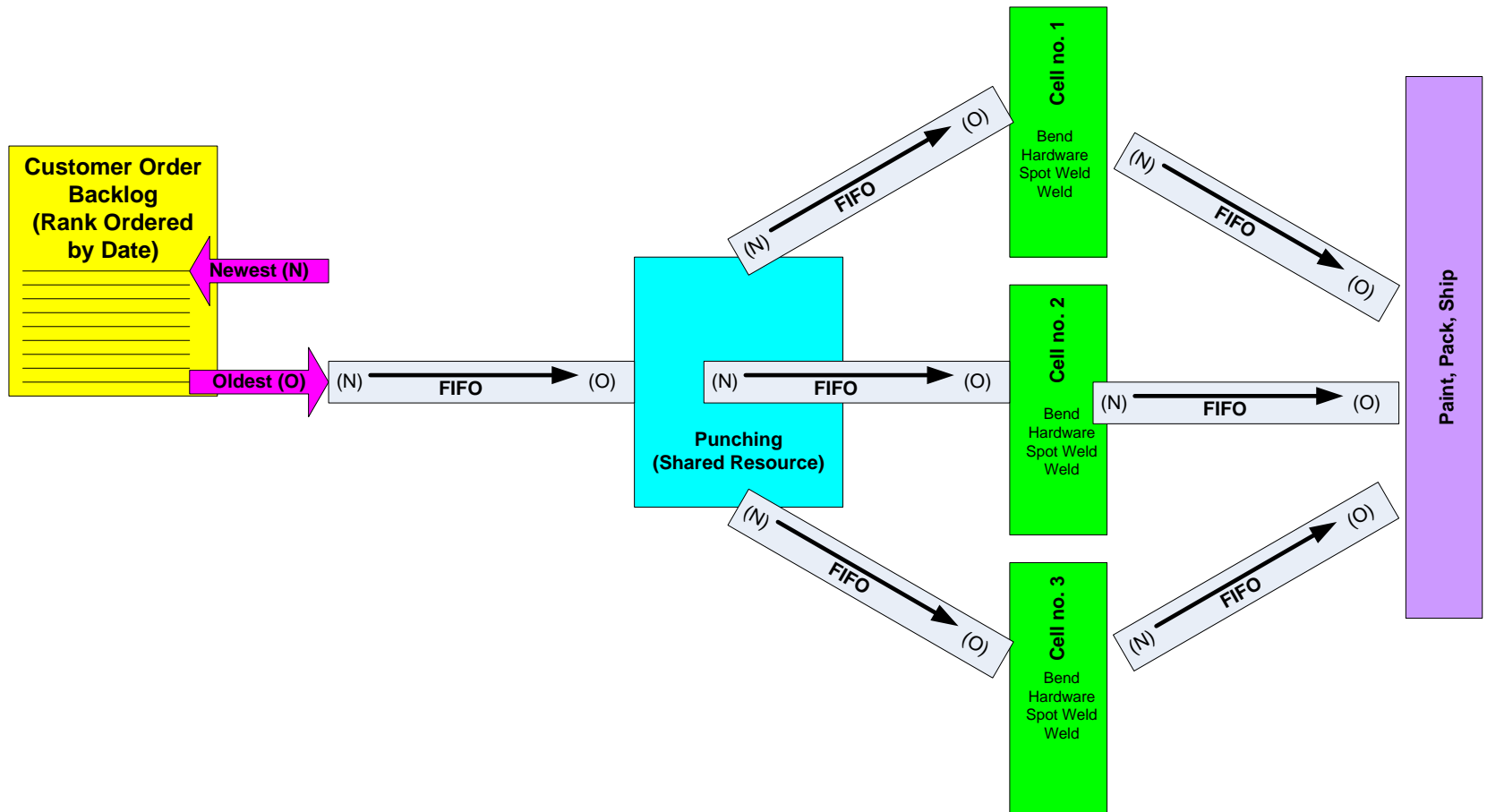
KEY DEFINITION

**IPK = Queue Limiter =
FIFO LANE**

POP Quiz

 How does an IPK differ from a POU/RIP stock inventory location?

FIFO/IPK Application



IN PROCESS KANBANS

**Can you use this technique to
limit queuing in your shop?**

DEMAND ANALYSIS



Are You Really A Job Shop?



MTS - Make to Stock



ATO - Assemble to Order

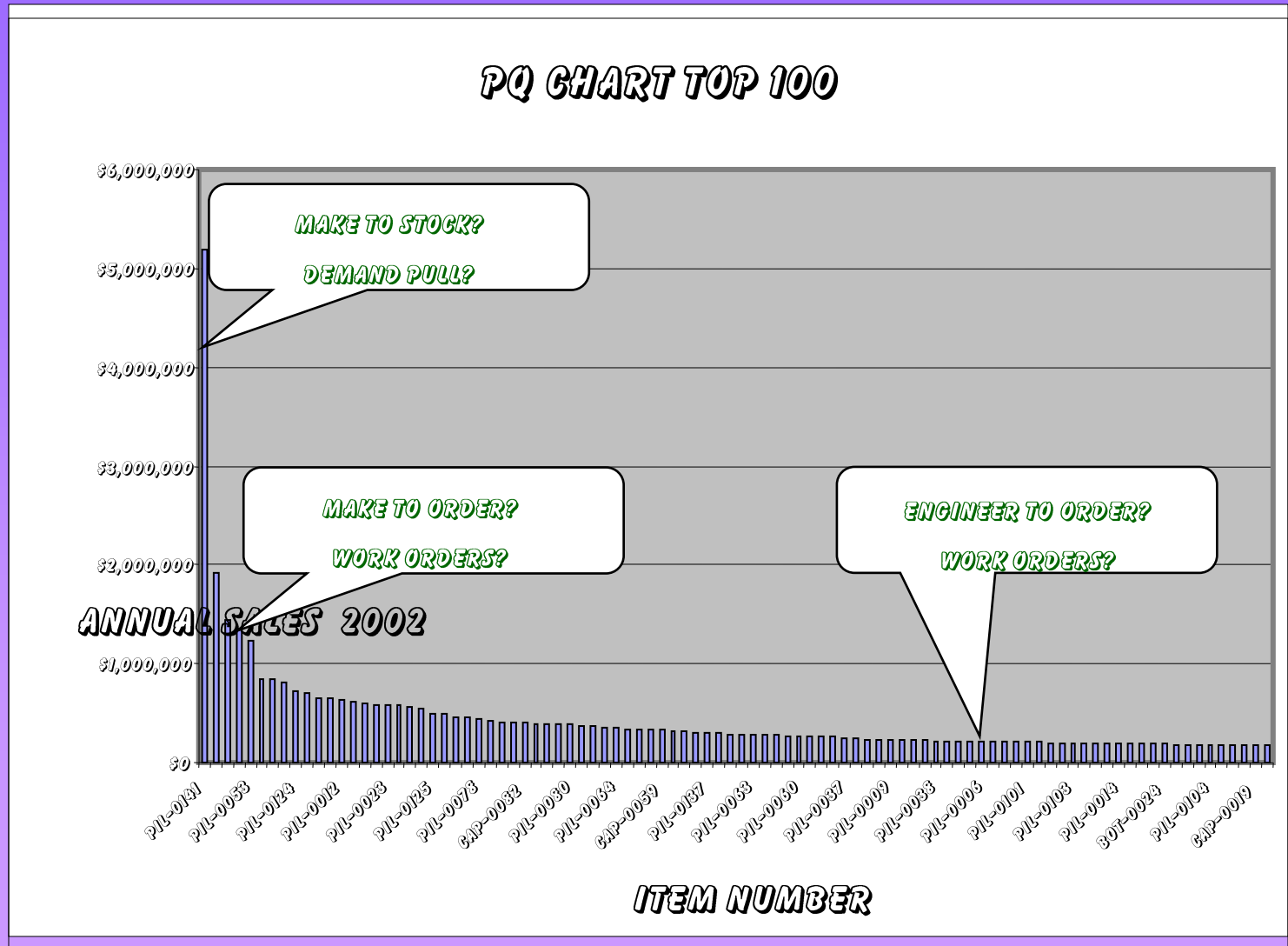


MTO - Make to Order



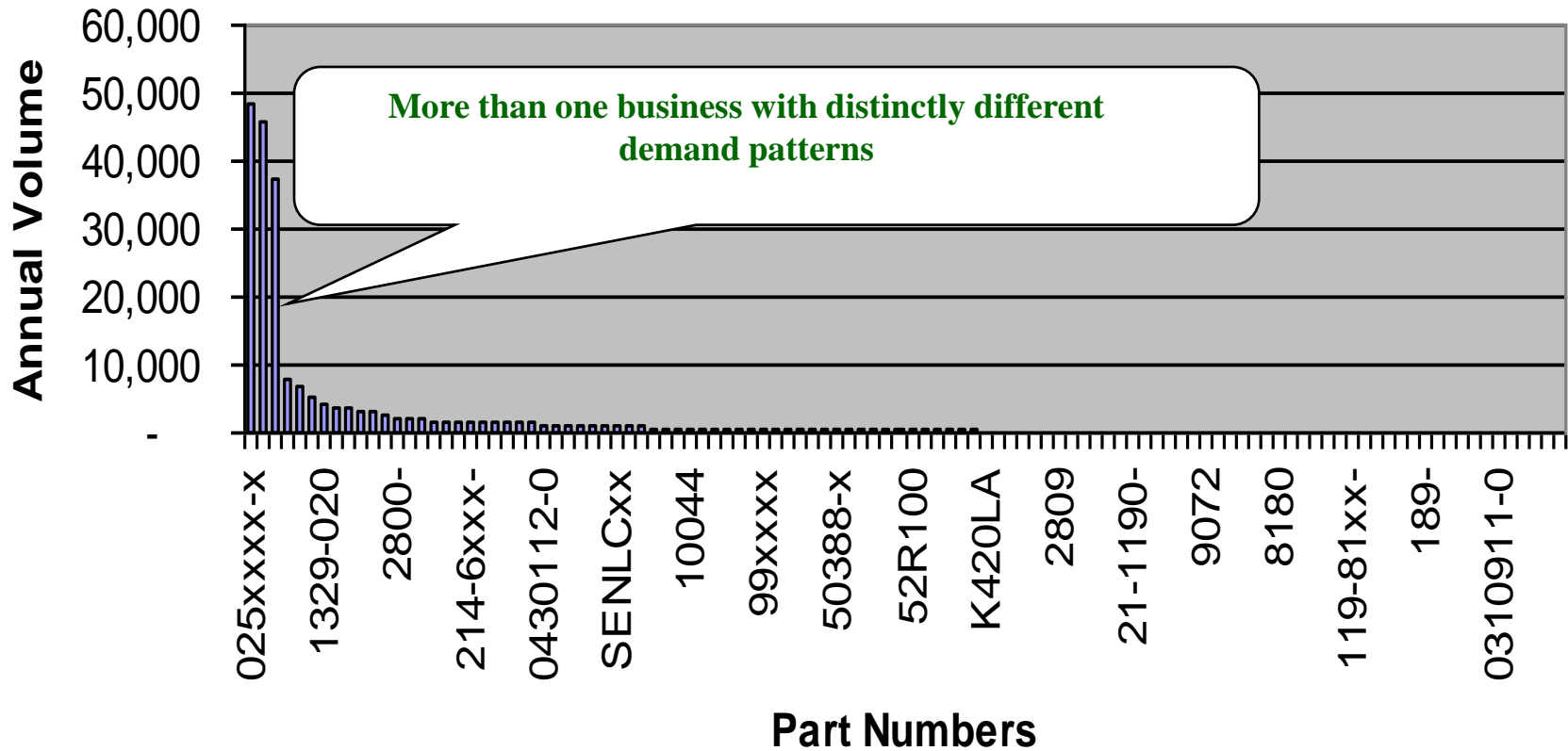
ETO - Engineer to Order

PQ CHART EXAMPLE



PQ CHART EXAMPLE (CONT)

PQ Chart



More than one business with distinctly different demand patterns




Key Point

 You probably have a mix of work that includes:

- ❖ Repetitive or fairly repetitive items
- ❖ Items that repeat, but infrequently
- ❖ Items that do not repeat

 Each type of work can be controlled with a pull system, but the application will be different

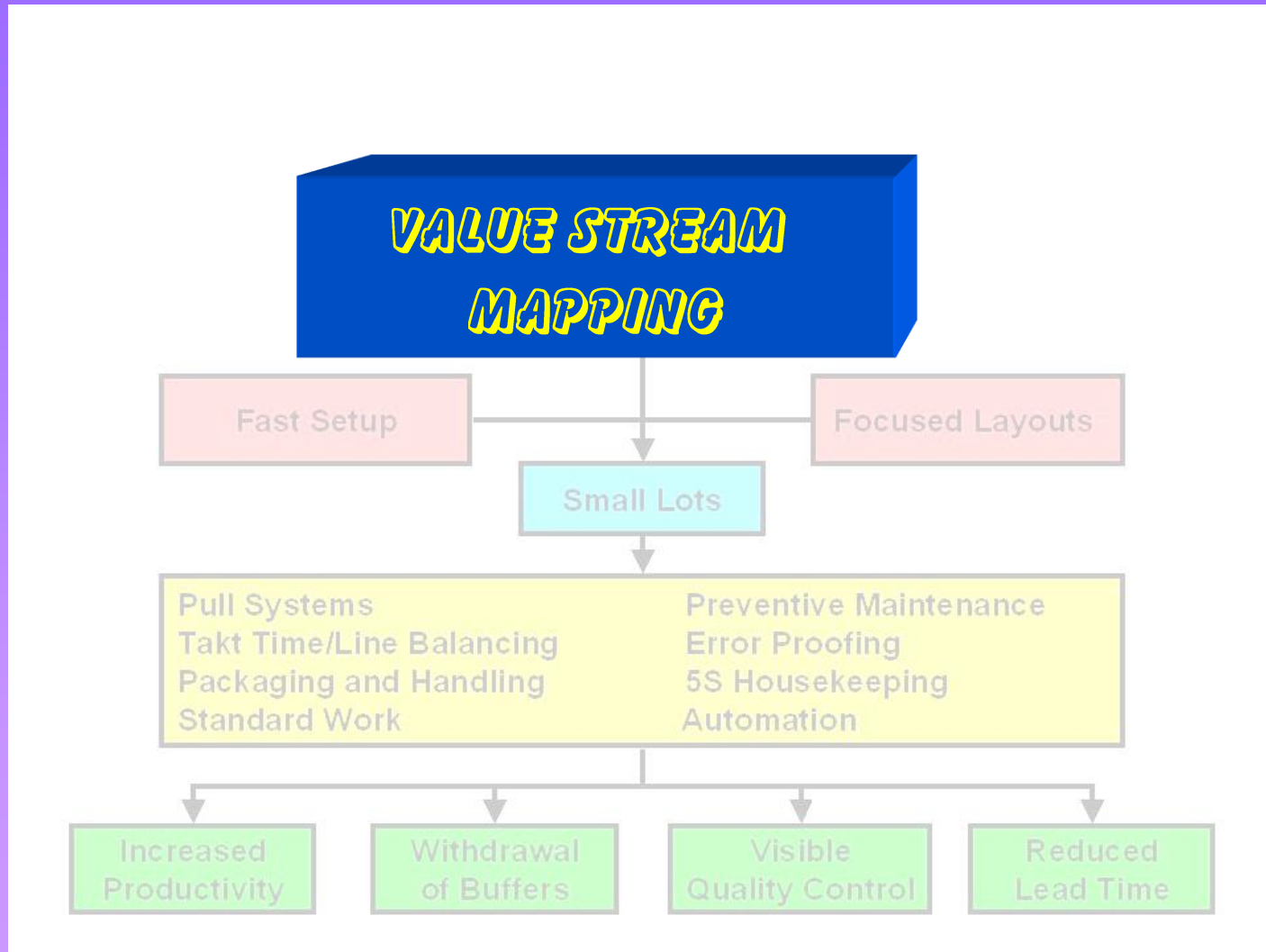
Seasonality and Spikes

-  Seasonality may force you to build to a forecast (repetitive) or flex capacity in the extreme (non-repetitive)
-  Periodic spikes will force you to carry more safety stock (repetitive) or level load and quote variable lead time (non-repetitive)
-  **There is no magic!!**

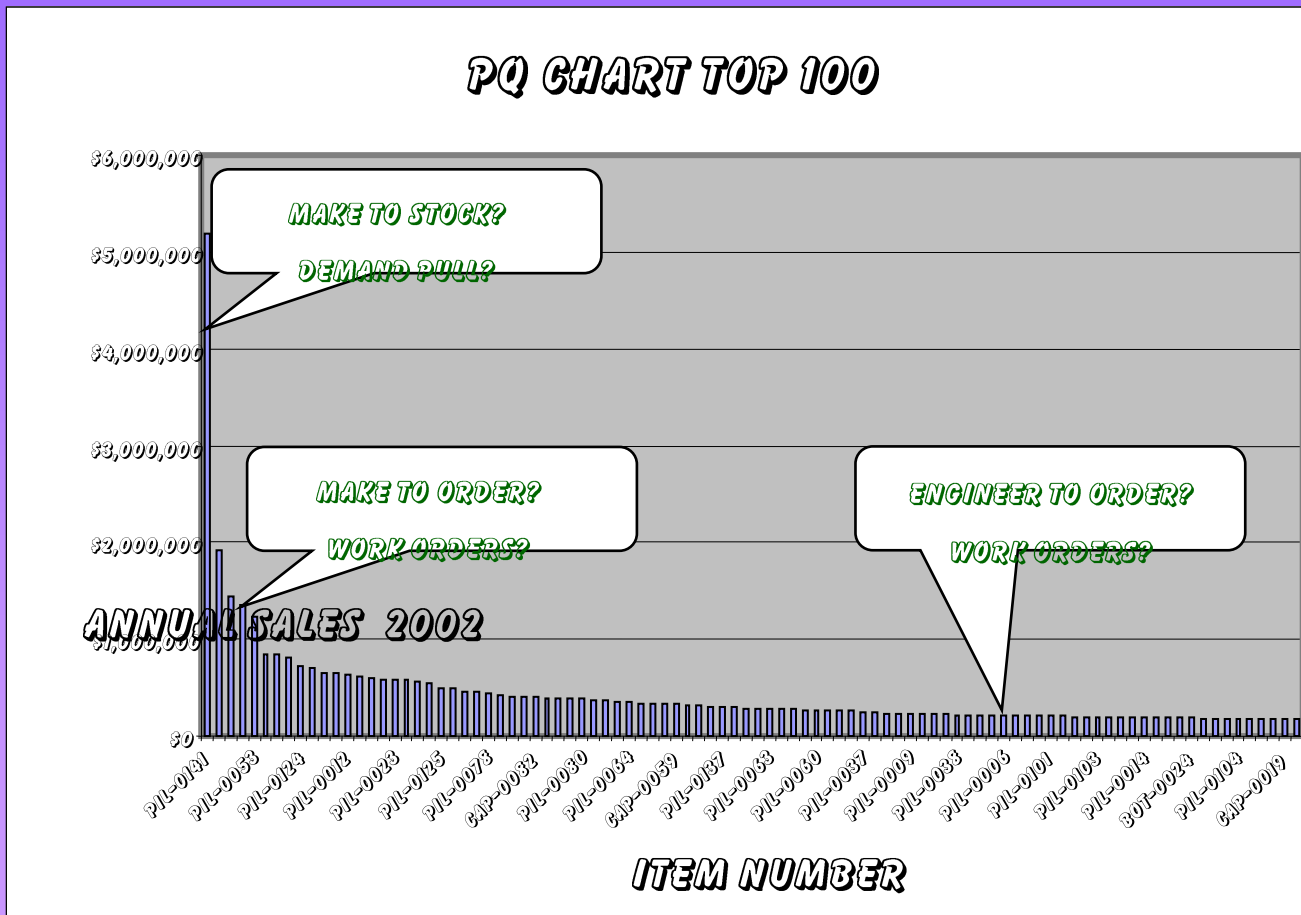


CREATING THE SHOP MODEL

LEAN MANUFACTURING OVERVIEW



PQ CHART EXAMPLE





PART/ROUTING MATRIX UNSORTED

Part number	Shear	Stamp	Punch	Laser	Drill	De-burr	Laser	Drill	From	Hardware	Tap	Weld
01	1		2			3			4			
2	1	2							3	4		5
3	1	2							3	4		5
04	1		2			3			4			
05	1			2				3				4
06	1				2		3				4	
07	1		2			3	4					
08	1				2	3		4				
9	1	2					3			4		5
010	1		2			3			4			
011	1		2						3		4	
012	1		2			3			4			
013	1	2							3	4		5
014	1	2							3			4
015	1	2							3			4
016	1			2				3		4		4
017	1		2						3		4	
018	1			2				3				
019	1		2			3			4			
020	1	2							3	4		5
021	1		2						3			
022	1			2			3					
023	1			2			3					
024	1		2						3			
025	1			2			3					
026	1		2						3			
027	1			2				3				
028	1		2			3			4			
029	1	2							3	4		5



PART/ROUTING MATRIX SORTED

Part number	Shear	Stamp	Punch	Laser	Drill	Deburr	Laser	Drill	Form	Hardware	Tap
2	1	2							3	4	
3	1	2							3	4	
09	1	2					3			4	
013	1	2							3	4	
014	1	2							3		
015	1	2							3		
020	1	2							3	4	
029	1	2							3	4	
1	1		2			3			4		
04	1		2			3			4		
07	1		2			3	4				
010	1		2			3			4		
011	1		2						3		4
012	1		2			3			4		
017	1		2						3		4
019	1		2			3			4		
021	1		2						3		
024	1		2						3		
026	1		2						3		
028	1		2			3			4		
05	1			2				3			
016	1			2				3		4	
018	1			2				3			
022	1			2			3				
023	1			2			3				
025	1			2			3				
027	1			2				3			
06	1				2		3				4
08	1				2	3		4			

TYPICAL SHOP MODEL

Office	Production	Accountability
<ul style="list-style-type: none"> • JIT <ul style="list-style-type: none"> – Order Processing – Purchasing – Estimating – Programming 	JIT Process Flow (Focused Factories) <ul style="list-style-type: none"> <li style="width: 33%;">– Punch <li style="width: 33%;">– Form <li style="width: 33%;">– Hardware <li style="width: 33%;">– Weld <li style="width: 33%;">– Paint <li style="width: 33%;">– Assembly 	JIT Focused Factory Manager
	JIT Parts Flow (Standards Cells) <ul style="list-style-type: none"> <li style="width: 33%;">– Punch <li style="width: 33%;">– Form <li style="width: 33%;">– Hardware <li style="width: 33%;">– Weld <li style="width: 33%;">– Paint <li style="width: 33%;">– Assembly 	Standards Manager Cell Leaders
<ul style="list-style-type: none"> • Proto Team <ul style="list-style-type: none"> – Engineering – Drafting – Estimating – Order Processing – Programming 	Problem Solving (Special Cells) <ul style="list-style-type: none"> <li style="width: 33%;">– Laser <li style="width: 33%;">– Form <li style="width: 33%;">– Punch <li style="width: 33%;">– Hardware <li style="width: 33%;">– Weld 	Specials Manager

SELECTING AND APPLYING THE TOOLS



WORK CENTER DAILY PRODUCTION BOARD

Work Center	Operator	YTD	WTD	DYD	YTD	WTD	DYD	YTD	WTD	DYD	YTD	WTD	DYD
Engineering	General												
Production/Document Control	Jack L.	902	348	454	800	300	400	800	300	400	800	300	400
Painting	Jack L.	0	0	0	0	0	0	0	0	0	0	0	0
Green/Punch/Laser/Cutout	Jack L.	0	0	0	0	0	0	0	0	0	0	0	0
Bake	Mark	0	0	0	0	0	0	0	0	0	0	0	0
Felt/Access	Dean W.	0	0	0	0	0	0	0	0	0	0	0	0
APD/Fabric Cell	Jack F.	0	0	0	0	0	0	0	0	0	0	0	0
Aluminum Cell	Frank C.	0	0	0	0	0	0	0	0	0	0	0	0
Panel Cell	John A.	0	0	0	0	0	0	0	0	0	0	0	0
Photo/Cut & Die Cell	Frank M.	0	0	0	0	0	0	0	0	0	0	0	0
Tyco Fab Cell	Robert L.	0	0	0	0	0	0	0	0	0	0	0	0
Outside Processing	Robert C.	0	0	0	0	0	0	0	0	0	0	0	0
Part Department	General	0	0	0	0	0	0	0	0	0	0	0	0
APC Assembly Cell	General	0	0	0	0	0	0	0	0	0	0	0	0
Capacitor Assembly Cell	John M.	0	0	0	0	0	0	0	0	0	0	0	0
Hardware Cell	John M.	0	0	0	0	0	0	0	0	0	0	0	0
Integration Cell-Large	General	0	0	0	0	0	0	0	0	0	0	0	0
Integration Cell-Small	General	0	0	0	0	0	0	0	0	0	0	0	0
Tyco Assembly Cell	General	0	0	0	0	0	0	0	0	0	0	0	0
Warranty Card Case Cell	General	0	0	0	0	0	0	0	0	0	0	0	0
Shipping													

MATERIAL PLANNING AND EXECUTION

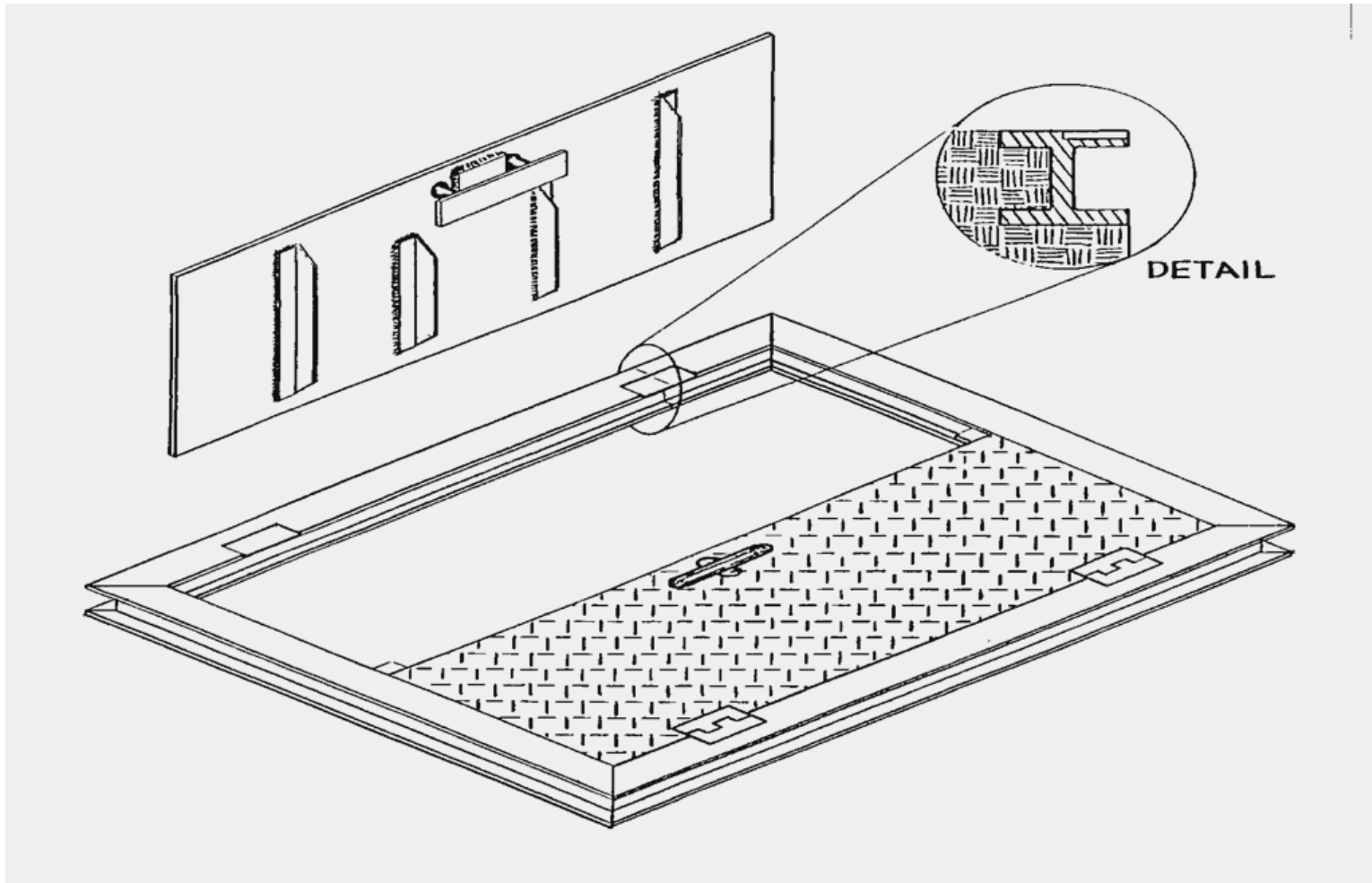
		PLANNING		EXECUTION	
		HIGH \$\$	LOW \$\$	HIGH \$\$	LOW \$\$
STOCK	MRP	ORDER POINT	P.O.'S KANBAN	KANBAN	
	PURCHASED SPECIAL	MRP	P.O.'S	P.O.'S	
STOCK POINT	ORDER POINT	ORDER POINT	KANBAN	KANBAN	
	FABRICATED SPECIAL	MRP	W.O.'S	W.O.'S	

FUNDAMENTAL DIFFERENCES

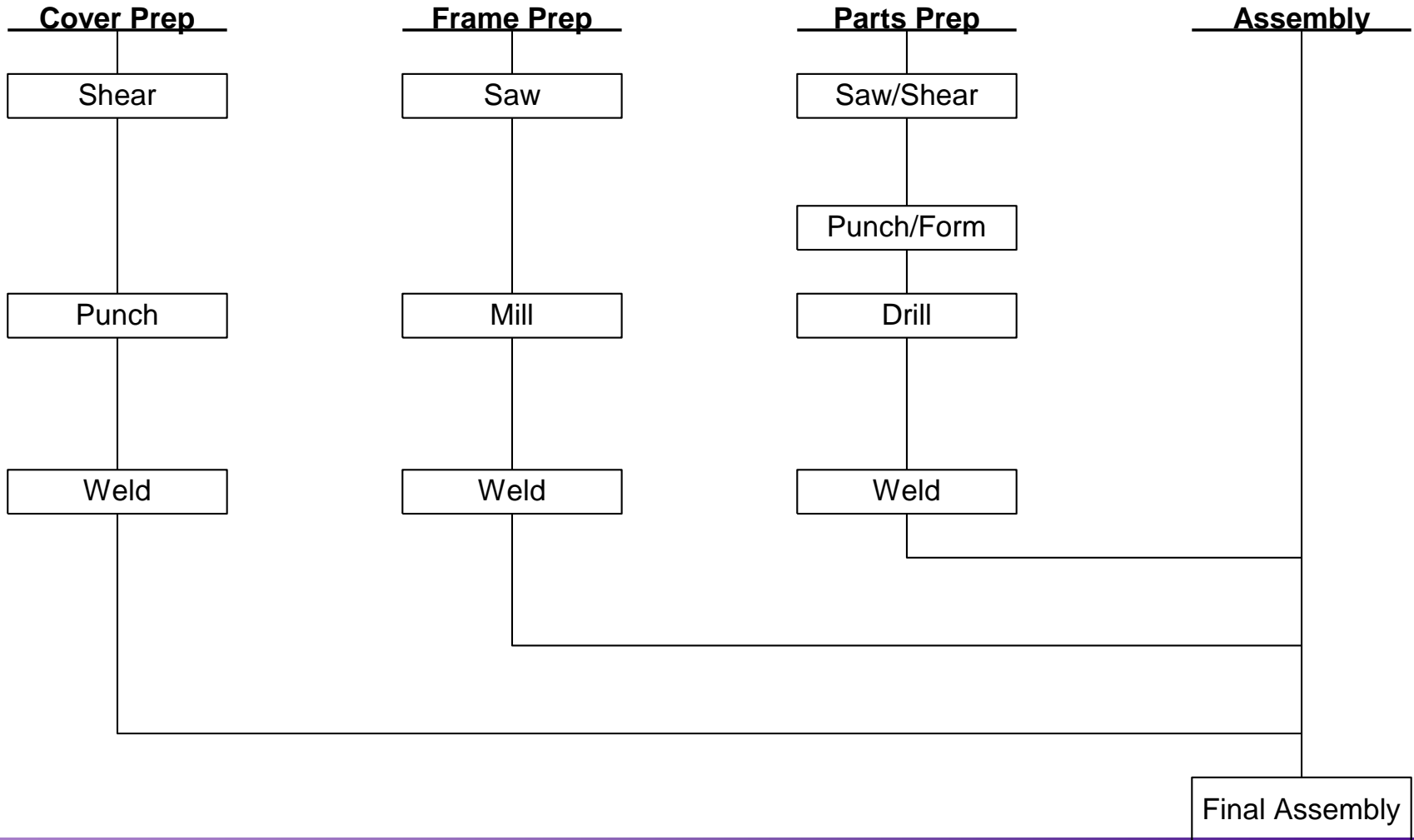
	MRP	LEAN/ SIMPLIFIED
DECISION MAKER	PLANNER	SHOP
AUTHORIZATION TO PRODUCE	ORDER	KANBAN

PANTERRA CASE STUDY

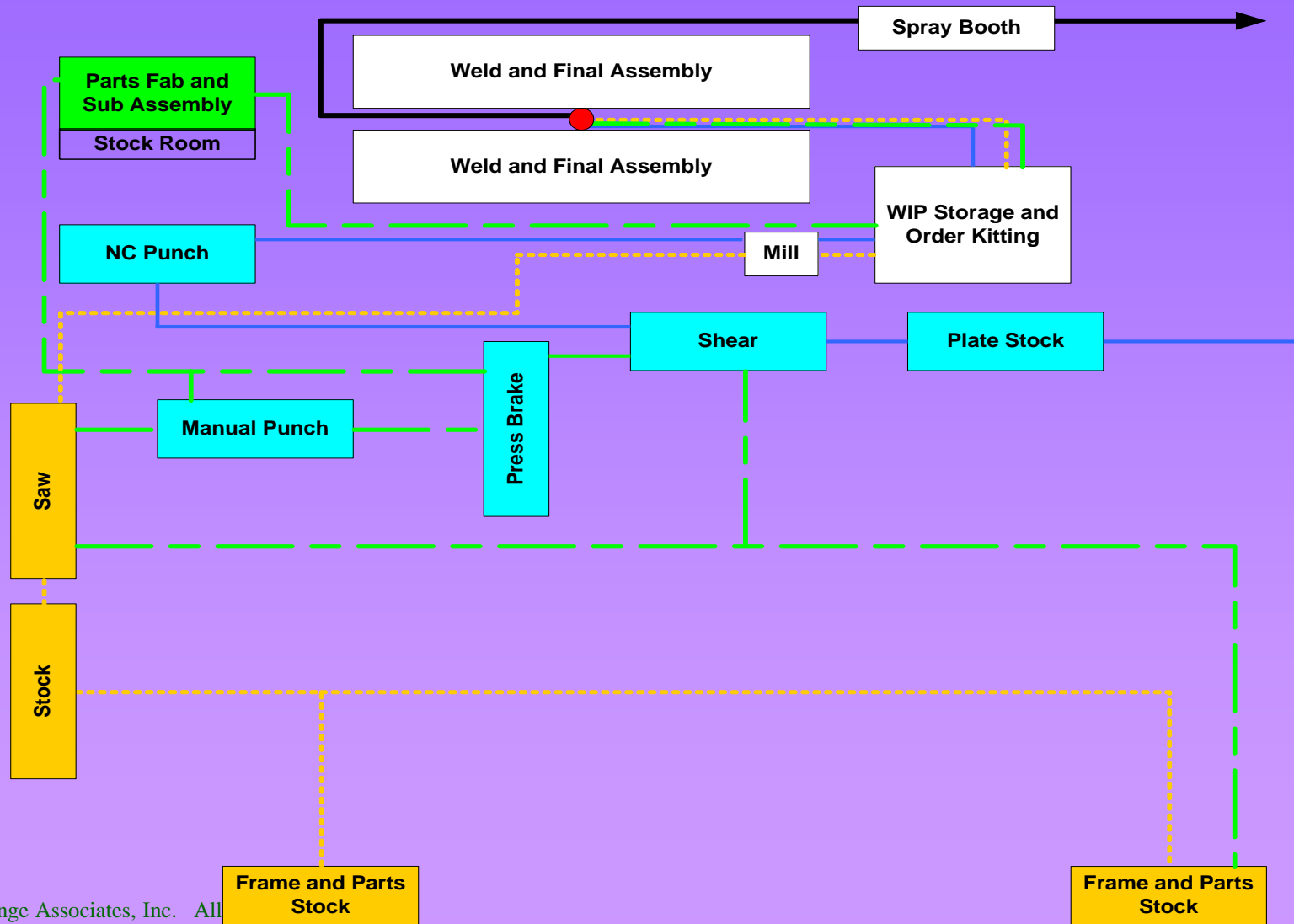
Access Door Production Description



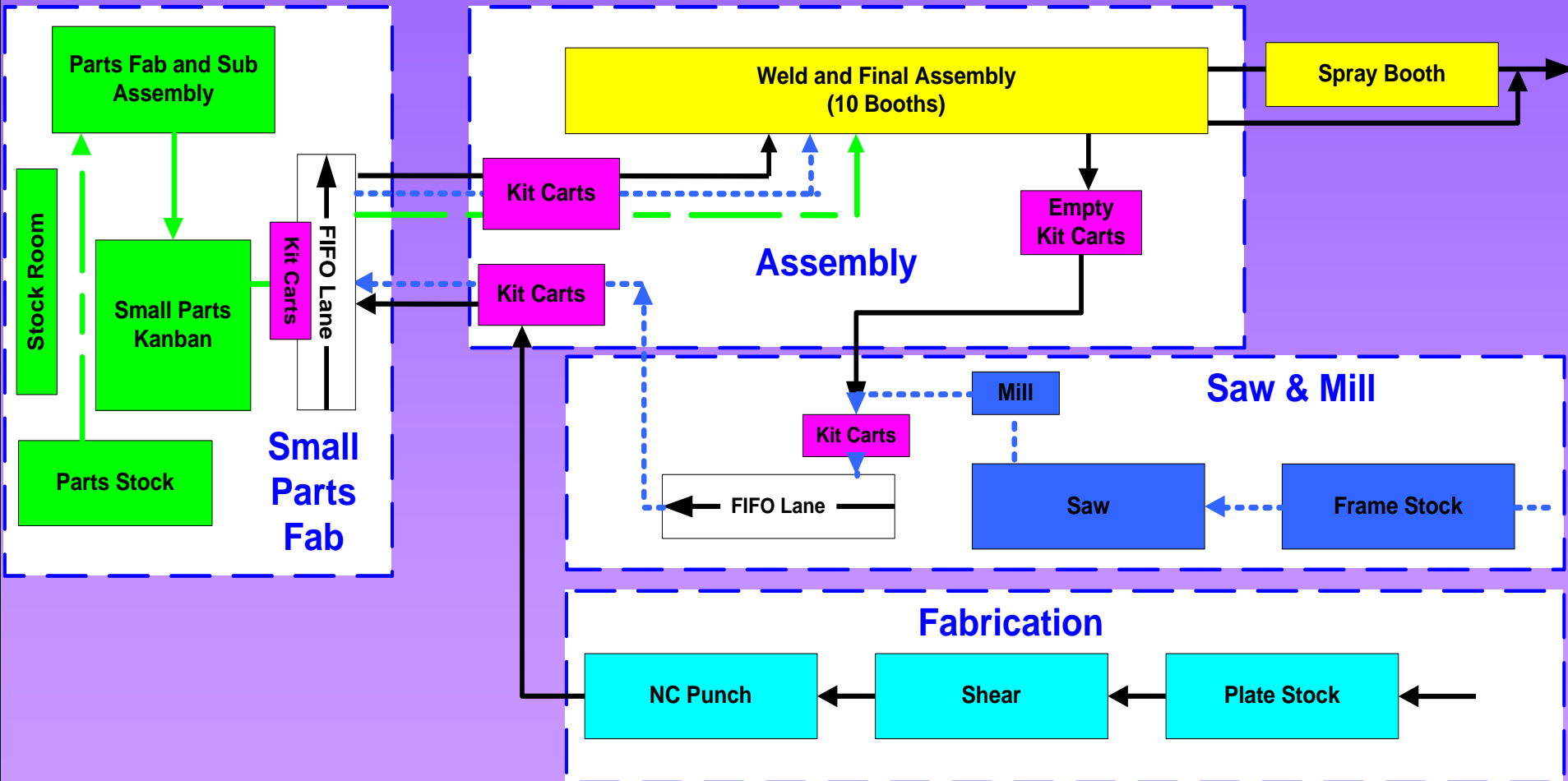
Door Fabrication Process



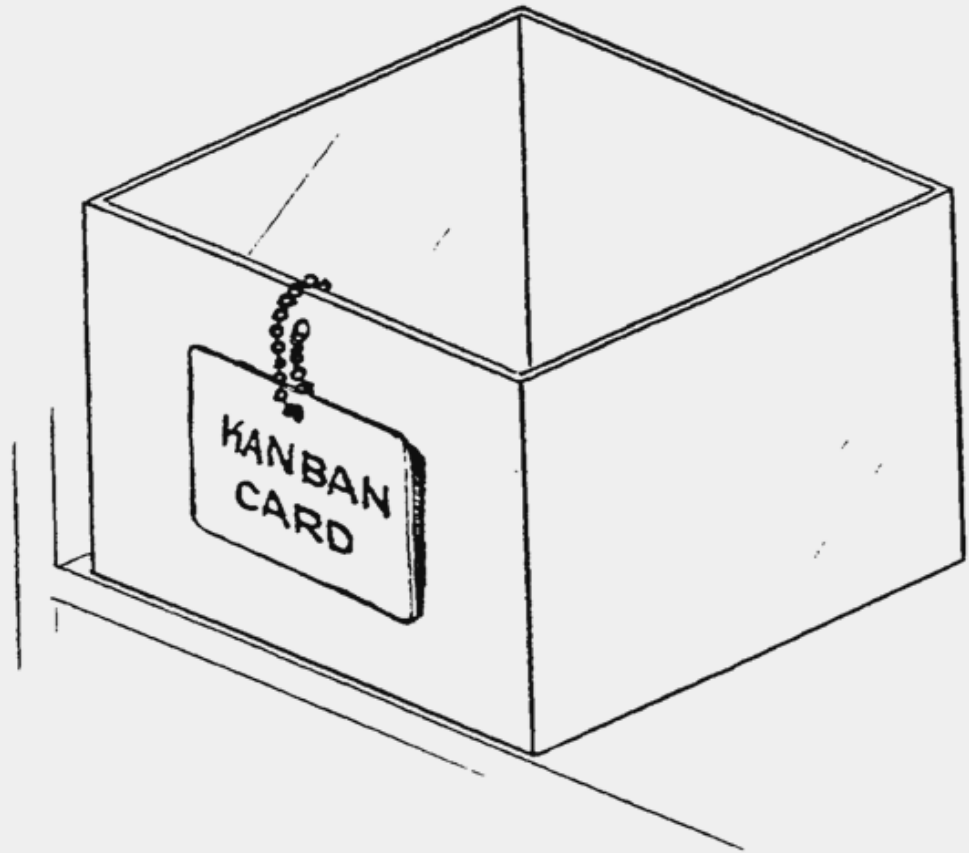
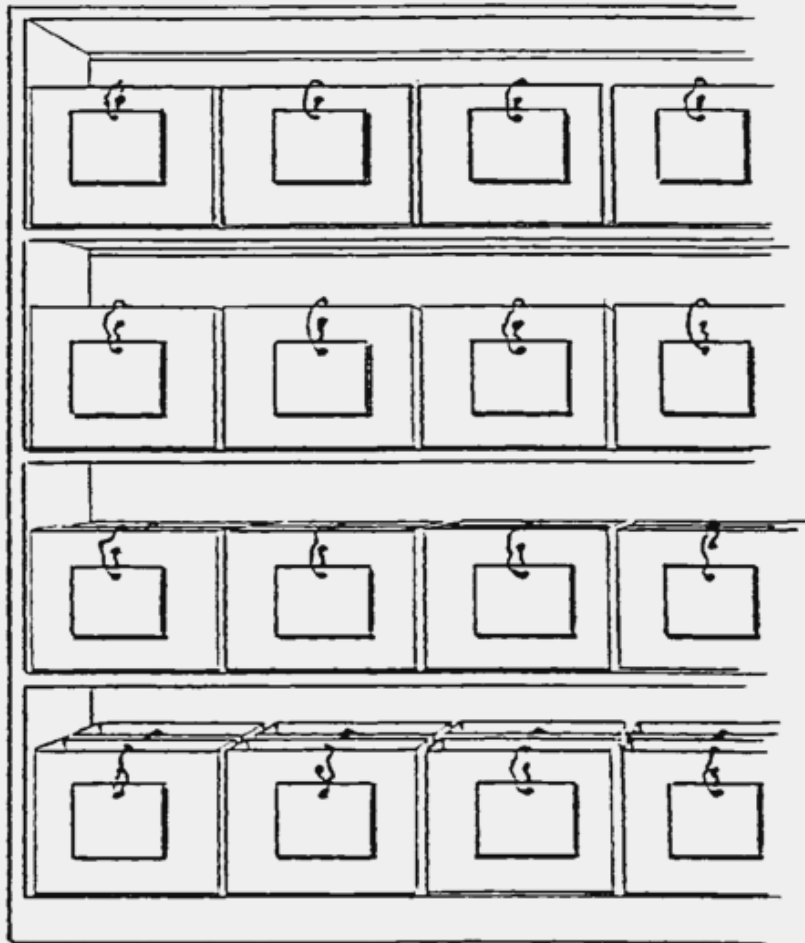
TRADITIONAL LAYOUT



LEAN/CELLULAR LAYOUT



TWO BIN KANBAN SYSTEM

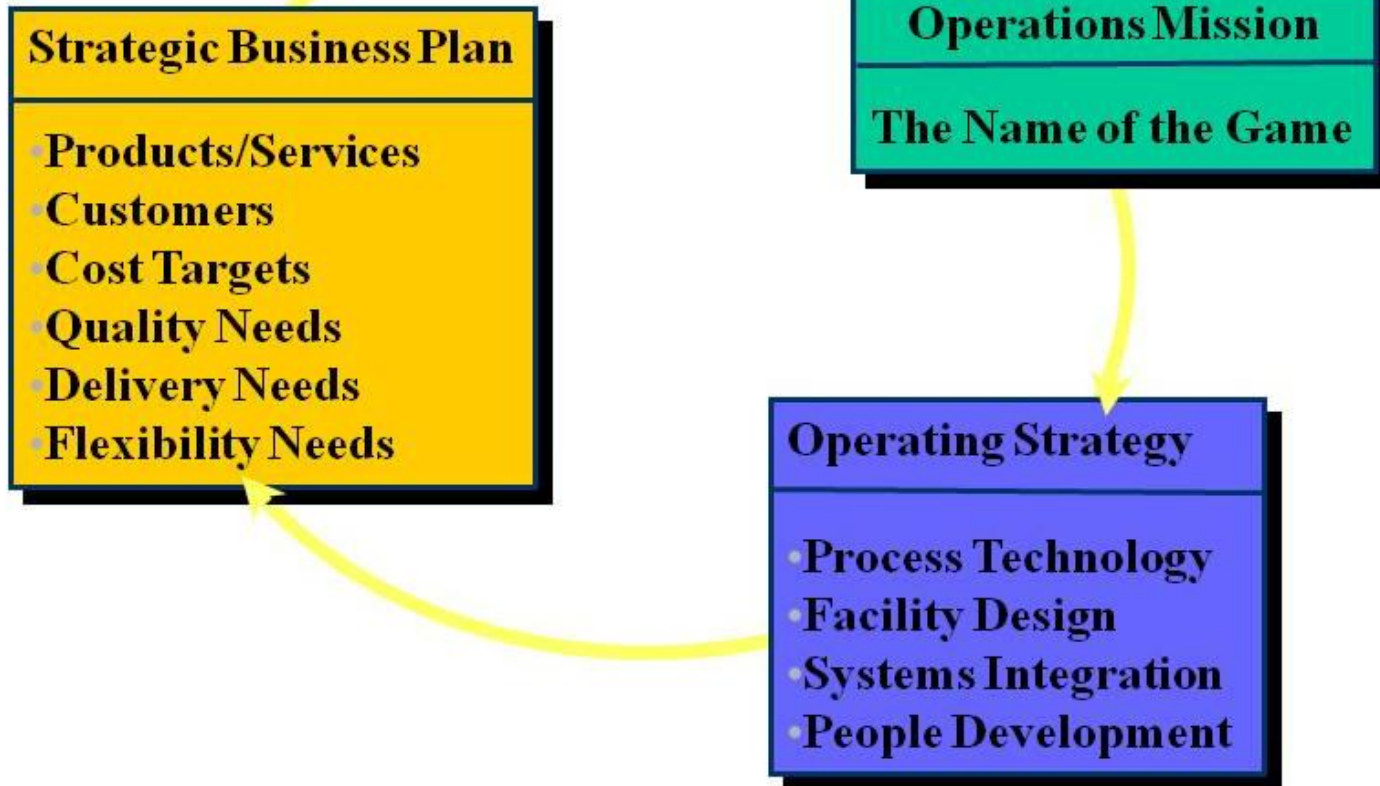


IMPLEMENTATION

Another Case Study

C3 Case Study

Strategic Planning



C3 Case History (cont)

Customer Profiles/Manufacturing Mission

Highly Repetitive?	Yes	<p>“Convert the Customer ASAP”</p> <p>Focused Factory</p> <ul style="list-style-type: none"> – JIT Production – Batch Delivery 	<p>“Match the Customer Flow”</p> <p>Focused Factory</p> <ul style="list-style-type: none"> – JIT Production – JIT Delivery 	
	No	<p>“Solve the Problems”</p> <p>Specials Cells</p>	<p>“Manage Capacity, Limit Queuing, Flow the Parts”</p> <p>Quick Turn,</p> <p>Flexible Cells</p>	
		No	Lean Adopter?	Yes

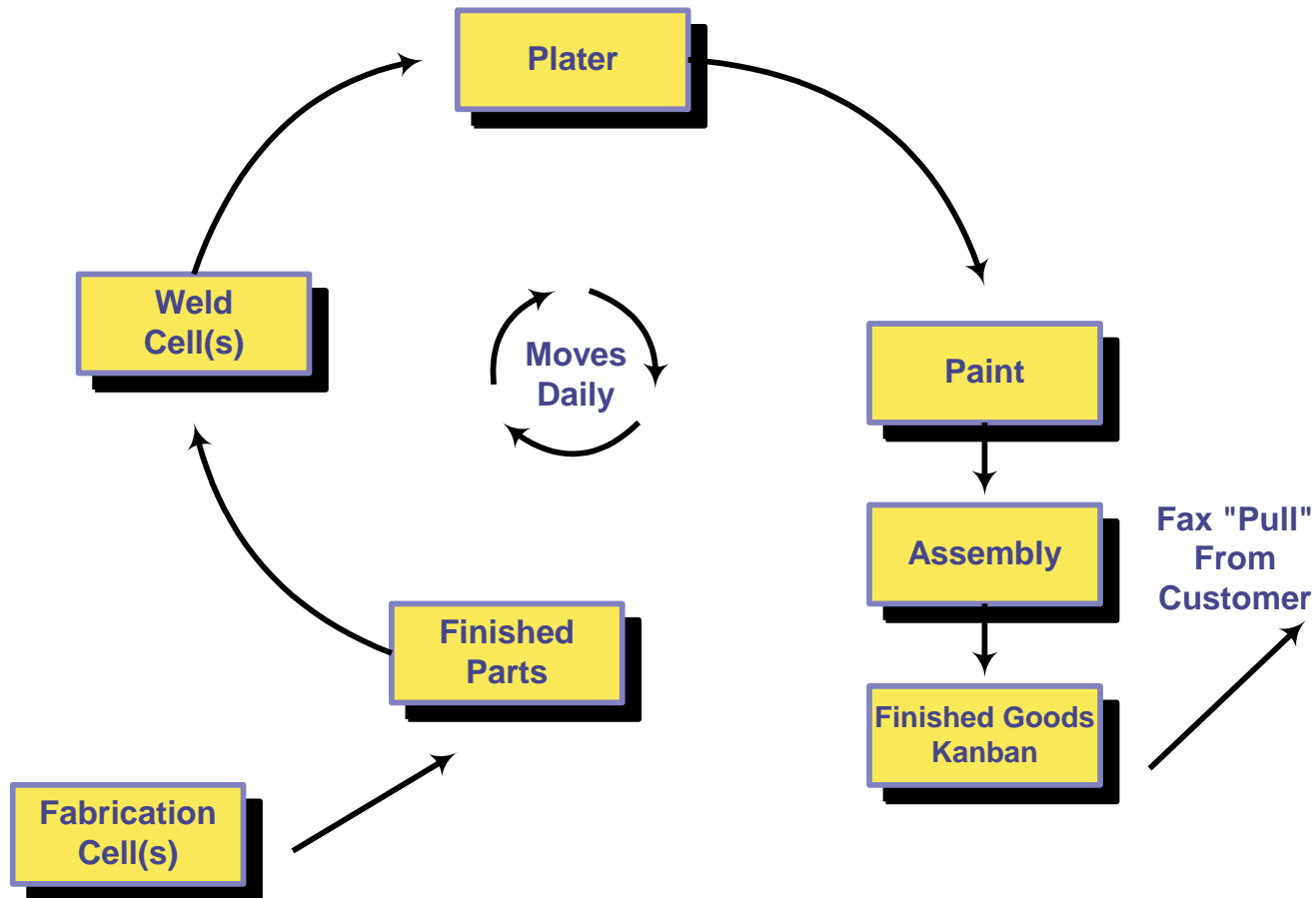
C3 Case History (cont)

Basic Manufacturing Strategy

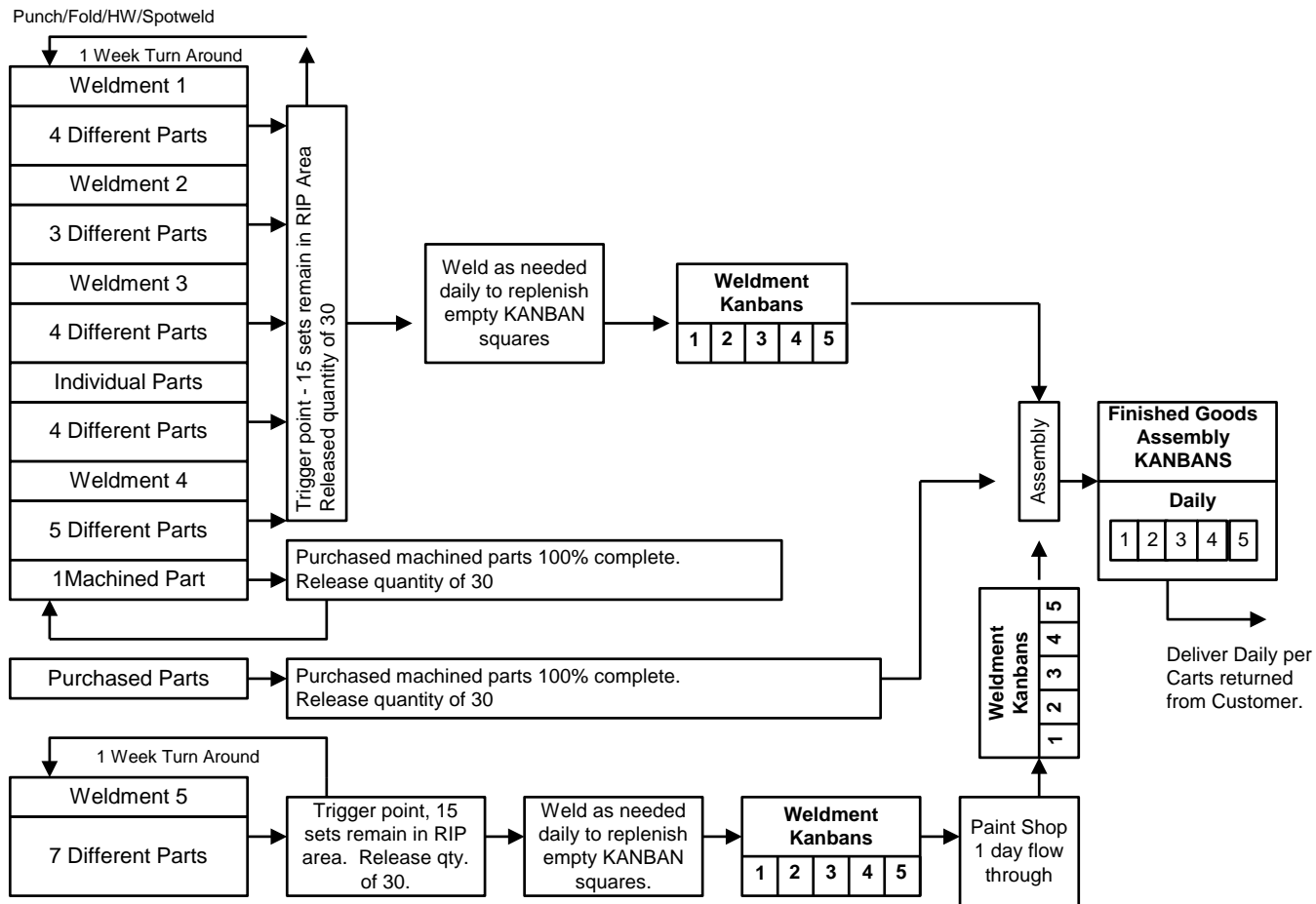
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<ul style="list-style-type: none"> • JIT <ul style="list-style-type: none"> – Order Processing – Purchasing – Estimating – Programming 	JIT Process Flow (Focused Factories) <ul style="list-style-type: none"> – Punch – Form – Hardware – Weld – Paint – Assembly 	JIT Focused Factory Manager
	JIT Parts Flow (Standards Cells) <ul style="list-style-type: none"> – Punch – Form – Hardware – Weld – Paint – Assembly 	Standards Manager Cell Leaders
<ul style="list-style-type: none"> • Proto Team <ul style="list-style-type: none"> – Engineering – Drafting – Estimating – Order Processing – Programming 	Problem Solving (Special Cells) <ul style="list-style-type: none"> – Laser – Form – Punch – Hardware – Weld 	Specials Manager

C3 Case History (cont)

JIT Process Flow (Focused Factory)

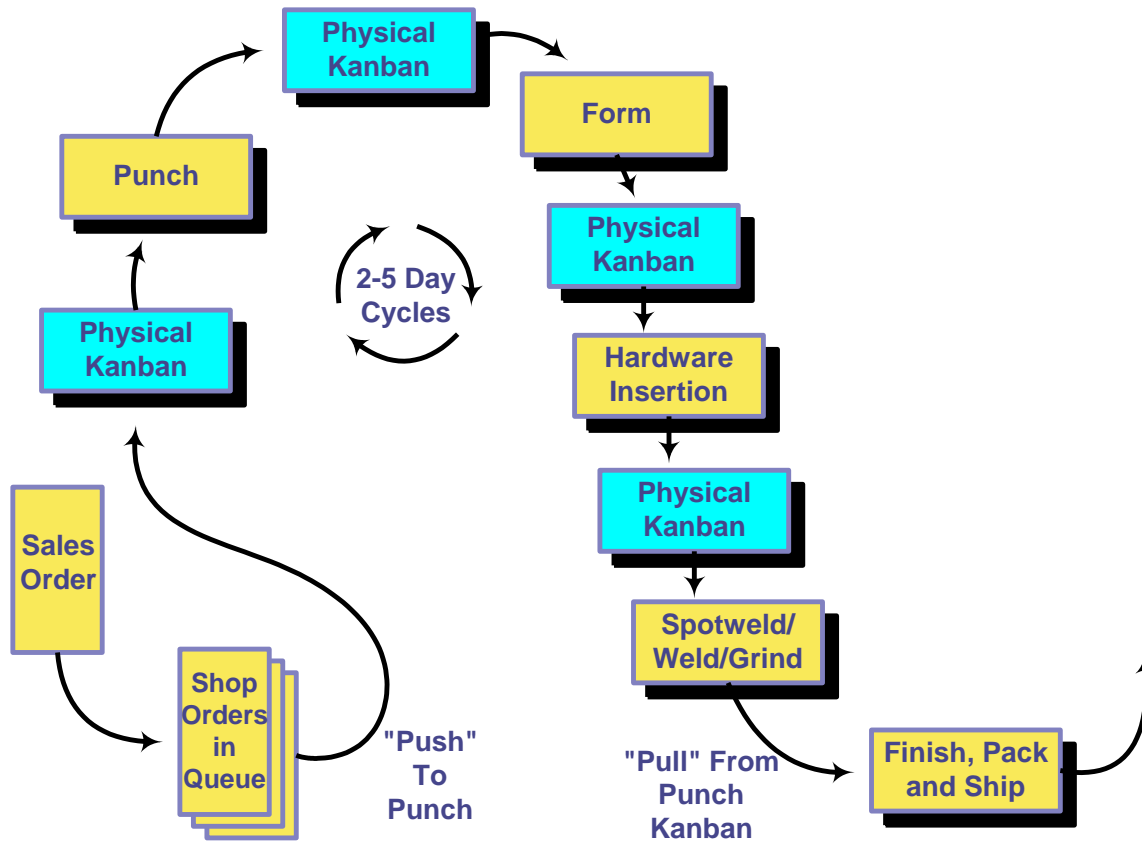


C3 Case History (cont)



C3 Case History (cont)






JIT Parts Flow

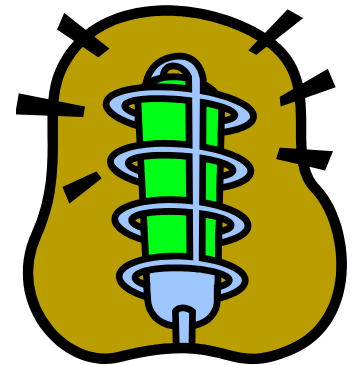


IT APPLICATIONS



IT Applications


-  Data capture at time of visual or automatic determination of reorder point
-  Electronic transfer of replenishment signals
-  Printing of Kanban cards
-  Electronic posting of Kanban signals
-  Updating of ERP system and required reporting




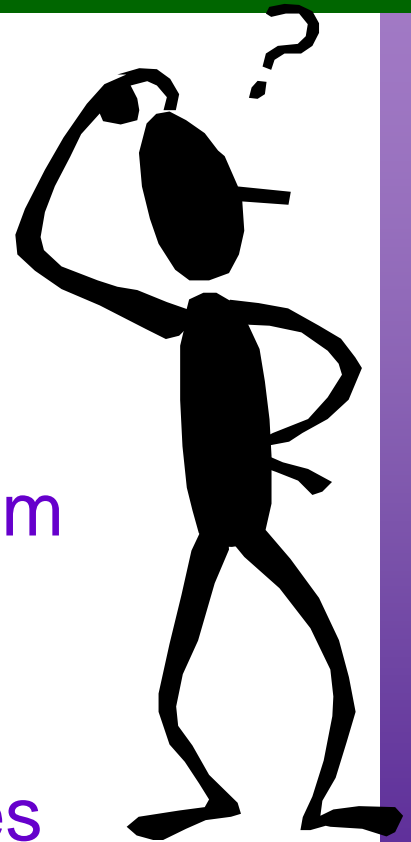
Some Key Questions

 Do you have Lean practices in place?

 Do you have ERP up and running?

 Do you have a strategy for getting them to work together?

 Can you run the factory with schedules and other documentation taken directly from your ERP system



Wrap-Up

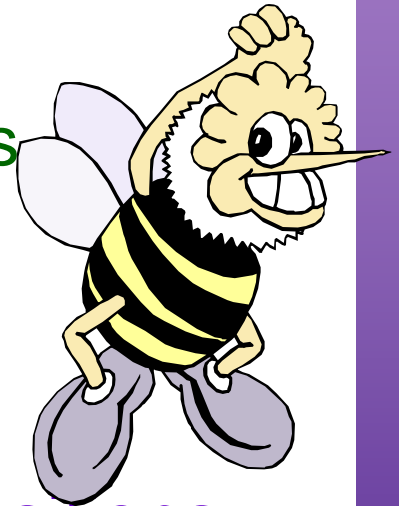
 Lean manufacturing requires that you limit queuing

❖ Remember the fundamental objectives

- Don't run out
- Don't have more than you planned for

 There are many ways to replenish downstream work queues/inventory positions using pull protocols

 You can control the flow of non-repetitive work with IPKs





INDIFFERENCE

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.

If you would like a set of these slides and a copy of *“The Top Ten Secrets of Lean Success,”* please leave me a business card at the end of the session

THANK YOU !

