What items to make to stock and what to make to order (pre-leveling discussion)

Assumptions / Key factors to consider:

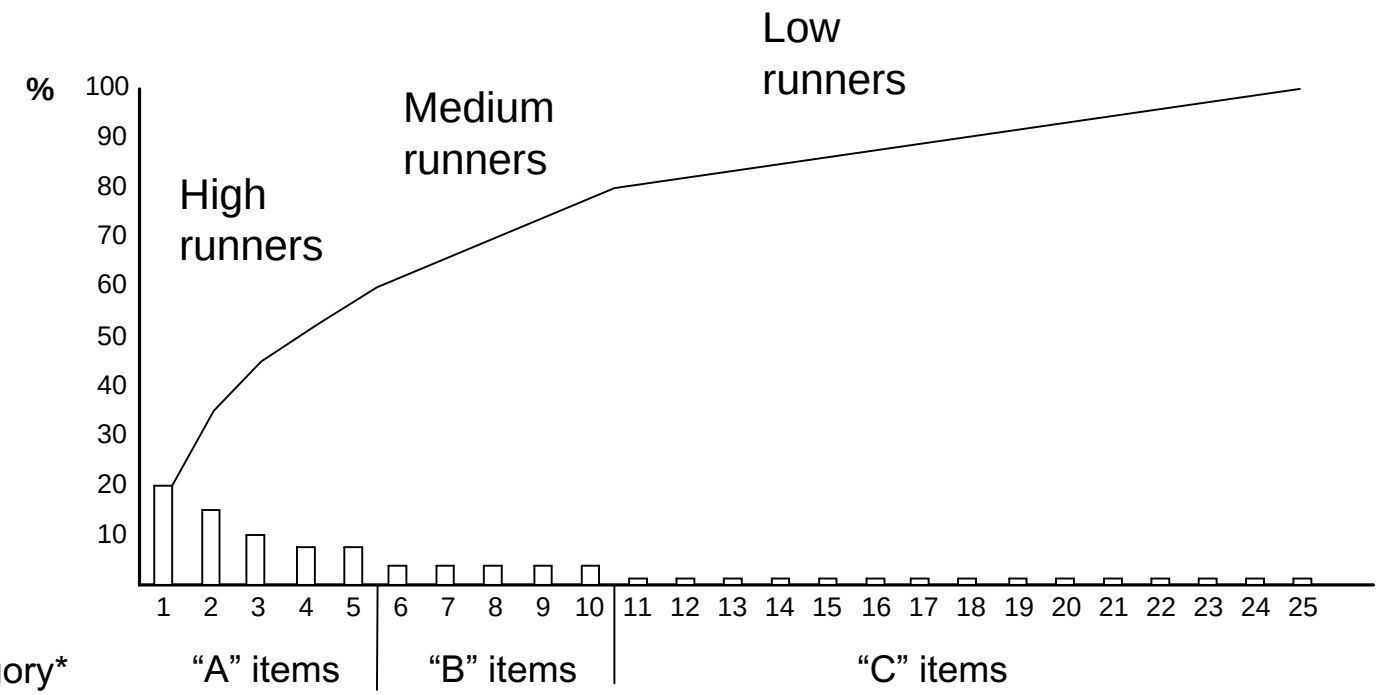
Select the value stream and identify the products	→	LTS
Establish the value stream takt time (basis for staffing)	→	LTS/CCF
Level quantity	→	CLP
Level the mix	→	CLP
Determine the “right” type of pull system to run	→	CLP

Question:

Why is level and pull production good to pursue?

1. Un-level push
2. Level push
3. Un-level pull
4. Level Pull

Part frequency analysis – Look for an 80/20 rule



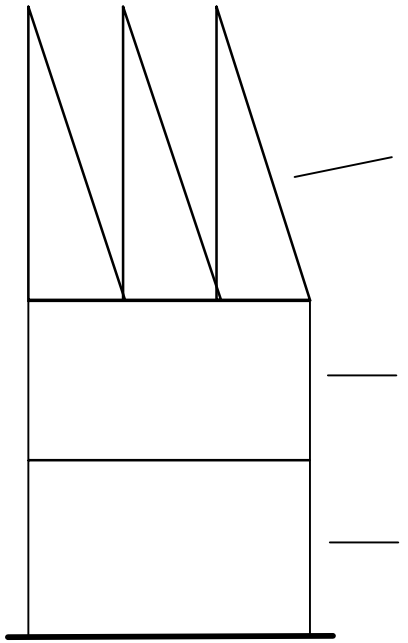
Category*	"A" items	"B" items	"C" items
% of daily demand	60%	20%	20%
Frequency	Daily	Weekly	Monthly

*Items are ordered by demand frequency not dollar value

Basic options

Options	Pros	Cons	Type of pull system	Comment
1. Hold FG inventory in everything and make all to stock	Ready to ship all items on short notice	Requires much inventory and space	Basic replenishment pull system	Toyota basic starting point
2. Hold no FG inventory and make all products to order	Less inventory	Requires high stability and short lead times to work best	Sequential pull system	More difficult to implement and maintain a level pull
3a. Hold Cs in inventory and make A and B products to order daily	Moderate inventory	Mixed production control. Requires daily stability.	Mixed pull system	Requires managing multiple schedule points and flows
3b. Hold As and Bs in FG inventory. Make Cs to order	Moderate inventory	Mixed production control. Requires visibility on Cs	Mixed pull system	Requires Managing multiple schedule points and flows

Toyota's basic inventory logic for dummies



Market Inventory

Cycle stock
Inventory required to fulfill average demand

Buffer stock
Inventory to buffer against fluctuations in orders

Safety stock
Inventory to buffer against variability in internal mfg. processes

Basic inventory logic

Average demand
x
Lead time to replenish

+

Standard deviation*
x
1 (covers 67% of deviation)
2 (covers 95% of deviation)
3 (covers 99% of deviation)

+

Down time losses
+
Quality losses

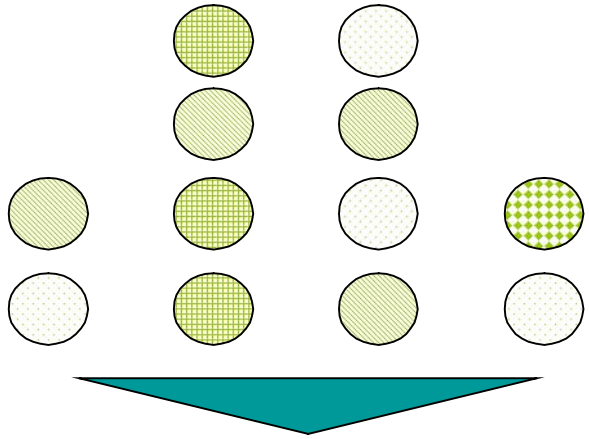
= Market inventory level

Stocking markets based upon average demand alone often will lead to shortages!

*Assuming a normal distribution

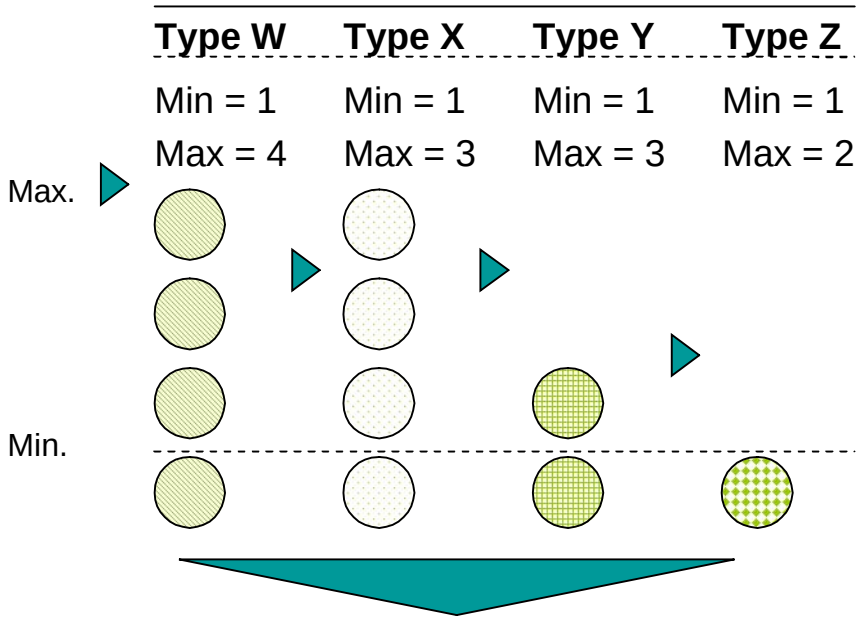
5S enables visual control (Inventory example)

No organization



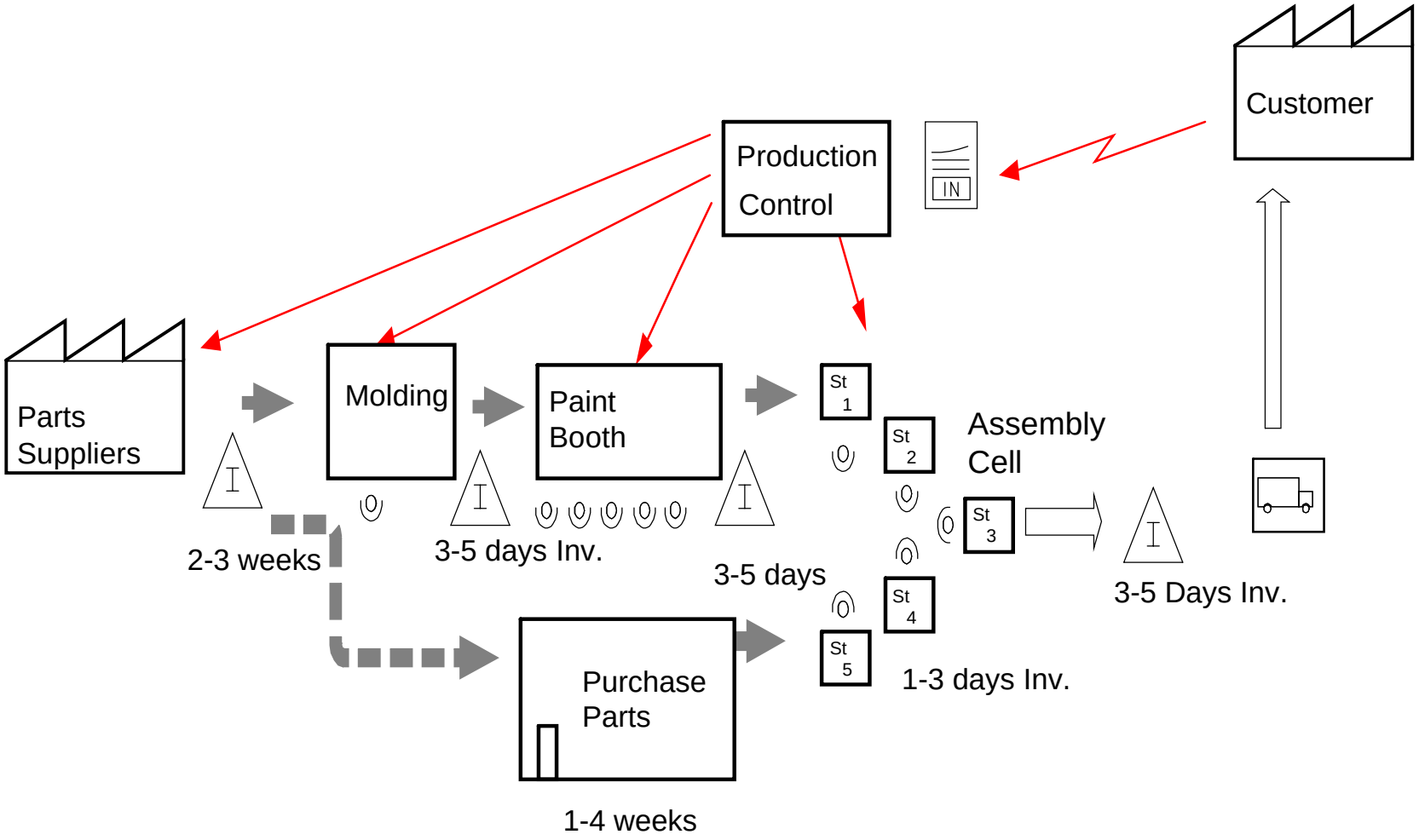
- Good or bad?? Unclear
- No standard or basis for comparison

Lean ideal



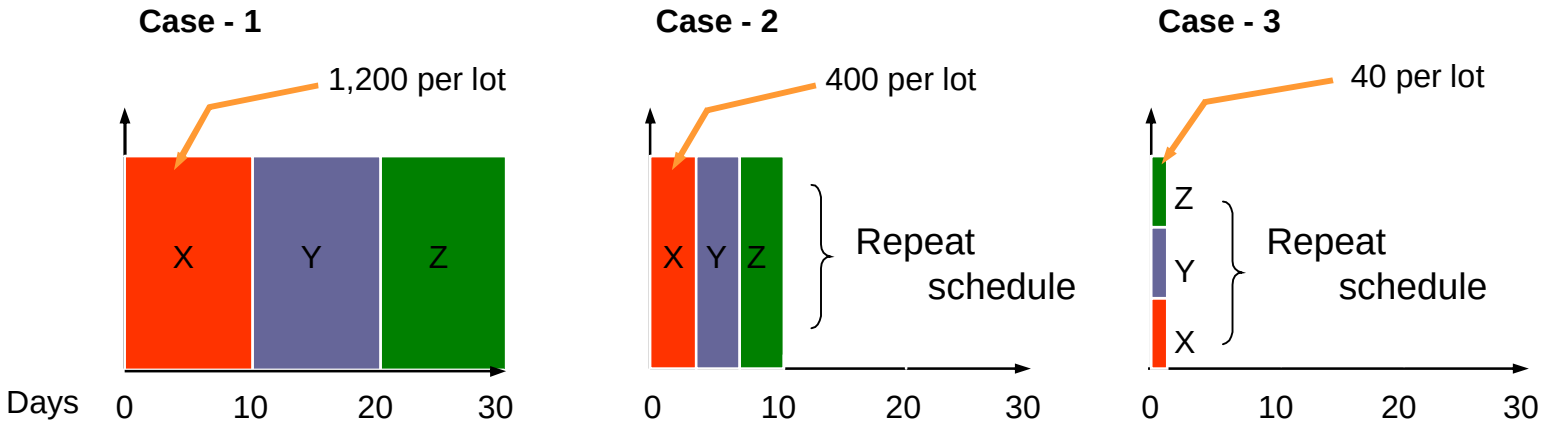
- Normal vs. Abnormal clear
- Standard basis for comparison

Multiple scheduling points can cause chaos



Level production mix concept and effect

Illustrative example



"Large batch"

- 3 lots of 1,200
- 3 changeovers
- 10 day build
  - 10 day avg. inventory
  - 10 to 21 day lead time

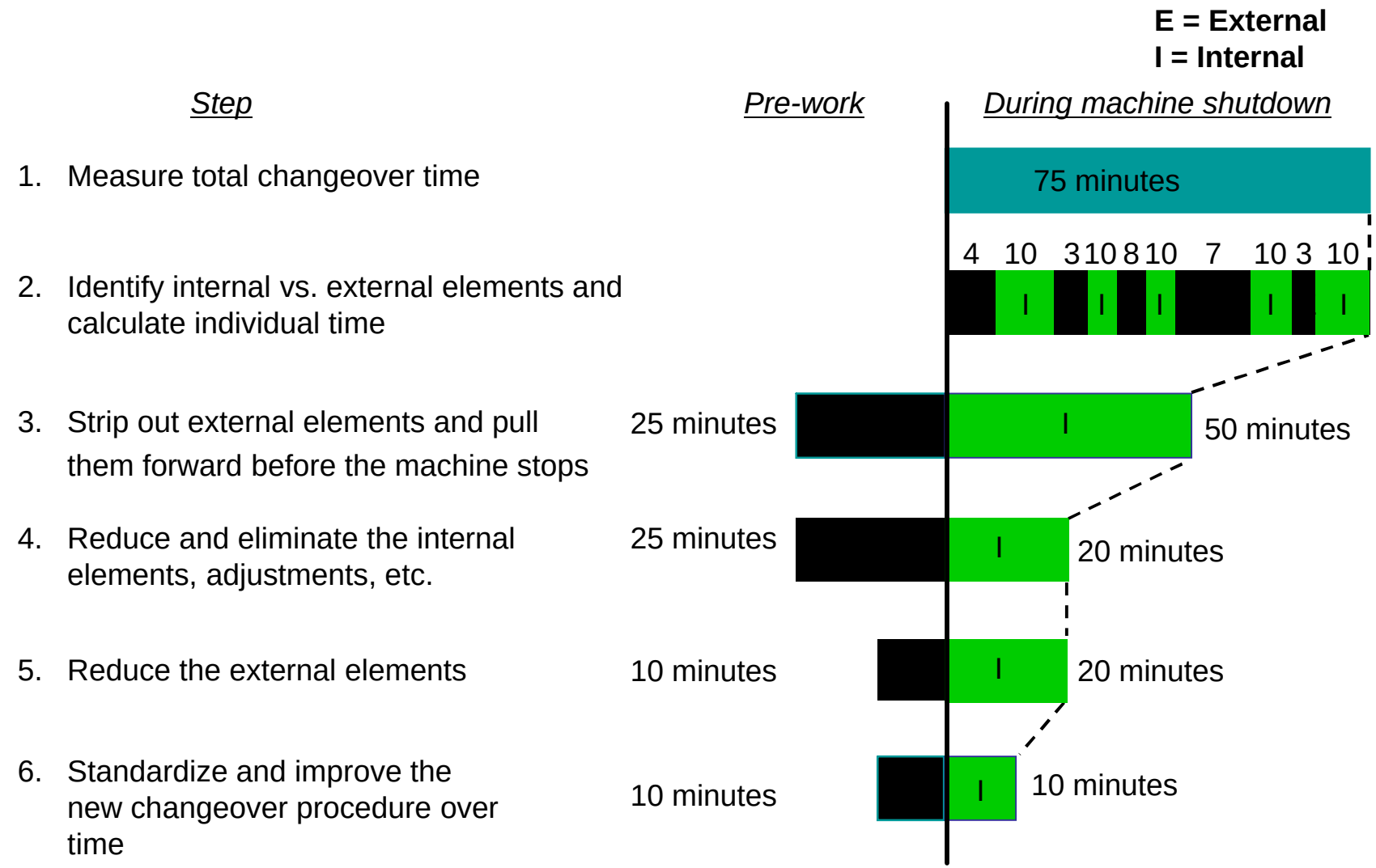
"Medium batch"

- 9 lots of 400
- 9 changeovers
- 3.3 day build
  - 3.3 day avg. inventory
  - 3.3 to 6.6 day lead time

"Small batch"

- 90 lots of 40
- 90 changeovers
- 3 items per day build (EPED)
  - 1 day avg. inventory
  - 1 day lead time

Change over reduction (SMED)



Determine time available for non-production work (1 machine example)

Part #	Average demand per day* (pieces)	Cycle time Per piece	Required run time per day	Average changeover time	Average scrap rate
15487	200	40 sec.	136 min.	55 min.	1.5%
15488	300	45 sec.	228 min.	55 min.	1.3%
15489	500	40 sec.	339 min.	55 min.	1.5%
	1,000		703 min.		

Total 1-shift production time available (net breaks and lunch)		450 min.
Number of shifts	x	2
Time available for production on 1 machine 1 day	=	900 min.
Time required per day to meet average demand*	-	703 min.
Net time available for set up and changeovers per day	=	197 min.

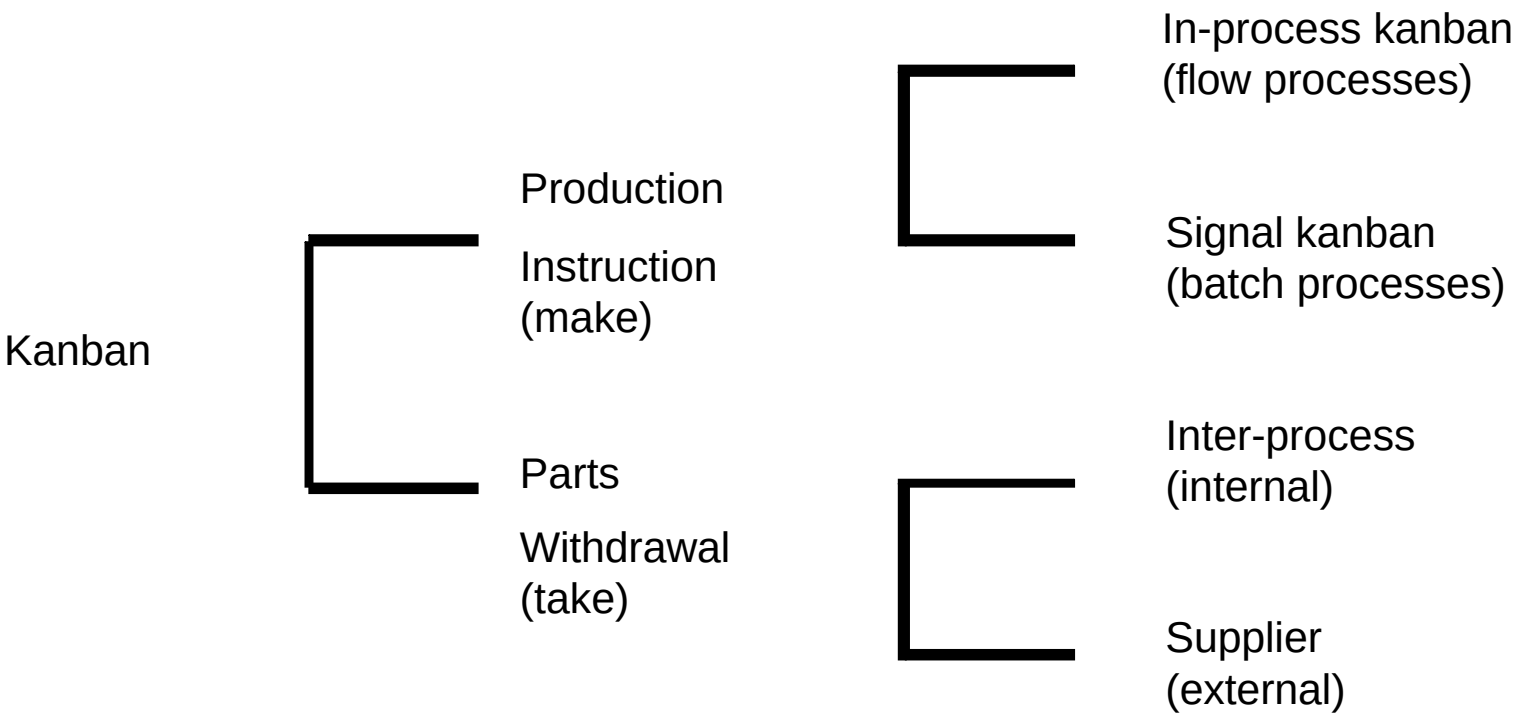
***Your situation may require calculating demand per week or month as required**

Set the number of change over events per interval

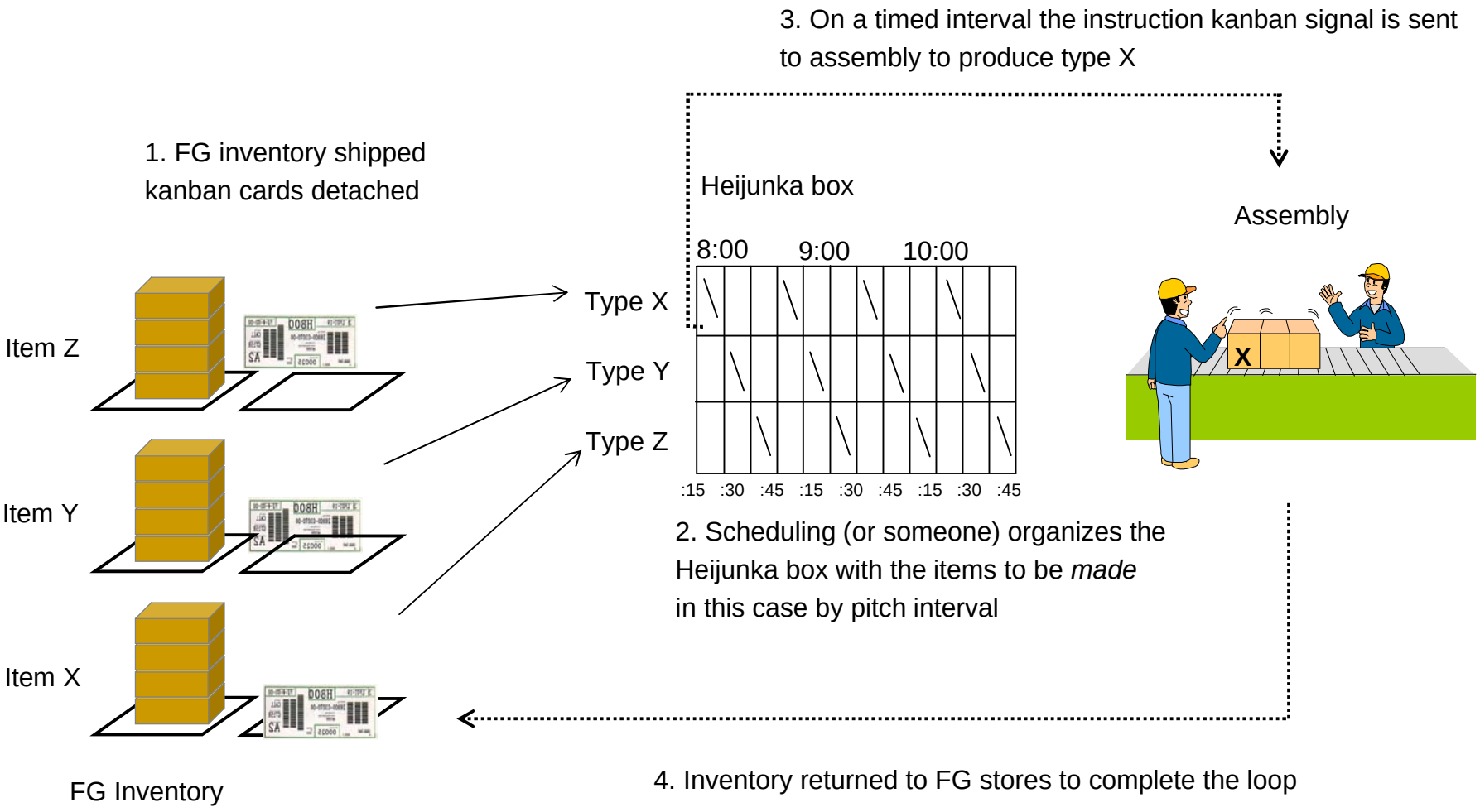
Non-production time available		197 min.
Average downtime (not including set-up and changeover times)	-	30 min.
Time available for changeover work on 1 machine 1 day	=	167 min.
Average changeover time	÷	55 min.
Possible number of changeovers per day	=	3.04

With only 3 part numbers and 3 possible changeovers per day -
Every part every day (EPED) is a good interval to start with in this instance

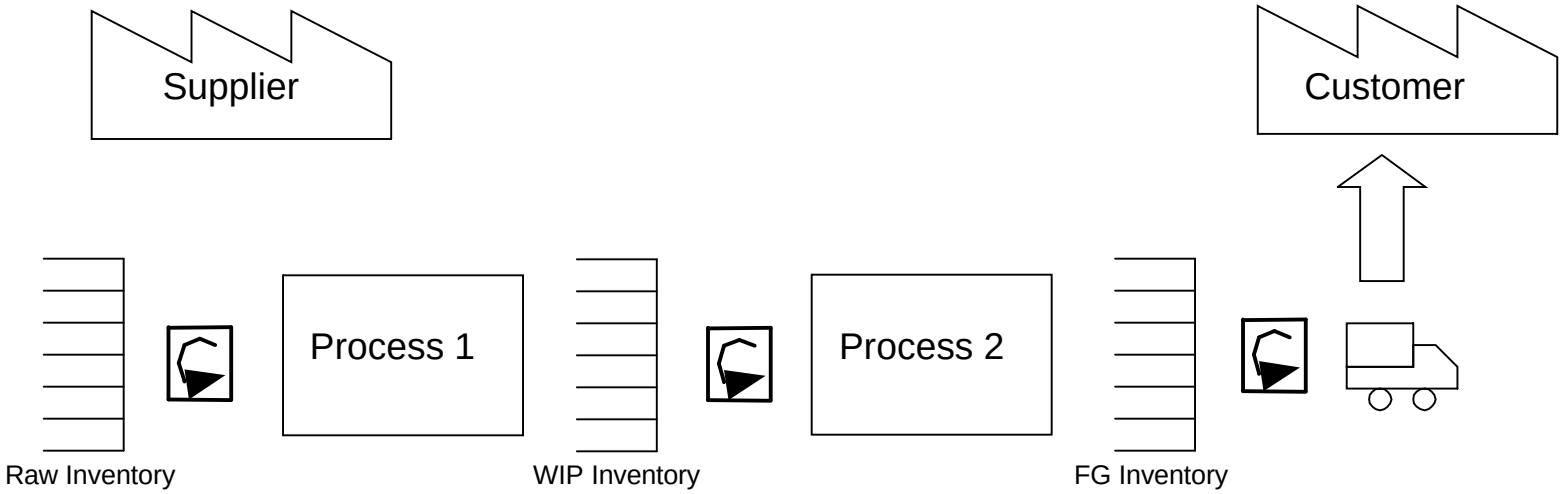
Types of kanban



Production instruction kanban with Heijunka box

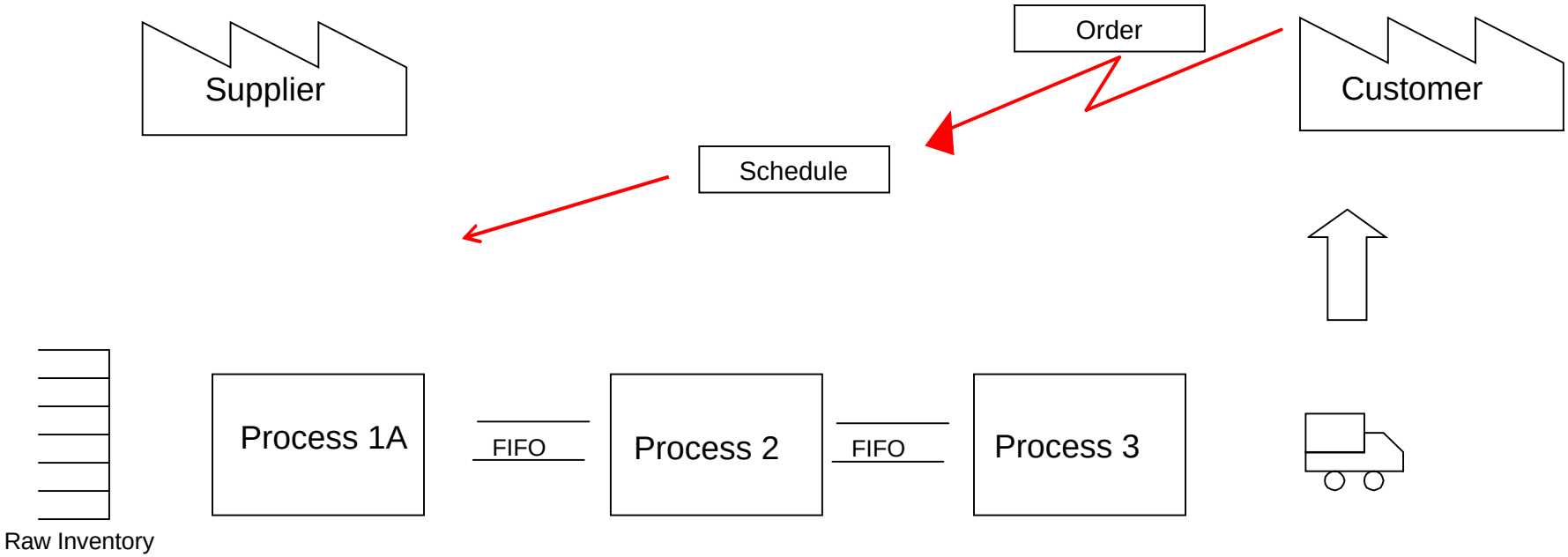


Pull can also be “governed” by markets in some instances



- Markets signal what to make and when to stop
- The market is normally located at the producing department (but not always)
- Types of inventory in the market can be determined by A,B,C analysis (i.e. not everything has to be in the market)
- Quantities should be set in accordance with Cycle, Buffer, and Safety rules
- Kanban usage needs to be determined regarding signals to both get material from the market and signals back upstream regarding what to put back in the market
- Material handling must be linked as part of the system (more later on this)

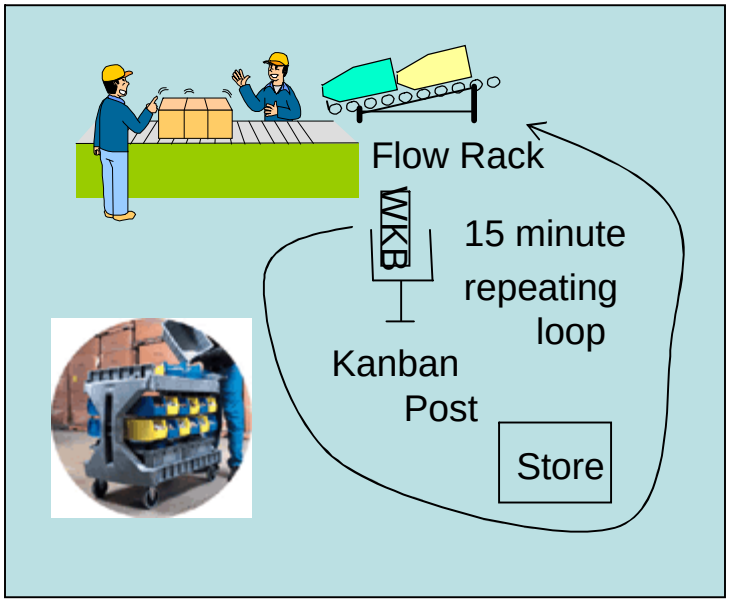
Pull can also be “governed” by FIFO lanes



- The FIFO lanes control the sequence of what to build
- The pace and quantity of production is controlled by the release of the schedule to the pacemakers at the start of the line
- Processes can not build without material being available
- WIP should be limited and regulated by designated certain finite spaces on the floor (e.g. “up”, “on deck”, & “in the hole”)

Parts withdrawal and conveyance – two systems

1. Fixed time but unfixed quantity

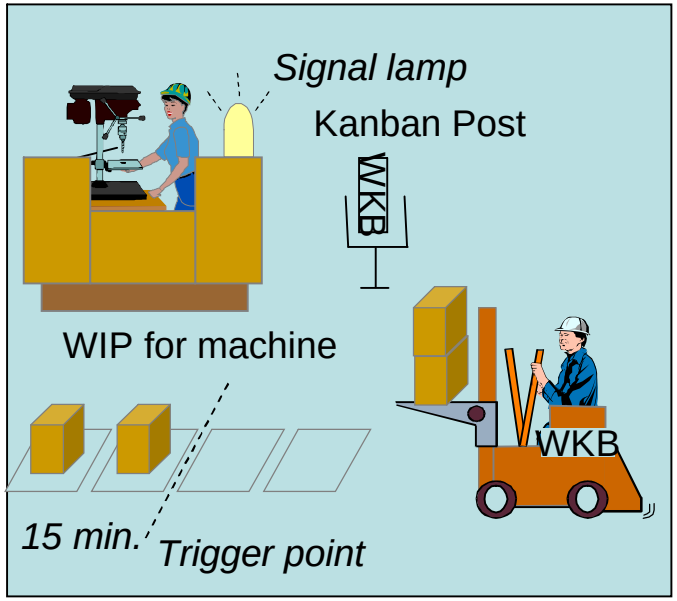


- Think of the analogy of a city bus driver on a loop route that repeats
- A one hour loop for example would expect to be repeated eight times per shift
- Inventory line side / point of use would only need to then be 1-2 hours. The rest should be in a controlled market
- The exact items delivered each trip will vary in accordance with consumption signals however the timing of delivery is standard and consistent with this method
- You have to have a Plan For Every Part (PFEP). See Making Materials Flow

For example:
On a set and timed route e.g. 15 minutes the material handler will pick up the kanban cards and deliver product line side

Parts withdrawal and conveyance – two systems

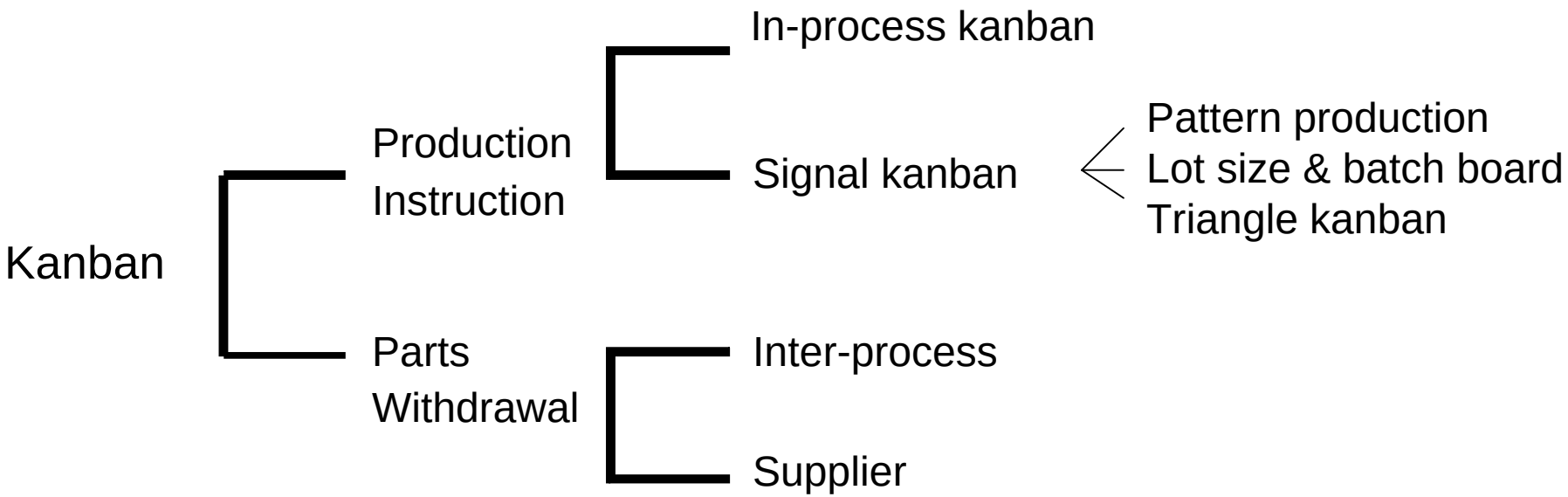
2. Fixed quantity unfixed time



- Think of the analogy of a taxi driver who is “on call”
- No standard repeating loop is possible due to the nature of production
- Inventory amounts and clear signals for when to call for material must be crystal clear
- The items delivered each be consistent however the timing of delivery is standard and consistent with this method

For example:
In response to inventory decreasing below the trigger point, the material handler brings a fixed quantity e.g. two boxes to the line in this example

Types of kanban



How to expand the system across the plant

Option	Advantages	Disadvantages	Comments
"Vertical" rollout by value stream	Clear pattern and start point customer back point of view Implementation patterns exist as in LTS*	Difficulty in resolving shared assets problems Lengthy process if you have many value streams	Best to pursue if assets are clearly dedicated to value streams
"Horizontal" rollout across departments	Solves scheduling problem at shared assets Capture of cross-value-stream such as material handling	Less clear where to start Transition points tricky. Sometime you have to "throw the switch" in one fell swoop	Best if more resources are shared

"Start based upon your greatest point of need" - Taiichi Ohno

*Learning To See: Value Stream Mapping

Three reasons why pull systems fail over time…

- **Monitor customer demand information carefully because it changes!**
  - -Average demand
  - -Seasonal factors
  - -Mix variation

- **Monitor process performance and stability**
  - -Metrics (Scrap, Rework, Downtime, Changeover time, etc.)

- **Daily supervision and problem solving – make abnormal conditions visual**
  - -Is production ahead or behind?
  - -Are inventory levels below normal?
  - -Are machines cycling on time?
  - -Are defects occurring?
  - -Are suppliers delivering on time?

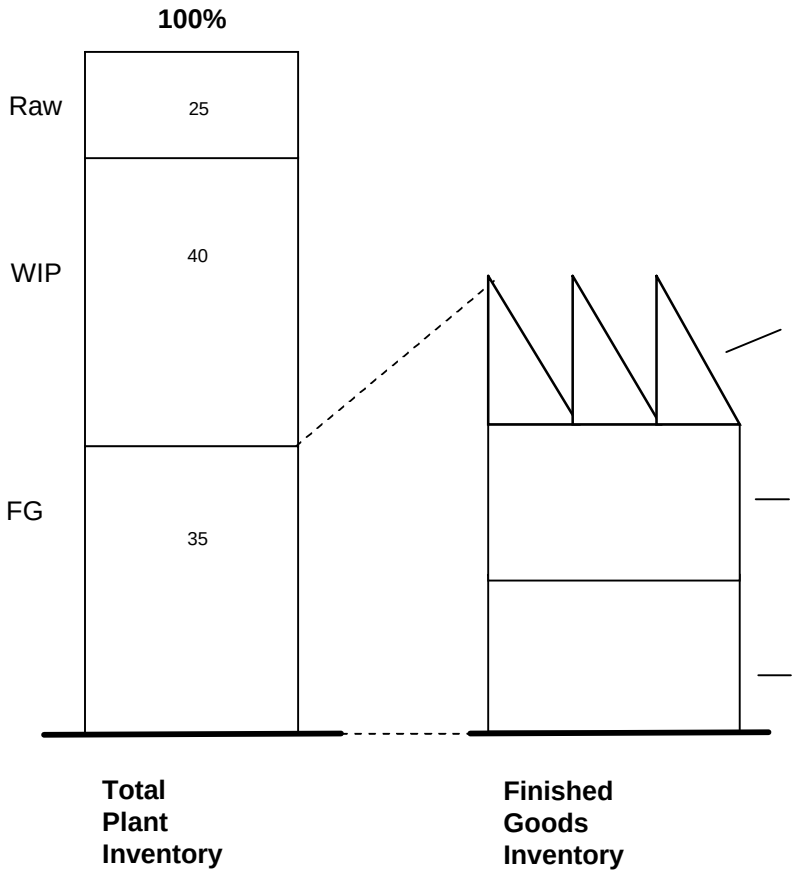
Where is the improvement potential?

- Sample questions to ask:

1) What is your on time delivery performance? How can we make it higher?
2) What is your lead-time? How can we make it shorter?
3) What is your inventory level? How can we make it lower?
4) What amount of time do you spend looking for parts? How can you make that go away?
5) How is direct labor productivity and indirect labor productivity affected by material delivery? How much can you improve it?
6) Are the unstable processes in the system? Can you improve them?
7) How good is supplier quality and on-time delivery? How can you improve them also?

Lead-time improvement lever – analysis by inventory driver

Illustrative example



Cycle stock (80%)

Inventory required to fulfill average demand

Demand side buffer stock(15%)

Inventory to buffer against fluctuations in customer orders

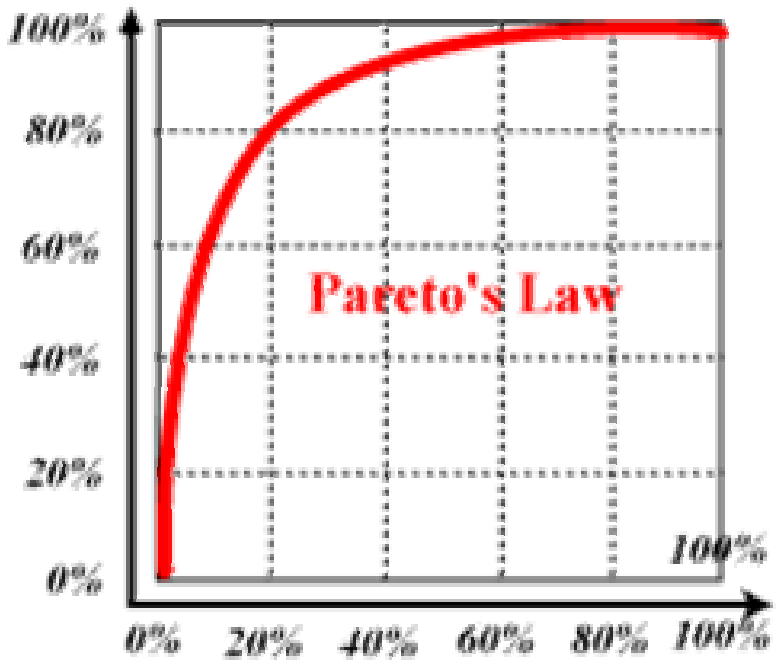
Supply side safety stock (5%)

Inventory to buffer against variability in internal mfg. processes

Key drivers

- Average demand
- Lead time to replenish
- Demand volatility
- Forecast/MPS errors
- Down time losses
- Quality losses

Learn to focus on what matters the most…



Original: 80% of wealth is in the hand of 20% of the population

Quality: 80% of total defect incidents are caused by only 20% of the causes.

Lead-time: 80% of lead-time is tied up by 20% of the operations

Inventory: 80% of the total is tied up in 20% of the part numbers

"In problem solving learn to separate the vital few from the trivial many"

Joseph Juran

In other words there are a thousand plus problems and things that we would like to do in any facility But there are a probably a few things that will matter more and we'll achieve impact faster by focusing on the vital few items first…