Standardized Work

Session 1 Slides

© Art of Lean, Inc.
www.ArtofLean.com

Role of a Leader

- Achieve the production plan
- Ensure quality parts are made
- Reduce cost
- Maintain a safe work environment
- Monitor 5S and PM tasks
- Educate and train team members
- Promote continuous improvement

5 Needs of a Leader

- Knowledge of work
- Knowledge of responsibility
- Skill in instructing
- Skill in improving methods
- Skill in leading

Basic Aims of TPS

- Provide the highest possible quality and service to the customer
- Develop employees potential based upon mutual respect and cooperation
- Reduce cost through elimination of waste in all aspects of production
- Develop a flexible production system capable of responding to changes in demand

Sales and Profit Trends

- Create for your own situation
  - Sales trend
  - Gross margin trend
  - Net margin trend

Overall Quality Trends

- Create for your own situation
  - Customer defects
  - Scrap
  - Rework
  - Etc.

On-Time Deliver Performance

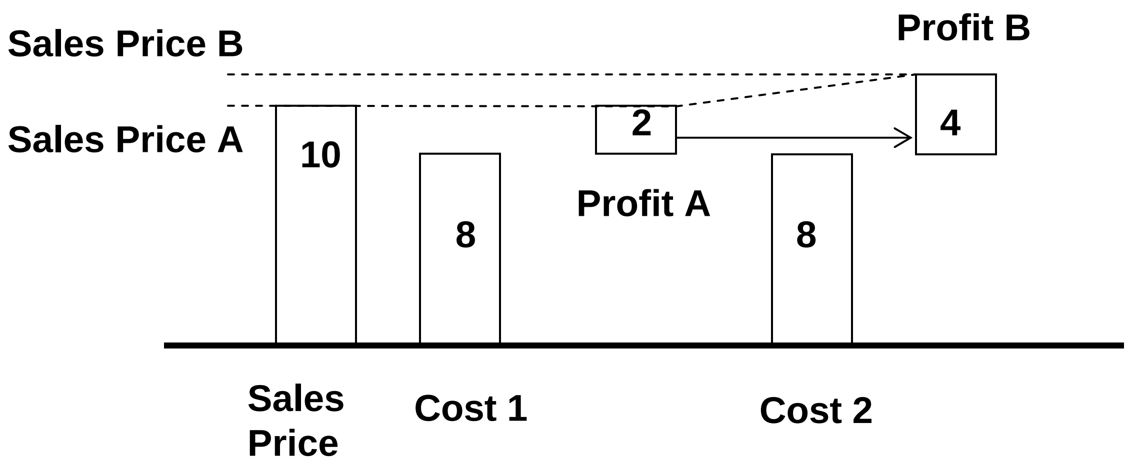
- Create for your own situation
  - On-time delivery to customer
  - Expedited freight
  - Etc.

Price Cost Squeeze

- Create for your own situation
  - Average sales price trend
  - Cost trends
    - Material
    - Labor
    - Overhead
    - Etc.

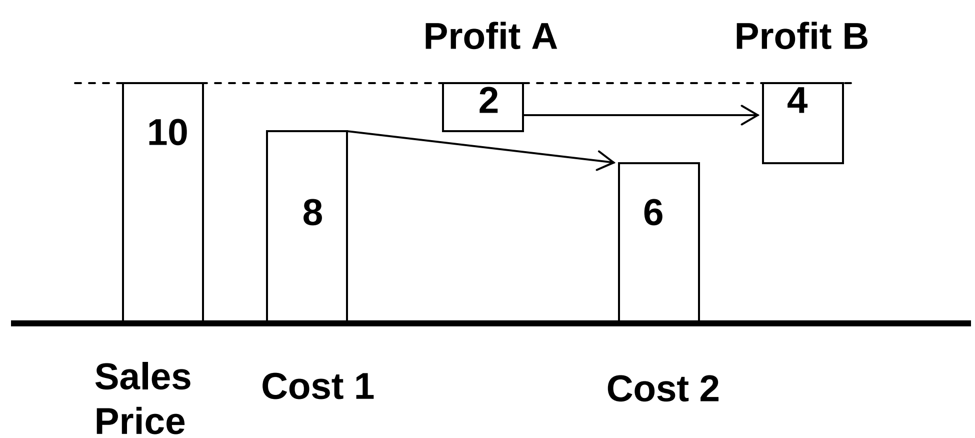
Cost Plus & Reduction Principle

Example 1: Cost Plus Principle



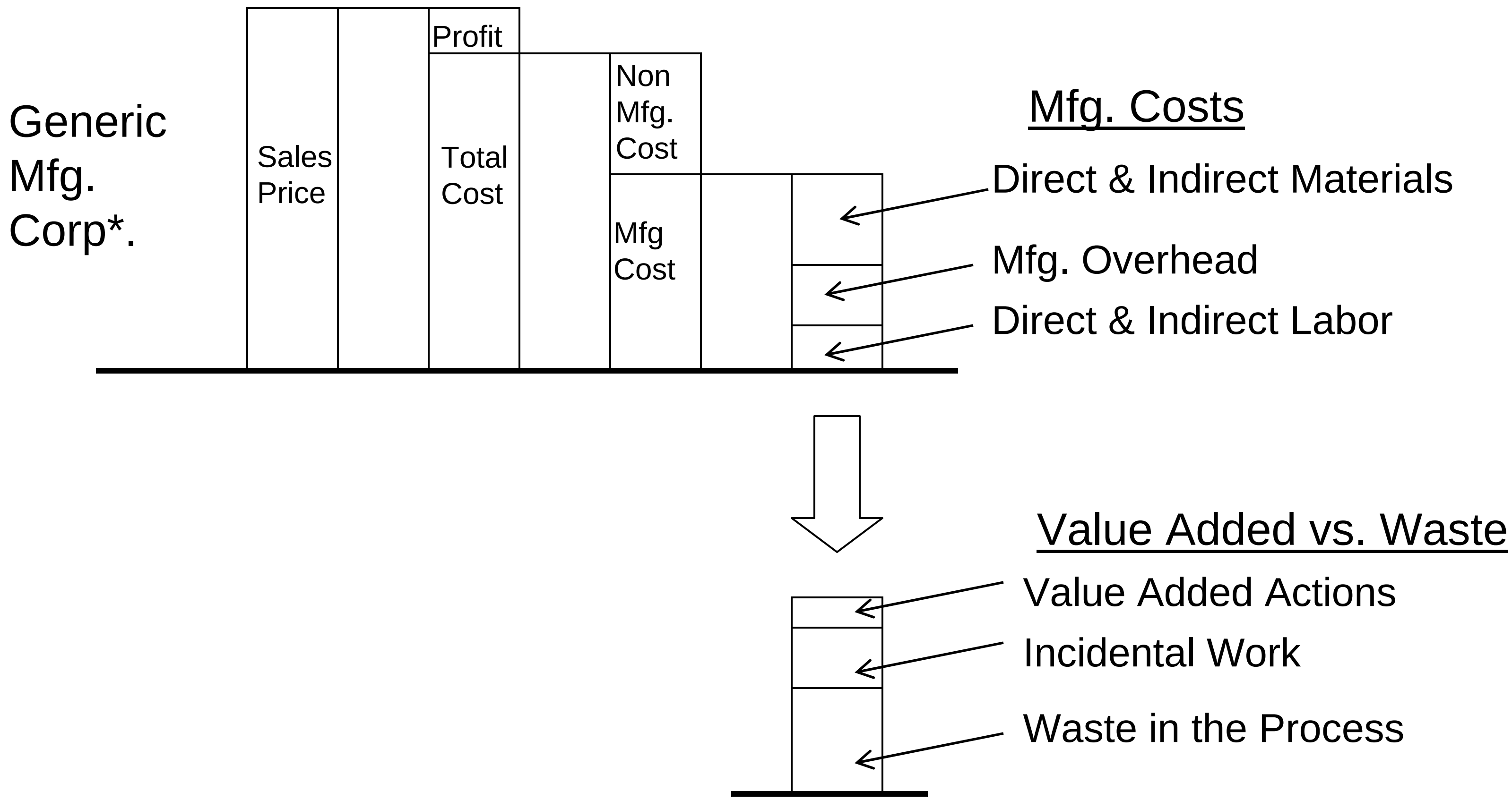
Increase the sales price to increase profits. Works best with a monopoly!

Example 2: Cost Reduction Principle (TPS)



Sales price is the same. Reduce cost to increase profits!

Cost Structure

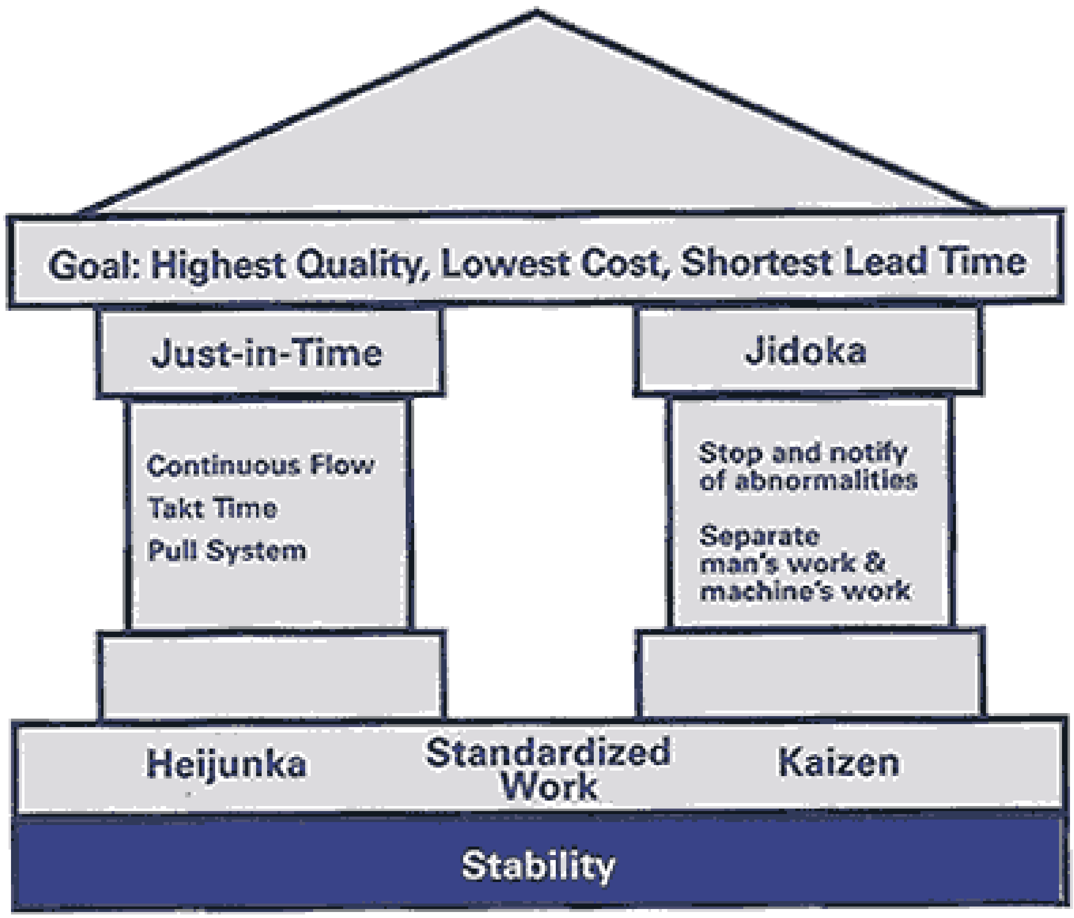


***Note: Create for your own situation**

4 Main Goals of TPS

- Provide world class quality and service
- Develop employee potential through mutual trust and cooperation
- Reduce cost through elimination of waste
- Develop a flexible production system that can respond to changes in market demand

TPS Pillar Chart



Toyota Production System "House"

TPS Main Pillars

JIT

- Flow Production / Small Lot Production
- Takt Time
- Pull Production
- Level Production

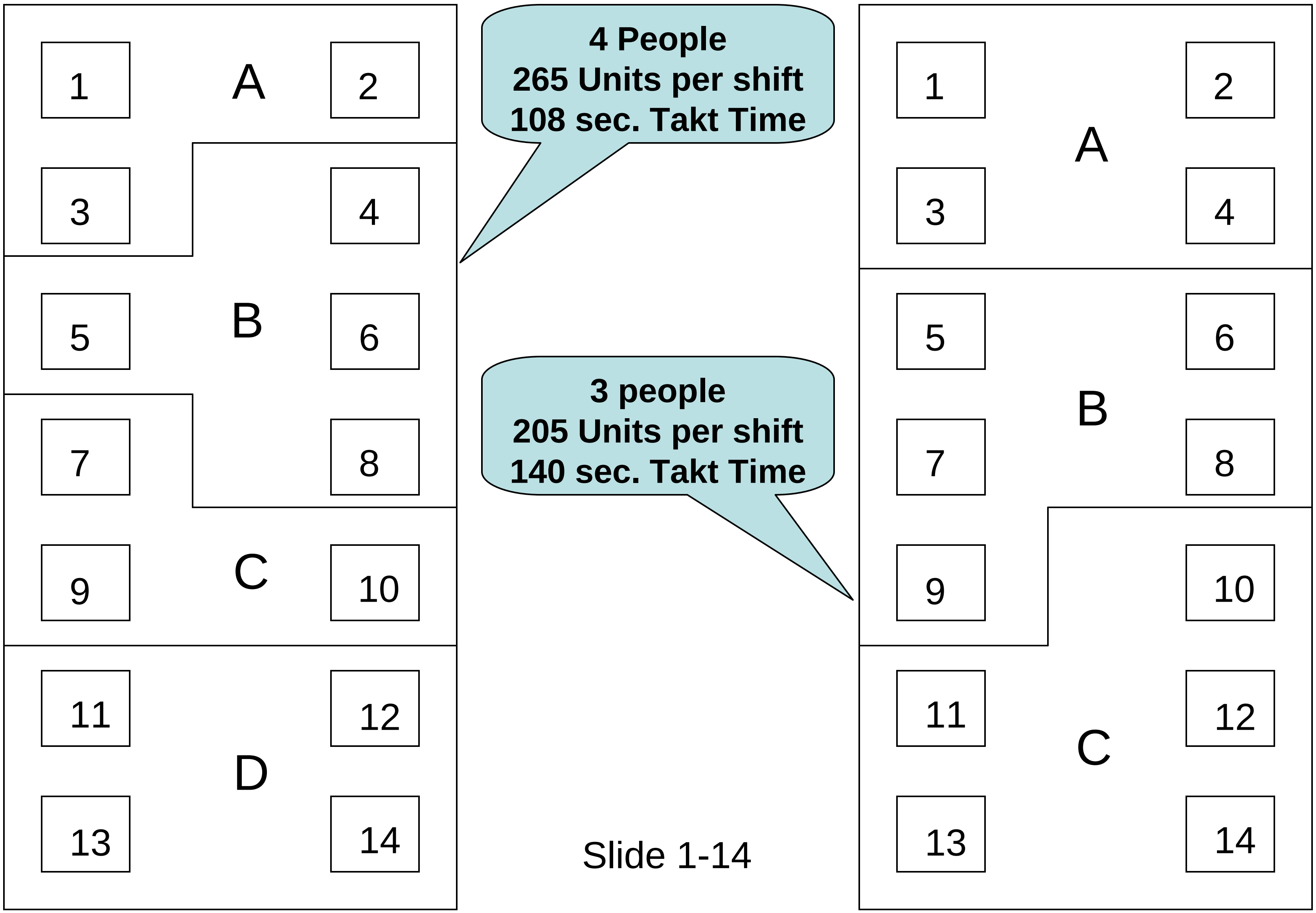
JIDOKA

- Build in quality at the process
- Enable separation of man and machine

Objectives of Jidoka

- Always strive to build in quality at the process 100% of the time
- Automatically detect and prevent equipment breakdowns
- Enable labor savings by achieving separation of man and machine

Efficient Resource Allocation



Standardized Work

Session 2 Slides

Main Points Session One

- Work site management & the role of a leader
  - Many problems in production.
  - Standardization and improvement are parts of our job
- Company circumstances
  - Pursuit of profit
  - Competitive reality in our industry
- Basic TPS philosophy
  - 4 Goals
  - 2 Pillars

Benefits of Standardization

- Helps maintain and improve quality
- Stabilizes the work conditions
- Increases the level of safety
- Allow for easier judgment regarding “normal” versus “abnormal” situations
- Enables cost reduction
- Stabilizes operating time (if takt time included)
- Others

Subjects for Standardization

- Operational Methods (Human centric)
  - Work instructions & procedures
  - Safety instructions
  - Work policies (break times, etc.)
- Process Methods (Machine & Process centric)
  - Equipment
  - Tooling
  - Gauging
  - Conveyance
- Control Methods (Rule & Method centric)
  - Quality controls
  - Machinery maintenance
  - Inspection methods
  - Material storage
  - Etc.

Documents in Manufacturing

Work Standards
-Work instructions
-Operation drawings
-Operation instruction sheets
-Process conditions sheets
-Quality control sheets
-Tooling layout drawings
-Etc.

Standardized Work*
-Process capacity sheet
-Work combination table
-Standardized work chart

Job Instruction
-Job breakdown sheet
-Cross training skills matrix
-Operation instruction sheets
-Etc.

Work study / Improvement
-Time study
-Motion study
-Work element analysis
-Etc.

***True standardized work is only a small subset of documents in manufacturing at Toyota**

List of Work Standards

- Product drawings
- Quality control plans
- Work instruction sheets
- Process condition sheets
- Tooling layout drawings
- Operation drawings
- Gauging instructions
- Maintenance instructions
- Etc.

Filling Out Work Instructions*

1. Process or operation name
2. Steps of the procedure
3. Key points
4. Operation conditions
5. Materials used, parts required, etc.
6. Special safety or quality concerns
7. Sketch of the job layout, or part if needed
8. Other related standards, remarks, etc.

***This needs to be customized regarding your specific situation**

Quality Check Sheet

- Due to the sensitive and proprietary nature of these documents you'll need to prepare an example from your own company

Operation Drawing

- Due to the sensitive and proprietary nature of these documents you'll need to prepare an example from your own company

Tooling Layout Drawing

- Due to the sensitive and proprietary nature of these documents you'll need to prepare an example from your own company

Process Condition Sheet

- Due to the sensitive and proprietary nature of these documents you'll need to prepare an example from your own company

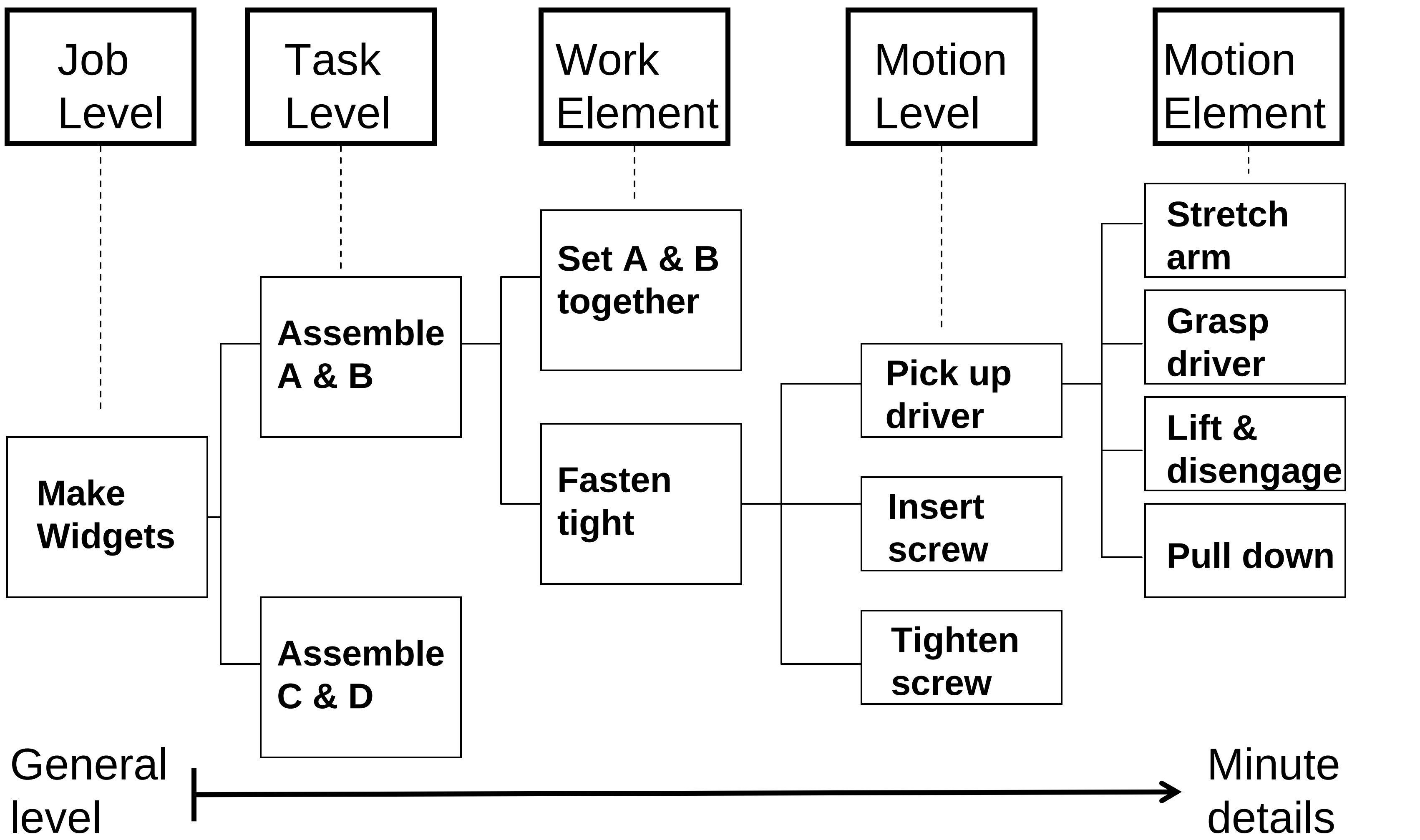
Operation Instruction Sheet

- Due to the sensitive and proprietary nature of these documents you'll need to prepare an example from your own company

Job Procedure Sheet

- Due to the sensitive and proprietary nature of these documents you'll need to prepare an example from your own company

Work Elements & Analysis Unit



Operation Instruction Sheet

Acme Corporation Work Standards Operation Instruction Sheet	Product		Prepared by:	
	Area		Approved by:	
	Machine		Date:	
	Operation		Sheet Number:	

No.	Work Elements	Key Points	Sketch or Drawing

Standardized Work Overview

Definition: a document centered around *human motion* that combines the elements of a job into the most effective sequence without waste to achieve the most efficient level of production.

Actual Standardize Work in TPS

- 3 Requirements
  - -Repetitive cyclical work
  - -High process and part quality
  - -Low equipment downtime
- 3 Elements
  - -Takt time
  - -Work sequence
  - -Standard work in process
- 3 Forms
  - -Process capacity sheet
  - -Standardized work combination table
  - -Standardize work chart

If these forms and conditions are not met then it is not true standardized work. The task is probably best suited by creating some form of work instruction or other standard.

Job Instruction

Job Breakdown Sheet
OPERATION:________________________________
PARTS:____________________________________
TOOLS & MATERIALS________________________:
SAFETY EQUIPMENT:________________________

MAJOR STEP Go through the task or subject. Select suitable portions for the trainee to master.	KEY POINT Anything in a major step which might: Affect Quality, Cause Injury, Make the work easier, & any special information

- Primary method for training in Toyota
- Only a small part of the basic teaching pattern in Job Instruction Training
- Is a simple tool for the trainer to organize his or her thoughts – it is not for the learner
- Requires skill in learning how to 1) Prepare, 2) Present, 3) Try out, & 4) Follow up in instruction

Summary of Main Points

- TPS and importance of standardization
- Work standards
- Elements of the operation
- Creation of operation instruction sheets
- True standardized work
- Job instruction

Standardized Work

Session 3 Slides

Main Points Session 2

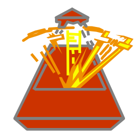
- TPS & standardization
  - Without standards there is no baseline to measure improvement
- Work standards
  - Support JIT & Jidoka. Inputs for standardized work
- Operation instruction sheet
  - Main steps and key points
- Standardized work
  - Specific definition. 3 requirements, 3 elements, 3 forms.
- Job Instruction
  - Primary tool for training in TPS.

Ideal Conditions for Standardized Work

- Work point of view
  - Work is centered around human motion
  - Work is done the same way each time
  - Small variation in work content
- Equipment point of view
  - Minimal trouble with machines
  - Minimal fluctuation in production volume
- Quality point of view
  - Minimal trouble in process quality
  - Minimal trouble in parts and material

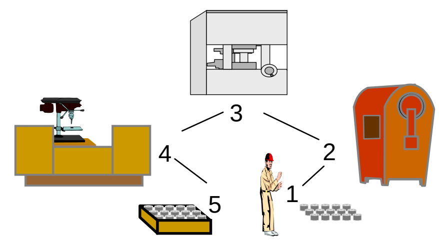
Three Elements of Standardized Work

- Takt Time

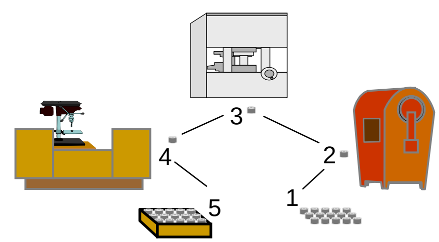


$$\frac{28{,}800 \text{ seconds}}{650 \text{ units}} = 47 \text{ seconds}$$

- Work Sequence



- Standard Work in Process



Takt Time

Time to produce one part or unit of production

$$\frac{\text{Monthly production requirement}}{\text{Number of working days}}$$

= Number of units per day

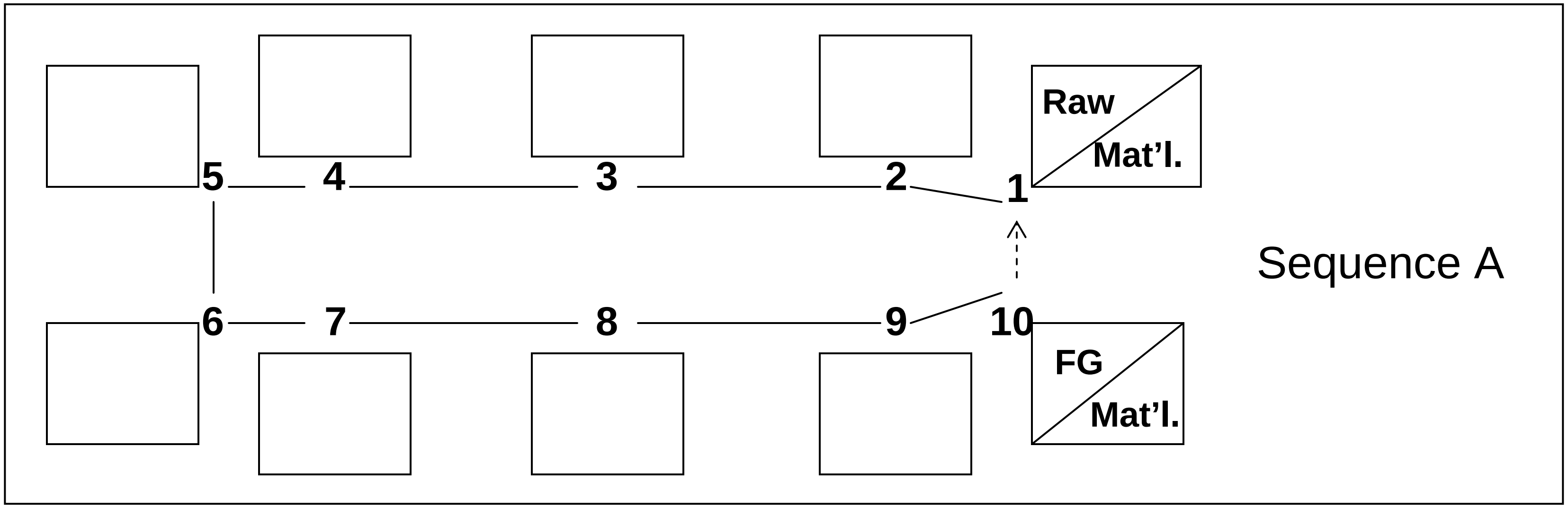
$$\text{Daily Takt Time} = \frac{\text{Hours available per day*}}{\text{Average units per day}}$$

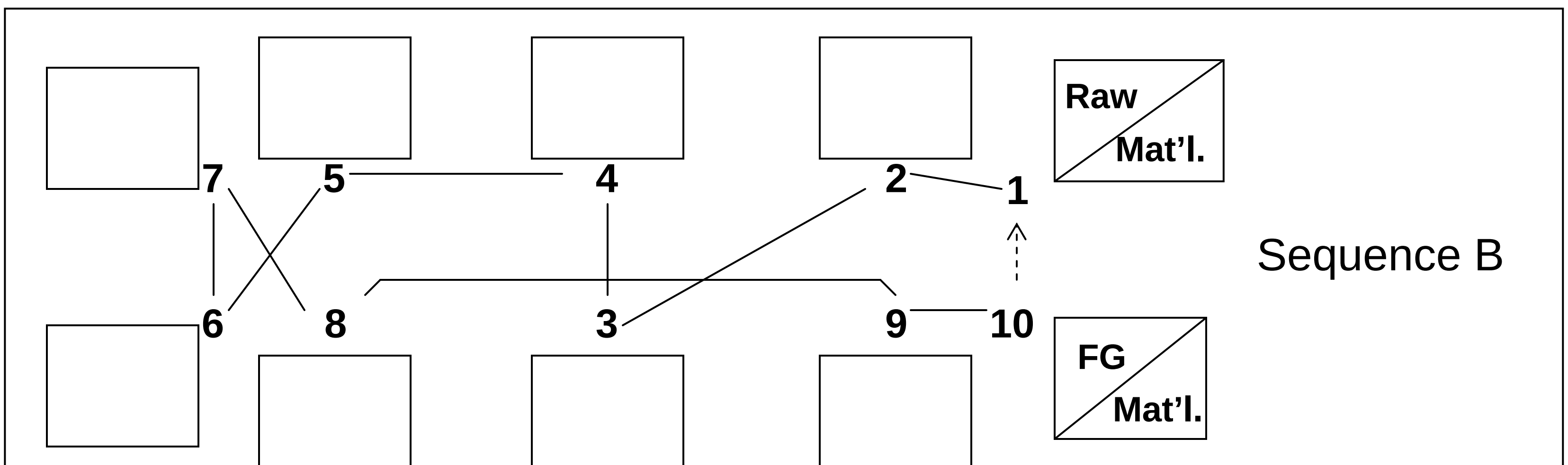
$$= \frac{\text{7.5 hours}}{\text{150 units}} \quad = \frac{\text{450 minutes}}{\text{150 units}}$$

= 3 minute takt time

***Assume one work shift in this example**

Work Sequence





Slide 3-5

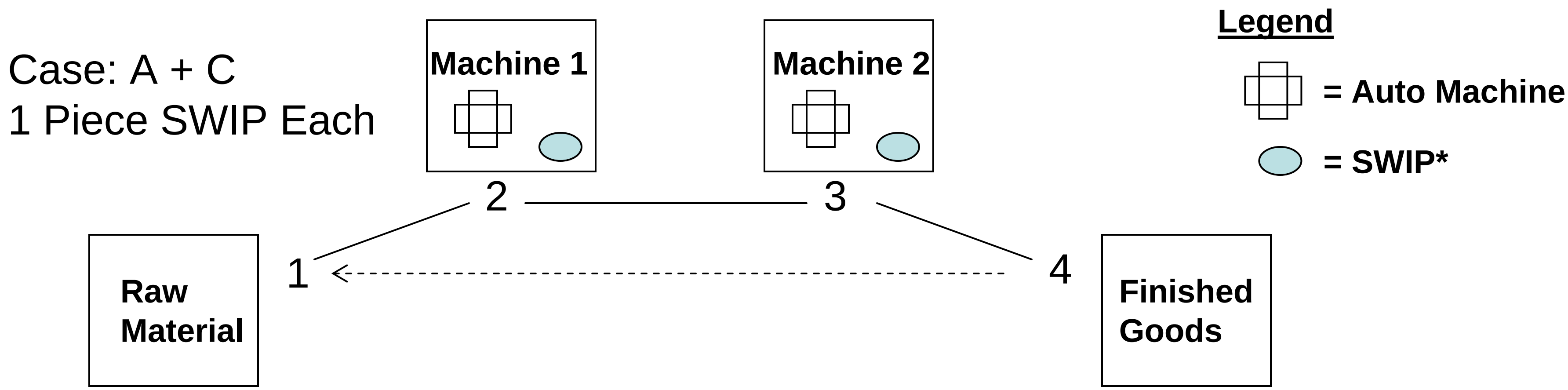
Standard Work in Process

Work sequence point of view	Work in same direction as part flow	0	A
	Work in same direction as part flow	1	B
Machine operation point of view	Automatic Machine	1	C
	Manual Machine	0	D

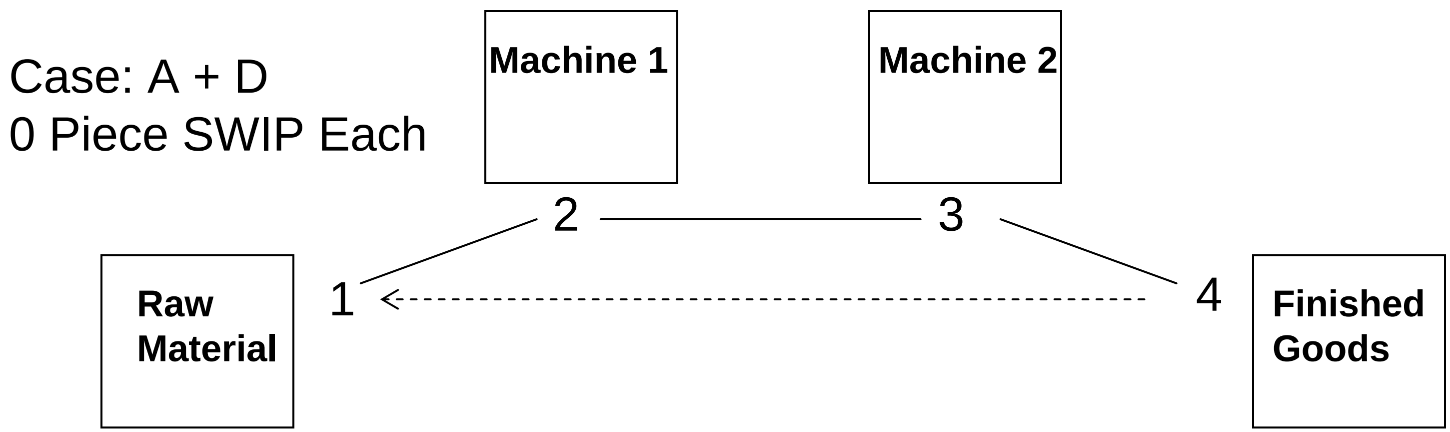
There are four basic patterns of standard work in process:

A + C
A + D
B + C
B + D

Auto Machine / Same Sequence



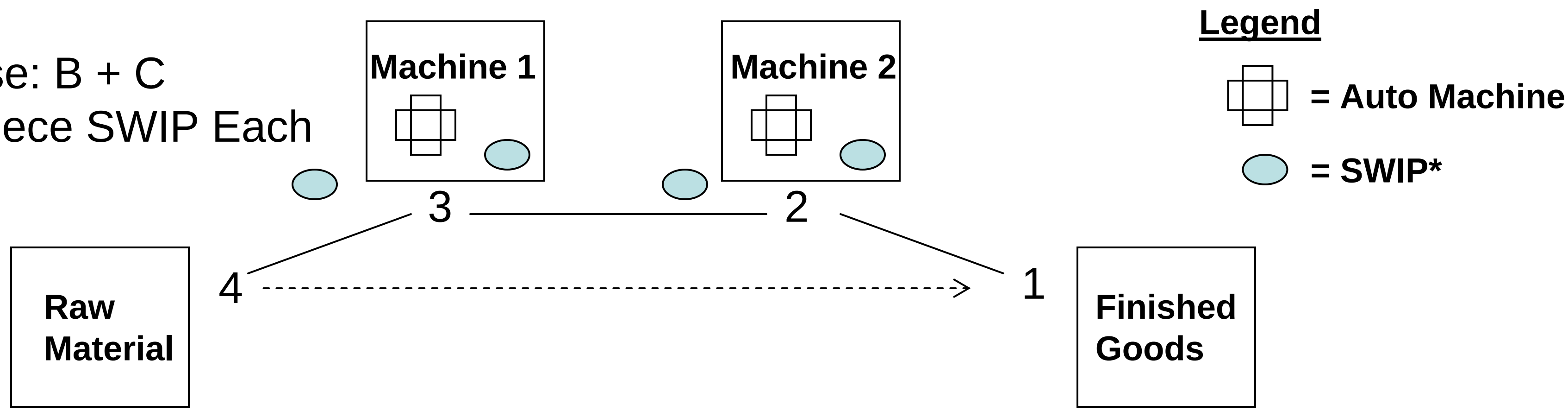
Manual Machine / Same Sequence



***SWIP: Standard Work in Process**

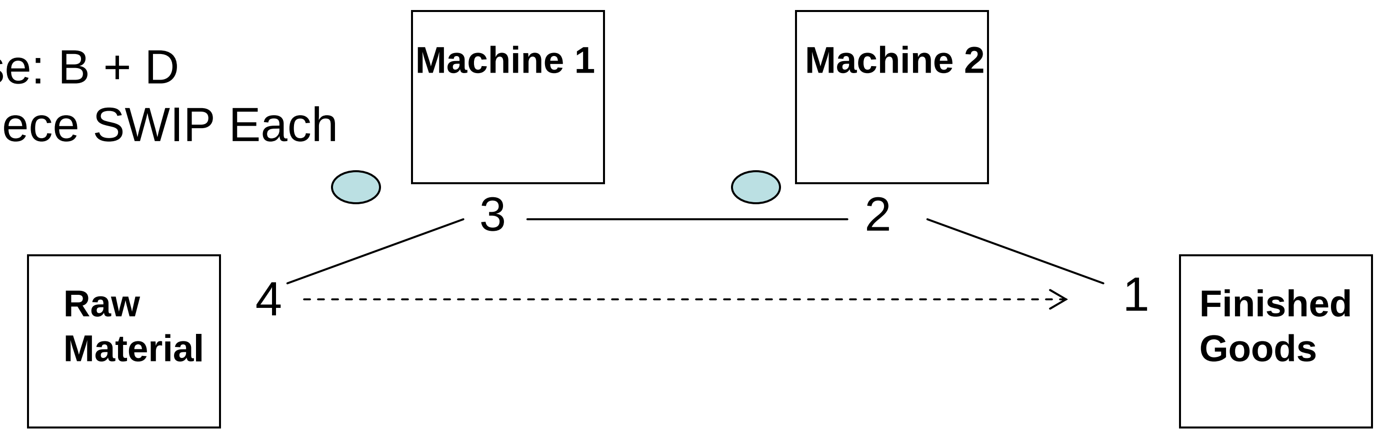
Auto Machine / Opposite Work Flow

Case: B + C
2 Piece SWIP Each



Manual Machine / Opposite Flow

Case: B + D
1 Piece SWIP Each



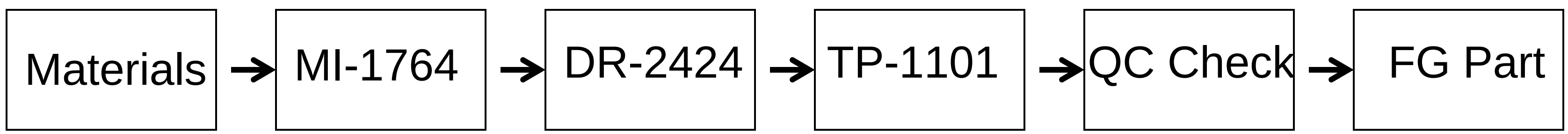
*SWIP: Standard Work in Process

Main Forms of Standardized Work

- Process Capacity Sheet
- Standardized Work Combination Table
- Standardized Work Chart

Sample Process Sequence

- Part Number: 17111-24060
- Part Name: Intake Manifold



Steps:
1) Raw Material
2) Mill face
3) Drill bolt holes
4) Tap threads
5) Quality Check
6) Finished goods

Sample Process Capacity Sheet

Definition:

A basic tool used to measure process output capability considering the time available and time required for change over work. It represents the maximum output possible from the process under current operating conditions.

Process Capacity Sheet					Dept:			Line:	
					Product:			Created by:	
Step #	Process Name	Machine Number	Manual Time	Auto Time	Total CT	# Pcs. / Change	Time to Change	Time Per Pc.	Shift Capacity
1	Mill Face	MI1764	3”	25”	28”	100	60”	0.6”	965
2	Drill Holes	DR2424	3”	21”	24”	1000	30”	0.03”	1148
3	Tap Holes	TP1101	3”	11”	14”	1000	30”	0.03”	1967

Blank Process Capacity Sheet

Process Capacity Sheet	Dept:	Line:
	Product:	Created by:

Step #	Process Name	Machine Number	Manual Time	Auto Time	Total CT	# Pcs. / Change	Time to Change	Time Per Pc.	Shift Capacity

Process Capacity Sheet: Exercise

Complete the Process Capacity Sheet, Standardized Work Combination table, and the Standardized Work Chart based upon the following conditions.

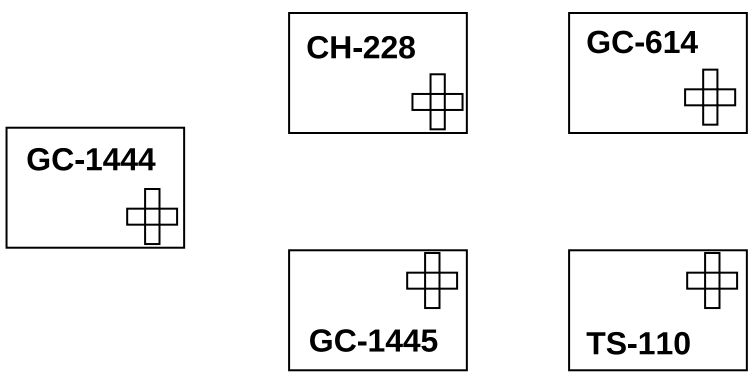
Process Sequence

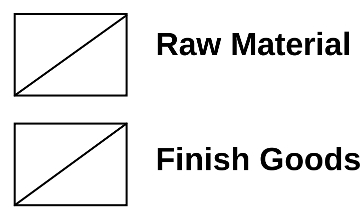
Part Name: 8 inch pinion gear
Part Number: 41211-2009

Manual load auto cycle

	Mat'l.	**GC-614**	**CH-228**	**GC-1444**	**GC-1445**	**TS-110**	**FG's**
Manual Time	1"	5"	6"	6"	6"	7"	1"
Auto Time	0"	28"	7"	38"	30"	3"	0"

Assume working time is 460 minutes per shift and two shifts. Production volume is 1200 units per day. For each process the number of pieces run before tool change is 300. Tool change time is 120". Assume 2 second walk time between stations.





Process Capacity Sheet: Answer

Process Capacity Sheet					Dept: Machining			Line: Pinion	
					Product: 8 Inch Pinion Gear			Created by: Example	
Step #	Process Name	Machine Number	Manual Time	Auto Time	Total CT	# Pcs. / Change	Time to Change	Time Per Pc.	Shift Capacity
1	Gear Cut	GC614	5”	38”	43”	300	120”	0.4”	635
2	Chamfer	CH228	6”	7”	13”	300	120”	0.4”	2059
3	Gear Cut	GC1444	6”	38”	44”	300	120”	0.4”	621
4	Gear Cut	GC1445	6”	30”	36”	300	120”	0.4”	758
5	Test	TS1110	7”	3”	10”	300	120”	0.4”	2653

(oval) = Capacity constraint of the line

Calculation of Machine Capacity

Process Capacity $= \dfrac{\text{Operational Time per Shift (seconds)}}{\text{Total cycle time} + \text{Tool change time per piece}}$

Example:

Operational time: 27,600 seconds
Manual + Machine Cycle Time = 43 seconds
Tool change time per piece = 0.5 seconds

Capacity: $\dfrac{\text{27,600 seconds}}{(43 + 0.5)\text{ seconds}}$

= 634 pieces per shift

Practice Analyzing Work Elements

1. Stand Up
2. Go to the flip chart
3. Pick up the marker
4. Write your name
5. Put down the marker
6. Return to chair
7. Sit down
8. Remain sitting

Plant Floor Observation Method

1. Draw the work layout – include the work sequence
2. Write down the work elements
3. Measure the total work cycle several times (3-5 times)
4. Measure / estimate each individual elements (combine several very short elements together if necessary)
5. Measure any irregular work that occurs and intervals outside of standardized work (if necessary)
6. Write down the times on the standardized work chart

Main Points of Session 3

- Ideal conditions for establishing standardized work
- Three elements of standardized work
- Process capacity sheets
- Basics of time measurement

Standardized Work

Session 4 Slides

Main Points Session 3

- Ideal conditions for establishing standardized work
  - Repetitive work, minimal downtime, minimal quality problems
- Three elements of standardized work
  - Takt time, work sequence, SWIP
- Process capacity sheets
  - Identifies process capacity
- Basics of time measurement
  - Key to determine measuring points

Standardized Work Combination Table

Acme Corp. **Standardized Work Combination Table**	Plant:	Product:
	Area:	Op. _____ of _____
	Process:	Pg. _____ of _____
Date: / By: / Line Takt:	Shifts:	Manual Work / Automatic
	Volume:	Walking / Wait

Date:	By:	Line Takt:

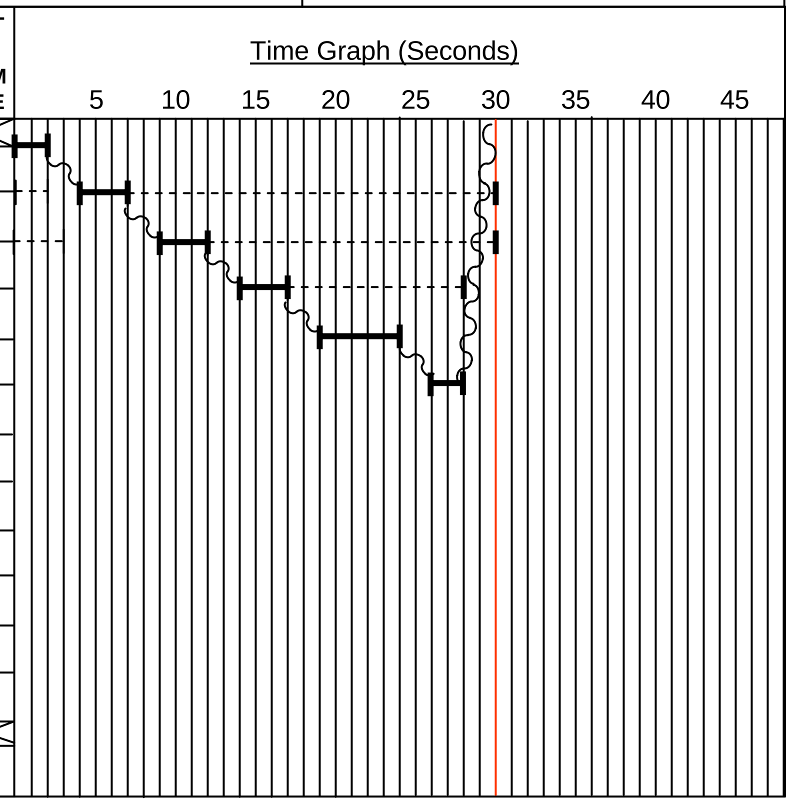
Manual Work	├───┤
Automatic	├- - - -┤
Walking	⁀‿⁀
Wait	⟺

No.	Major Steps	MAN TIME	AUTO TIME	WAIT TIME	WALK TIME	Time Graph (Seconds) 5 10 15 20 25 30 35 40

Standardized Work Combination Table

Acme Corp. **Standardized Work Combination Table**	Plant: Acme	Product: Intake Manifold
	Area: Manifold Machining	Op. _____ of _____
	Process: Booster Machining	Pg. _____ of _____
Date: 5/23/2006 | By: Art of Lean | Line Takt: 30 secs.	Shifts: 2	Manual Work / Automatic / Walking / Wait
	Volume: 920 / Shift	

No.	Major Steps	MAN TIME	AUTO TIME	WAIT TIME	WALK TIME
1	Pick up raw material	2	--	--	2
2	Load part and start machine (MI-1764)	3	25	--	2
3	Load part and start machine (DR-2424)	3	21	--	2
4	Load part and start machine (TP-1101)	3	11	--	2
5	Check threads	5	--	--	2
6	Place in FG pallet	2	--	--	
	Totals	18		---	12

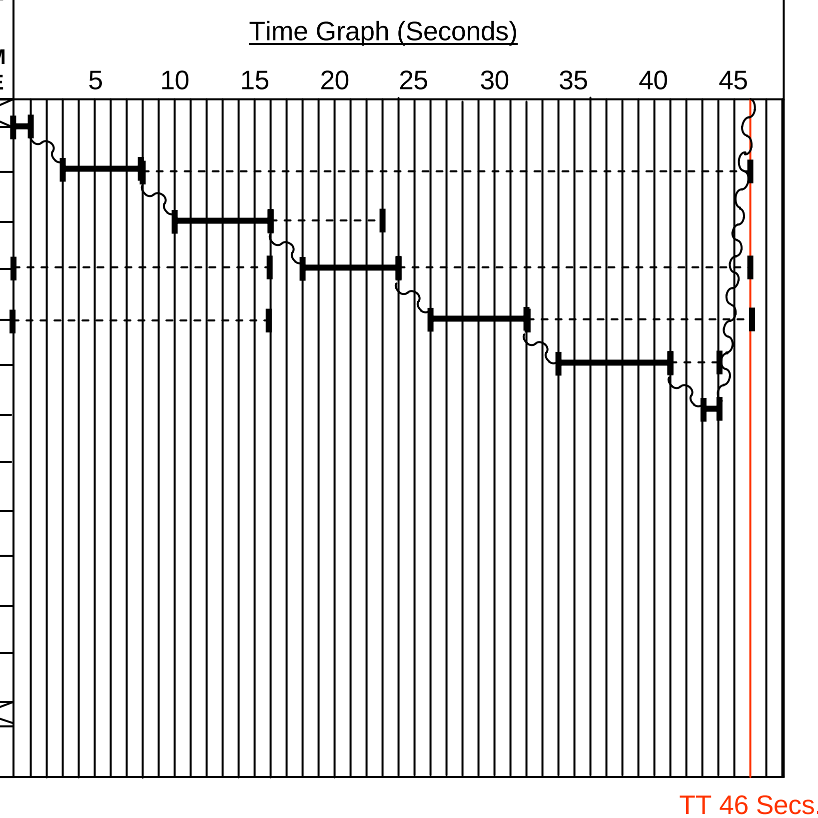


TT 30 Secs.

Standardized Work Combination Table

Acme Corp. **Standardized Work Combination Table**			Plant: Acme	Product: 8” Pinion Gear
			Area: Machining	Op. _1_ of _1_
			Process: Gear Cutting Exercise	Pg. _1_ of _1_
Date: 5/23/2006	By: Art of Lean	Line Takt: 46 secs.	Shifts: 2 Volume: 600 / Shift	Manual Work / Automatic / Walking / Wait

No.	Major Steps	MAN TIME	AUTO TIME	WAIT TIME	WALK TIME
1	Pick up raw material	1	--	--	
					2
2	Unload,/ load and start M/C GC-614	5	38	--	
					2
3	Unload / Load and start M/C CH-228	6	7	--	
					2
4	Unload / Load and start M/C GC-1444	6	38	--	
					2
5	Unload / load and start M/C GC-1445	6	30	--	
					2
6	Unload / load and start M/C TS-110	7	3	--	
					2
7	Pack Part	1	--	--	
					2
	Totals	32		---	14



Standardized Work Chart

Acme Corp. **Standardized Work Combination Table**			Plant:	Product:	
			Area:	Op. _1_ of _1_	
			Process:	Pg. _1_of _1_	
Date:	By:	Approved By:	Shifts: Volume:	Takt Time:	Cycle Time:

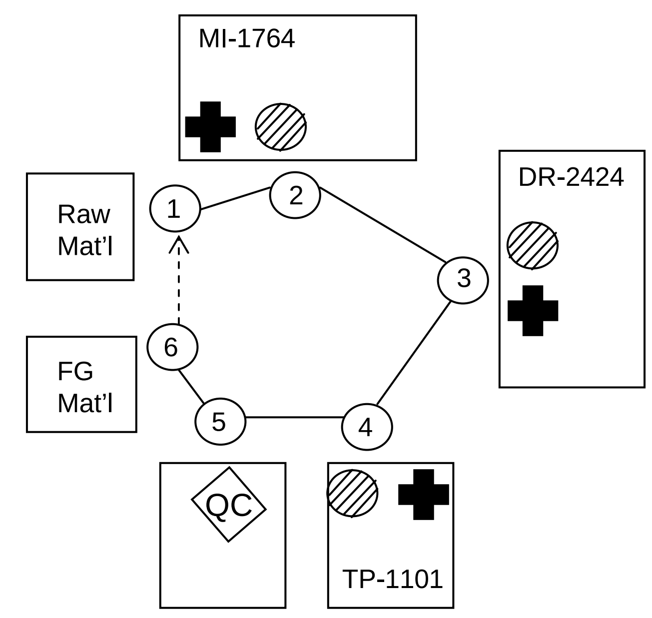
No.	**Major Steps**	**MAN TIME**	**AUTO TIME**	**WAIT TIME**	**WALK TIME**	◯ Working Sequence ——— Walking - - - - - Return to Start	Safety	SWIP	Quality QC

Standardized Work Chart

Acme Corp.			Plant: Acme	Product: Intake Manifold	
			Area: Machining	Op. _1_ of _1_	
Standardized Work Combination Table			Process: Intake machining and pack	Pg. _1_ of _1_	
Date: 5/23/2006	By: Art of Lean	Approved By:	Shifts: 2	Takt Time: 30 secs.	Cycle Time: 30 secs.
			Volume: 900 / shift		

No.	Major Steps	MAN TIME	AUTO TIME	WAIT TIME	WALK TIME
1	Pick up raw material	2	--	--	2
2	Load part and start machine	3	25	--	2
3	Load part and start machine	3	21	--	2
4	Load part and start machine	3	11	--	2
5	Check threads	5	--	--	2
6	Pack part	2	--	--	2

Legend: ○ Working Sequence; —— Walking; - - - - - Return to Start; Safety; SWIP; Quality (QC)



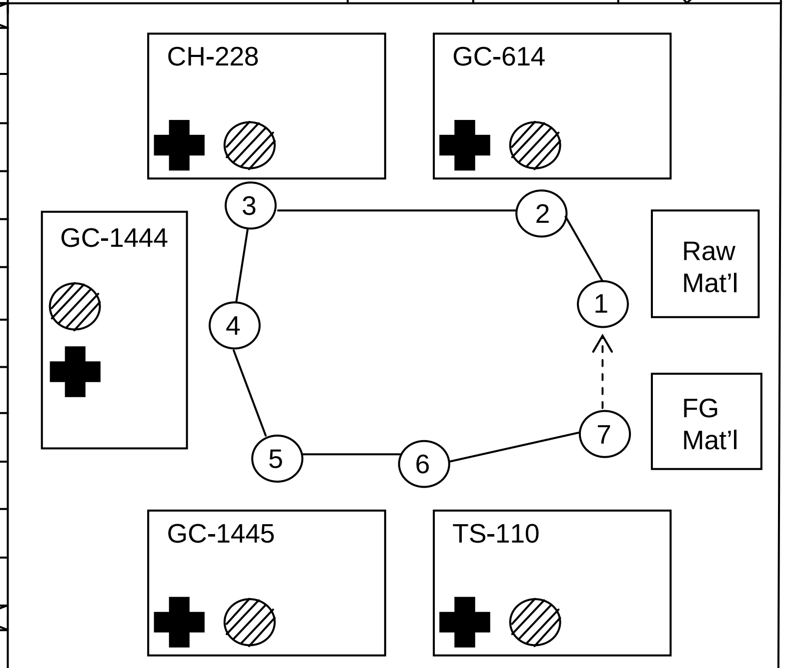
Standardized Work Chart

Acme Corp. **Standardized Work Combination Table**			Plant: Acme	Product: 8" Pinion Gear	
			Area: Gear Machining	Op. _1_ of _1_	
			Process: Gear cutting exercise	Pg. _1_ of _1_	
Date:	By:	Approved By:	Shifts: 2	Takt Time: 46 secs.	Cycle Time: 46 secs.
			Volume: 600		

Working Sequence (circle) — Walking (solid line) — Return to Start (dashed line)

Safety	SWIP	Quality
✚	(hatched circle)	QC

No.	Major Steps	MANUAL TIME	AUTO TIME	WAIT TIME	WALK TIME
1	Pick up raw material	1	--	--	2
2	Unload, load part and start M/C GC614	5	38	--	2
3	Unload, load part and start M/C CH228	6	7	--	2
4	Unload, load part and start M/C GC1444	6	38	--	2
5	Unload, load part and start M/C GC1445	6	30	--	2
6	Unload, load part and start M/C TS110	7	3	--	2
7	Pack FG in pallet	1	--		2



Main Points Session 4

- Standardized work combination sheet
  - Tool using takt time as a basis for work allocation
  - Highlights man machine combination problems and delays
- Standardized work chart
  - Three elements of takt time, work sequence, SWIP
  - Visual control and tool for improvement

Standardized Work

Session 5 Slides

Main Points Session 4

- Standardized work combination sheet
  - Tool using takt time as a basis for work allocation
  - Highlights man machine combination problems
- Standardized work chart
  - Three elements (takt time, work sequence, SWIP)
  - Tool for visual control and improvement in the work area
  - Must be changed when takt time changes

Typical Responses

- Increase Manpower
- Increase Equipment
- Work Longer
- Work Harder
- Eliminate Waste

Ways to Increase Production

Methods to Increase Production

<u>Current</u>
1 Man
1 Machine
1 Hour
= 100 Units

How to Increase Production?

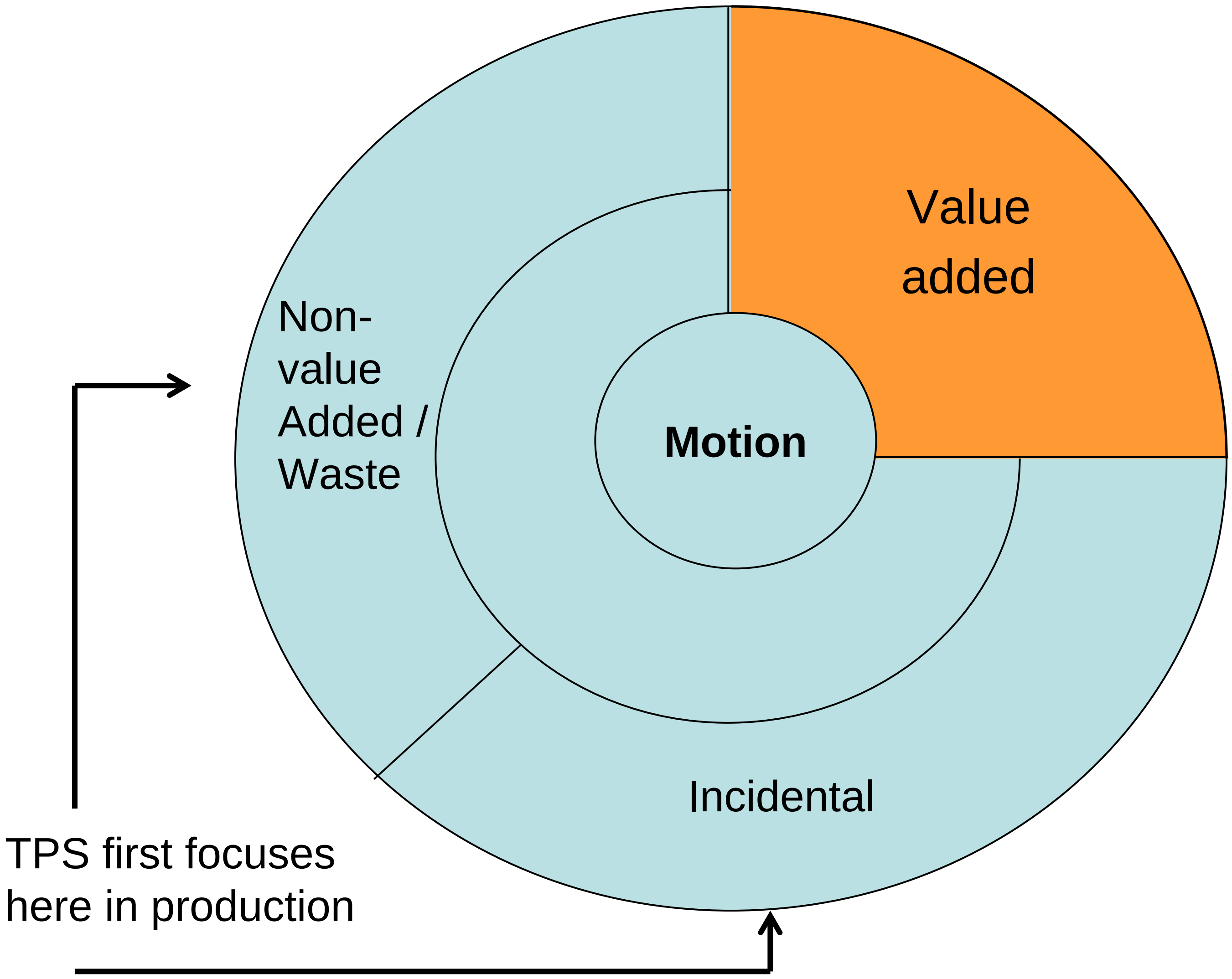
- "Quantity" based approach
  - 1) More Workers
  - 2) More Machines
  - 3) Work Longer
- "Quality" based approach
  - 4) Work Harder
  - 5) Eliminate Waste & Make Easier!

TPS Goal

<u>Future</u>
1 Man
1 Machine
1 Hour
= 120 Units

Slide 5-3

Waste and Work

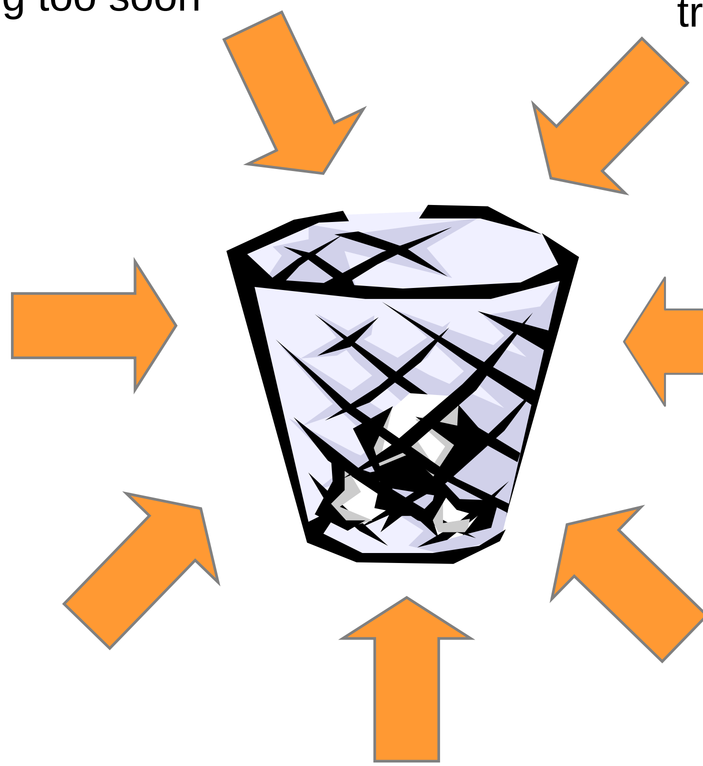


7 Types of Waste

Overproduction
Producing too much,
or producing too soon

Conveyance
Any nonessential
transport is waste

Motion
Any motion that
does not add value



Inventory
Any more than the
minimum required

Correction
Any repair,
scrap,
or rework

Processing
Over-processing

Waiting
Waiting on parts, waiting for a
machine to finish cycle

Waste of Over-Production*

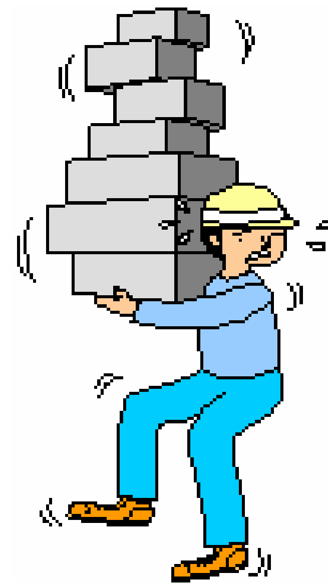
Overproduction is damaging as it requires:

- Extra people, equipment, and time
- Extra materials and parts
- Extra energy, oils, and consumable items
- Extra skids, pallets, and containers
- Extra material handling
- Extra space and warehousing
- Additional inventory control
- Covers up the need for improvement

***Producing too much or too little, too early or too late**

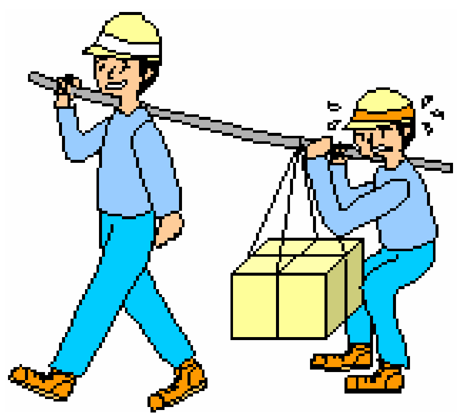
Muda, Mura, Muri

Any form of **waste** in the process…



Muri

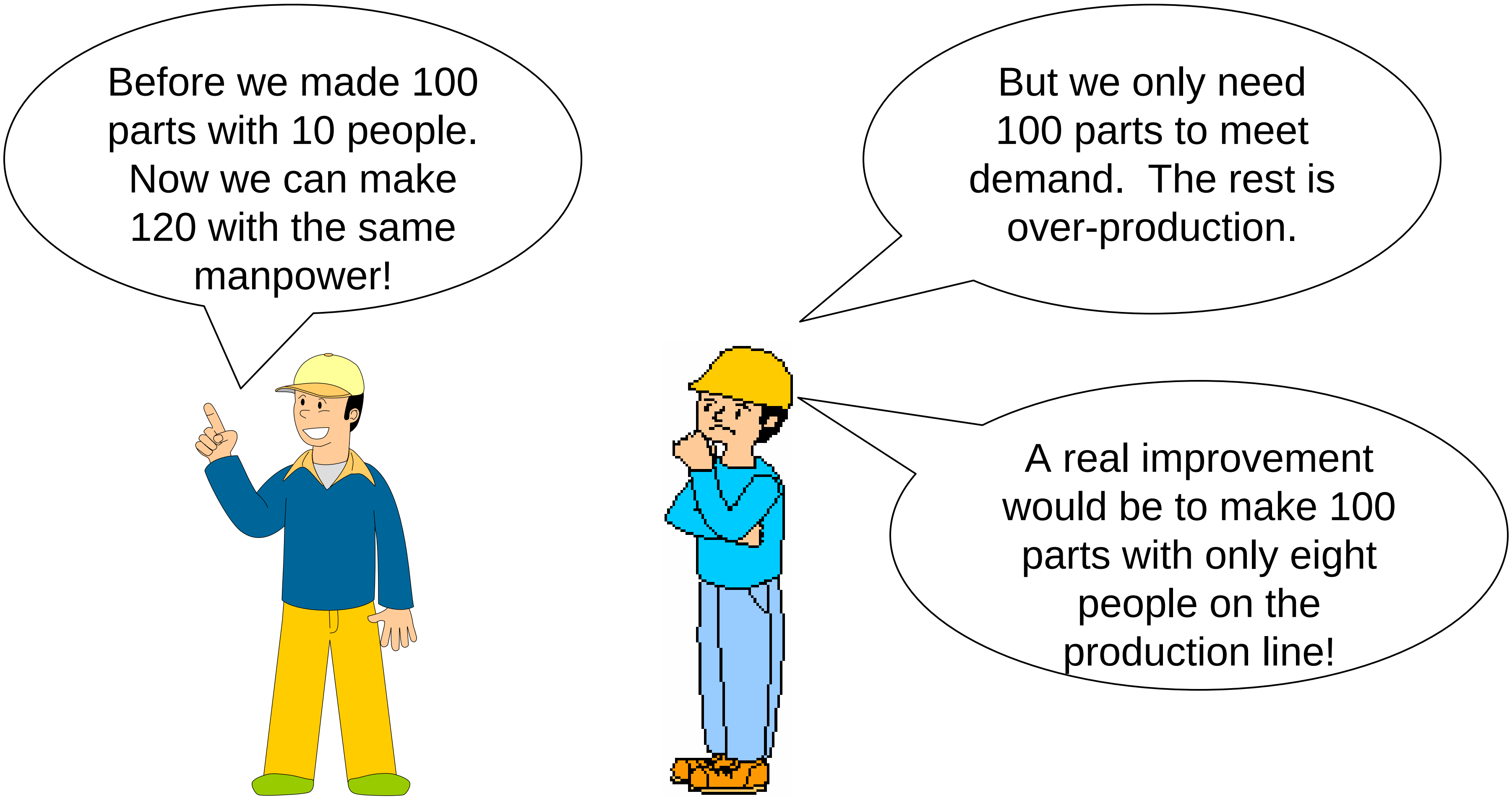
Unreasonable burden on people or machines…



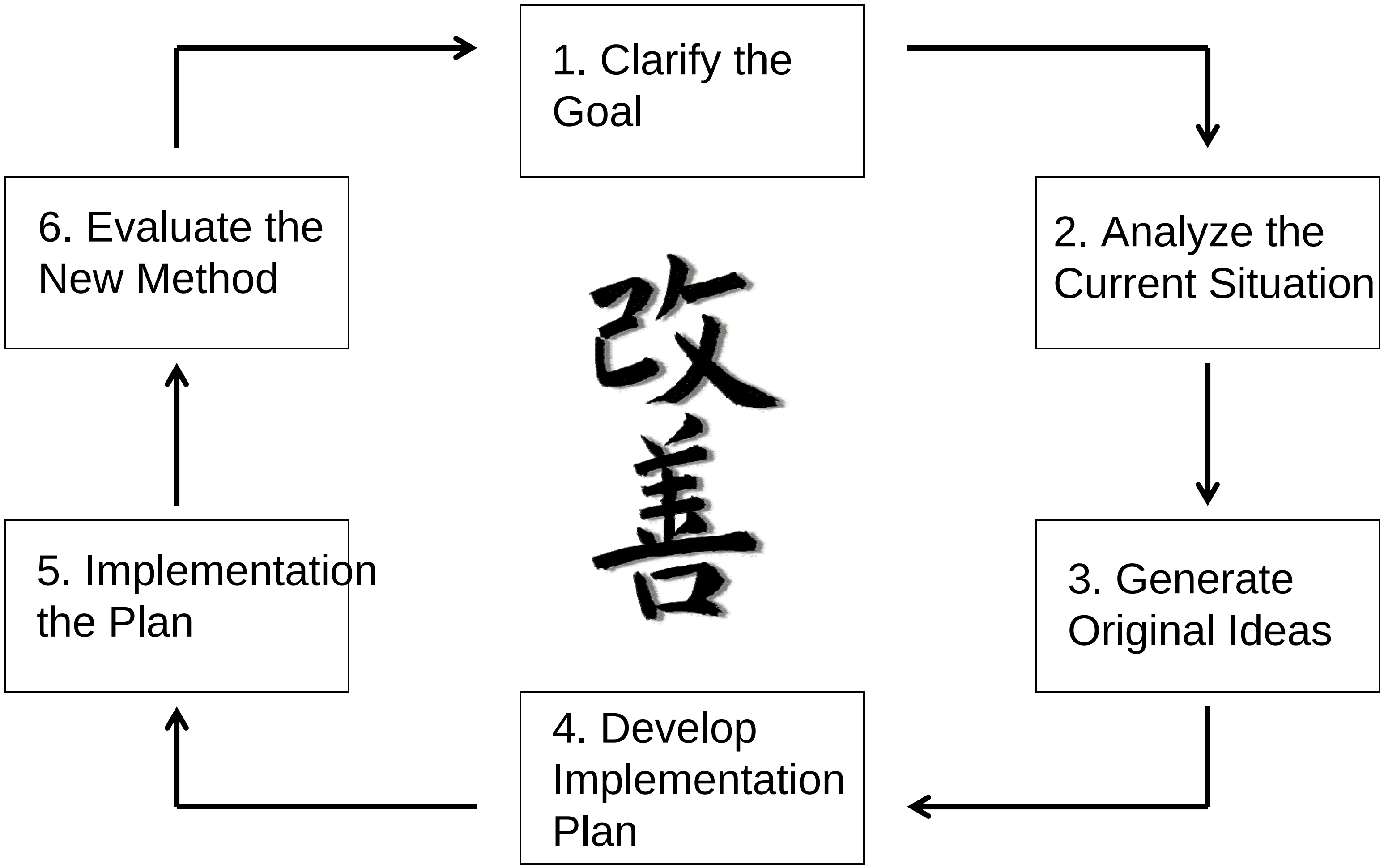
Mura

Un-level workloads on people or machines

True versus Apparent Efficiency



Procedure for Kaizen

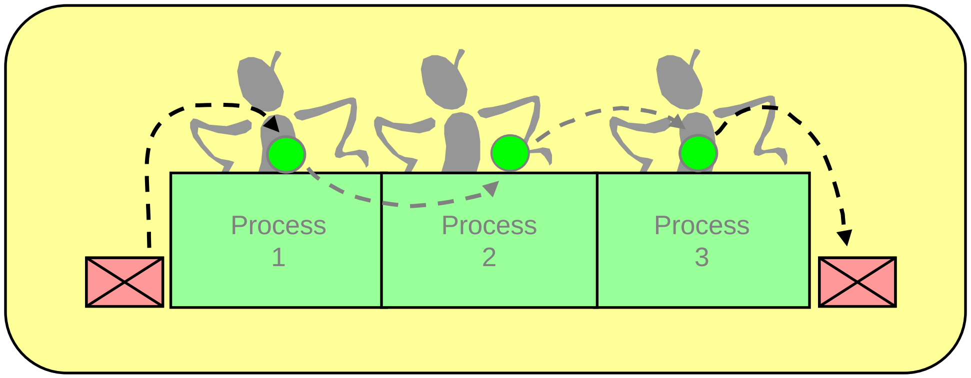


Key Points for Standardized Work

- Standardized work and the leader
- Standardized work and quality control
- Standardized work and safety
- Standardized work and improvement

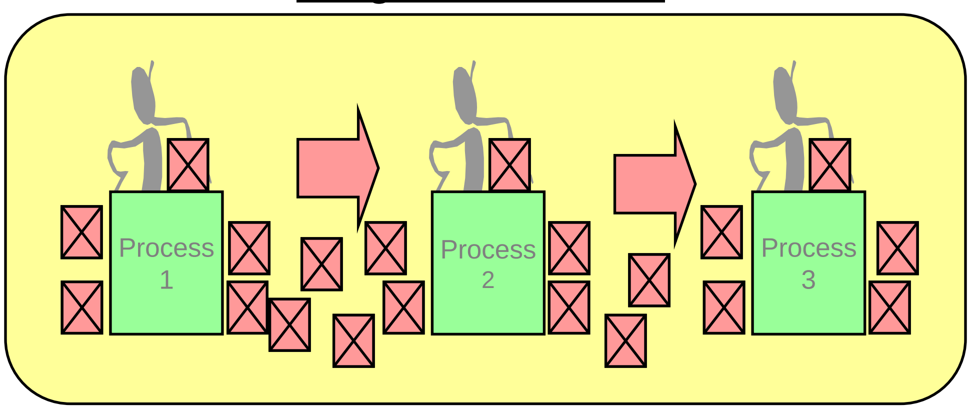
One Piece Flow vs. Large Lots

Small lot size



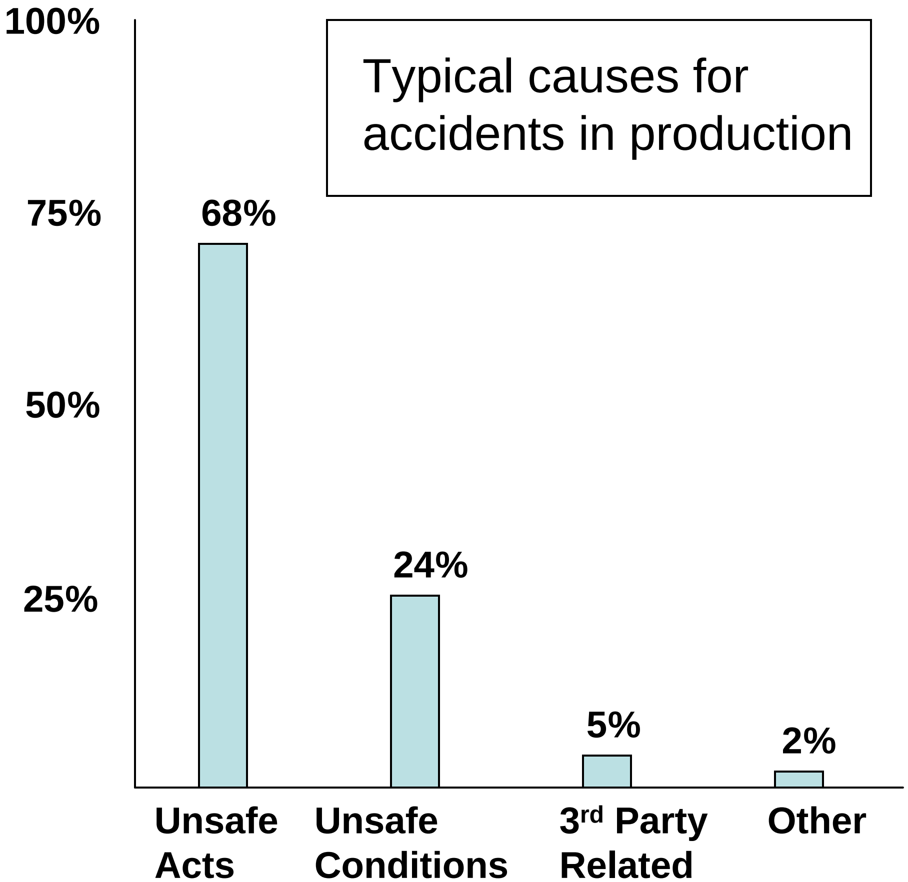
- Shorter lead time
- Less WIP
- Fewer handling mistakes
- Rapid detection of errors
- Better visual control
- Easier communication

Larger batch size



- Longer lead time
- More WIP
- More handling mistakes
- Slow detection of errors
- Less visual control
- Harder communication

Standardized Work and Safety



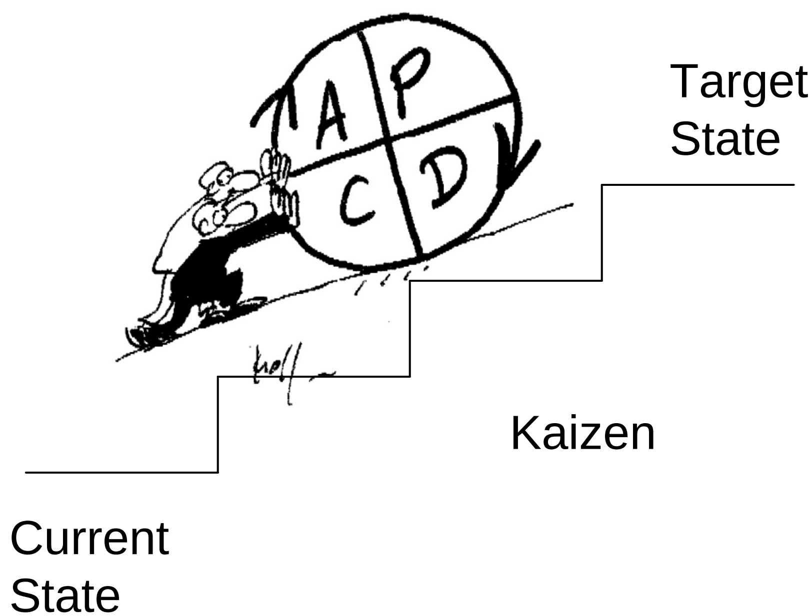
Unintentional unsafe acts are the leading cause of accidents in most work places in industry.

Properly establishing standardized work and following standardized work can prevent injuries

Five S


SEIRI
Classification
SEITON
Organization
SEISO
Cleanliness
SEIKETSU
Maintenance
SHITSUKE
Discipline
5S

Kaizen is Endless



改善

Summary of Training Sessions

Session 1	•Role of a leader •Importance of cost reduction •4 Aims of TPS
Session 2	•TPS & standardization •Examples of work standards •Example of job instruction
Session 3	•Definition of standardized work •3 elements of standardized work •Process capacity sheet
Session 4	•Standardized work combination table •Standardized work chart
Session 5	•Ways to increase production •Waste and work •Kaizen process