

Standardized Work

Session 1 Slides



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

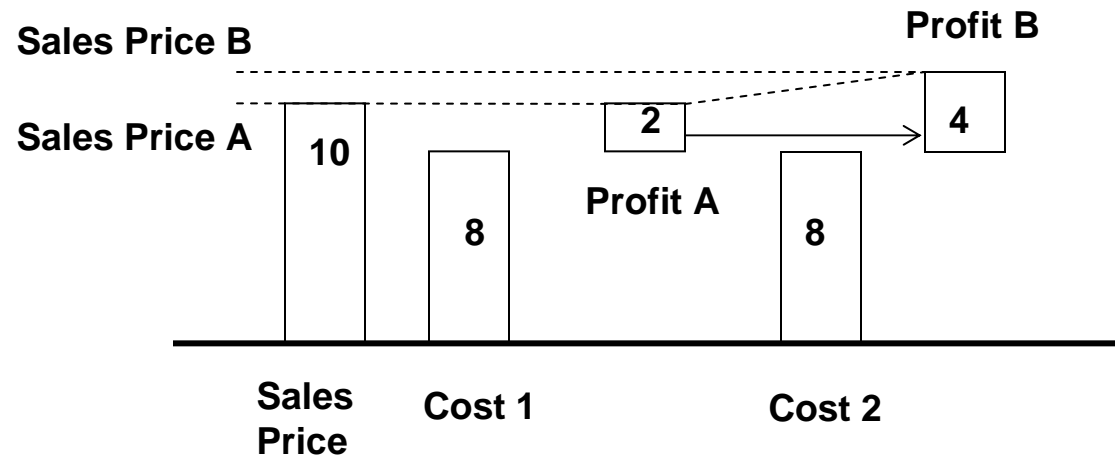
- Create for your own situation
 - On-time delivery to customer
 - Expedited freight
 - Etc.

Price Cost Squeeze

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

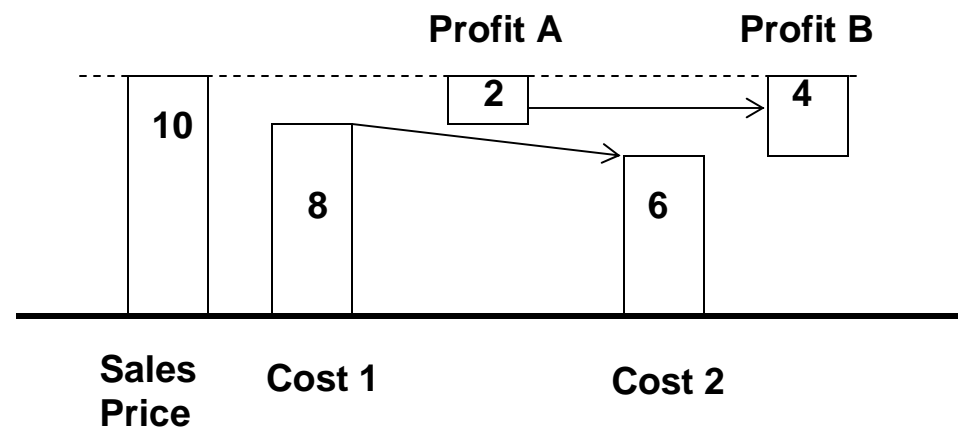
Cost Plus & Reduction Principle

Example 1: Cost Plus Principle



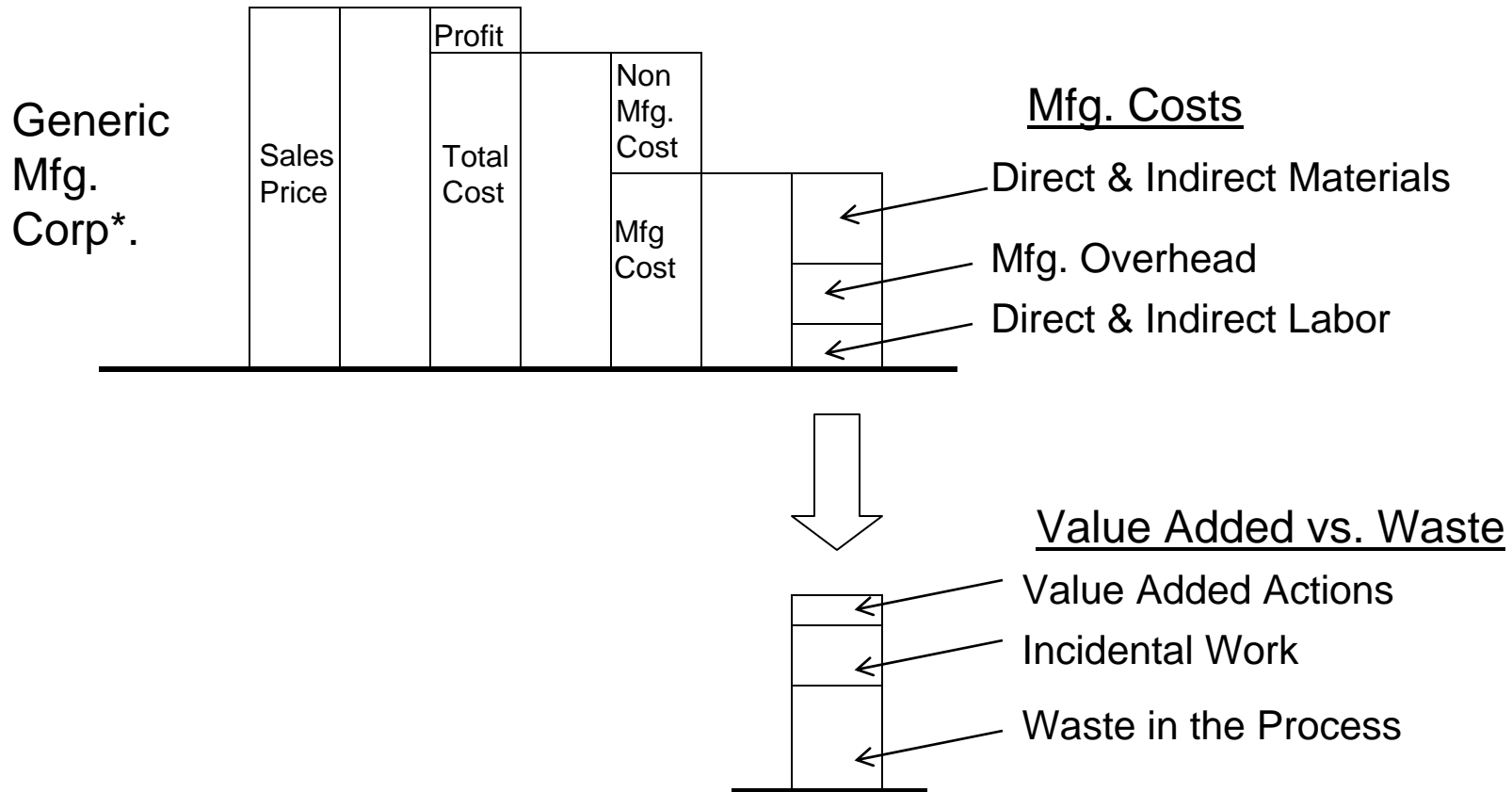
Increase the sales price to increase profits. Works best with a monopoly!

Example 2: Cost Reduction Principle (TPS)



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

Cost Structure

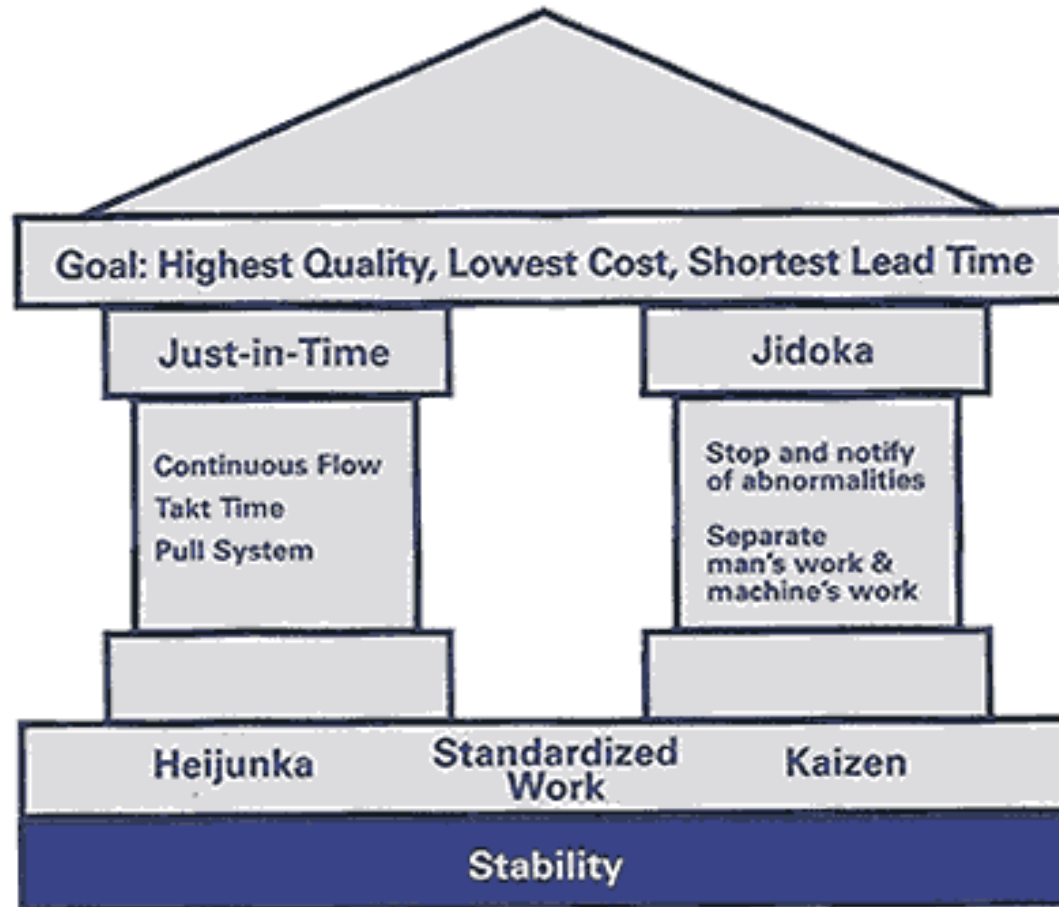


*Note: Create for your own situation

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

**J
I
T**

Flow Production / Small Lot Production

Takt Time

Pull Production

Level Production

**J
I
D
O
K
A**

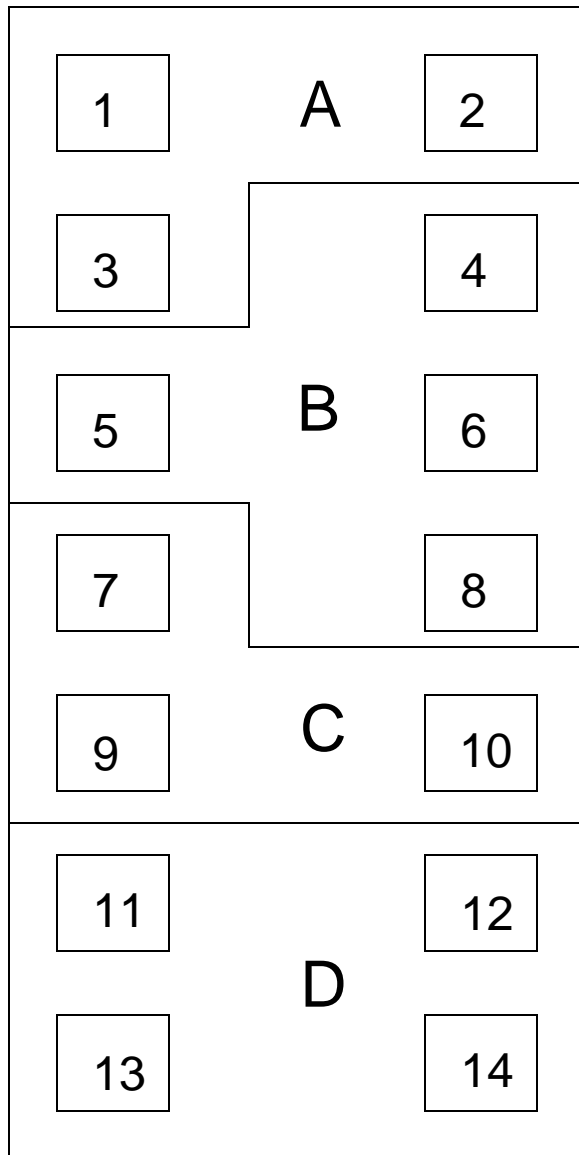
Build in quality at the process

Enable separation of man and machine

Objectives of Jidoka

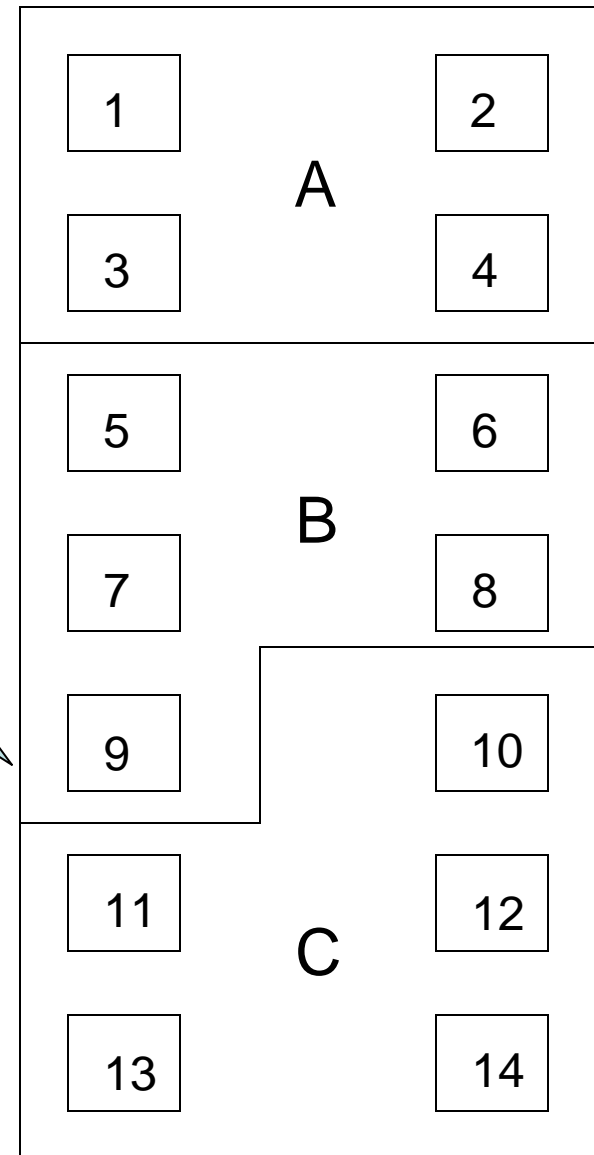
- Always strive to build in quality at the process 100% of the time
- Automatically detect and prevent equipment breakdowns
- Enable labor savings by achieving separation of man and machine

Efficient Resource Allocation



4 People
265 Units per shift
108 sec. Takt Time

3 people
205 Units per shift
140 sec. Takt Time



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

Slide 2-4

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

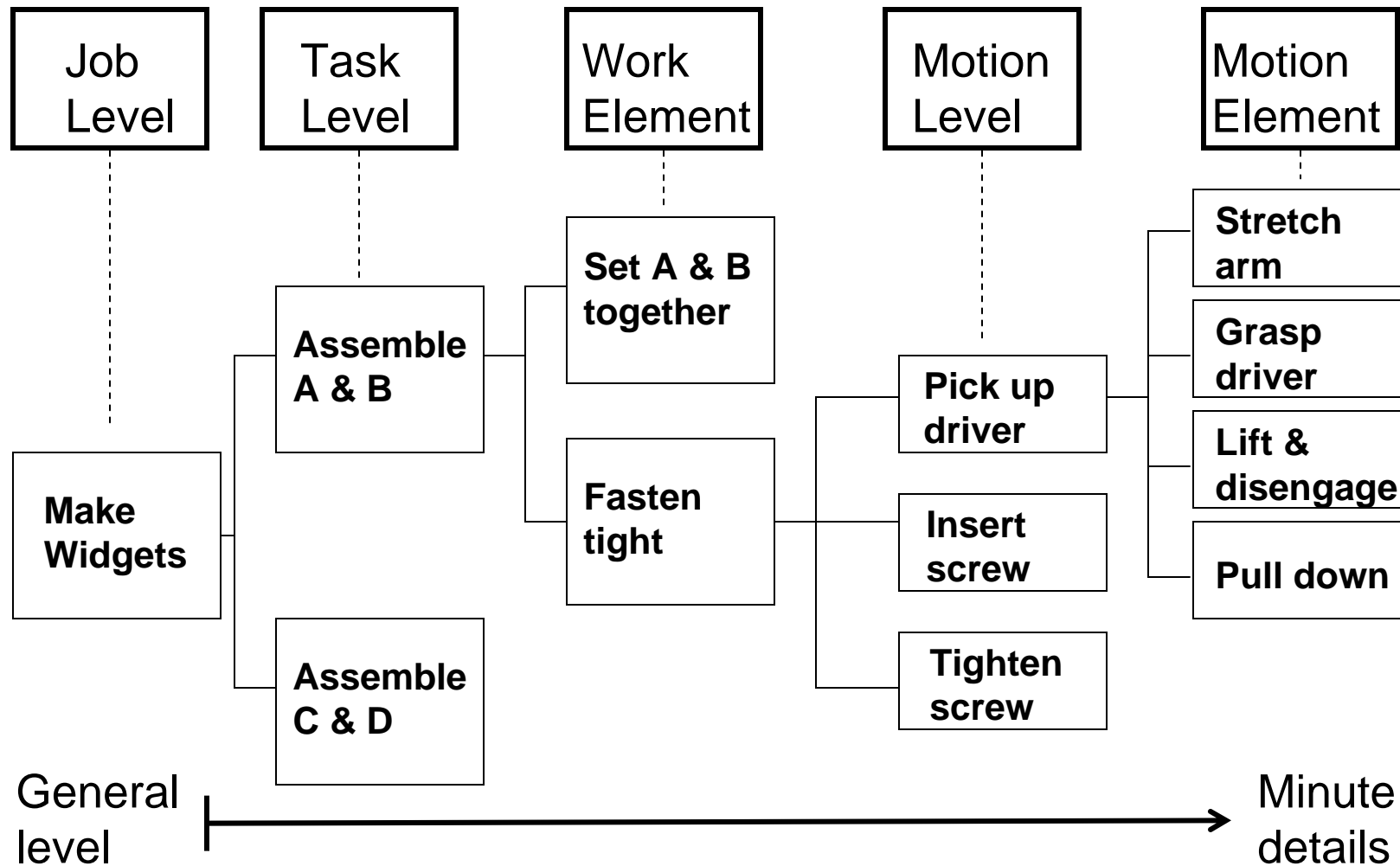
Operation Instruction Sheet

- 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

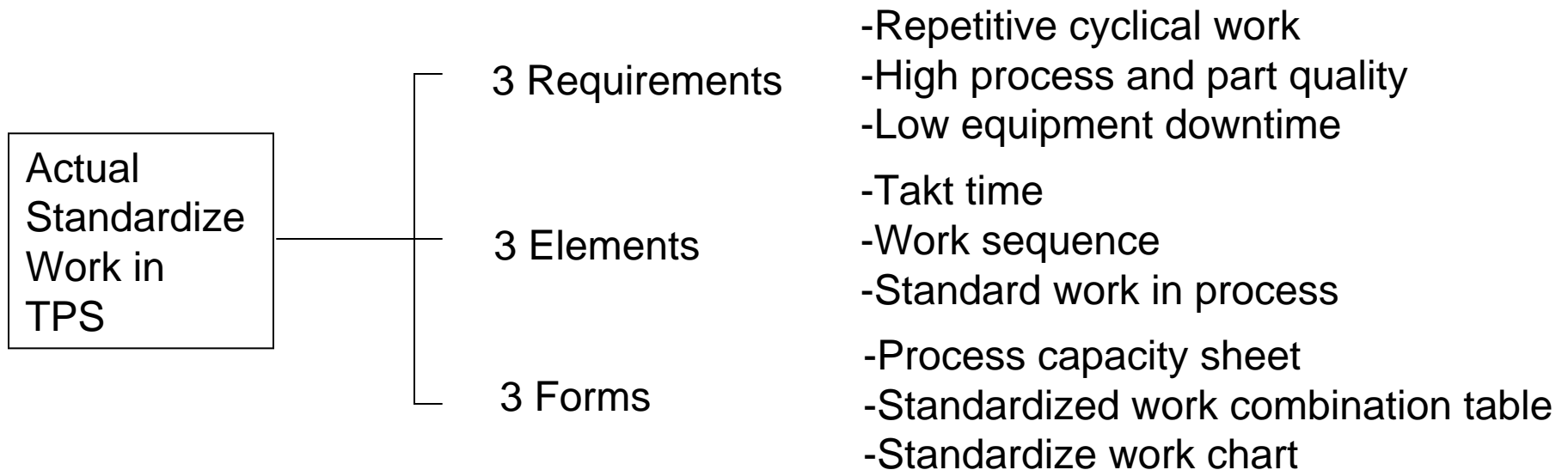


Operation Instruction Sheet

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.



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: _____

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

- 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

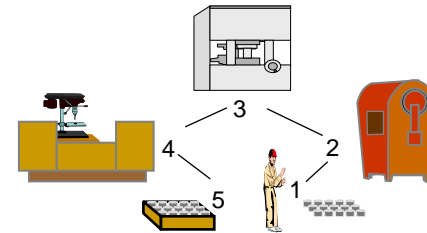
Three Elements of Standardized Work

- Takt Time

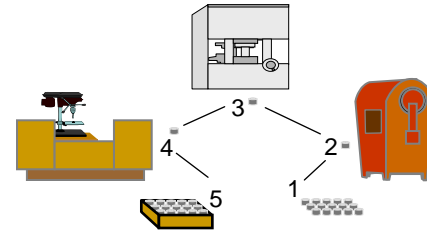


$$\frac{28,800 \text{ seconds}}{650 \text{ units}} = 47 \text{ seconds}$$

- Work Sequence



- Standard Work in Process

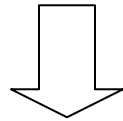


Takt Time

Time to produce one part or unit of production

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

$$= \text{Number of units per day}$$



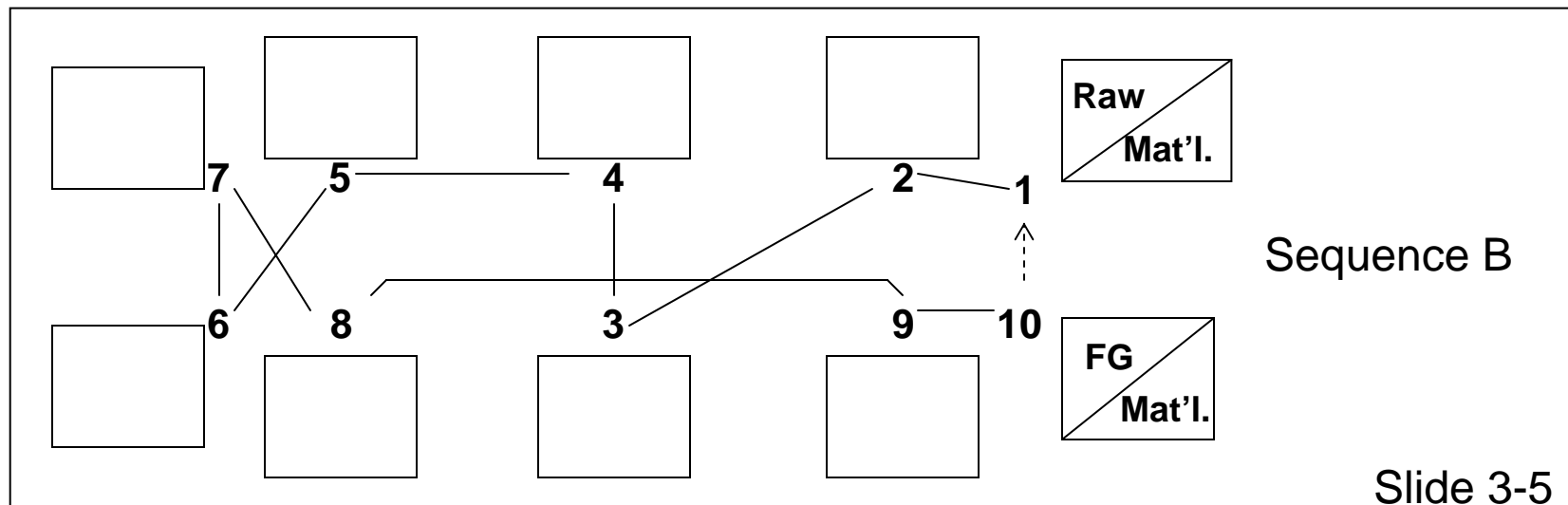
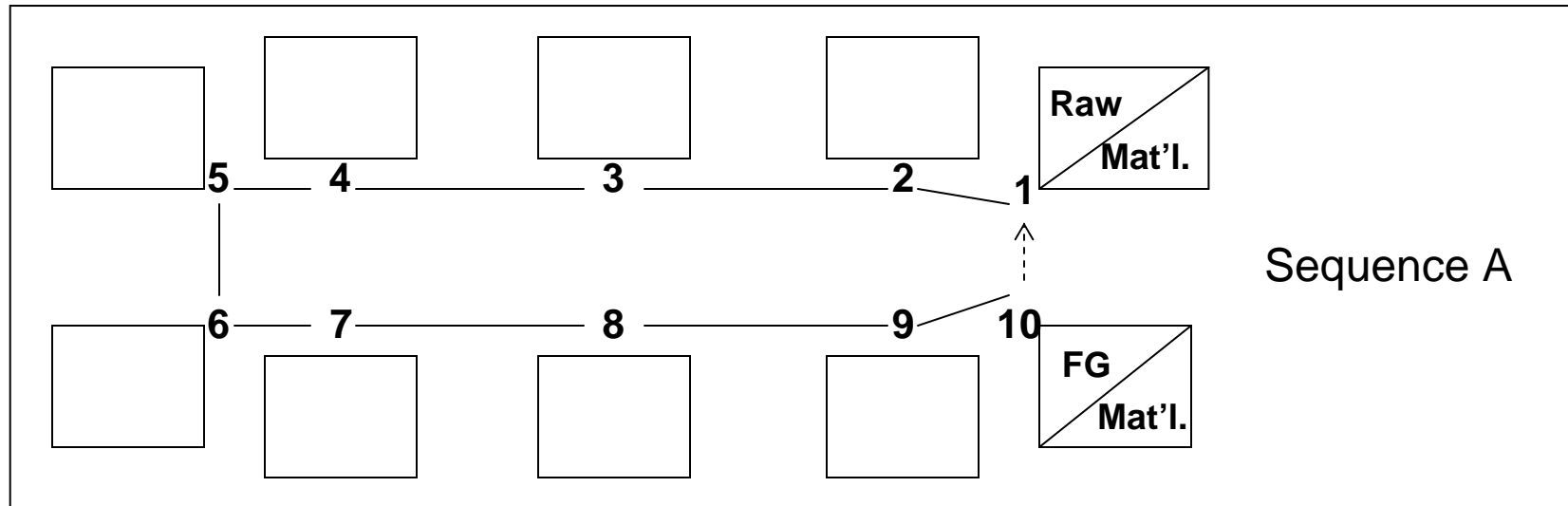
$$\text{Daily Takt Time} = \frac{\text{Hours available per day}^*}{\text{Average units per day}}$$

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

$$= 3 \text{ minute takt time}$$

*Assume one work shift in this example

Work Sequence



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

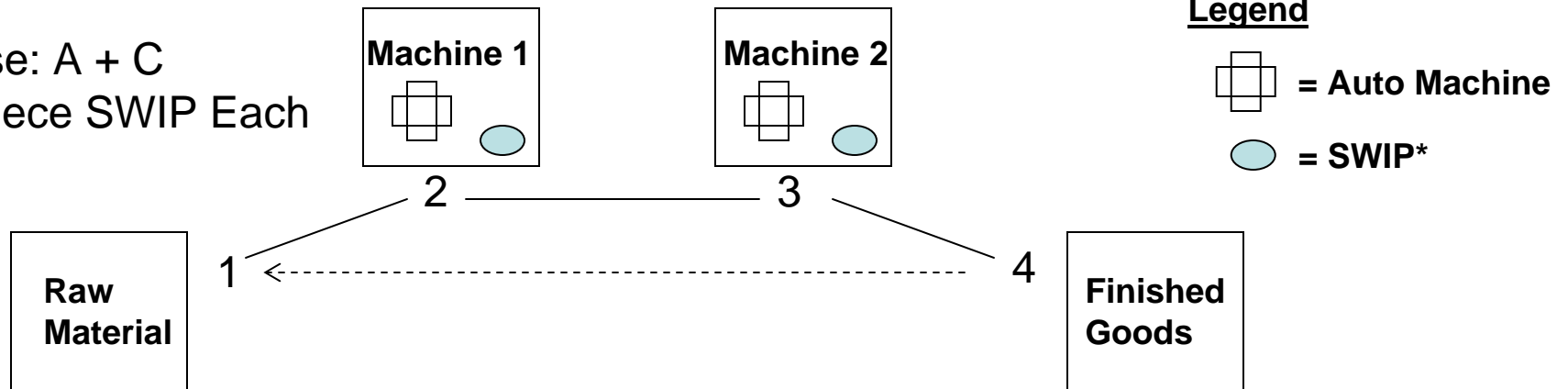
B + C

B + D

Slide 3-6

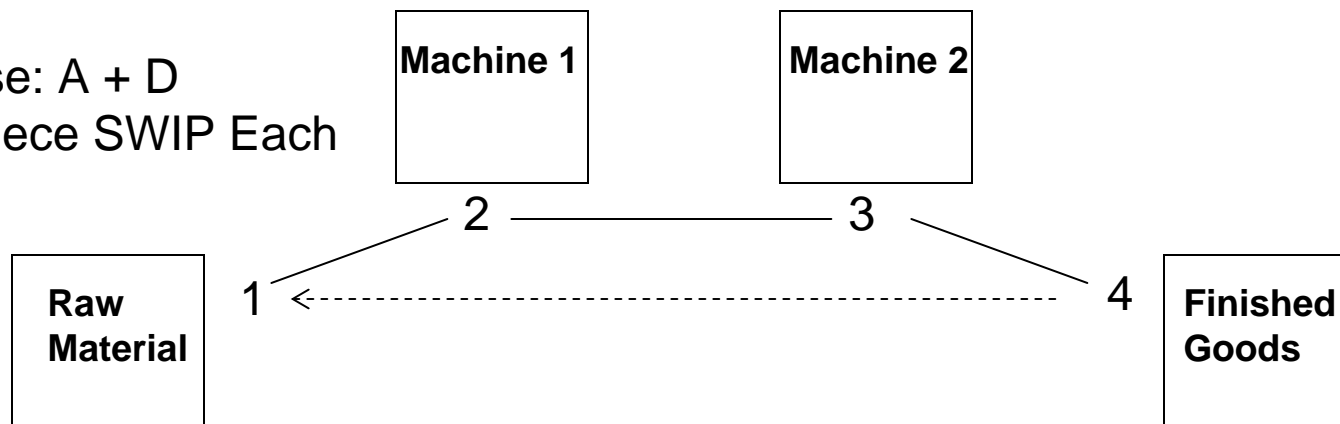
Auto Machine / Same Sequence

Case: A + C
1 Piece SWIP Each



Manual Machine / Same Sequence

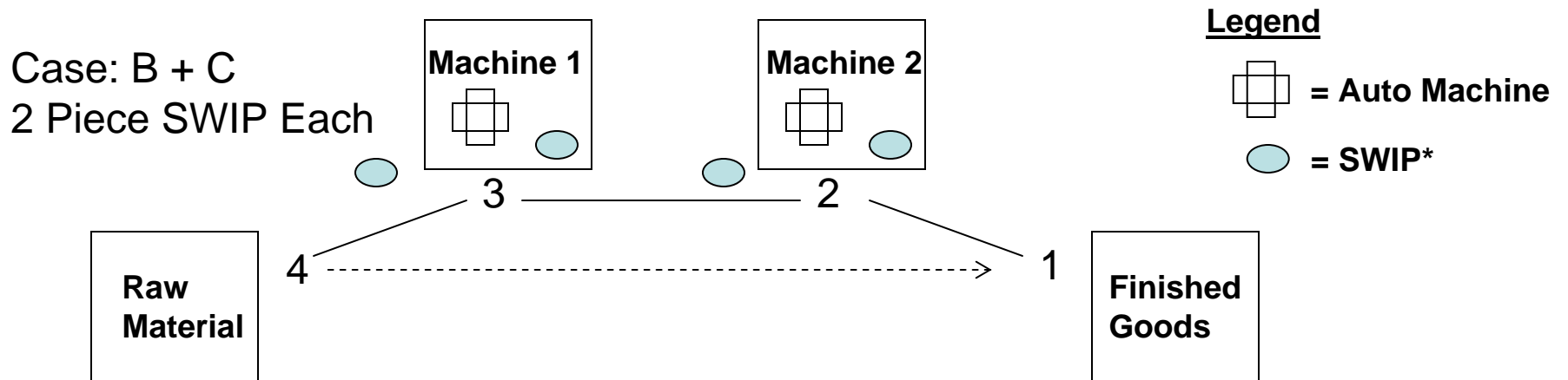
Case: A + D
0 Piece SWIP Each



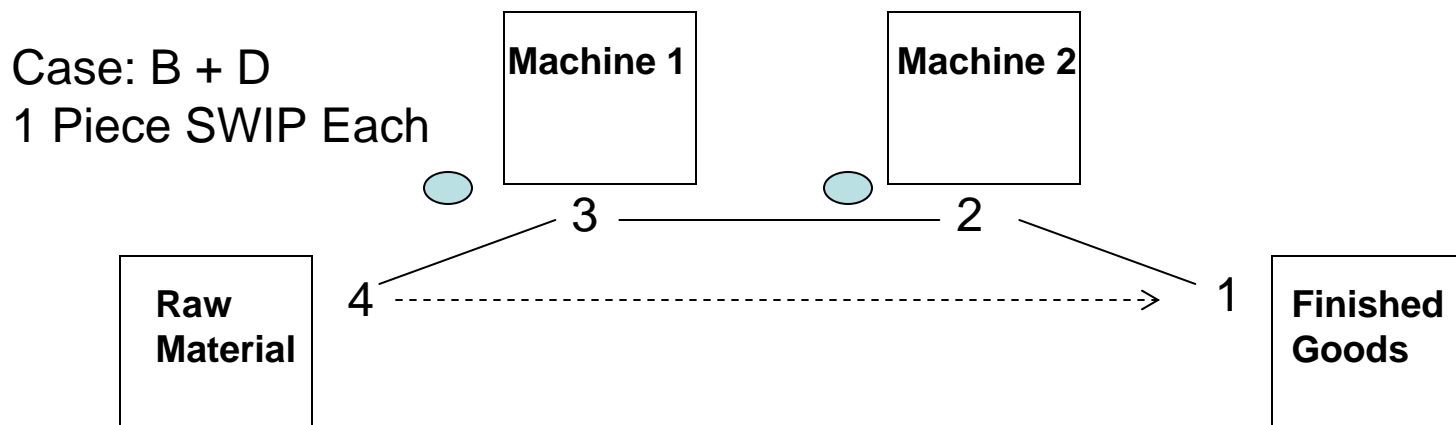
*SWIP: Standard Work in Process

Slide 3-7

Auto Machine / Opposite Work Flow



Manual Machine / Opposite Flow



*SWIP: Standard Work in Process

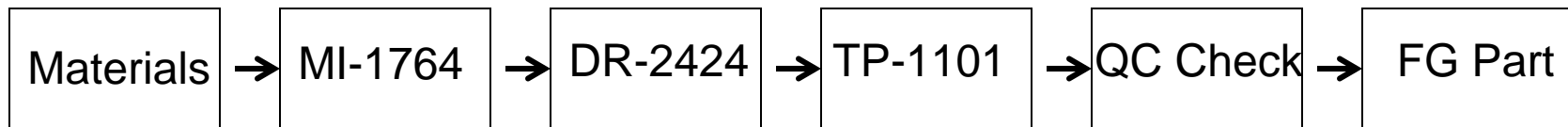
Slide 3-8

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

Slide 3-11

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

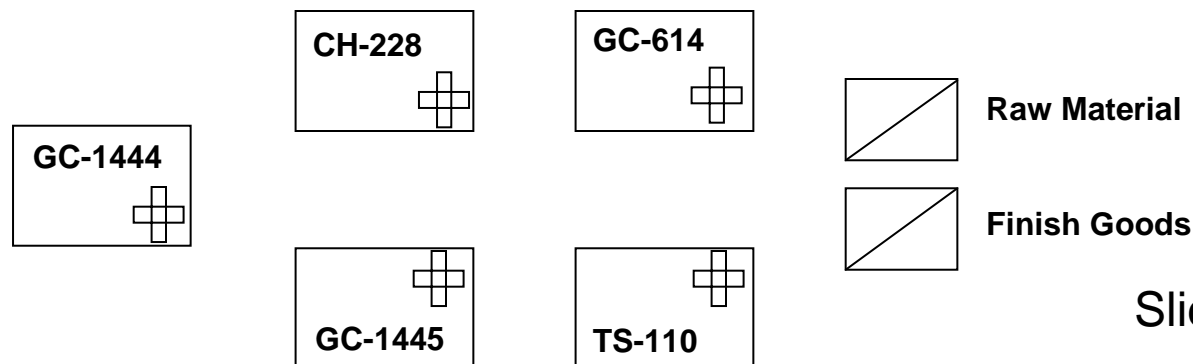
Part Number: 41211-2009



Manual load auto cycle


	<u>Mat'l.</u>	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

 = Capacity constraint of the line

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Calculation of Machine Capacity

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

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

$$\text{Capacity: } \frac{27,600 \text{ seconds}}{(43 + 0.5) \text{ seconds}} = 634 \text{ pieces per shift}$$

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.			Plant:			Product:																	
			Area:			Op. ____ of ____																	
Standardized Work Combination Table			Process:			Pg. ____ of ____																	
Date:	By:	Line Takt:	Shifts:			Manual Work	—	Walking															
			Volume:			Automatic	---	Wait															
No.	Major Steps	T M A N	I M E	A U O	T M E	W I T	T I M	W A I	T A I	L M K	Time Graph (Seconds)												
											5	10	15	20	25	30	35	40					







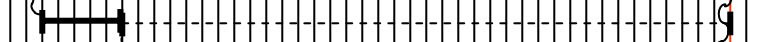





Standardized Work Combination Table

Acme Corp.				Plant: Acme				Product: Intake Manifold													
Standardized Work Combination Table				Area: Manifold Machining				Op. ____ of ____													
				Process: Booster Machining				Pg. ____ of ____													
Date: 5/23/2006		By: Art of Lean		Line Takt: 30 secs.				Shifts: 2													
				Volume: 920 / Shift				Manual Work 		Walking 											
				Automatic 		Wait 															
No.	Major Steps	T M A N E	A U T O E	W A I T E	W A I T E	T M L K	Time Graph (Seconds)														
							5	10	15	20	25	30	35	40	45						
1	Pick up raw material	2	--	--	X																
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	X	---	X	12															

TT 30 Secs.

Slide 4-3

Standardized Work Combination Table

Acme Corp.			Plant: Acme				Product: 8" Pinion Gear				
Standardized Work Combination Table			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		Manual Work 		Walking 	
				Volume: 600 / Shift		Automatic 		Wait 			
No.	Major Steps	T M A N E	I M O E	A T M O E	W T I M T E	W T A I L M K E	Time Graph (Seconds)				
							5	10	15	20	25
1	Pick up raw material	1	--	--							
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					

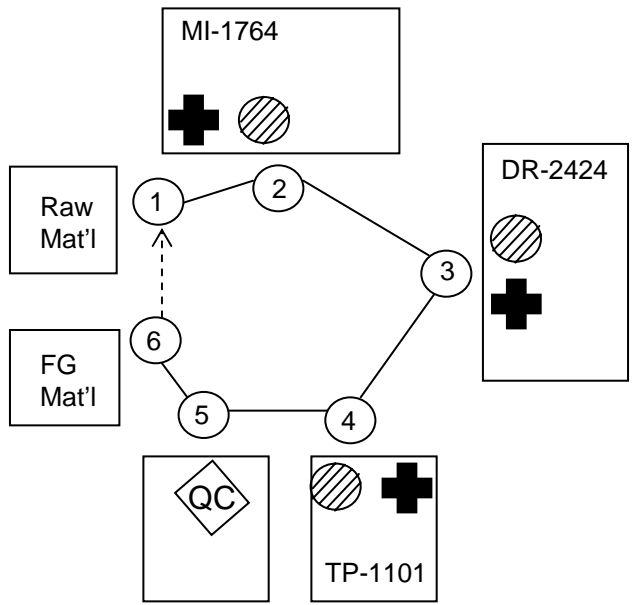
TT 46 Secs.

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:		Takt Time:		Cycle Time:							
				Volume:												
No.	Major Steps	M A N	I M E	T U O	A T O	W A T	T I M	W A L	T A L	I M L	K E	Working Sequence Walking Return to Start	Safety	SWIP	Quality	
													+			

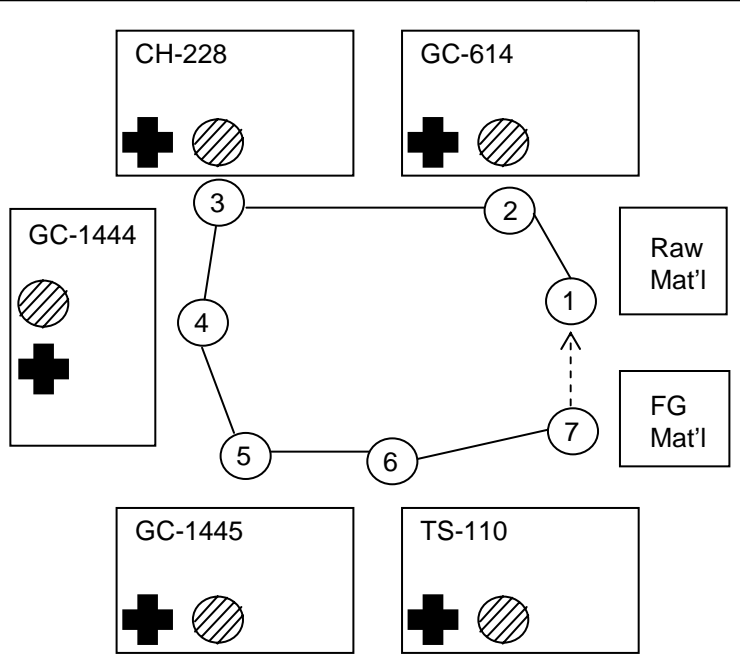
Standardized Work Chart

Acme Corp. Standardized Work Combination Table			Plant: Acme			Product: Intake Manifold					
			Area: Machining			Op. _1_ of _1_					
			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	M A N	I M E	T U O	A I E	W T I M E	W T A I L M E	Working Sequence Walking Return to Start	Safety	SWIP	Quality
1	Pick up raw material	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				



Standardized Work Chart

Acme Corp.				Plant: Acme				Product: 8" Pinion Gear				
				Area: Gear Machining				Op. _1_ of _1_				
Standardized Work Combination Table				Process: Gear cutting exercise				Pg. _1_ of _1_				
Date:		By:		Approved By:		Shifts: 2		Takt Time: 46 secs.		Cycle Time: 46 secs.		
				Volume: 600								
No.	Major Steps	M A N	I M E	T O E	A T M	W I M	T E	W T L M K E	Working Sequence Walking Return to Start	Safety	SWIP	Quality
1	Pick up raw material	1	--	--								
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

Current

1 Man
1 Machine = 100 Units
1 Hour

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!

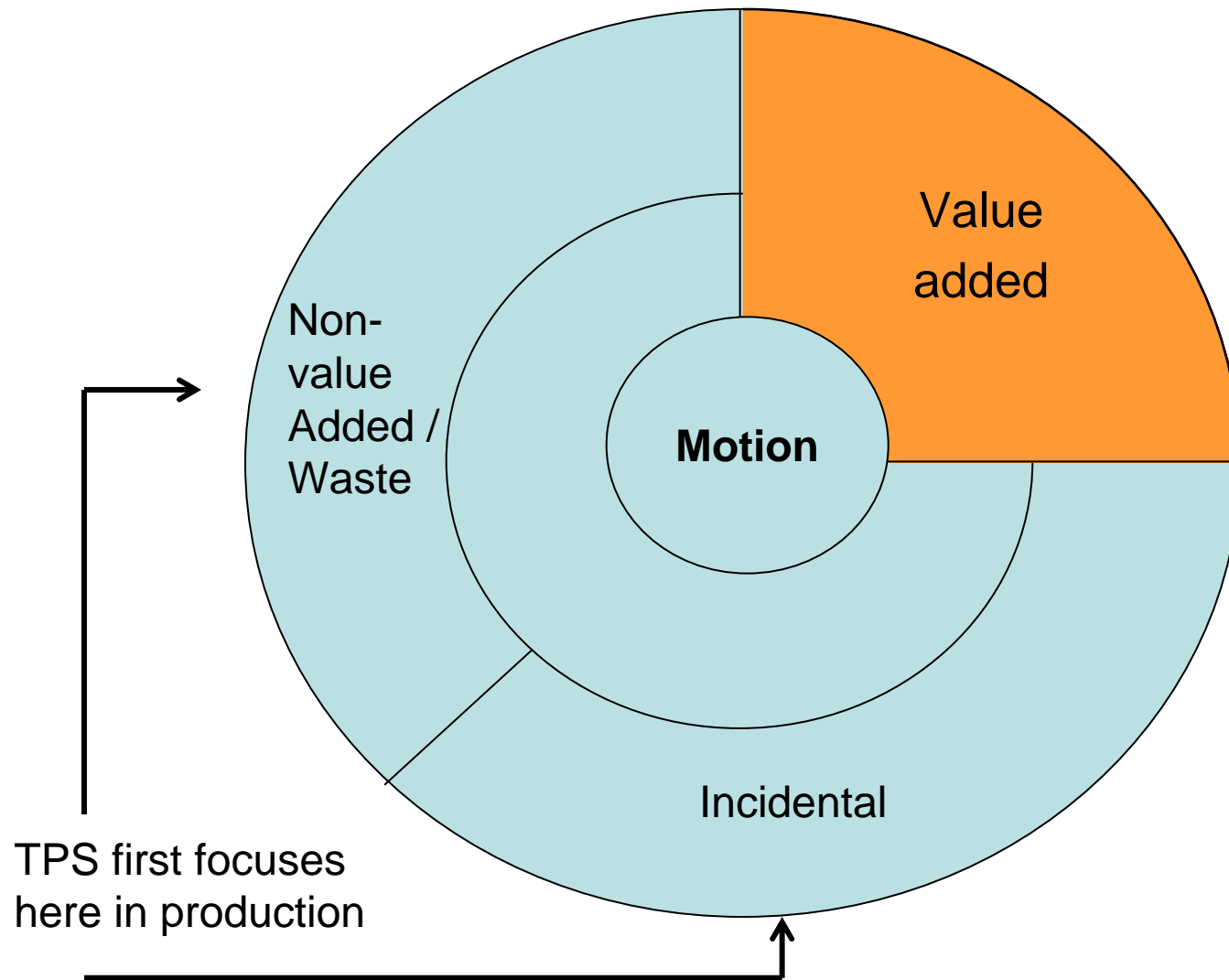
Future

1 Man
1 Machine = 120 Units
1 Hour



Slide 5-3

Waste and Work



7 Types of Waste

Overproduction

Producing too much,
or producing too soon

Conveyance

Any nonessential
transport is waste

Inventory

Any more than the
minimum required

Waiting

Waiting on parts, waiting for a
machine to finish cycle

Processing

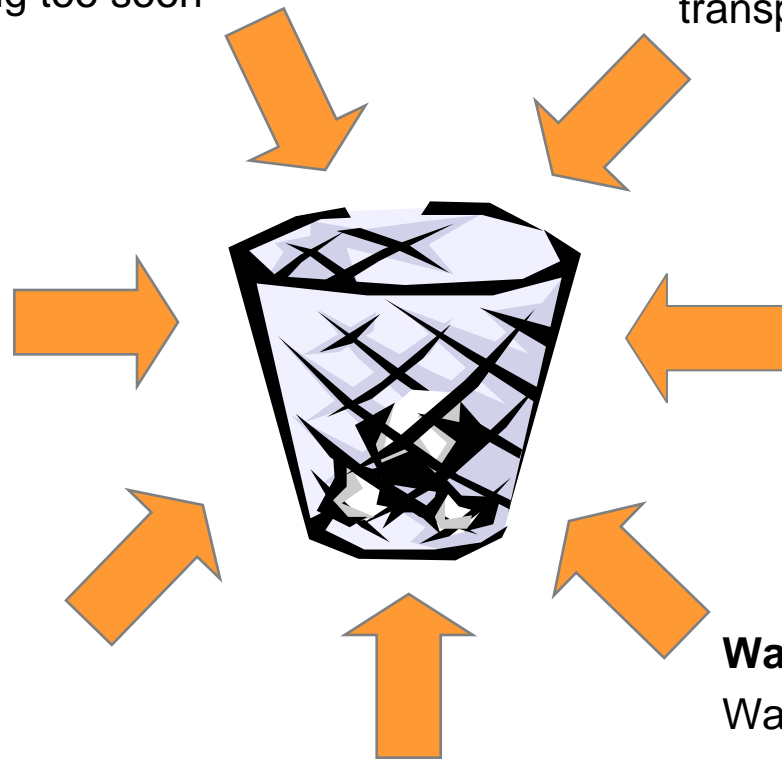
Over-processing

Correction

Any repair,
scrap,
or rework

Motion

Any motion that
does not add value

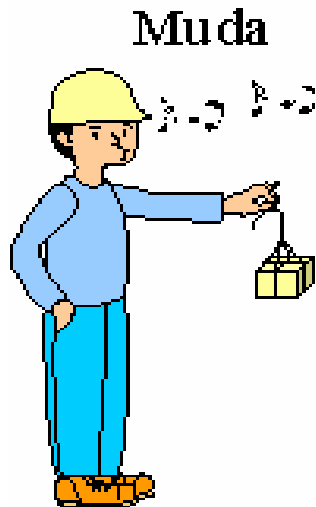


Waste of Over-Production*

Overproduction is damaging as it requires:

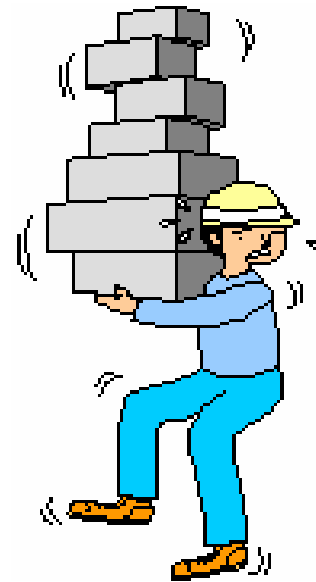
- Extra people, equipment, and time
- Extra materials and parts
- Extra energy, oils, and consumable items
- Extra skids, pallets, and containers
- Extra material handling
- Extra space and warehousing
- Additional inventory control
- Covers up the need for improvement

Muda, Mura, Muri



Muda

Any form of **waste** in the process...



Muri

Unreasonable burden on people or machines...

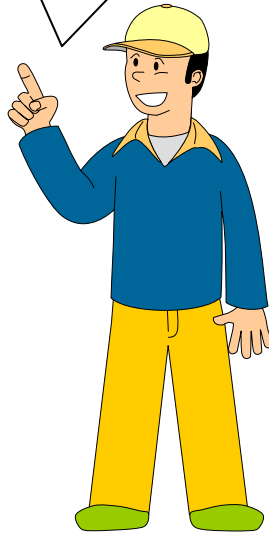


Mura

Un-level workloads on people or machines

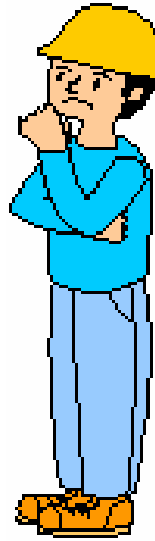
True versus Apparent Efficiency

Before we made 100 parts with 10 people. Now we can make 120 with the same manpower!

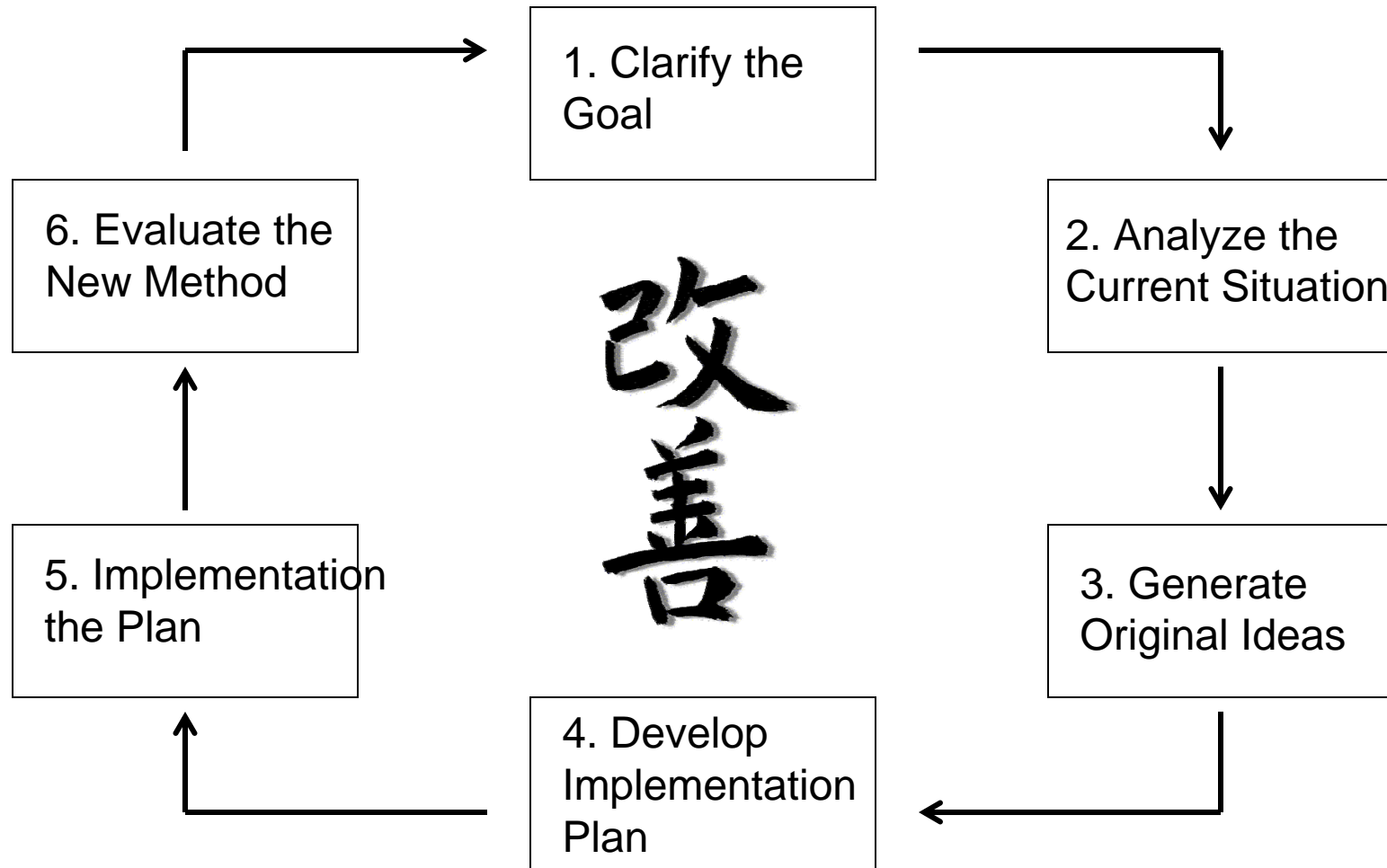


But we only need 100 parts to meet demand. The rest is over-production.

A real improvement would be to make 100 parts with only eight people on the production line!



Procedure for Kaizen

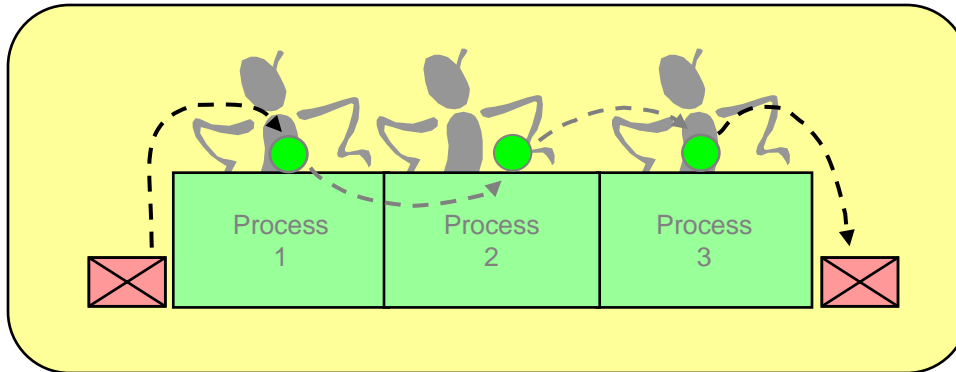


Key Points for Standardized Work

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

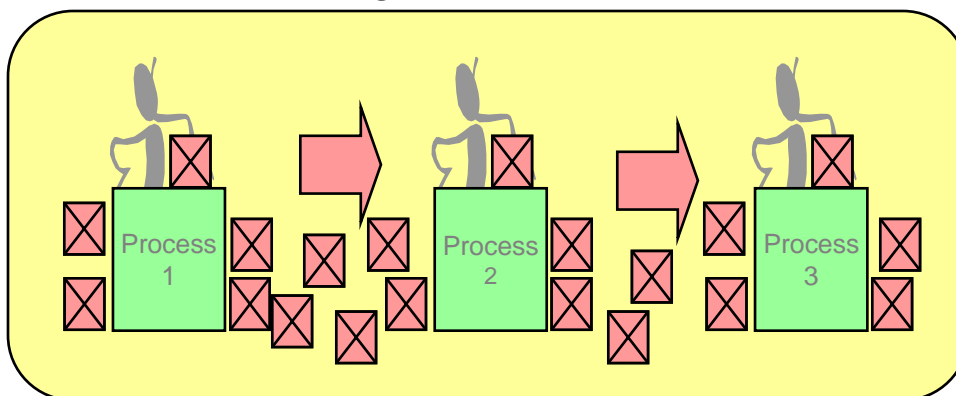
One Piece Flow vs. Large Lots

Small lot size



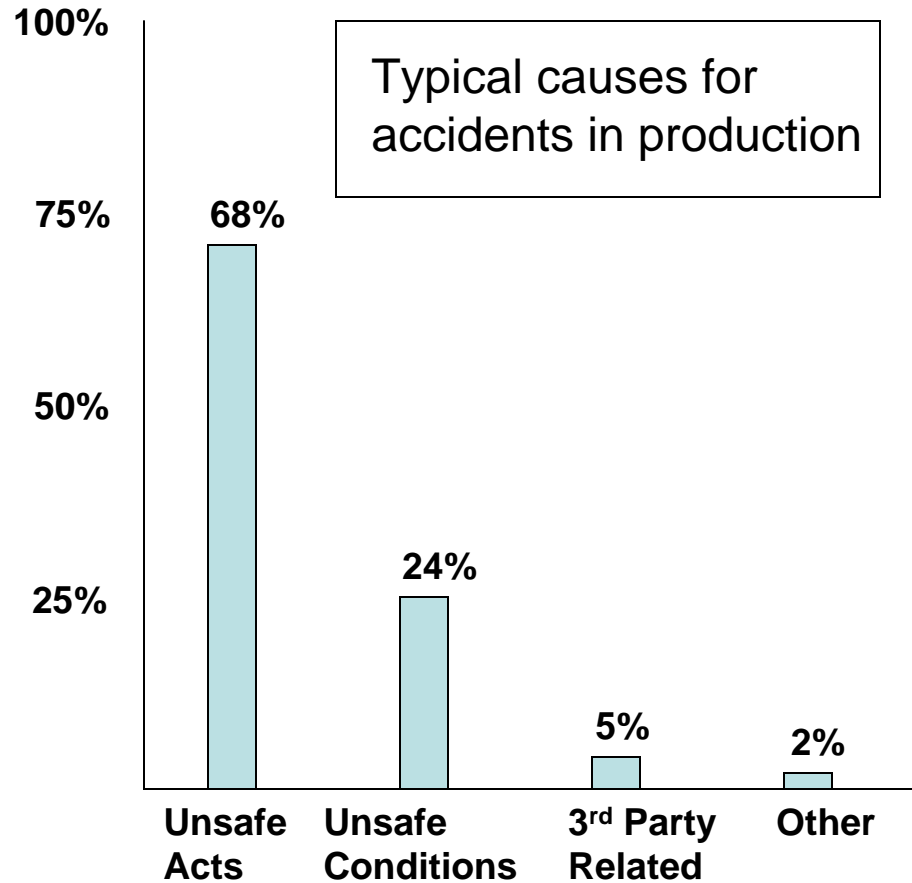
- Shorter lead time
- Less WIP
- Fewer handling mistakes
- Rapid detection of errors
- Better visual control
- Easier communication

Larger batch size



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

Standardized Work and Safety



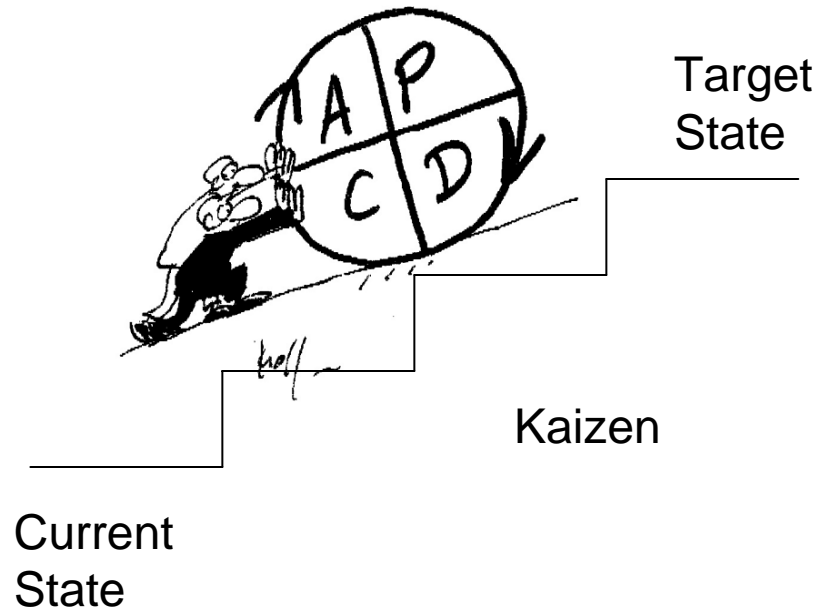
Unintentional unsafe acts are the leading cause of accidents in most work places in industry.

Properly establishing standardized work and following standardized work can prevent injuries

Five S



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