STANDARD WORK

NORTHEAST INDIANA LEAN NETWORK

JUNE 14, 2018

INTRODUCTION

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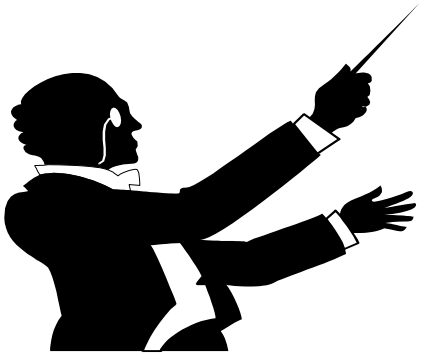
- Jeremy Freeman – lean leader team, Chore Time Group
- Bill Roper – former lean leader CTB Inc.

STANDARD WORK

- Standard work defines how a job is performed; it details the interaction of the operator and machine or process to complete the work as “waste free” as possible
- Standard work:
  - Is defined by operators (ideally)
  - Represents the best, safest way to produce required quality and output
  - Provides the basis for maintenance and improvement; standard work is followed by everyone until improvements are identified and implemented
  - Traditionally addressed repetitive manufacturing operations, but has value in standardizing all types of operations

STANDARD WORK HAS THREE COMPONENTS

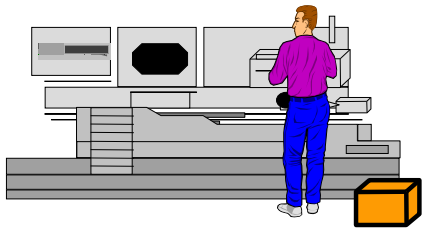


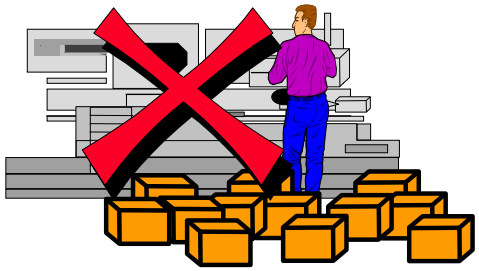
Takt time

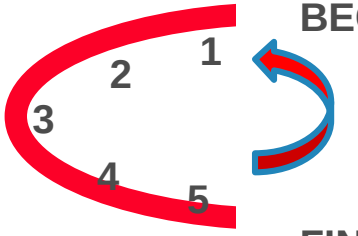
Work time and sequence

Standard Work

Standard work-in-process



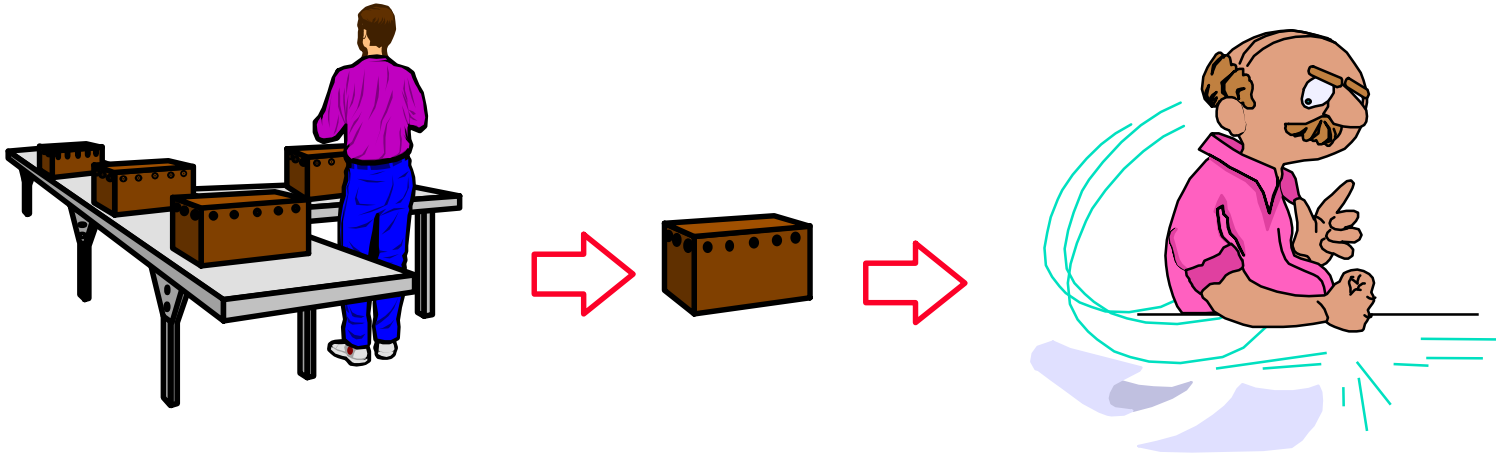




CONTINUOUS IMPROVEMENT
Innovation that Leads

TAKT TIME

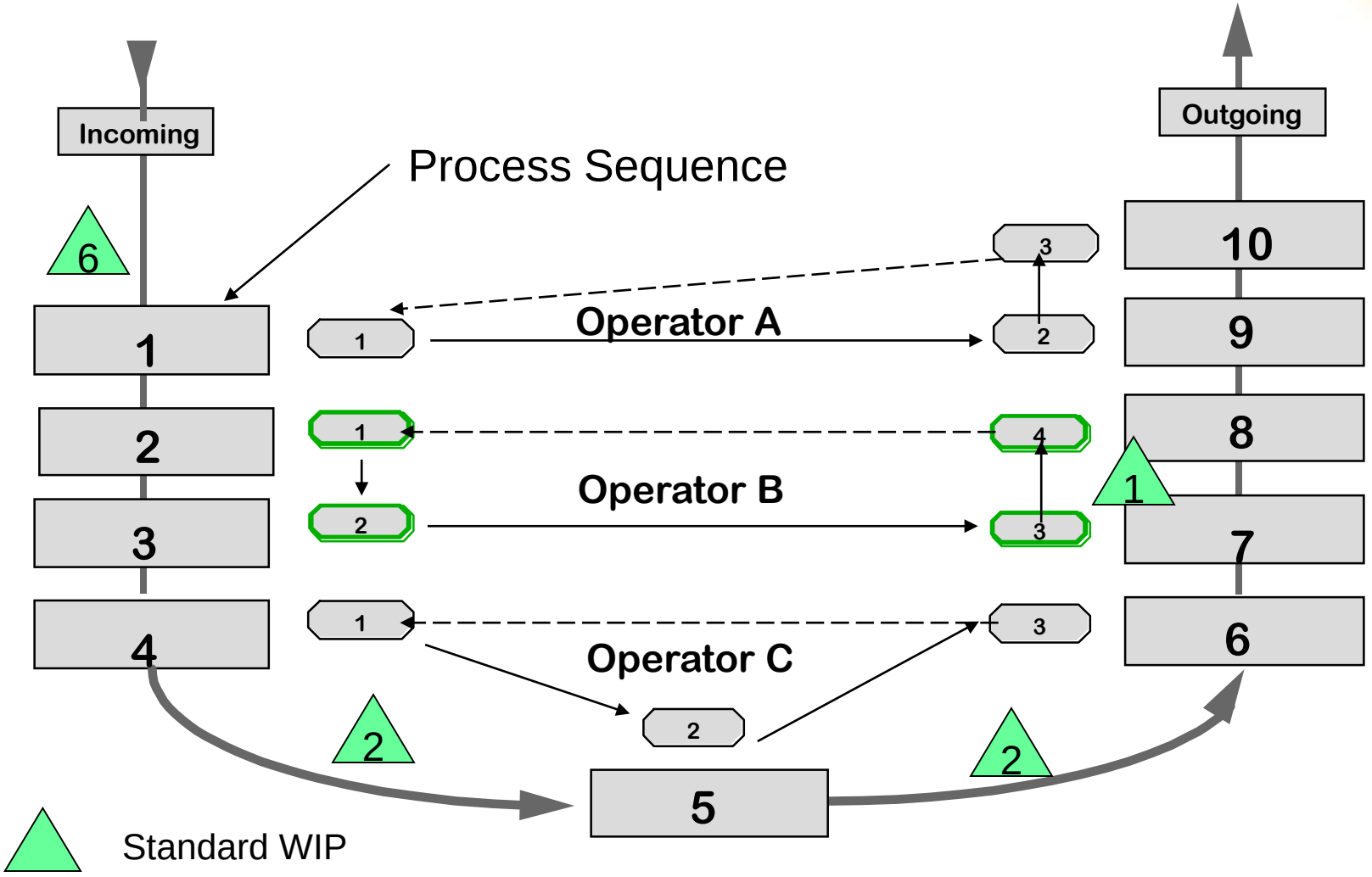
Takt time = production rate to meet customer demand



$$\text{Takt time} = \frac{\text{Total daily work time}}{\text{Average daily customer demand}}$$

WORK SEQUENCE AND WIP

Operator work tasks and sequence based on balanced work time



CONTINUOUS FLOW IMPLEMENTATION

- Standard work necessary to implement continuous flow which is a 8 step process:

1. Select a family of parts or type of transaction to improve
2. Analyze part activity levels to identify most active items:
3. Locate equipment / people in process sequence and minimize separation between work steps (create cells)
4. Produce in small lots (1 piece flow ideal)
5. Produce at the rate of consumption
6. **Balance operations using standard work**
7. Cross train operators to operate multiple processes
8. Measure performance and continuously improve operations

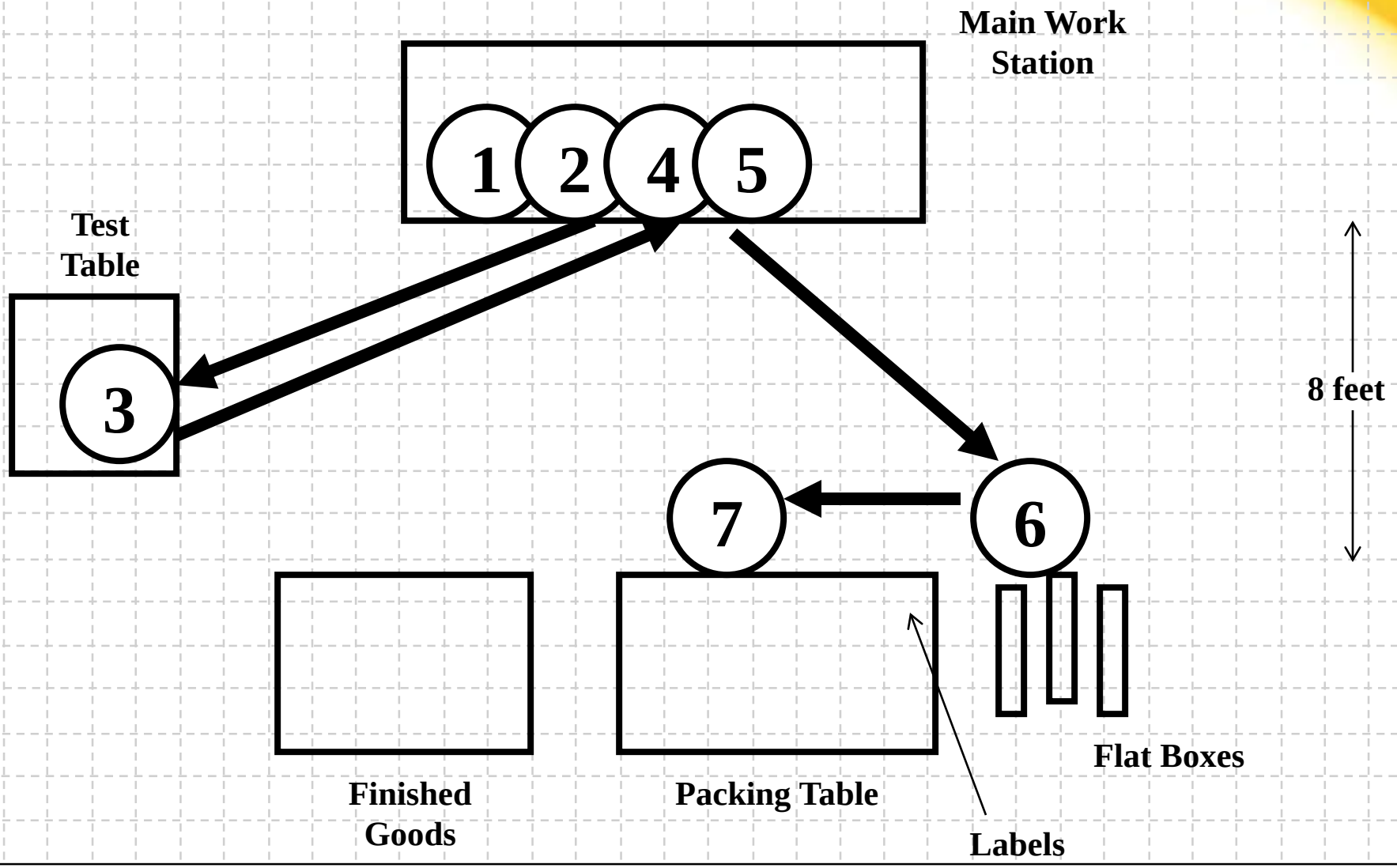
STANDARD WORK IMPLEMENTATION

1. Define process characteristics and improvement target – takt time / run rate to be achieved
2. Observe process to identify basic process flow, work responsibilities, process wastes, etc.
3. Create standard work diagram
4. Define operator cycle times, summarize current work content and balance
5. Analyze and improve work balance
6. Document standard work
7. Review with operators and pilot new approach

STANDARD WORK DIAGRAM

Date: Page of

Manager Or Team Leader	Area Or Process Name	Person Preparing This Sheet
	Electronic Phone Switch – Final Assembly	



Quality Check	Safety Precaution	Standard Work In Process	Takt Time	Required Output	Net Time	Operator Number
			65 Sec.			

OPERATION CYCLE TIMES

Operation cycle times are determined for each step in a work flow

1. Observe job and define work steps
2. Record work tasks on the Time Observation Form
3. Time several cycles of the job to get a fair representation of times and task difficulties
4. While defining work sequence, record work done and other relevant information, such as:
   - Walk time and distance, operator delays, ergonomic issues
   - Machine cycle times (no operator time required)
   - Periodic operator activities, such as tool change, getting material, etc.

TIME OBSERVATION FORM

Task/Process Being Observed	Observer(s)	Date/time Of Observation
Anvil Insertion		

Step No.	Task Component	Observation Number 1	2	3	4	5	6	7	8	9	10	11	12	ASSIGNED COMPONENT TIME	REMARKS
1	PU Anv.bot./spr.														
2	Place on fixture														
3	PU/place base														
4	PU/place anvil														
5	Cycle machine														
6	Unload & place														
Time For One Cycle														Total Time	Running time (cumulative) / Time for each component

TIME OBSERVATION FORM

Task/Process Being Observed: **Anvil Insertion**

Observer(s):

Date/time Of Observation:

Step No.	Task Component	Observation Number 1	2	3	4	5	6	7	8	9	10	11	12	ASSIGNED COMPONENT TIME	REMARKS
1	PU Anv.bot./spr.	2.0		10.5		19.9		29.0							
2	Place on fixture	3.9		13.0		21.9		30.8							
3	PU/place base	6.1		14.8		24.0		32.7							
4	PU/place anvil	7.0		16.9		26.0		34.7							
5	Cycle machine	7.5		17.4		26.5		35.2							
6	Unload & place	8.0		18.4		27.0		35.7							
Time For One Cycle														Total Time	

2. Time runs continuously; in this case 4 work cycles took 35.7 seconds

1. After defining basic work tasks, record times for several work cycles. Easiest to record running times, at the end of each work element as shown above.

Running time (cumulative)
Time for each component

TIME OBSERVATION FORM

Task/Process Being Observed: **Anvil Insertion**

Observer(s):

Date/time Of Observation:

Step No.	Task Component	Observation Number 1	2	3	4	5	6	7	8	9	10	11	12	ASSIGNED COMPONENT TIME	REMARKS
1	PU Anv.bot./spr.	2.0		10.5		19.9		29.0						2.0	
		2.0		2.5		1.5		2.0							
2	Place on fixture	3.9		13.0		21.9		30.8						2.0	
		1.9		2.5		2.0		1.8							
3	PU/place base	6.1		14.8		24.0		32.7						2.0	
		2.2		1.8		2.1		1.9							
4	PU/place anvil	7.0		16.9		26.0		34.7						2.0	
		1.9		2.1		2.0		2.0							
5	Cycle machine	7.5		17.4		26.5		35.2						0.5	
		0.5		0.5		0.5		0.5							
6	Unload & place	8.0		18.4		27.0		35.7						0.5	
		0.5		1.0		0.5		0.5							
	Time For One Cycle	8.0		10.4		8.6		8.7						Total Time 9.0	

2. Calculate element times as the average value across cycles, or most representative time

1. Calculate individual element times (shown in red) by subtracting successive cumulative times. For example, time for task 6, of cycle 1:
8 sec - 7.5 sec = 0.5 seconds

4. Also, calculate and compare total time per cycle and average total cycle time

Avg = 8.9

3. Sum task times to determine total element time

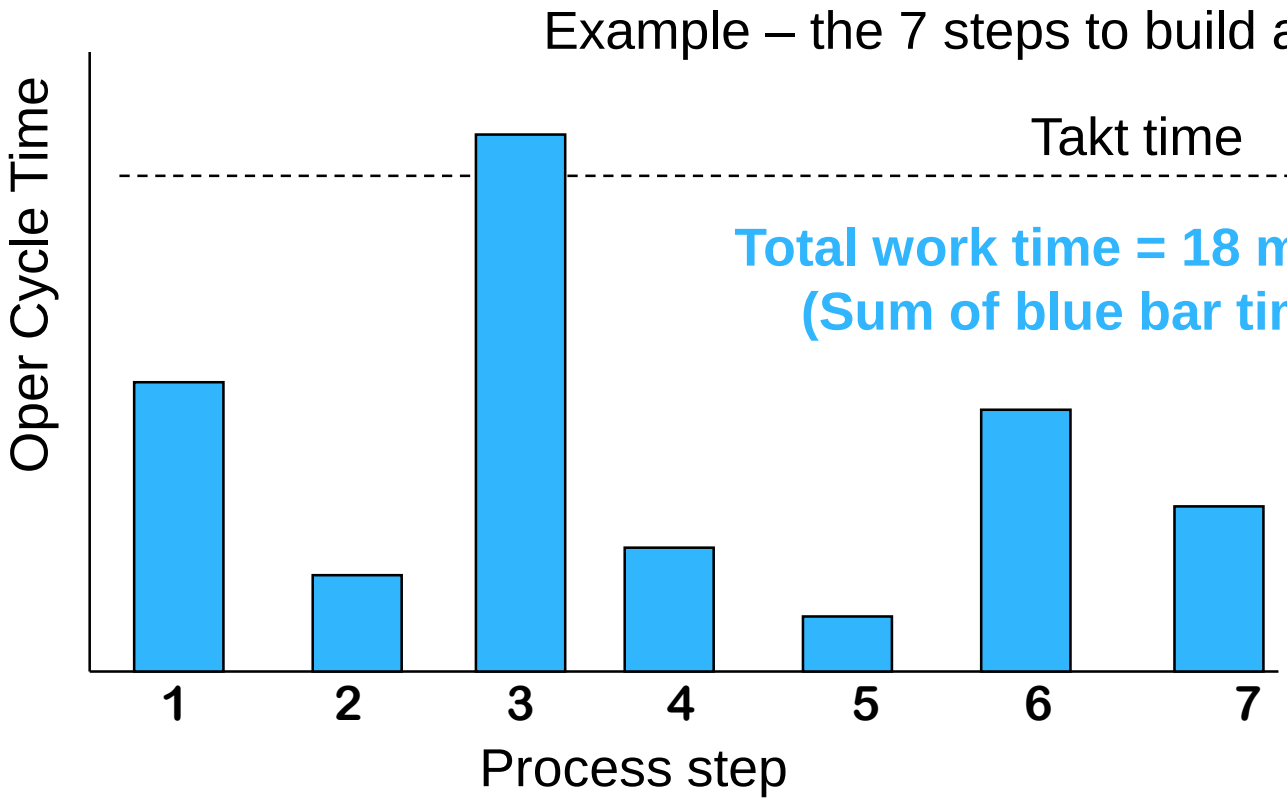
Running time (cumulative)
Time for each component

OPERATION CYCLE TIMES

- Assigned ***element time*** is the required time to perform the work observed
- ***Operation cycle time*** should include allowance for personal time and fatigue (typically 5% - 10% of cycle time)
- For this example:
  - Operation Cycle Time = Total element time + 10%
  - OCT = 9.0 seconds X 1.1 = 9.9 seconds
- With standard work the devil and the opportunity is in the details:
  - You must understand the “waste free” work content and then design the process to reduce / eliminate the wastes
  - Average time per piece will always include some waste we should eliminate

DETERMINE REQUIRED MANNING

- Typical operator work balance has some operations over loaded and others under loaded
- Without standard work it is difficult to manage the process and you must batch to be “efficient”

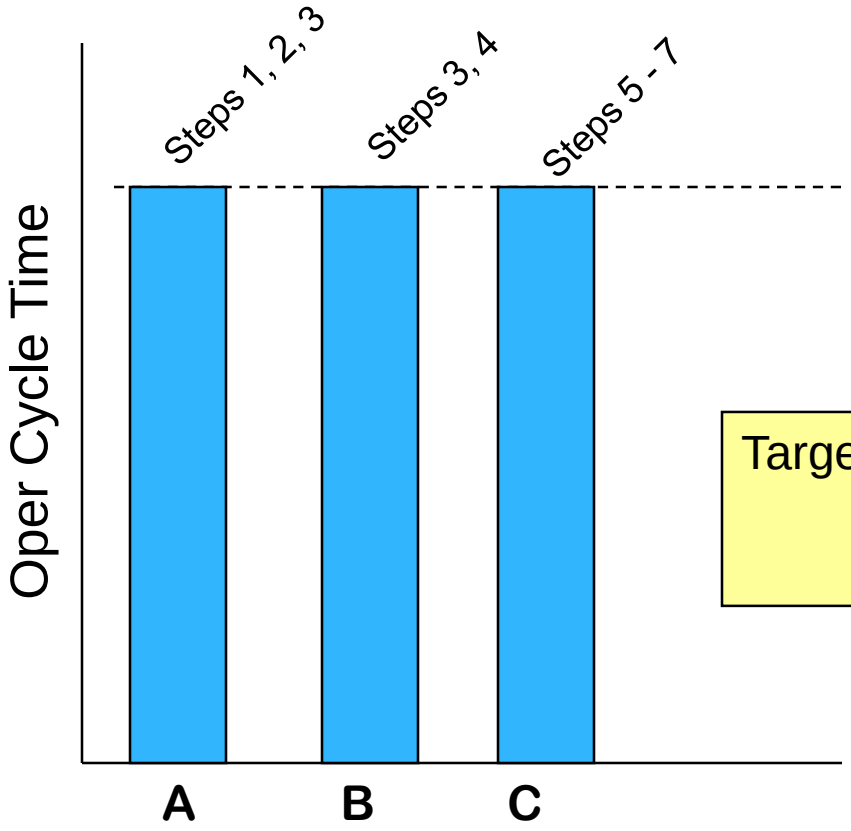


Always lots of waste embedded in batch / no flow processes

DETERMINE REQUIRED MANNING

- Number of operators needed in a balanced, flow = sum the cycle times divided by takt time

  $(OCT_1 + OCT_2 + \ldots + OCT_7)$ / Takt time = Target manning



Target production rate 10 per hour; 60 mins / 10 fans = 6 minutes per fan (takt time)

Target manning = Total work time / Takt time
= 18 mins / 6 mins
= 3 operators

STANDARD WORK EXAMPLE – REGULATOR CELL

- Before improvement
  - Separate assembly tables for each of two products
  - Large batches, built to order
  - 17.8 minutes per box of 4
  - No consistent process
- After improvement
  - U-Shaped cell with 1 piece flow; floor space significantly reduced
  - Build to a finished goods stock
  - 12.9 minutes per box of 4
    - 28% reduction in process time
  - Component parts placed on EPK (electronic pull)
  - Process repeatable at established rate

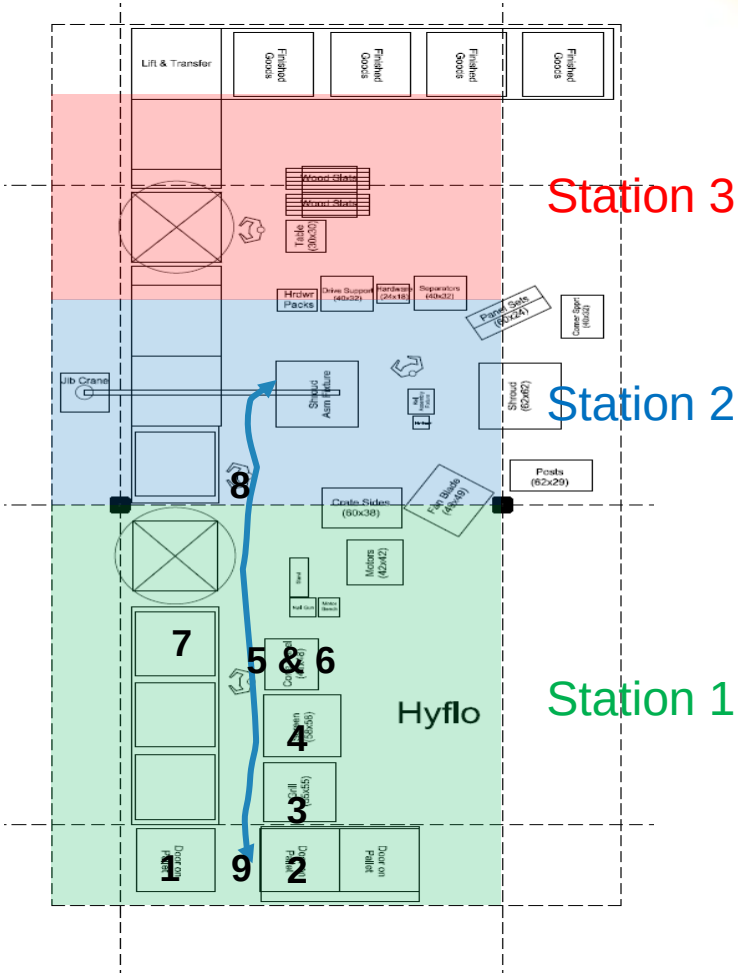
STANDARD WORK EXAMPLE – FAN ASSEMBLY

- Before improvement:
  - 3-4 separate assembly areas based on fan size
  - 4 people assembled 45 fans per shift
  - Assemblers picked all parts; changeovers took 15-30 minutes
  - 5S and ergonomics poor
- After improvement:
  - Mixed model line makes all fan sizes
  - 3 operators assemble 60 fans per shift
  - Component parts kept at line on carts; changeovers 5-10 minutes
  - 5S and ergonomics greatly improved

STANDARD WORK DEVELOPED FOR EACH OPERATOR

Operator 1

Step#	WORK STEP	C/T
1.1	Push door and crate onto the conveyor	0.50
1.2	Place grill, screen and cone panels on top of the door. Install 2 screws to hold the panels.	0.60
1.3	Staple side rails to the crate base.	0.70
1.4	Apply the label.	0.50
1.5	Attach the pulley and wire ties to the motor.	0.75
1.6	Set motor into crate on cardboard, then attach to the crate with the wire ties.	0.25
1.7	Lower the crate, push the skid off the lift, and raise the table.	0.50
1.8	Assist operator at Station 2 in lifting the sub assembly onto the shroud, then place the blades onto the assembly fixture.	0.70
1.9	Return to starting position	0.33
		4.83



CONTINUOUS IMPROVEMENT
Innovation that Leads

STANDARD WORK DEVELOPED FOR EACH OPERATOR

Standard Work Instruction

CHORE-TIME

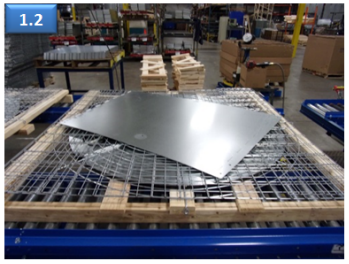
Work Element Sheet

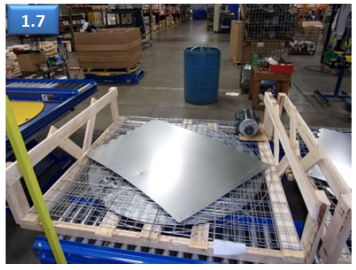
Instruction Title	Hyflo Fan Line, C225, 54" Fans			**Issue Date**	03-Feb-16	**Page**	5 of 7
Element Name	Hyflo Door and Crate and Motor Assembly (Operator 1)			**Element #**	1	**Element Time**	0:04

Symbols		Step#	WORK STEP	Symbol	KEY POINT / SAFETY HIGHLIGHT	REASON WHY
Quality	Q	1.1	Push door and crate onto the conveyor			
HSE	✚	1.2	Place grill, screen and cone panels on top of the door. Install 2 screws to hold the panels.			
Knack	☺	1.3	Staple side rails to the crate base.			
		1.4	Apply the label.			
		1.5	Attach the pulley and wire ties to the motor.			
		1.6	Set motor into crate on cardboard, then attach to the crate with the wire ties.			
		1.7	Lower the crate, push the skid off the lift, and raise the table.			
		1.8	Assist operator at Station 2 in lifting the sub assembly onto the shroud, then place the blades onto the assembly fixture.	✚	Teamwork lifting	Improper lifting techniques can lead to added stress to the body, leading to possible muscle strains and sprains.

Visuals

this is actually the first step for oper 1

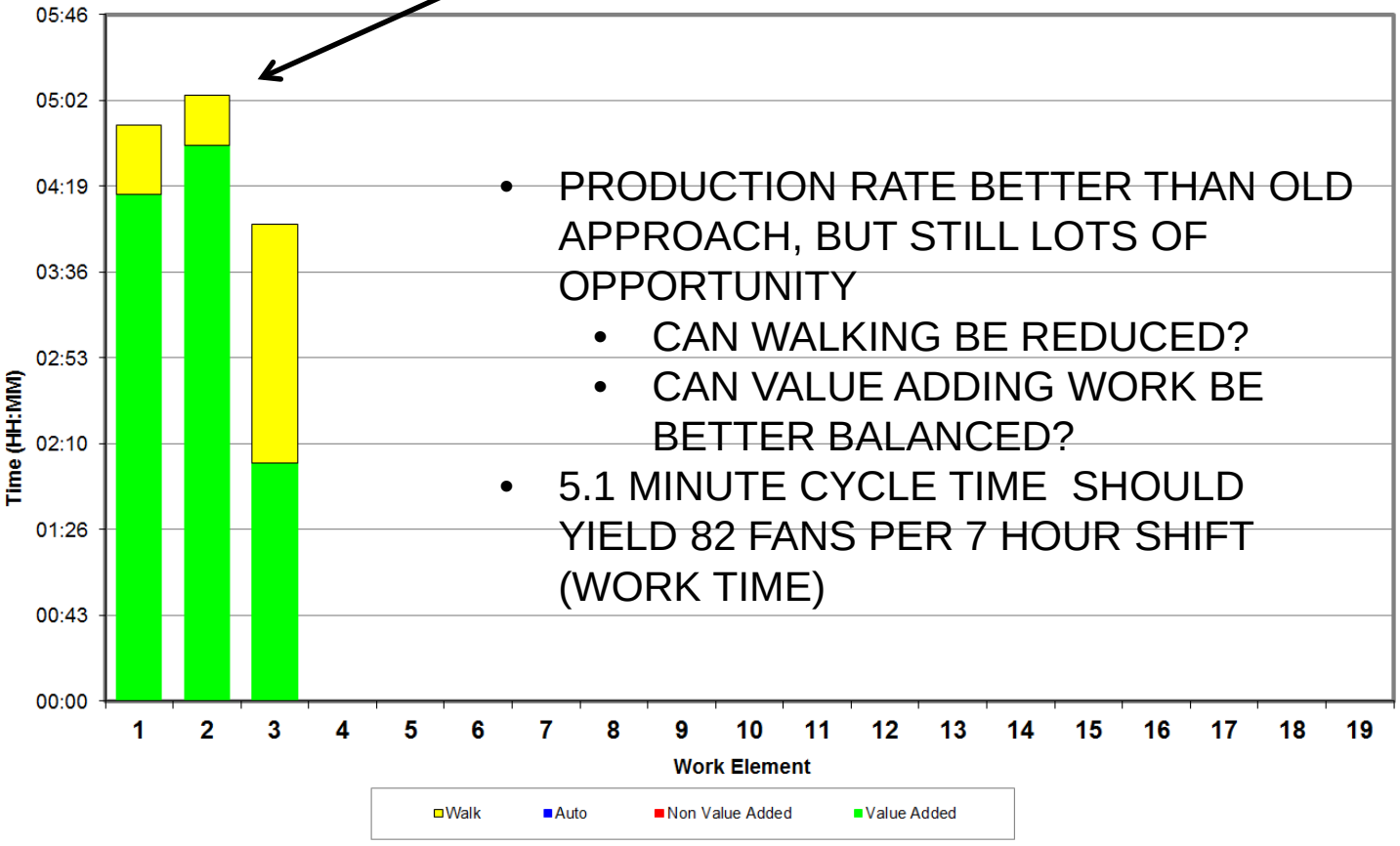




CONTINUOUS IMPROVEMENT
Innovation that Leads

FAN ASSEMBLY WORK BALANCE

LONGEST CYCLE TIME DETERMINES LINE OUTPUT;
WE SHOULD COMPLETE A FAN EVERY 5 MINUTES

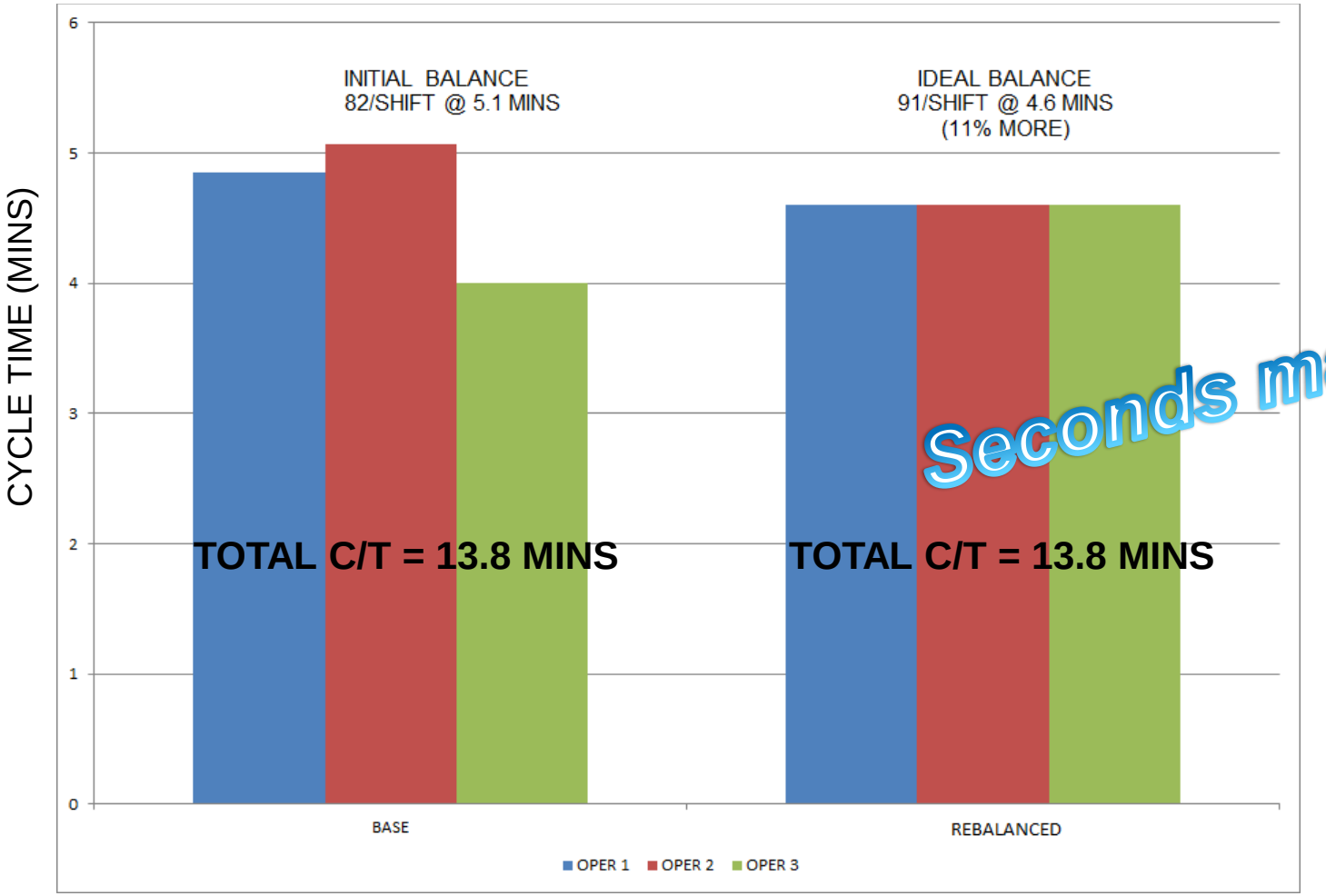


- PRODUCTION RATE BETTER THAN OLD APPROACH, BUT STILL LOTS OF OPPORTUNITY
  - CAN WALKING BE REDUCED?
  - CAN VALUE ADDING WORK BE BETTER BALANCED?
- 5.1 MINUTE CYCLE TIME SHOULD YIELD 82 FANS PER 7 HOUR SHIFT (WORK TIME)

CONTINUOUS IMPROVEMENT
Innovation that Leads

IMPROVED WORK BALANCE INCREASES CAPACITY

Same total work time, but balanced flow yields 11% more output



CONTINUOUS IMPROVEMENT
Innovation that Leads

STANDARD WORK MUST BE MANAGED

- Track performance in short intervals to identify problems; easier when we know exactly what we ***should get***

Hour by Hour Board — Date / /

Line name **Hyflo fan – 52”** — Demand **60 fans** per shift — Takt time seconds

Time	Plan	Day Shift Actual	Stoppage time	Reason
7:00 - 8:00 17:00 - 18:00	**10**	**8**		**Start up meeting**
8:00 - 9:00 18:00 - 19:00	**10**	**9**		**New operator**
9:10 - 10:10 19:10 - 20:10	**10**	**8**		**Bad motor & fan drive**

Summarize problems and focus on solving most frequent

- Operators track performance, identify problems and drive solutions

TRACK PERFORMANCE IN SHORT INTERVALS

- Make it visual – keep it at the line
- Resist the urge to go electronic – high touch, low tech builds understanding and commitment to the process
- Operators update the chart – it is *their line and results*

STANDARD WORK SETS CLEAR EXPECTATIONS

- By hour / day and longer term – week, month, etc.

	TAKT TIME VS SIZE AND STAFF			UNITS FOR WEEK BEG	REQD LINE MINS		
FAN TYPE	3	4	5	11-Mar	@ 3	@ 4	@ 5
15 HC	24.0	18.0	14.4		0	0	0
18 HC	25.3	19.0	15.2	7	177	133	106
22 HC	26.7	20.0	16.0	5	133	100	80
22 low	26.7	20.0	16.0	6	160	120	96
24 low	28.0	21.0	16.8	11	308	231	185
27 low	29.3	22.0	17.6	24	704	528	422
30 low	32.0	24.0	19.2	8	256	192	154
33 low	37.0	28.0	22.4	10	370	280	224
LINE WORK MINS				71	2,109	1,584	1,267
EQUIV LINE HOURS					39.2	29.5	23.6
AVG TAKT TIME					29.7	22.3	17.8
AVG UNITS/DAY*					14	19	24
EQUIV 8 HOUR DAYS*					4.	3.7	2.9

* - @ 430 WORK MINUTES PER 8 HOUR SHIFT

NEXT WEEK'S SCHEDULE

STANDARD WORK = FREE CAPACITY

- Standard work & layout only:
  - Watering – 36% capacity increase
  - Control assembly – 67% capacity increase
  - Regulator assembly – 40% capacity increase
- Standard work, layout, equipment:
  - Fan assembly – 70% capacity increase at SW target

PROCESS SUMMARY

Standard Work Instruction

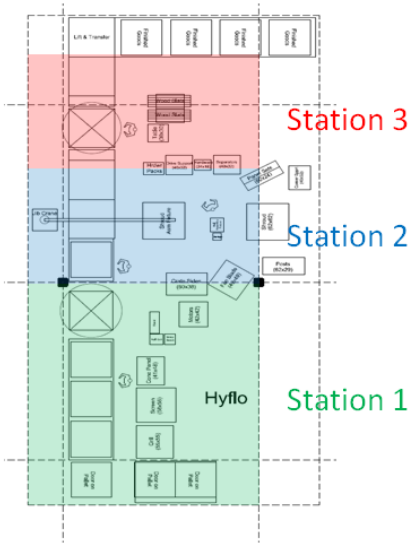
CHORE-TIME

Work Element Summary

Page 3

			Instruction No.		SWI C225-1		
			Cycle Time				
#	Work Element Description	OPT	VA	NVA	Auto	Walk	Total
1	Hyflo Door and Crate and Motor Assembly (Operator 1)		04:15			00:35	04:50
2	Fan Assembly (Operator 2)		04:40			00:25	05:05
3	Complete Fan and Crate (Operator 3)		02:00			02:00	04:00
4							00:00
5							00:00
6							00:00
7							00:00
8							00:00
9							00:00
10							00:00
11							00:00
12							00:00
13							00:00
14							00:00
15							00:00
16							00:00
17							00:00
18							00:00
19							00:00
		Total	10:55	00:00	00:00	03:00	13:55

Layout



Cover sheet summarizes OCT by operator and work layout / flow

CONTINUOUS IMPROVEMENT
Innovation that Leads

WORK STATION SHEET

Standard Work Instruction

CHORE-TIME

Work Element Sheet

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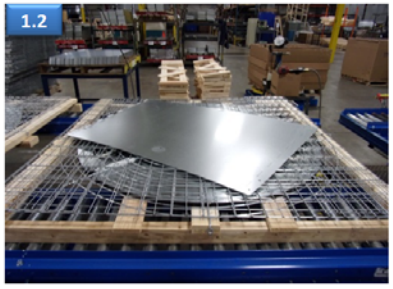
HSE +	1.2	Place grill, screen and cone panels on top of the door. Install 2 screws to hold the panels.					
Knack ☺	1.3	Staple side rails to the crate base.					
	1.4	Apply the label.					
	1.5	Attach the pulley and wire ties to the motor.					
	1.6	Set motor into crate on cardboard, then attach to the crate with the wire ties.					
	1.7	Lower the crate, push the skid off the lift, and raise the table.					
	1.8	Assist operator at Station 2 in lifting the sub assembly onto the shroud, then place the blades onto the assembly fixture.	+	Teamwork lifting		Improper lifting techniques can lead to added stress to the body, leading to possible muscle strains and sprains.	

SHOULD ALSO SHOW TIME PER STEP

SAFETY AND TEAM WORK ISSUES HIGHLIGHTED

Visuals

this is actually the first step for oper 1



Work station sheet summarizes work steps and sequence for operator, safety and quality issues

CONTINUOUS IMPROVEMENT
Innovation that Leads

SET UP STANDARD WORK

Changeover - Loader System

PPM-FSL011

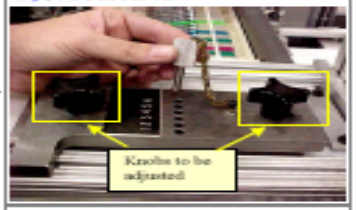
Target 22 min

Special Reminders	Procedure Overview	Instructions & Explanations
GMP guidelines apply surgical gloves or very clean hands Hearing protection Eye protection lock & tag If this is not done correctly, severe problems will occur i1 Use table on reverse of this form to determine correct position Additional person(s) required □1 Picture on front side ⌖1 Enlarged picture on reverse side Obtain all tools & materials listed on reverse side Related SOPs, documents, etc. PPM-FLS001 PPM-FLS002 PPM-FLS010 PPM-FLS012	1 Determine settings for desired product	1.1 Complete pre-checks opposite 1.2 Determine vertical & horizontal positions of Vacuum Valves for the product to be run i1 1.3 Lock & Tag before proceeding
	2 Set Vacuum Valves Positions	2.1 Do the following for each side of each Robot: 2.2 Start with "handle" side of Robot. Loosen nut, move the locking bar out of position □1 2.3 Place Vacuum Valve in correct vertical position ⌖1 ⌖2. Move locking bar back & tighten lock nut. 2.4 Repeat for both Vacuum Valves on "handle side" of this bay. 2.5 On "brush side" of Robot arm, Loosen nut & move locking bar out of position □1 2.6 Place Vacuum Valve into correct vertical & horizontal position. □2 ⌖1 ⌖2 2.7 Move locking bar back into position & tighten lock nut. 2.8 Repeat for both Vacuum Valves on "brush side" of this bay 2.9 Repeat for each bay of each Line
	3 Set Aligner Pin Position	3.1 For each Robot do the following: 3.2 Confirm required Aligner Pin i1 3.3 Pull Pin out □3 3.4 Loosen both knobs 3.5 Place Pin in correct position & move plate until knob moves all the way down i1 3.6 Tighten the knobs
	4 Enter Recipe for desired product	4.1 Identify correct recipe for product to be run i1 4.2 Go to a Control Screen □4 . 4.3 From *Operation* Screen, touch *Tool* screen, On *Tool* screen touch *Recipe* area & scroll until required recipe is shown 4.4 Touch *Select Table Entry* & enter your password 4.5 Enter value for Recipe & confirm
	5 Home Robots	5.1 On Control Screen *Operation* screen, touch *Home Robots* 5.2 Watch the Robots to ensure they "Home" correctly 5.3 Clear any faults
	6 Start system when all systems ready	6.1 Notify operators of other systems. Press green Start button □6

□1 ⬇ 2.1. Loosen nut, move locking bar

□2 ⬇ 2.5 Place in correct vertical & horizontal position

□3 ⬇ 3.2 Pull Pin out



□4 ⬇ 4.2 Control Screen & 6.1

Doc Owner: Filomena Sousa	Version: 1.1	Effective: 18 Dec 04	Approvals:

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SINGLE POINT LESSON

PART #	PART DESCRIPTION	COMPONENTS & QTY'S	DESCRIPTION
51426	PKG, GRILL GENESIS (R)	(2) - 50340	CAP, GENESIS (R) SUPPORT
		(4) - 51774	SLIDE, C-LOCK
		(2) - 51862	INSERT, FEED REGULATOR

(2) - 50340

(2) - 51862

(4) - 51774

LEADER STANDARD WORK

Prior to Start of Shift

- Meet with out-going Team Leader to review prior shift activities, material availability, machine problems, etc.
- Review call-offs for the upcoming shift and make shift schedule
- Prepare for and conduct shift start up meeting – schedule, issues to address, non-production activities, etc.

During the shift

- Check line performance every hour; note and document reasons for missed units
- Check operator compliance with standard work 4 times per shift; coach and train as required
- Attend daily superintendent meeting to update work group performance, issues and needs

Before the End of the Shift

- Review daily Audit results and corrective actions
- Plan the next day's activities
- Summarize shift production, post to visual display and update tracking report
- Meet with incoming TL to review Shift performance and highlight all carry-over issues

RUN RULES DEFINE HOW A JOB IS PERFORMED

SUPPLY THE LINE:

- DELIVER MOTORS, WHEELS, CONES, AND SIDE PANELS TO THE LINE AS REQUESTED ON THE “COMPONENT ORDER SHEET.”
- THIS WILL NEED TO BE DONE SEVERAL TIMES A DAY DEPENDING ON DAILY SCHEDULE AND FAN SIZE GROUPINGS WITHIN THE SCHEDULE.
- MOTORS SHOULD BE DELIVERED TO THE LINE ONE SKID, OR LESS, AT A TIME, PLACED IN DESIGNATED STAGING AREA, STRIPPED OF ALL PACKAGING MATERIAL AND READY TO LIFT TO THE PREP TABLE.

REPLENISH THE LINE:

DAILY:

- REPLENISH CONDUIT, WIRE, PRESSROOM AND OTHER PARTS SUPPLIED BY OUTSIDE VENDORS, SUCH AS
- CONDUIT FITTINGS, WIRE SPLICE CONNECTORS, WIRE NUTS, DECALS, ETC.
- EMPTY WOOD AND CARDBOARD HOPPERS.

WEEKLY:

- REFILL THE TUBS OF NUTS AND BOLTS.
- EMPTY SCRAP WIRE AND METAL BOXES.

ADMINISTRATIVE APPLICATIONS

- Lean easiest to apply in:
  - Transaction processes – order entry, mortgage application processing, A/P, ECO processing, quote creation, etc.
  - Time bound, cross functional processes – monthly close
- Some common problems:
  - No documented, standard approach
  - Poorly defined requirements
  - Lack of clear priorities / expectations
  - Poor communication and information transfer across functional boundaries (internal and external)
  - No measures of effectiveness
  - Too much in process; each item in process means meetings, emails, phone calls, drop ins, etc. to status what's in process

SOUNDS LIKE NO STANDARD WORK

ADMINISTRATIVE STANDARD WORK EXAMPLES

- Customer service – standard order entry process
- New entity set up and compliance:
  - Standard documented approach for each set up type
  - Defined process roles and responsibilities
  - Process metrics – completion lead time, WIP, rework rates, etc.

STANDARD WORK SUMMARY

- Standard work:
  - Defines the *waste free* steps of a process, process work times, operator work assignments and work in process
  - Defined with operators
  - Represents the best, safest way to produce required quality and output
  - Provides the basis for maintenance and improvement; standard work is followed by everyone until improvements are identified and implemented
  - Places great accountability on group leaders and supervisors to implement and sustain the standard processes

STANDARD WORK SUMMARY

- Increases capacity and makes work easier to manage by clearly defining work process and expected results
- Provides a way to prevent errors, minimize variation, preserve know-how, maintain and improve a process
- Defines the standard way to perform a job – process steps and sequence, quality checks, expected process time, in process inventory, etc.

STANDARD WORK SUMMARY

- Standard work opportunity is in the details:
  - Work times must be determined at work element level; average time per unit “buries” waste in the average
  - “Wastes” at work element level identified and reduced during analysis and as ongoing continuous improvement - excessive walking, delays, over processing, quality problems, etc.
- It takes time to develop, but doing so reinforces the importance and improves process
- Forces identification, and solution of the problems that impact performance.

QUESTIONS

- Structure/Struggles of over-complicated documentation
- How do you verify understanding of standard work? Training, Audit process
- Keep it simple
- Operator-driven standard work development
- Challenge of multiple shifts
- How do we ensure changes are implemented and understood?
- Tribal knowledge
- Document control
- Push-back from the floor