LEAN: A Practical Approach

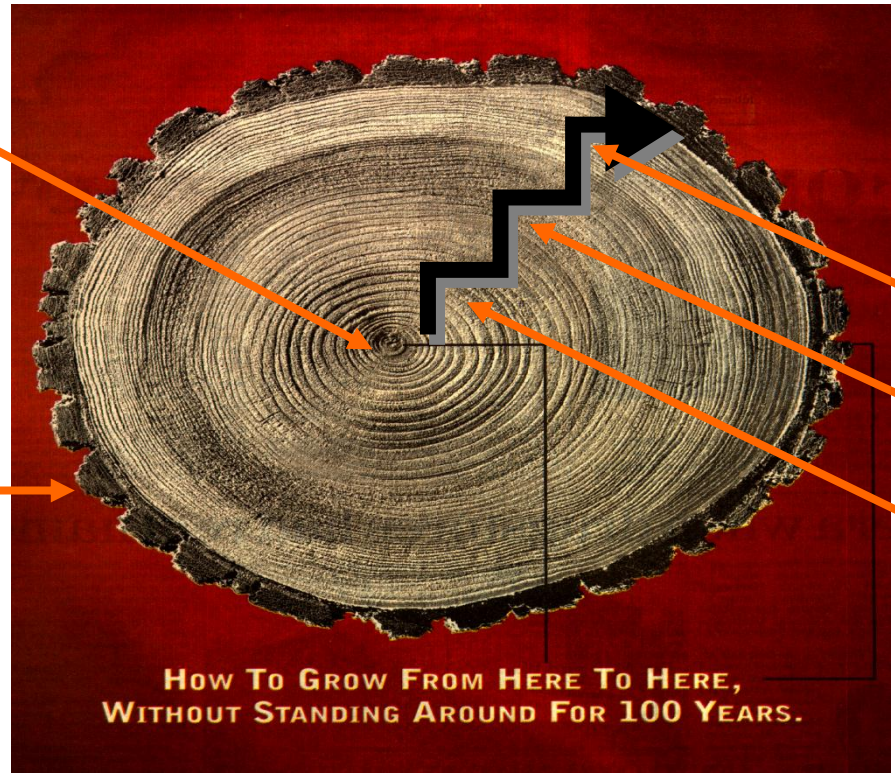
Ryerson University: IIE Ryerson & YDelay Group

Kaizen Blitz - A 10 Step Approach

What is Kaizen?

- A philosophy or practice that focuses on **Continuous Improvement**
- If Lean is the vision, then Kaizen is the way
- It is a collective effort between the management and employees
- Kaizen events are usually 2 to 5 days long
- Do we terminate regular production during a Kaizen Event??
- Do we make all the improvements at once??

Kaizen Process



Continuous Improvement through incremental steps

Kaizen Steps

- What triggers a Kaizen event?
- What are the necessary steps prior to a Kaizen Event?
  - Identify the area/location for a Kaizen Event
  - Have a firm plan in place prior to the event
  - Have an open mind set when planning the event
  - **Do not** walk-in to the event with a solution
  - Form a cross functional team with members from management and employees
  - Train the team on Kaizen; what it is and how its done?
  - Prepare a schedule to highlight the activities by day

Kaizen Steps

Steps 1, 2 and 3 = **RECORD AS IS**

What is the current situation?

- Step 1 - Calculate TAKT time
- Step 2 - Video tape current state and complete Time Study Sheet
- Step 3 - Complete movement map - see example

Kaizen Steps

Steps 4 to 8 = **ANALYSIS**

Break it down into it's smallest pieces, identify & eliminate waste!

- Step 4 - Decouple man-time from machine-time
- Step 5 - Complete loaded TAKT time graph
- Step 6 – Identify and Eliminate non Value Added Work
- Step 7 - Identify the 8 kinds of waste
- Step 8 – Brainstorming - use fishbone diagram to eliminate sources of waste

Kaizen Steps

Steps 9 & 10 = **CONCLUSION**

Implement and Standardize

- Step 9 - Load to new TAKT time graph
- Step 10 – Standardize the new process

Step 1 - Calculate Takt Time

- Takt Time, **$T = T_a / D$**
  - T_a = Net Available Time per day (after breaks, lunches, etc)
  - D = Customer Demand (Units)

- D = 500,000/year, T_a = 1215 mins/day (240 days/year)
- Takt Time = (1,215 mins/day x 240 days x 85%)/(500,000 units)

  = 0.4957 mins/unit

  = **29.7 secs/unit**
- Takt Time @ 85% Efficiency = 29.7 secs/unit

Step 2 – Current State & Time Study

- What is Current State??
  - Pictures
  - Video
  - Process Map/Flow
  - Movement Map/Spaghetti Diagram
  - 5S status
  - Products
    - Demand
    - Inventory Levels & WIP

Step 2 – Current State & Time Study

Time Study Work Sheet

Model:	Process Name:	Total Cycle Time	Parts/Hour at %eff.
Part Name:	Operator Name:		
Suzuki Part No. :	Study Date:	sec's	parts/hr
Cami Part No. :	Analyzed by:	Summary	Special Notes

No.	Operation Name	Measured Time (minutes : seconds)							Std. time	Min.	Max.	Avg.	

tmsdysht

Step 2 – Current State & Time Study

Example - Time study sheet

Model: GMT 800
Part Name: Rail Assembly
Part No.: GM1370-71
Job No.: W/C 404

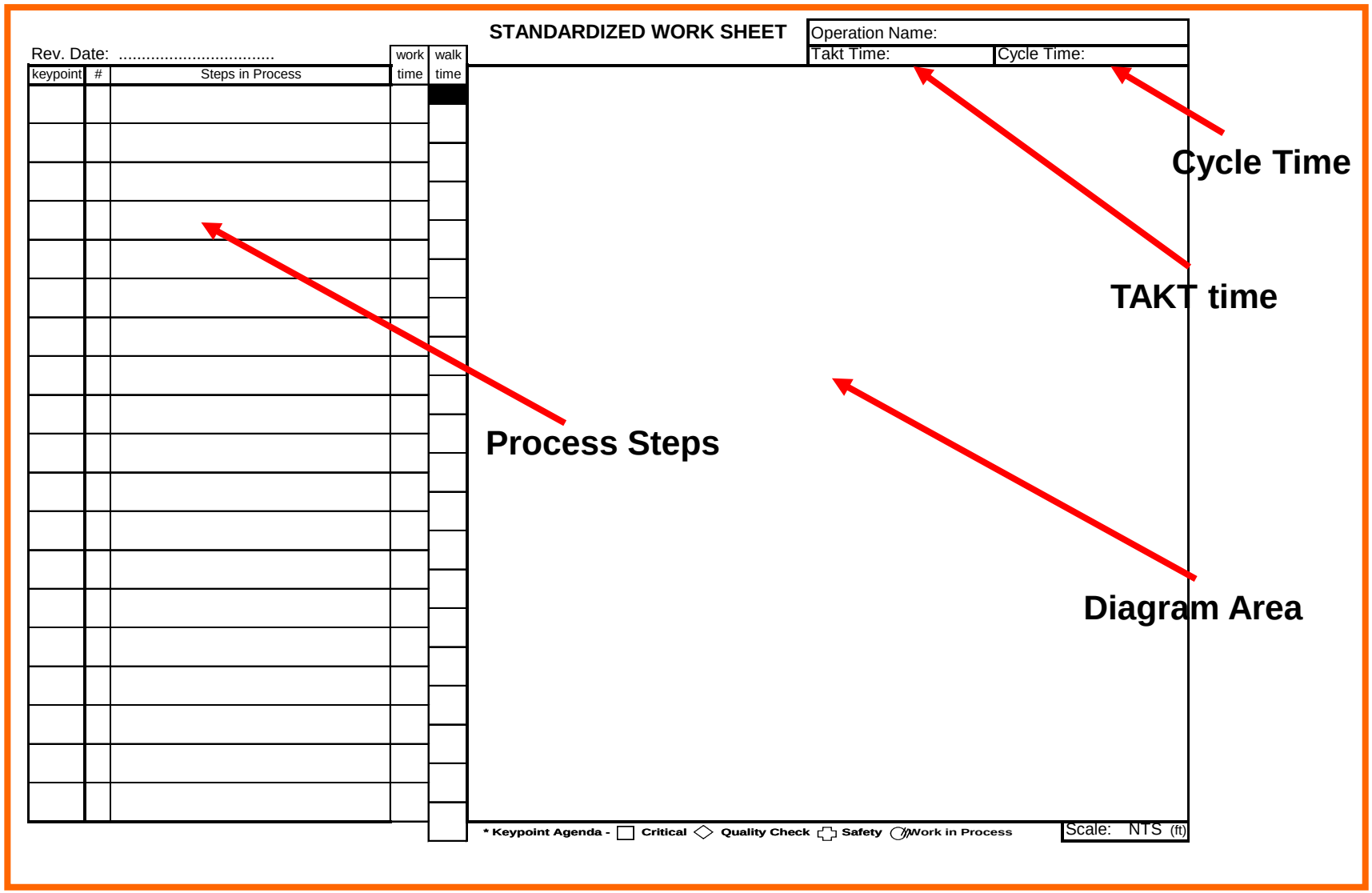
Process Name: GM1370-71 C
Operator Name: operator 2
Study Date: 04/10/01
Analyzed by:

Total Cycle Time: 70 sec's
Parts/Hour at % efficiency: parts/hour

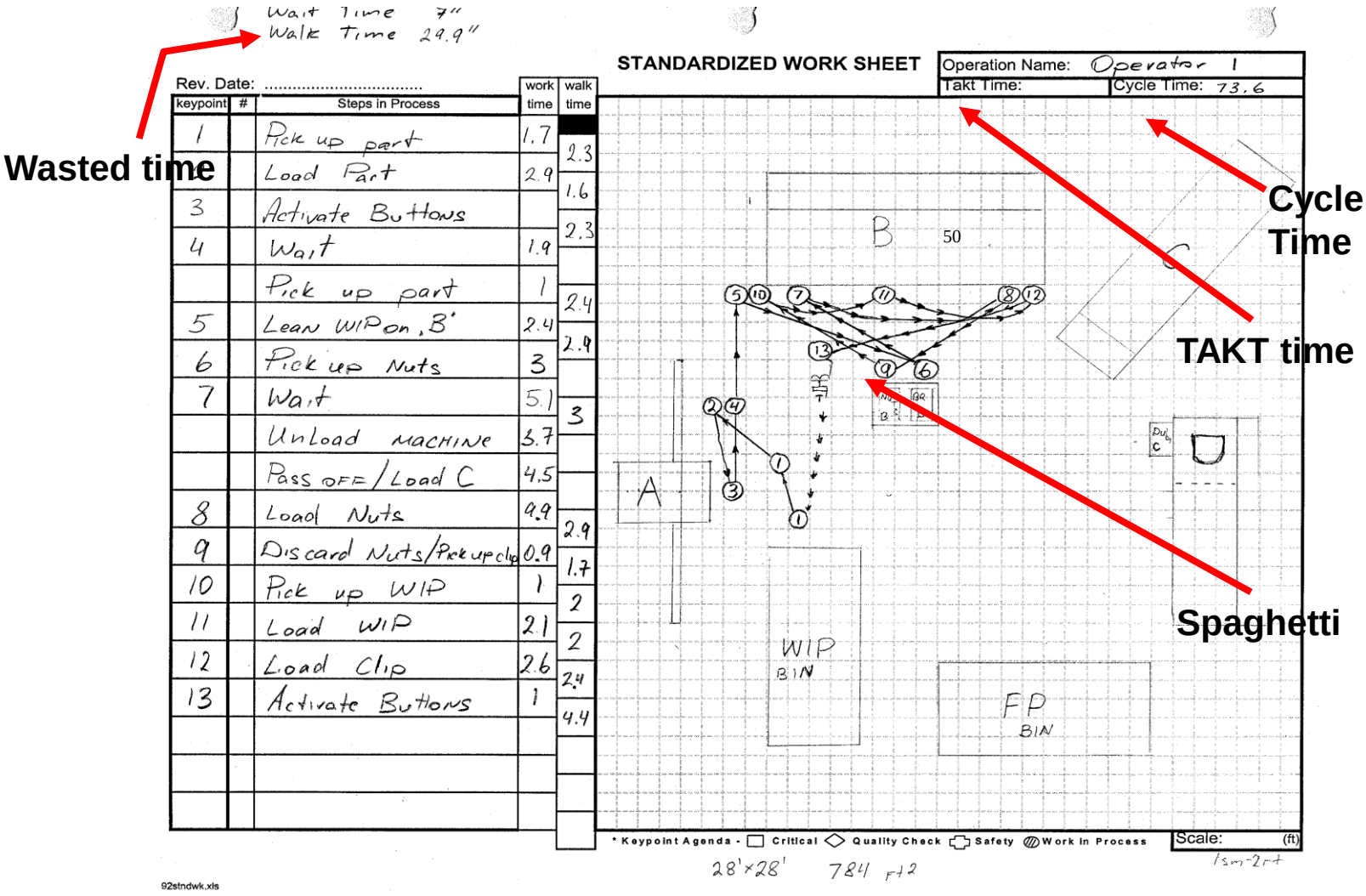
No.	Operation Name	Measured Time (minutes : seconds)							Std. time	Summary Min.	Summary Max.	Summary Avg.	Special Notes
	LIFT CLIPHOLDER	0 / 2	1 / 108	0 / 216	1 / 323	0 / 436	0 / 1707	2 / 1758	0.5	0	2	.5	• OPEARTOR FOUND MISSING HOLE → STATION 'B'
	WALK TO CENTER OF PART	2 / 4	2 / 110	2 / 218	2 / 325	0 / 436	0 / 1707	2 / 1800	2	0	2	1.42	
	PICK UP PART	1 / 5	1 / 111	1 / 219	1 / 326	0 / 436	0 / 1707	1 / 1801	1	0	1	.71	
	WALK TO MACHINE C	4 / 9	4 / 115	5 / 224	4 / 330	0 / 436	0 / 1707	5 / 1806	4	0	5	3.14	
	LOAD PART	3 / 12	4 / 119	4 / 228	5 / 335	3 / 439	2 / 1709	5 / 1811	4	2	5	3.71	
	WALK TO GUN	2 / 14	1 / 120	1 / 229	3 / 338	1 / 440	1 / 1710	2 / 1813	1.5	1	3	1.57	
	WELD PART	26 / 40	26 / 146	25 / 254	29 / 405	28 / 508	28 / 1738	27 / 1840	27	25	29	~~27~~	27.
	WALK TO PART (UNCLAMP)	3 / 43	3 / 149	4 / 258	4 / 409	4 / 512	1 / 1739	3 / 1843	3	1	4	3.14	
	TAKE PART TO 'D'	7 / 50	7 / 156	9 / 307	7 / 416	10 / 522	0 / 1739	7 / 1850	7	0	10	6.71	
	WAIT	0 / 50	5 / 201	0 / 307	4 / 420	33 / 555	0 / 1739	0 / 1850	3	0	33	6.0	
	LOAD PART TO 'D'	0 / 50	6 / 207	6 / 313	11 / 431	19 / 614	0 / 1739	26 / 1916	6	0	26	9.7	
	WALK TO PLATE	0 / 50	2 / 209	3 / 316	2 / 433	49 / 1703	0 / 1739	2 / 1918	2	0	49	~~8.14~~	1.5
	PICK UP PLATE	1 / 51	1 / 210	1 / 317	1 / 434	0 / 1703	1 / 1740	0 / 1918	1	0	1	.71	
	WALK TO 'C'	1 / 52	1 / 211	1 / 318	1 / 435	2 / 1705	2 / 1742	1 / 1919	1	1	2	1.28	
	LOAD PLATE	1 / 53	3 / 214	1 / 319	1 / 436	2 / 1707	2 / 1744	2 / 1921	.5	1	3	1.71	
	WALK TO 'B'	4 / 57	2 / 216	2 / 321	0 / 436	0 / 1707	2 / 1746	0 / 1921	2	0	4	1.42	
	WAIT	10 / 107	0 / 216	1 / 322	0 / 436	0 / 1707	10 / 1756	0 / 1921	3	0	10	3.0	

72 72

Step 3 – Movement Map

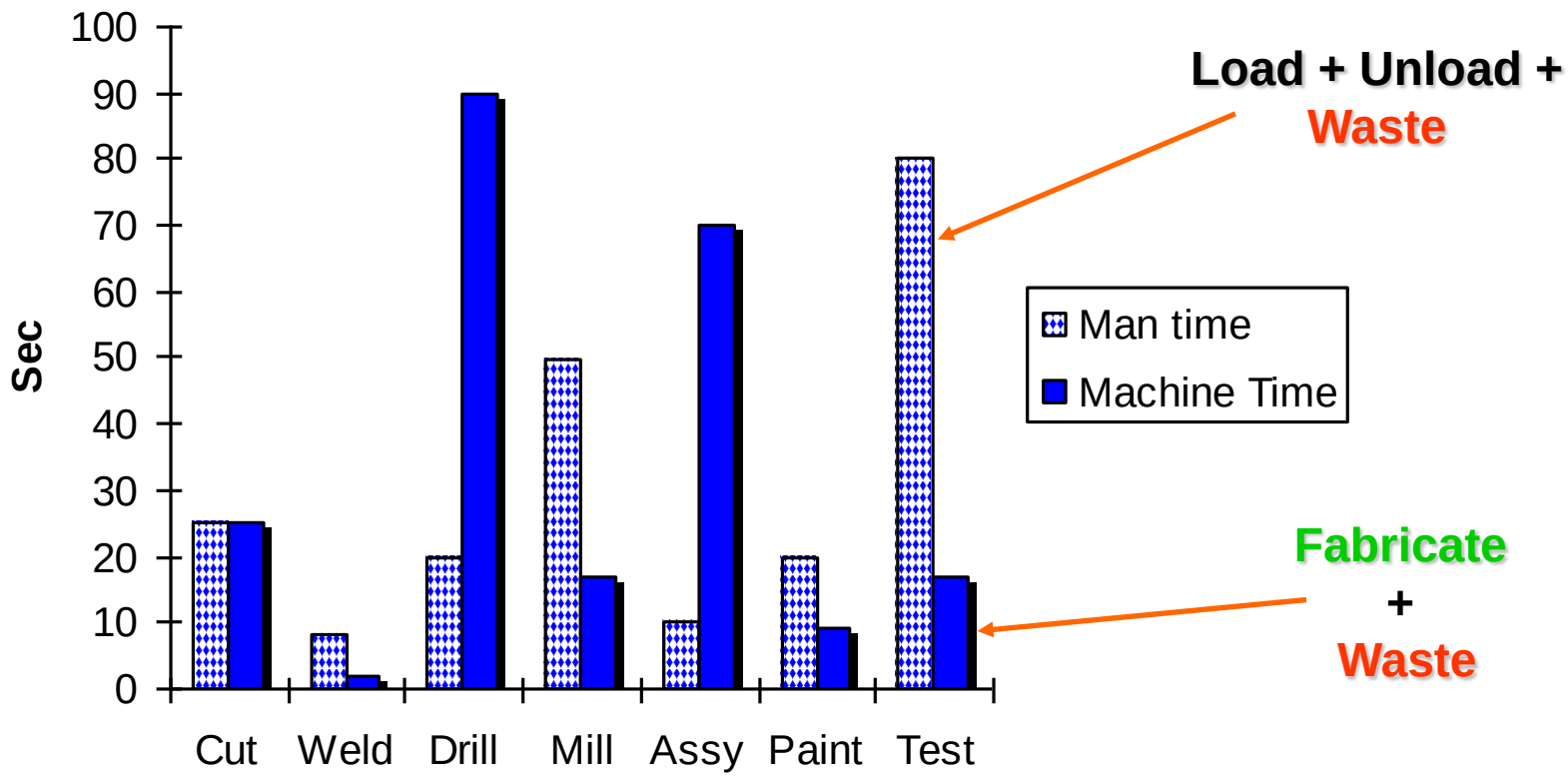


Step 3 – Movement Map



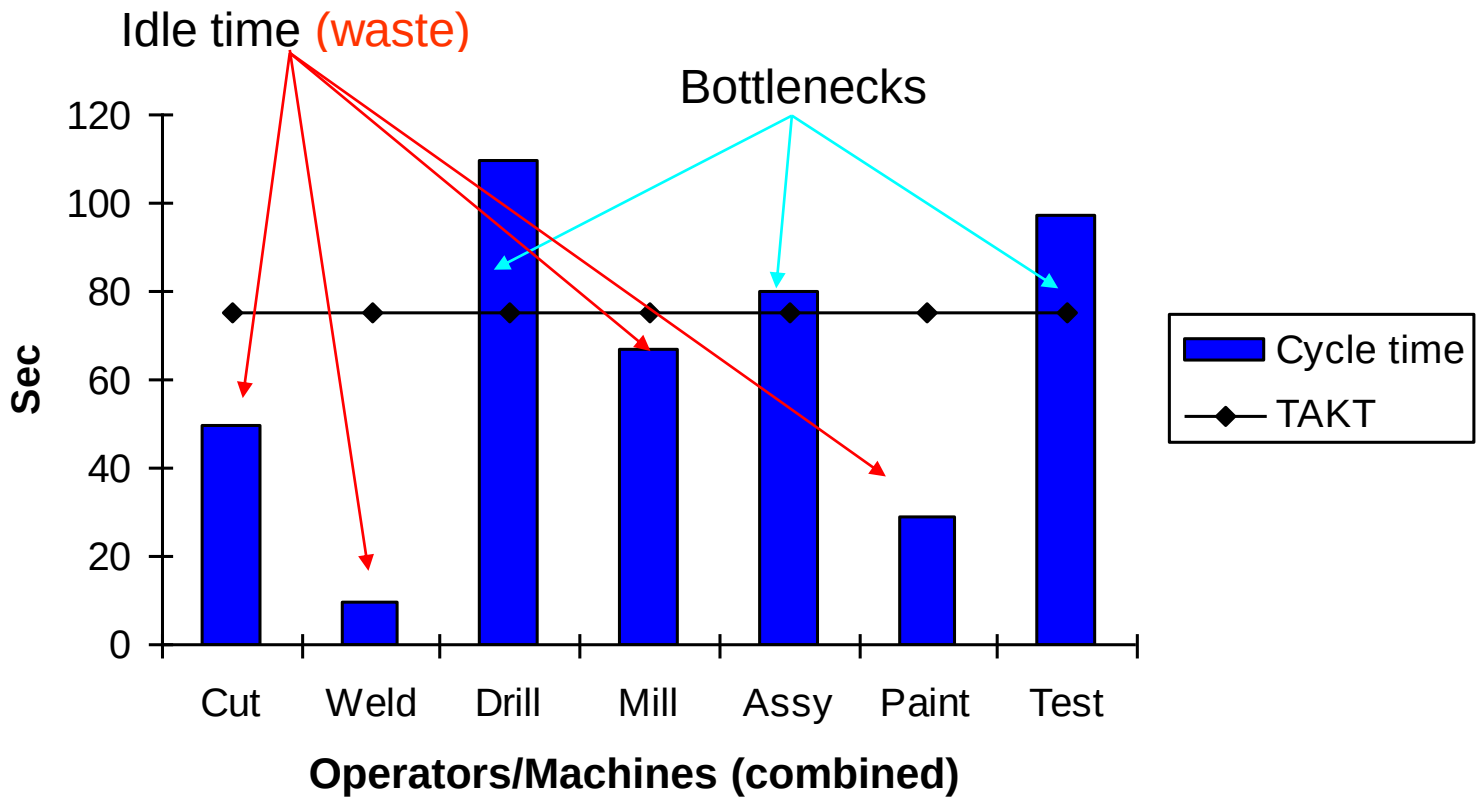
keypoint	#	Steps in Process	work time	walk time
1		Pick up part	1.7	
				2.3
2		Load Part	2.9	
				1.6
3		Activate Buttons		
				2.3
4		Wait	1.9	
		Pick up part	1	
				2.4
5		Lean WIP on B'	2.4	
				2.9
6		Pick up Nuts	3	
7		Wait	5.1	
				3
		Unload machine	3.7	
		Pass off / Load C	4.5	
8		Load Nuts	9.9	
				2.9
9		Discard Nuts/Pick up clip	0.9	
				1.7
10		Pick up WIP	1	
				2
11		Load WIP	21	
				2
12		Load Clip	2.6	
				2.4
13		Activate Buttons	1	
				4.4

Step 4 – Decouple Man-Time from Machine-Time



- Identifies the manual/man time (load & unload + waste) and machine time
- Try to keep machine and man time independent of each other (dual fixtures…)

Step 5 – Takt Time Graph



Step 6 – Identify and Eliminate Non-Value Added Work

- Value Added Activities
- Non-Value Added Activities
  - Necessary
  - Unnecessary (Waste/MUDA)
- **The GOAL**
  - Minimize value added and non-value added activities
  - Identify waste (unnecessary non-value added activities)
  - **ELIMINATE WASTE!!!**

Step 7 – Identify the 8 types of waste

T :Transportation

I :Inventory

M :Motion

W :Waiting

O :Over Production

O :Over Processing

D :Defect

S :Skills

8 WASTES

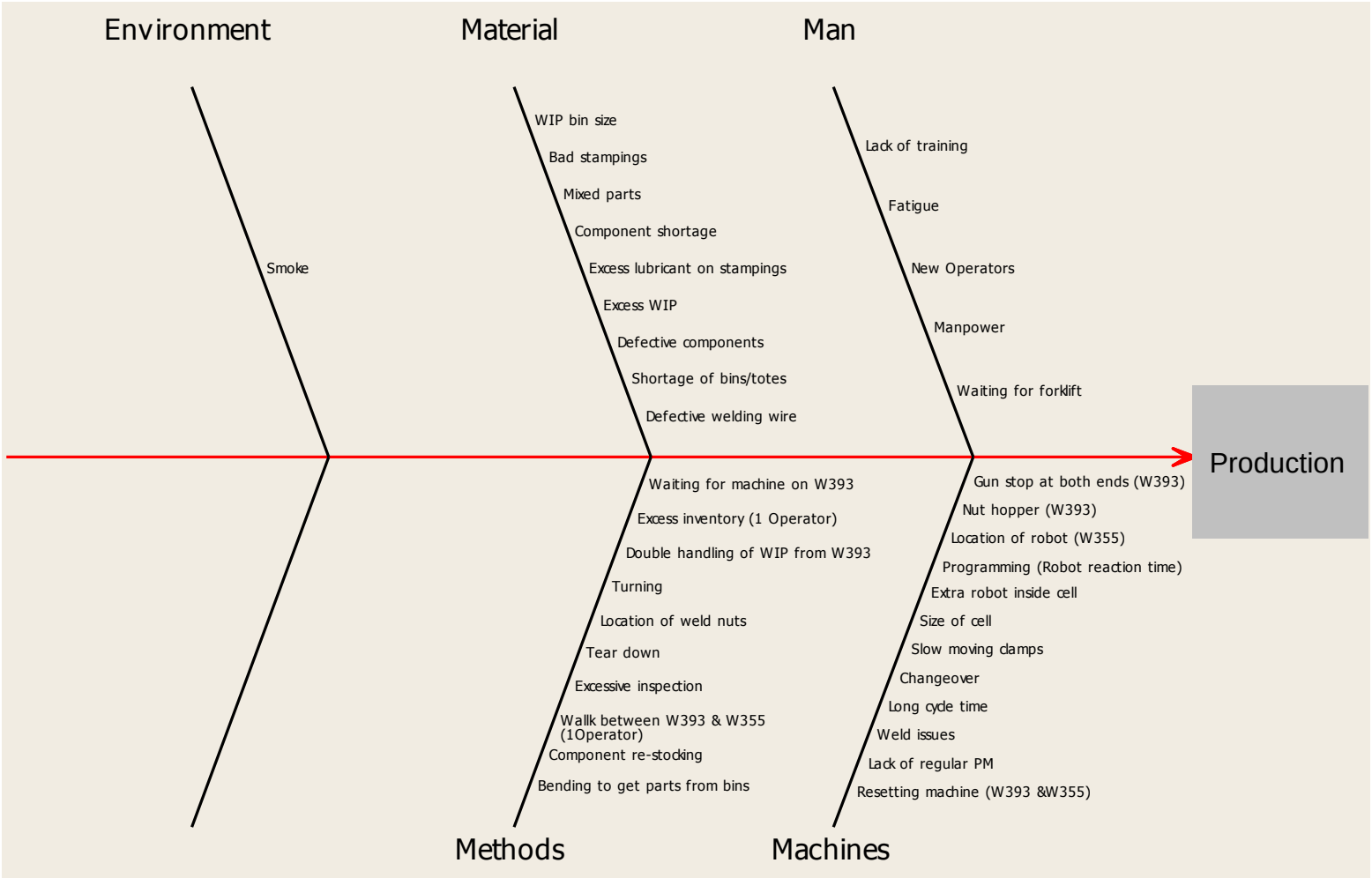
Step 7 – Identify the 8 types of waste

Waste Identification Matrix

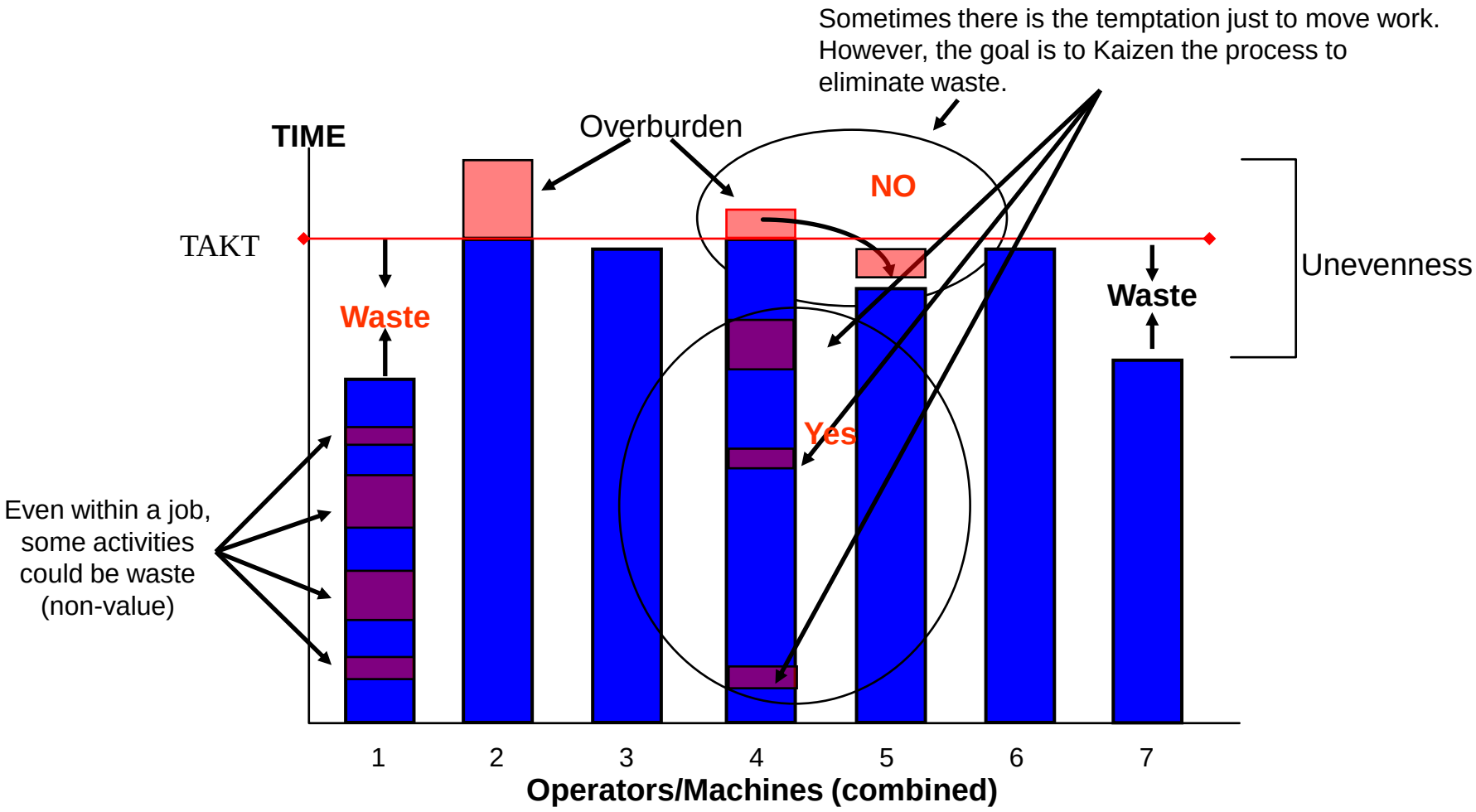
8 Wastes							
Over Production	Defects	Transportation	Over Processing	Excess Inventory	Waiting	Motion	Skills

Step 8 – Brainstorming & Waste Elimination

Fishbone / Ishikawa / Cause & Effect Diagram

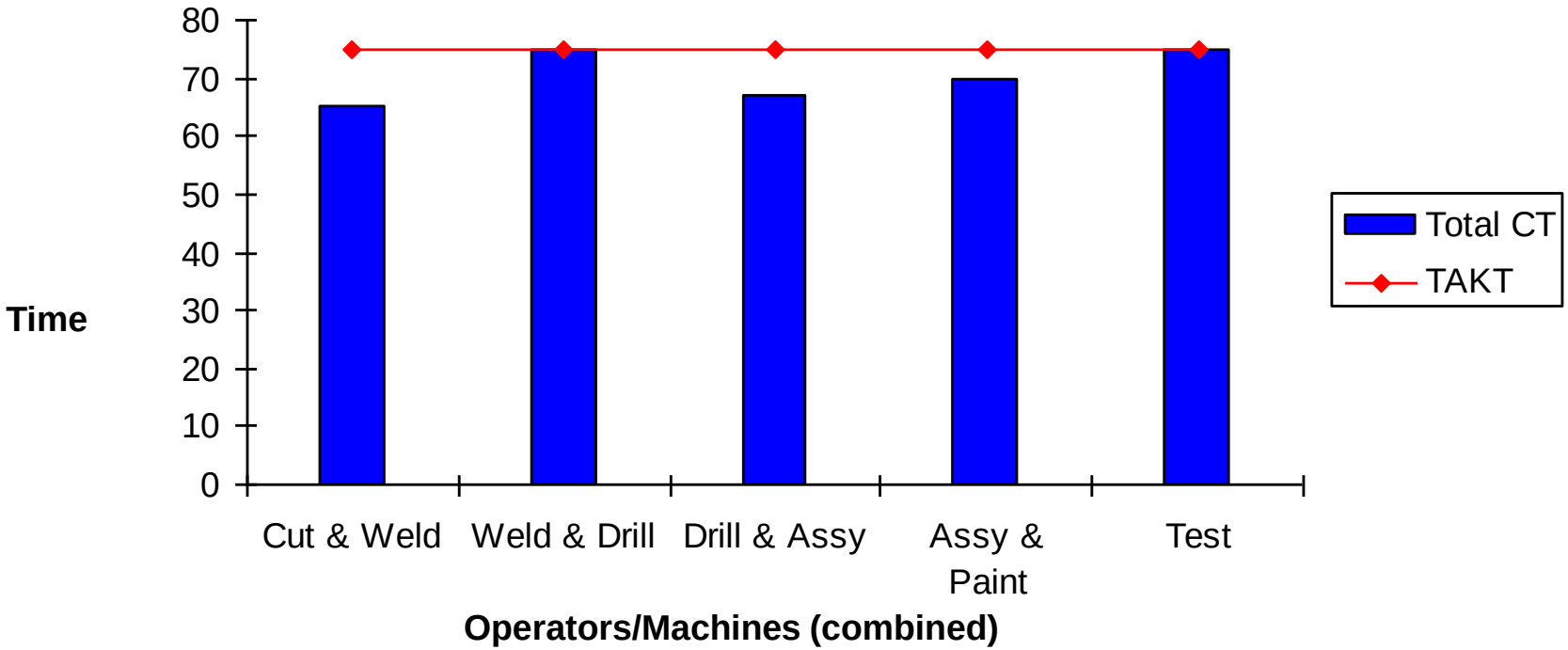


Step 9 – Load new Takt Time Graph



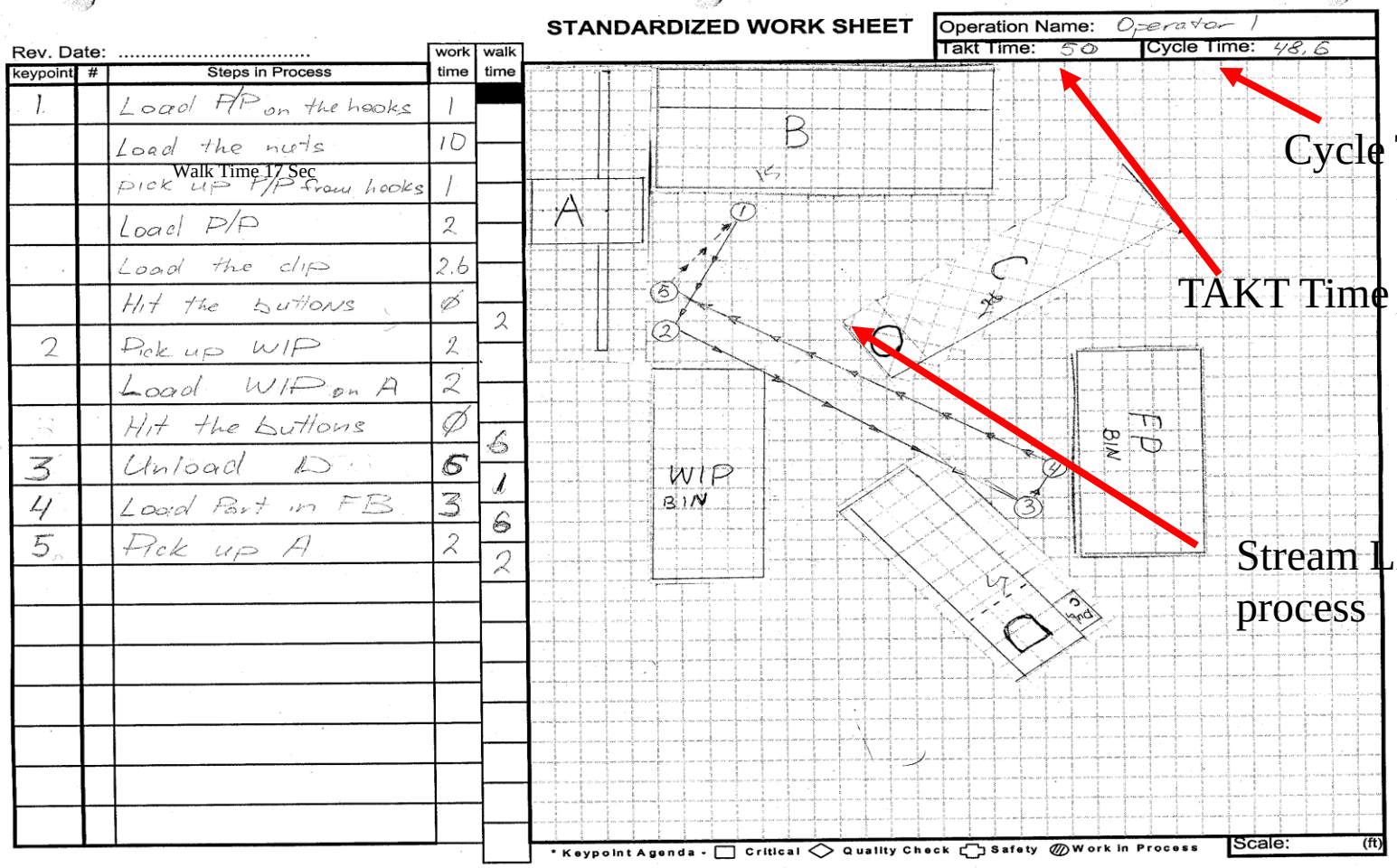
Step 9 – Load new Takt Time Graph

Kaizen Results should look like this



- Reduced number of operations and all are under TAKT time

Step 10 – Standardize the new process



STANDARDIZED WORK SHEET

Operation Name: Operator 1

Takt Time: 50 Cycle Time: 48,6

Rev. Date: .....

keypoint	#	Steps in Process	work time	walk time
1		Load P/P on the hooks	1	
		Load the nuts	10	
		Pick up P/P from hooks	1	
		Load P/P	2	
		Load the clip	2.6	
		Hit the buttons	Ø	2
2		Pick up WIP	2	
		Load WIP on A	2	
		Hit the buttons	Ø	6
3		Unload D	6	1
4		Load Part in FB	3	6
5		Pick up A	2	2

Walk Time 17 Sec

A

B

C

WIP BIN

FP BIN

3 yard

Scale: (ft)

* Keypoint Agenda - Critical Quality Check Safety Work in Process

92stndwk.xls

Cycle Time

TAKT Time

Stream Lined process

Tips when creating/modifying Layouts

- One piece flow
- Functional layout
- Quality at source
- Minimal walking (Step and a turn/rhythmical movements)
- U-shaped cell/cellular manufacturing
- Shared work
- Simple machine tools

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Kaizen - Example

East End Packing Area

- VN127 (F2400) CCB
- EN(F2838) CCB
- FN(F2800) CCB
- U387(FD3002) CCB
- U388(FD3004) CCB
- U377(FD3008) CCB

VN127 (F2400) CCB

- Annual Volume – 130,000 pcs
- Takt Time – 73 secs/pc
- Containment includes
  - Marking of nuts on the wash line conveyor
  - Label application
  - Gauge for radio bracket
  - Thread check for nuts
- Parts packed in racks
- Shipping label applied by operators

ENFN (F2838 &F2800) CCB

- EN Annual Volume – 170,000 pcs
- FN Annual Volume – 41,000 pcs
- Takt Time – 66 secs/pc
- Containment done on the wash line conveyor
- Containment includes
  - Marking certain welds
  - Marking certain holes
  - Marking clips
- Parts packed in racks
- Shipping label applied by operators

U387/8 (FD3002/4) CCB

- U387 Annual Volume – 120,000 pcs
- U388 Annual Volume – 52,000 pcs
- Takt Time – 60 secs/pc
- Part goes through clipping machine prior to containment
- Air bag bracket attached on the clip machine for U388 CCB's
- Felt tape applied on passenger EA brackets
- Containment includes
  - Marking of all welds
  - Marking of all clips
  - Marking of all nuts
  - Spatter check inside tube ends
- Parts packed in racks
- Shipping label applied by operators

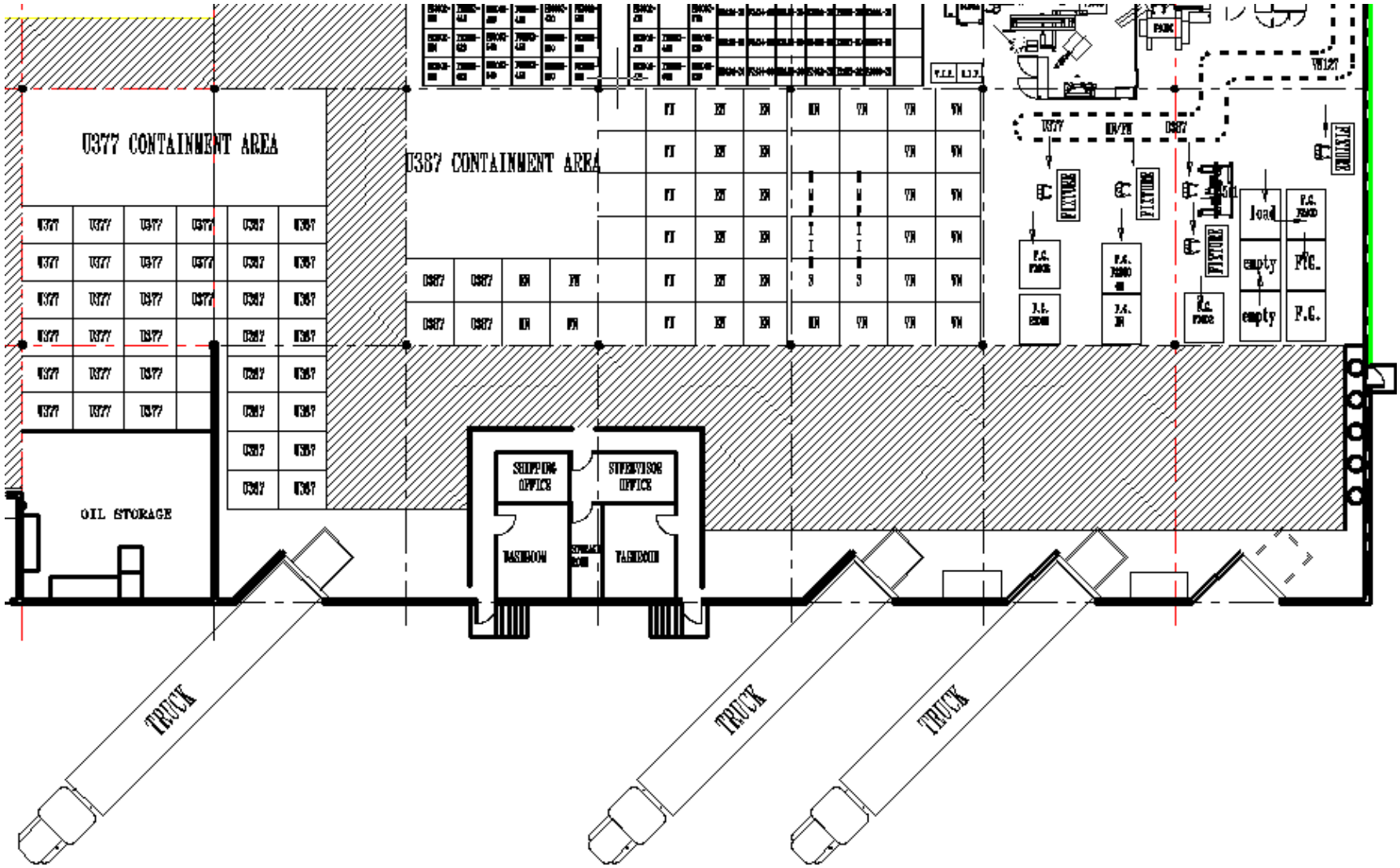
U377 (FD3008) CCB

- Annual Volume – 224,000 pcs
- Takt Time – 60 secs/pc
- Containment includes
  - Marking of all welds
  - Marking of all clips
  - Marking of all nuts
  - Spatter check inside tube ends
- Parts packed in racks
- Shipping label applied by operators

Sequence of Events

No.	Task
1	Kaizen Training
2	Pictures & Video of current process/area
3	Current volumes & Takt time
4	Number of FG bins/racks for each line
5	Standardized worksheet/layout of current process/area
6	Time studies & process flow for each finished product
7	Current floor space used - complete area & individual area
8	5S and LEAP audit & discussion
9	Identification of wastes
10	Brainstorming ideas/areas for improvement
11	Select improvement plan
12	Feasibility of improvement plan
13	Preparation for implementation of new plan
14	Implement new plan
15	Test improved plan
16	Develop standardized worksheet for new process/area
17	Train operators on new process/area
18	Pictures & Video of new process/area
19	New floor space used - complete area & individual area
20	Presentation

Layout Before



Layout Before

Layout Before

Layout Before

Layout Before

Layout Before

WIP Before

Program Name	Frequency of parts (sec/part)	Parts per rack	Total # of racks on floor	WIP Quantity
VN127	51.9	18	4	0-72 pcs
ENFN	50.0	24	2	0-48 pcs
U387/8	55.4	10	4	0-40 pcs
U377	46.2	7	4-6	0-42 pcs

Process Flow Before

PROCESS FLOW DIAGRAM

PART NUMBER: FD3002/4 **PROGRAM NAME** U387/8 **VAN ROB LOCATION:** Scarborough **REV: 1** **DATE:** 15-May-07
PART NAME: **VAN-ROB CODE:** FD **PREPARED BY:** **PAGE 1 OF** 1

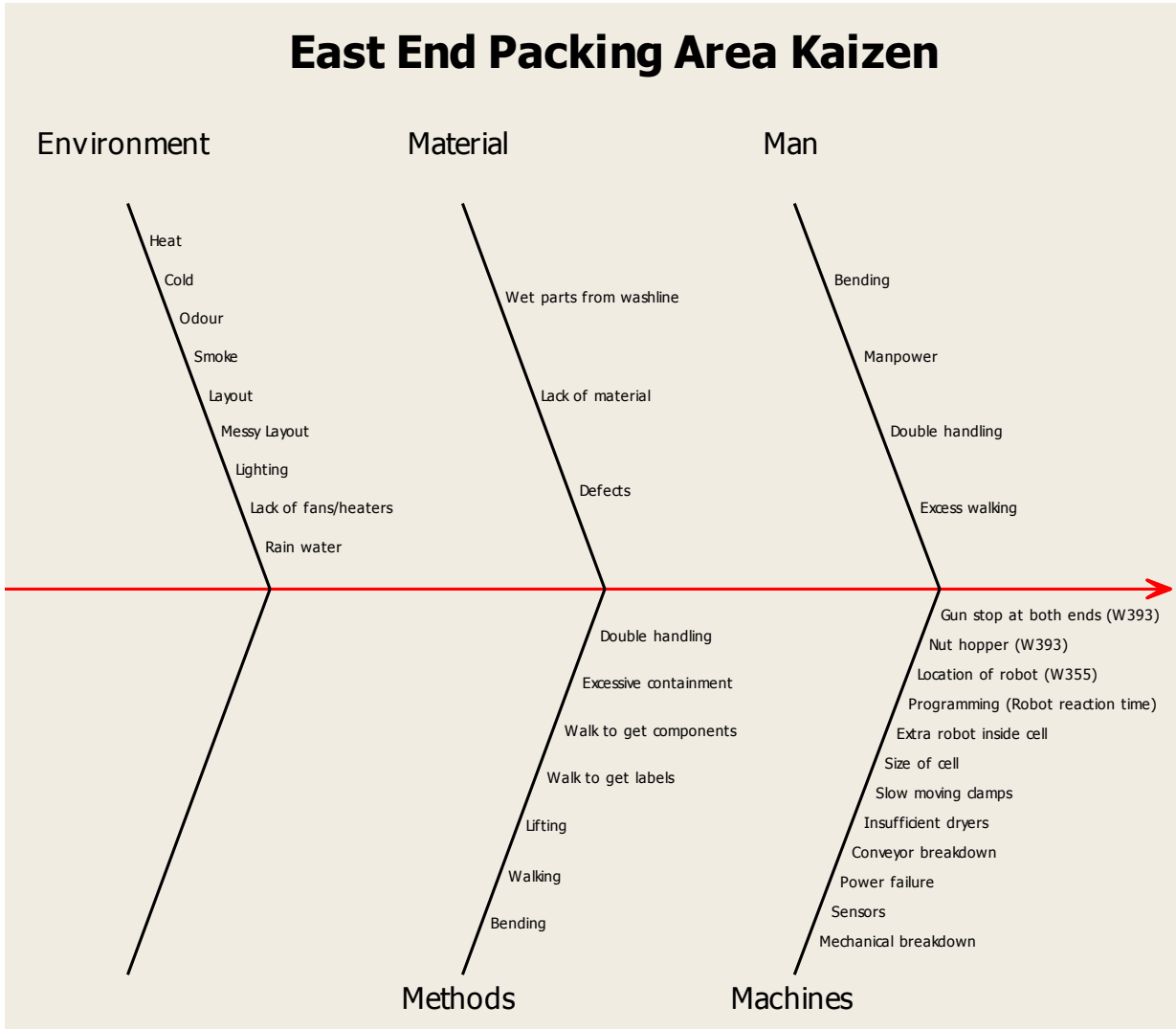
STEP	OPERATION	INSPECTION	STORAGE	TRANSPORT	DELAY	OPERATION / DESCRIPTION	INSPECTION METHOD
1	○	□	▽	▲	⬡	Transport part from wash line conveyor to clip machine	
2	●	□	▽	△	⬡	Load clips into machine fixture	
3	●	□	▽	△	⬡	Apply felt tape on part	
4	●	□	▽	△	⬡	Machine time	
5	○	□	▽	▲	⬡	Transport part into rack	
6	○	□	▽	△	⬢	Wait for forklift driver	
7	○	□	▽	▲	⬡	Transport rack to temporary storage area	
8	○	□	▼	△	⬡	Store racks in temporary storage area	
9	○	□	▽	▲	⬡	Transport rack from temporary storage area to containment area	
10	○	□	▽	▲	⬡	Transport part from rack to containment fixture	Visual inspection and marker
11	○	■	▽	△	⬡	Containment/Inspection	
12	○	□	▽	▲	⬡	Transport part from containment fixture to new rack	
13	○	□	▽	△	⬢	Wait for forklift driver	
14	○	□	▽	▲	⬡	Transport rack to storage area	
15	○	□	▼	△	⬡	Store racks	

Waste Identification

7 Wastes

Over production	Defects	Conveyence	Over Processing	Excess Inventory	Waiting	Motion
Overtime	Parts	Double handling	Containment	Too many FG racks	Parts	Walk to rack
Over production when running through breaks	Welds	Traffic	Marking all welds	Congested conveyor	Forklift	Walk to QA table
	Components		Marking all nuts		Racks	Walk to containment stands
	Damaged Parts		Marking all clips		Labels	Walk to scrap bins
	Mixing clipped and non-clipped parts				Markers	Walk to page driver
					Ink	Walk to get labels for racks
					Components	Walk to get components
					Team Leader	Bending
					Maintenance	Twisting
						Reaching
						Lifting

Fishbone Diagram



Improvement Plan

S.No.	Issues to be addressed
1	Walk from wash line conveyor to FG racks
2	Walking between wash line conveyor with parts
3	VN127 rack transfer system
4	WIP rack location
5	Number of WIP racks
6	Double Handling
7	Motion
8	Containment
9	Containment location

Process Design Analysis

Process Design Analysis

Current	Measure	Proposed
5,530	Floor Space used (Total square feet)	2,335
140	Total Part Travel (U38x) (Linear feet)	36
17	Number of operators required	13
2	Number of support personel	2
0-24 racks	Standard WIP	0-12 racks
240	Units/Labor hour	240
	Cost/Piece	
45-55	Manufacturing lead time (sec)	45-55
	5S rating	
	Value-adding ratio (One piece/one part)	

Improvement Plan – Action Items

S.No.	Action Items
1	Dismantle VN127 rack transfer system
2	Relocate gas canisters
3	Move wash line conveyor
4	Relocate U387/8 clip machine
5	Layout change (FG racks for all programs)
6	Relocate U387/8 & U377 containment areas
7	Modify containment stands
8	Modify U388 radio bracket fixture to make it mobile
9	Eliminate QA stands & install angle liners for QA documents
10	Stands to write on labels
11	Common stand to fill ink

Process Flow - After

PROCESS FLOW DIAGRAM

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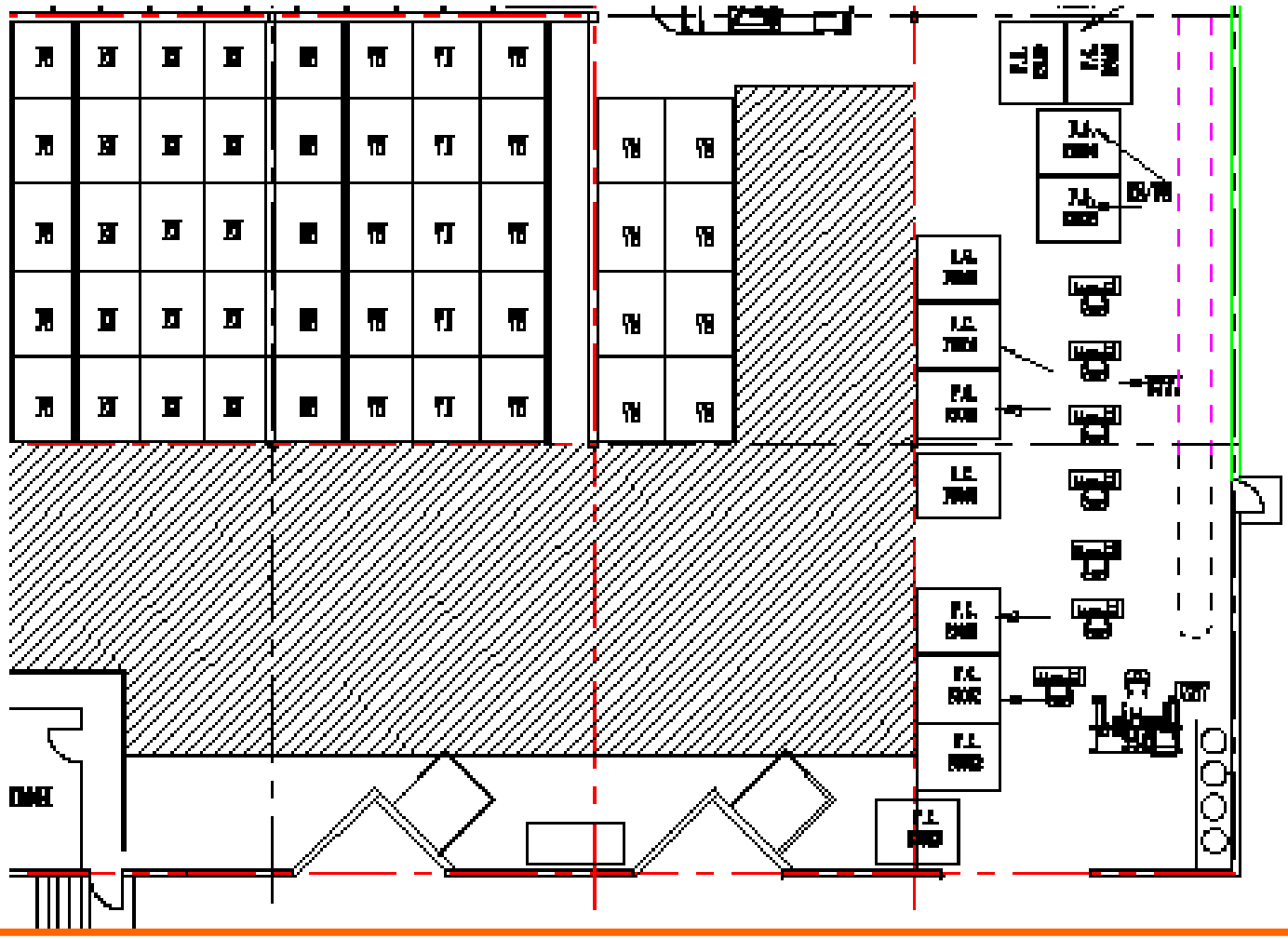
4	●	□	▽	△	⯃	Machine time	
5	○	□	▽	▲	⯃	Transport part to containment fixture	
6	○	■	▽	△	⯃	Containment/Inspection	Visual inspection and marker
7	○	□	▽	▲	⯃	Transport part from containment fixture to rack	
8	○	□	▽	▲	⯃	Transport rack to storage area	
9	○	□	▼	△	⯃	Store racks	

WIP - After

Program Name	Frequency of parts (sec/part)	Parts per rack	Total # of racks on floor	WIP Quantity
VN127	51.9	18	2	0-36 pcs
ENFN	50.0	24	2	0-48 pcs
U387/8	55.4	10	4	0-40 pcs
U377	46.2	7	3-4	0-28 pcs

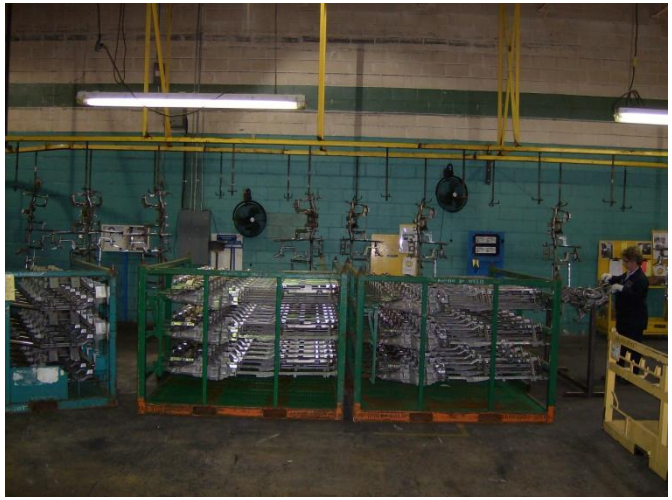
Layout After



Layout After

Layout After

Layout After



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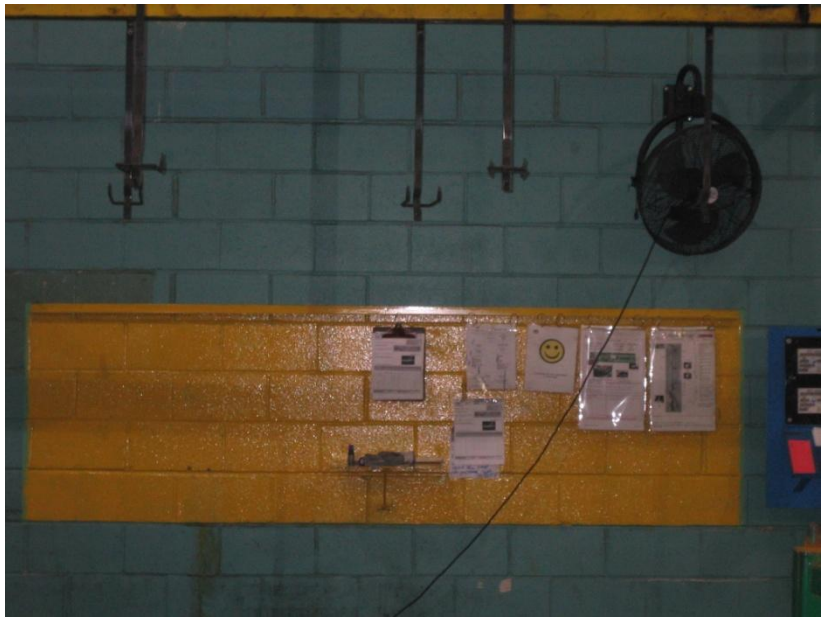
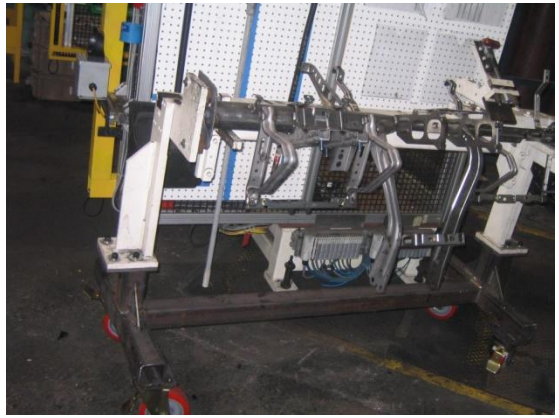
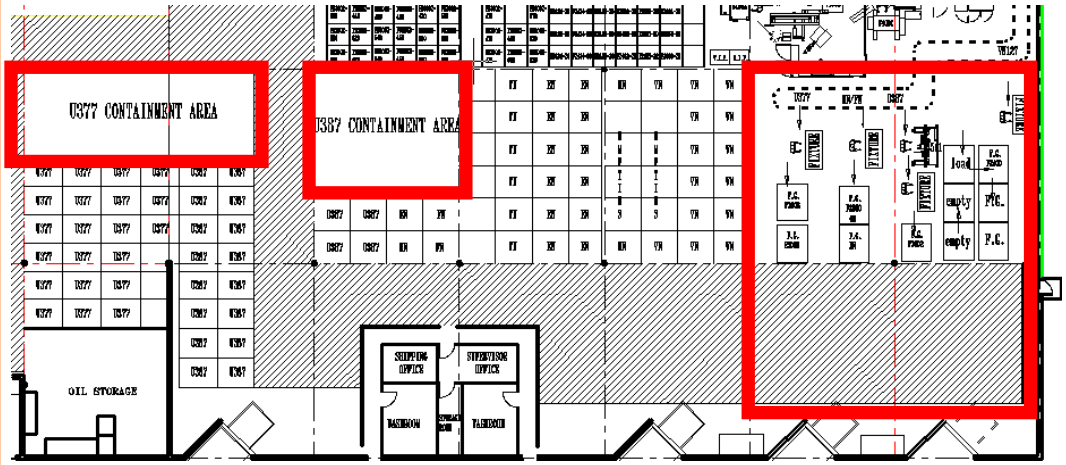




Layout Comparison



Before

After

Savings Calculation

Before Kaizen

- Packing Area = 3,868 sq.ft.
- Total Containment Area = 1,662 sq.ft.
- WIP before containment area = 1307 sq.ft.
- Floor Space utilized = 6,837
- Annual Floor Space cost - $82,044
- Annual Operating cost with 48 operators - $1,868,006

After Kaizen

- Packing Area = 2,335 sq.ft.
- Total Containment Area = 0 sq.ft.
- WIP before containment area = 0 sq.ft.
- Floor Space utilized = 2,335
- Annual Floor Space cost - $28,020
- Annual Operating cost with 36 operators - $1,401,005