

MIXED-MODEL LINE DESIGN

LINE DESIGN CALCULATION FLOW

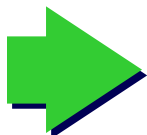
Dc's

Required / Optional %

Yield

Scrap

Product	Dc
22227777-000	155
22227777-CDT	65
33338888-000	64
33338888-CDT	38



Product	Process			
	Terminal Ass'y	Panels Ass'y	Panels Test	
	Labor	Labor	Machine	Labor
22227777-000		R	R	R
22227777-CDT	R	R	R	R
33338888-000		R	R	R
33338888-CDT	R X 2	R	O - 22%	O - 22%

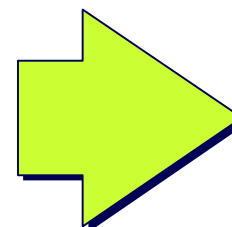
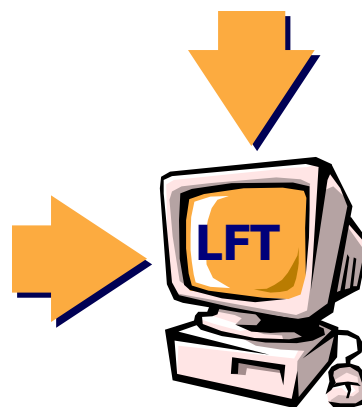
Panels Test	
Machine	Labor
110%	105%
100%	108%
105%	112%
200%	22%

Panels Test	
Machine	Labor
2%	3%
3%	4%
5%	10%



Actual Time from SOE's

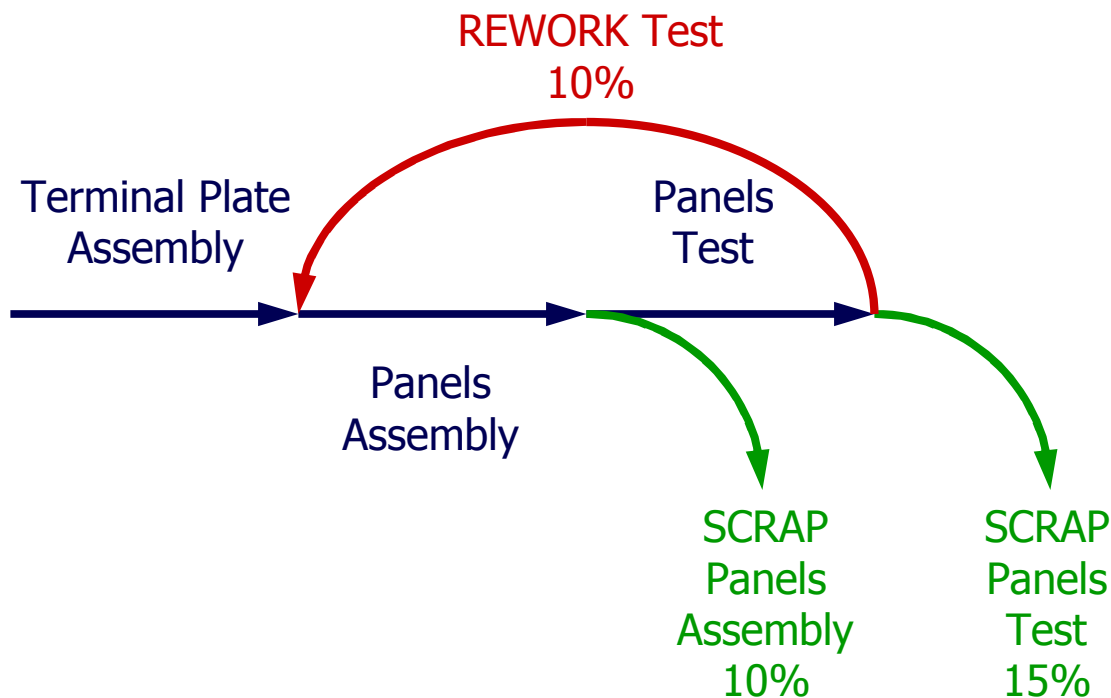
Product	Process			
	Terminal Ass'y	Panels Ass'y	Panels Test	
	Labor	Labor	Machine	Labor
22227777-000		19.0	0.2	2.8
22227777-CDT	6.2	18.3	0.2	4.8
33338888-000		14.5	0.2	5.3
33338888-CDT	4.4	21.0	0.2	7.7



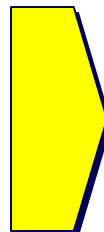
ΣD_c
TAKT
 AT_w
Resources

MIXED-MODEL LINE DESIGN

REWORK AND SCRAP IMPACTS



Product	Process			
	Terminal Ass'y Labor	Panels Ass'y Labor	Panels Test Labor	Test Rework Labor
22227777-000		Y – 90%	Y – 90%	O – 10%
22227777-CDT	R	S – 10%	S – 15%	
33338888-000		Y – 90%	S – 5%	
33338888-CDT	R X 2	S – 10%	S – 5%	



Product	Process			
	Terminal Ass'y Labor	Panels Ass'y Labor	Panels Test Labor	Test Rework Labor
22227777-000		110%	110%	10%
22227777-CDT	126%	126%	115%	
33338888-000		116%	105%	
33338888-CDT	232%	116%	105%	

ALL FACTORS ROLLED PROCESS MAP OVERVIEW

Product	Process		
	L101 Brazing	L101 Test	L101 Packaging
	Labor	Machine	Labor
22227777-000	109%	109%	10%
22227777-CDT	218%	109%	10%
33338888-000	218%		100%
33338888-CDT	218%	109%	100%
44447777-000	109%		100%
44447777-CDT	210%	105%	100%
55559999-000	102%	102%	100%
FRU111	113%	113%	

- Rolled-Up Volume Percentages – on a 100% basis – After having Considered :
 - Required and Optional Work %.
 - All Loops Rework Impacts %.
 - Scrap and Cascading Impacts %.
- Defining how Frequently a Process is consumed by a Product.
- Mixed-Model Process Map with **ONLY ONE NUMBER.**

PROCESS MAP TIME OVERVIEW

Product	Process		
	L101 Brazing	L101 Test	L101 Packaging
	Labor	Machine	Labor
22227777-000	21.3	12.3	10.3
22227777-CDT	21.3	14.4	10.3
33338888-000	21.3		10.3
33338888-CDT	5.6	23.7	12.4
44447777-000	5.6		12.4
44447777-CDT	8.9	20.5	10.3
55559999-000	12.8	8.3	10.3
FRU111	3.8	5.1	

- Work Content required, by Process, to transform each Specific Product.
- **Total Times come Directly from Sequences of Events** are used to complete Process Map Time.
 - Labor Time.
 - Machine Time.
- Other Definition of Mixed-Model Process Map with :
 - ONE LABOR TOTAL TIME,
 - ONE MACHINE TOTAL TIME,
- by Product and Process Relationship.

DAILY DEMAND MANAGEMENT OVERVIEW

LINE DESIGN : ONCE TO D_c

$$\frac{AT_w}{TAKT} = \text{RESOURCES } D_c$$

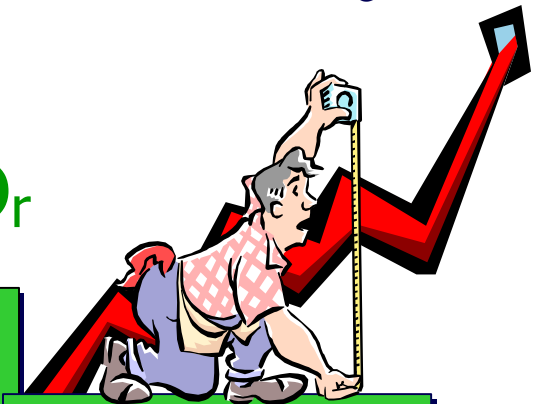
Labor – Machine

$$AT_w = \frac{\Sigma (D_c \times AT)}{\Sigma D_c}$$

DAILY MANAGEMENT : ONCE TO D_r

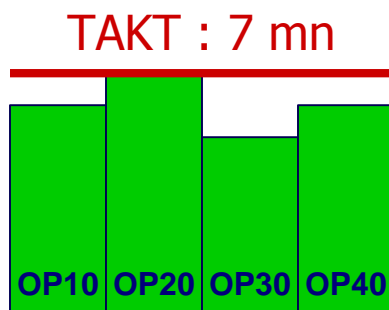
$$\frac{\Sigma (D_r \times AT)}{H \times S} = \text{RESOURCES } D_r$$

D_r = Daily Rate. (Number of Products)

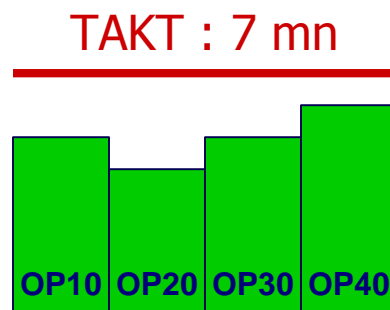


People
To serve DEMAND

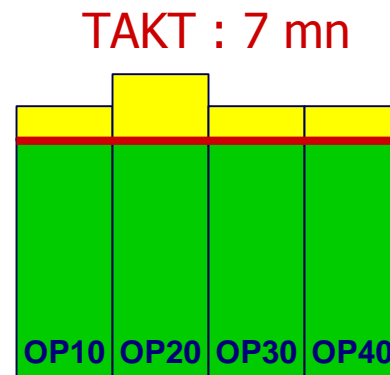
HIGH, AVERAGE AND LOW TIMES FLEXIBLE OPERATIONS



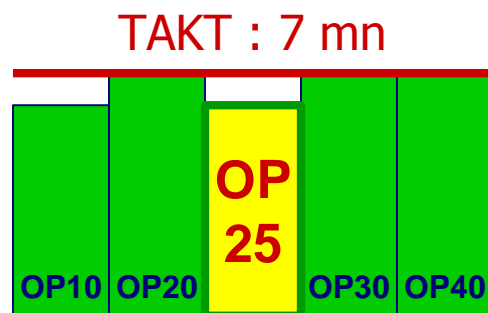
ATw : 24 mn



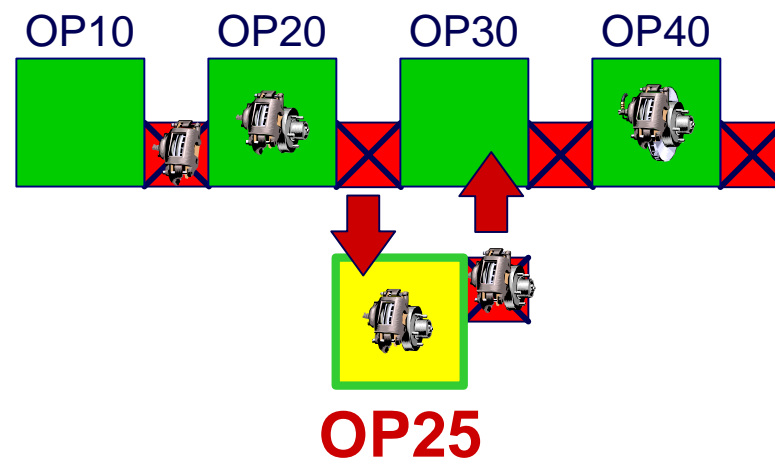
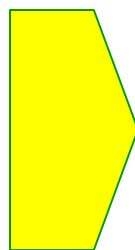
AT LOW : 20 mn



AT HIGH : 33 mn



AT HIGH : 33 mn



FAMILY OF PRODUCTS

POWERFUL BENEFITS OF MIXED-MODEL

Assembly Lines	Products		Demand at Capacity (Dc)	Machine Maximum	Daily Rate (Dr)	(Dr/Dc) %	Machine Utilization Rate
L01	FUS-001	40A	170	200	200	59%	50%
L02	FUS-002	40A	160	200	200	94%	75%
L03	FUS-004A	40A	170	200	200	147%	125%
L04	PLG-145 S	63A	100	200	200	70%	35%
L05	PLG-854 S	63A	155	200	200	71%	55%

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- New Mixed-Model Line for Family of Products 40A with **3** Machines :

L01-L02-L03	Products 40A	500	600	500	100%	83%
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- New Mixed-Model Line for Family of Products 63A with **2** Machines :

L04-L05	Products 63A	255	400	180	71%	45%
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- We can Increase the Utilization Rate, with fewer Machines, by Improving our Response Capability.
- TPM Recommendation : Dc = 85% of Machine Capacity.

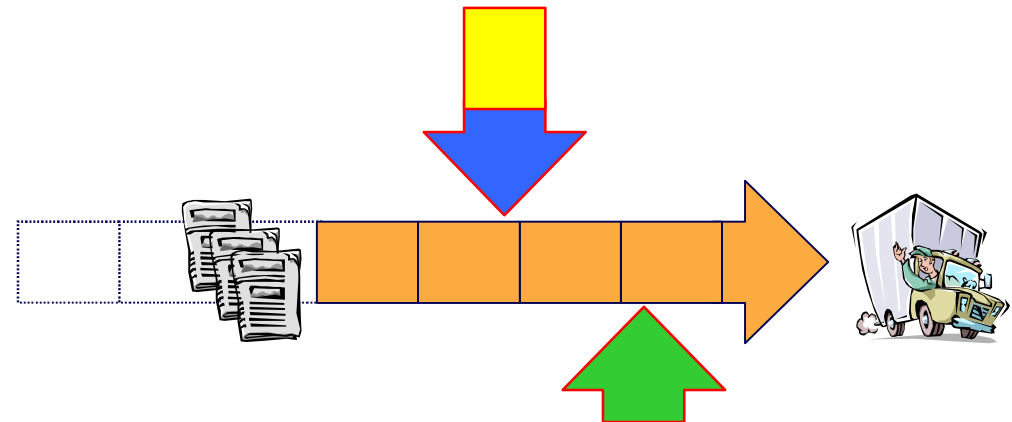
RESPONSE OPTIMIZATION

TPc/t REDUCTION

- Continuous Process Improvement.
- Along TPc/t Path First :

1. Eliminate Non-Value Added Work.
2. Eliminate Quality Criteria.
3. Move Internal Setup to External.
4. Reduce Setup and Move Times.
5. Reduce Value Added Work Times.

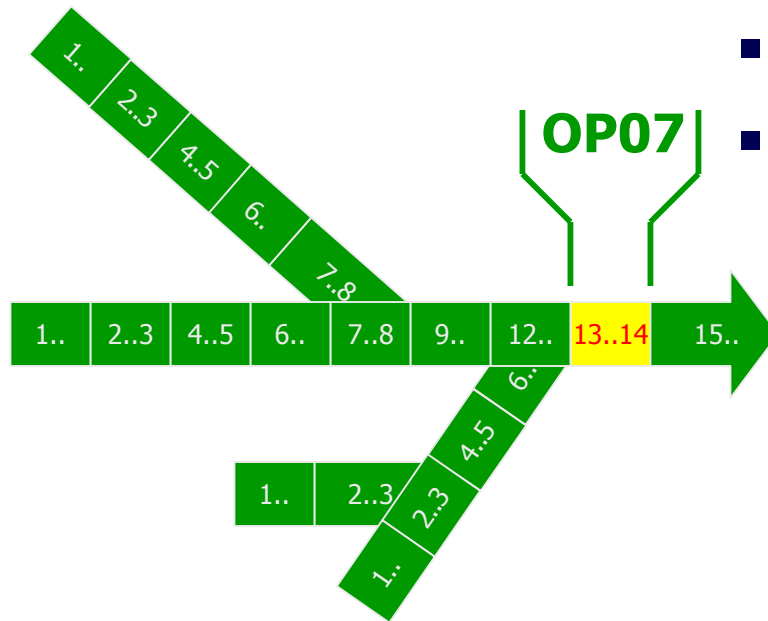
RIGHT ORDER



OPERATIONAL DEFINITION OVERVIEW

$$\text{TAKT} = \frac{H(S)}{\Sigma D_c}$$

- Tasks Grouped "At or Below" TAKT Time Target.
- Physical Place to Do Work,...
- ... and One-Up, One-Down Flexibility.
- Consistent Process and Quality.
- Enables Flow of Product.



OPERATIONAL DEFINITION SEQUENCE OF EVENTS

TAKT Time : 2.5 mn

2.4 mn

2.5 mn

2.5 mn

2.4 mn

Product P/N CONTROL PANEL TWK 530-536 NBL/NBL-OC 22227777-000 / 22227777-CDT / 33338888-000 / 33338888-CDT										SEQUENCE OF EVENTS										Process I.D. Main Line Assembly	
WS	Seq. #	Overlap	Task	VA	Setup					Required		Move						Quality Criteria / Safety			
					Mach	Labor	D/S	Qty	I/E	Mach	Labor	Mach	Labor	D/S	Qty	I/E	Dist.	TQC	Description		
A 10	10		Unpack electrical cap			0.2	D		E												
A 10	20		Install cap to control panel frame	X							0.2										
A 10	30		Fix 24V contactor – 1 screw – 1 washer – 1 wire	X							0.6							X	P/N : 45CG20AJ/45FG20AJ		
A 10	40		Fix 24V contactor – 1 screw – 1 washer	X							0.3										
A 10	50		Fix start relay to front support – 1 screw	X							0.6							X	Left side Size 530 : 3ARR3CT10V5 Size 536 : 3ARR3CT6A5		
A 10	60		Install support to control panel – 2 screws	X						0.3	0.5								Use screws SCR23		
B 20	70		Install fan capacitor – 1 nut	X							0.8								Label : 4µF at the top		
B 20	80		Connect Wire N°7 to fan capacitor	X							0.3							X	M/F connector to Left plug		
B 20	90		Connect Wire N°7 to power contactor	X							0.3								M/F connector to Center plug		
B 20	100		Install compressor capacitor – 1 nut	X							1.1								Use nut NUT89 Size 530 : 35µF Size 536 : 40µF		
C 30	110		Install Sub-Assembly terminal plate – 2 screws	X							1.0								Use locations : A4 and A5		
C 30	120		Connect Wire N°2 to fan capacitor	X							0.3							X	F connector to Left plug		
C 30	130		Connect Wire N°2 to power connector	X							0.3								Plug identification : "N1"		
C 30	140		Connect Wire N°21 to power connector	X							0.3							X	Plug identification : "L1"		
C 30	150		Connect Wire N°20 to power connector	X							0.3							X	Plug identification : "N2"		
C 30	160		Connect Wire N°6 (Red) to power connector	X							0.3								Plug identification : "N2"		
D 40	170		Connect Groung Wire to groung connector	X							0.8								Plug identification : "Ground"		
D 40	180		Connect Wire N°4 (Black) to K5 contactor	X							0.7							X	Use K51 plug to connect		
D 40	190		Connect Wire N°5 (Blue) to 100µF capacitor	X							0.8								Right plug		
D 40	200		Evacuate Sub-Assembly control panel to IPK										0.1	D		E	0.2				

OP A

OP B

OP C

OP D

STATIC SETUPS

SPECIFIC OPERATION TO PERFORM S/U

TAKT Time : 2.5 mn

2.5 mn

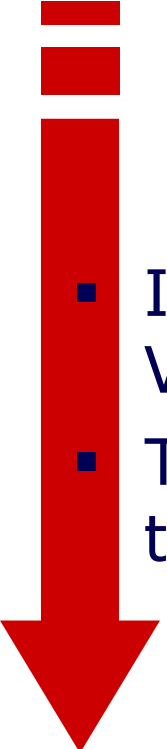
2.4 mn

2.5 mn

OP

Product P/N CONTROL PANEL TWK 530-536 NBL/NBL-OC 22227777-000 / 22227777-CDT / 33338888-000 / 33338888-CDT										SEQUENCE OF EVENTS										Process I.D. Main Line Assembly	
WS	Seq. #	Overlap	Task	VA	Setup					Required		Move						Quality Criteria / Safety			
					Mach	Labor	D/S	Qty	I/E	Mach	Labor	Mach	Labor	D/S	Qty	I/E	Dist.	TQC	Description		
A 10	10		Unpack electrical cap			0.2	D		E												
A 10	20		Install cap to control panel frame	X							0.7										
A 10	40		Fix 24V contactor – 2 screws – 2 washers	X						0.5	0.5							X	P/N : 45CG20AJ/45FG20AJ		
A 10	50		Fix start relay to front support – 1 screw	X						0.5	0.6							X	Left side Size 530 : 3ARR3CT10V5 Size 536 : 3ARR3CT6A5		
A 10	60		Install support to control panel – 2 screws	X						0.3	0.5								Use screws SCR23		
B 20	70		Install fan capacitor – 1 nut	X							0.5								Label : 4µF at the top		
B 20	90		Crimp Wire N°7	X						0.3	0.3								M/F connector		
B 20	100		Install compressor capacitor – 1 nut	X							0.6								Use AA56 reference point Size 530 : 35µF Size 536 : 40µF		
B 20	110		Install Sub-Assembly terminal plate – 2 screws	X							1.0								Use locations : A4 and A5		
C 30	120		Connect Wire N°2 to fan capacitor	X							0.3							X	F connector to Left plug		
C 30	130		Connect Wire N°2 to power connector	X							0.3								Plug identification : "N1"		
C 30	140		Connect Wire N°21 to power connector	X							0.3							X	Plug identification : "L1"		
C 30	150		Connect Wire N°20 to power connector	X							0.3							X	Plug identification : "N2"		
C 40	160		Connect Wire N°6 (Red) to power connector	X							0.3								Plug identification : "N2"		
C 40	170		Connect Ground Wire to ground connector	X							0.3								Plug identification : "Ground"		
C 40	180		Connect Wire N°4 (Black) to K5 contactor	X							0.3							X	Use K51 plug to connect		
C 40	190		Connect Wire N°5 (Blue) to 100µF capacitor	X							0.3								Right plug		
C 40	200		Evacuate Sub-Assembly control panel to IPK											0.1	D		E	0.2			
	30		Set screwing machine - Check Torque		1.6	1.6	S	200	E										Torque : 16 N.m		
	80		Set crimping machine - Check wrench traction		2.3	2.3	S	100	E										Wrench traction : 80 N		

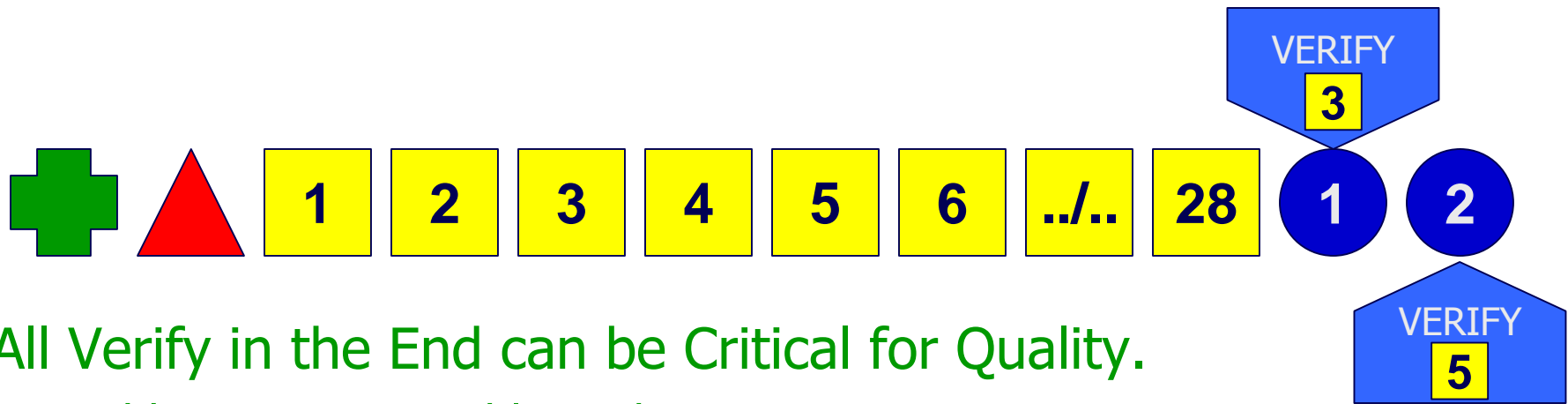
OPERATIONAL METHOD SHEETS OVERVIEW

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- Graphical Representation, at an Operation :
 - Safety Criteria – Safety is Quality.
 - Quality Criteria. – Verify – TQC's.
 - Work.
 - Information comes from Sequence of Events. – Not Vice Versa.
 - To reinforce the Training Employees receive "Off-Line" to the detailed Sequence of Events.

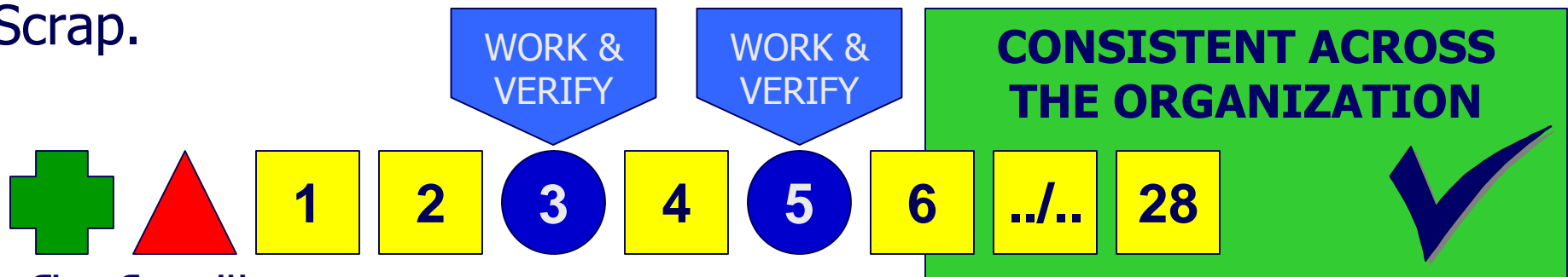
LFT TOOL FOR EMPLOYEES FLEXIBILITY

OPERATIONAL METHOD SHEETS

LONG OPERATIONS

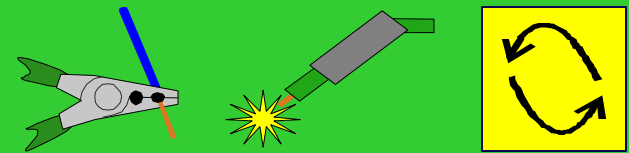


- All Verify in the End can be Critical for Quality.
 - Hidden, or Inaccessible Tasks.
- Long Rework Times.
 - To remove more parts.
- Scrap.



OPERATIONAL METHOD SHEETS STANDARDIZATION ACROSS SITE

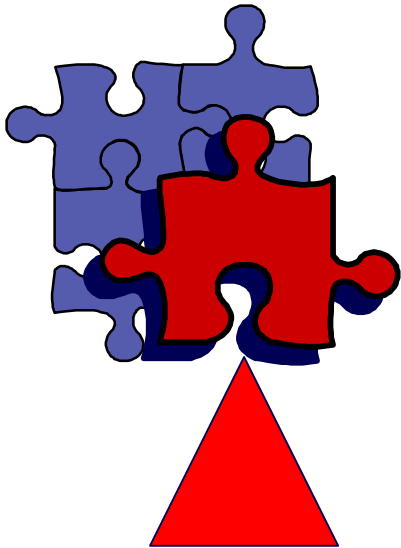
- **EMPLOYEE FLEXIBILITY.**
- Engineering Control Ease.
 - More People Can do Updates.
- **Library of Symbols.**
 - **Eliminate Variation when Flexing.**
- **Training Standards.**
 - "Off-Line" and "On-Line" Trainings.



QUALITY MANAGEMENT

PRODUCT In-PROCESS AUDIT

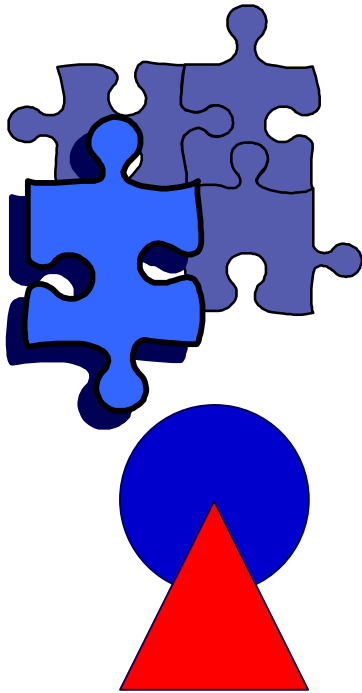
PRODUCT In-PROCESS



- To Guarantee Elimination of Defect Near The Point Where Work is Performed.
 - "Touch for Quality" Checks.
- By Team Members, or Assembly Line Certified Employees.
- Permanent Audit.

QUALITY MANAGEMENT FINISHED GOODS AUDIT

FINISHED GOODS



- To Guarantee Free Defect in Finished Good by Quality Inspection.
 - "Touch for Quality" Checks.
- Under the Responsibility of the Team's Quality Technician :
 - By Audit Team :
 - Manufacturing, Engineering, Marketing,...
 - By Team Members, or Assembly Line Certified Employees.
- Permanent Audit.

QUALITY MANAGEMENT

REDUCE POTENTIAL VARIATION

- When there are **Multiple Ways to Perform Work**, and **ONLY ONE WAY IS CORRECT.**

Product P/N CONTROL PANELS TWK 530-536 NBL/NBL-OC 22227777-000 / 22227777-CDT										SEQUENCE OF EVENTS										Control Panel Assembly	
WS	Seq. #	Overlap	Task	VA	Setup					Required		Move					Quality Criteria / Safety				
					Mach	Labor	D/S	Qty	I/E	Mach	Labor	Mach	Labor	D/S	Qty	I/E	Dist.	TQC	Description		
D50	170		Assemble fuse support to frame A – 1 screw	X						0.6							X	Left side Size 530 : 3ARR3CT1OV5 Size 536 : 3ARR3CT6A5			
D50	180		Install support to control panel - 2 screws	X						0.3	0.5							Connectors orientation			
E60	188		TQC – Contactor Model Number TQC – Fuse Model Number															Contactor : 45(C/F)G20AJ Size 530 : 3ARR3CT1OV5 Size 536 : 3ARR3CT6A5			
E60	190		Install fan capacitor - 1 nut	X						0.5								Identification : 4µF at the top			

FINISHED GOODS AUDITS

PRODUCT In-PROCESS AUDITS

