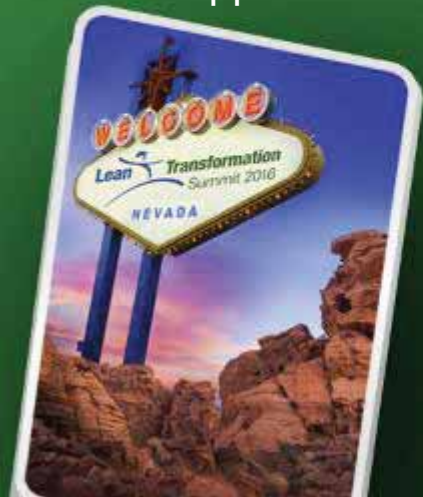


Propelling Ahead: Thrustmaster of Texas' Lean Journey

Presenters: Frank Montemayor

TMOT Support: Joe Bekker, Jason Small

LEI Support: David Westphal



Let's Deal With The Work

March 17-18, 2016 | Las Vegas



INTRODUCING
THRUSTMASTER



PROBLEM
STATEMENT



SOLUTIONS
(TODAYS TOPIC'S)



ROAD MAP



Problem Statement



Quality Issues (~50 FPY Est. Q1 '14)



Low On-Time Delivery (~20% Q1'14)



High Project Costs (>100% Target)

Contributing Factor's



+1,021% annual revenue increase over 10 years

+700% increase in staff

200k ft² factory expansion in 2009





UNSUCCESSFUL STRATEGIES



MRP Scheduling



Advanced Planning and Scheduling (APS)



More Overtime



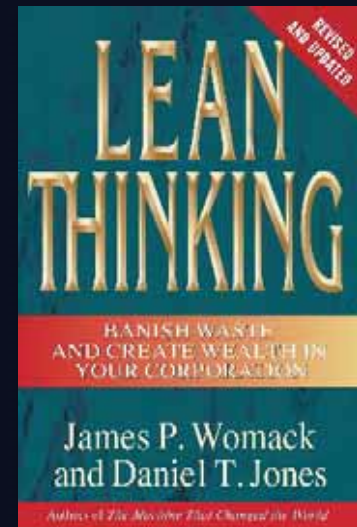
More Labor and Support Resources



Larger, more Complex and Expensive

“Software is not your problem, read this.”

- Best Advice from a Consultant





Learning Session Topics

How the Vision was Set and Conveyed

Setting the Foundation: Standard Work, Visual Management, Flow & Bottlenecks

Replaced MRP Scheduling

Problem Solving on the shop floor

Leverage lessons learned in Product Development

Success in high-mix/low-volume, engineered-to-order market



Before the Journey



ENSURE COMMITMENT FROM UPPER MANAGEMENT

- Commitment must be firm and resolute.
- In it for the “long haul”

DETERMINE KEY DRIVERS NEGATIVELY IMPACTING THE COMPANY

- Quality Issues
- Low On-Time Delivery
- Unfavorable Project Cost



Setting the Vision

Develop Vision

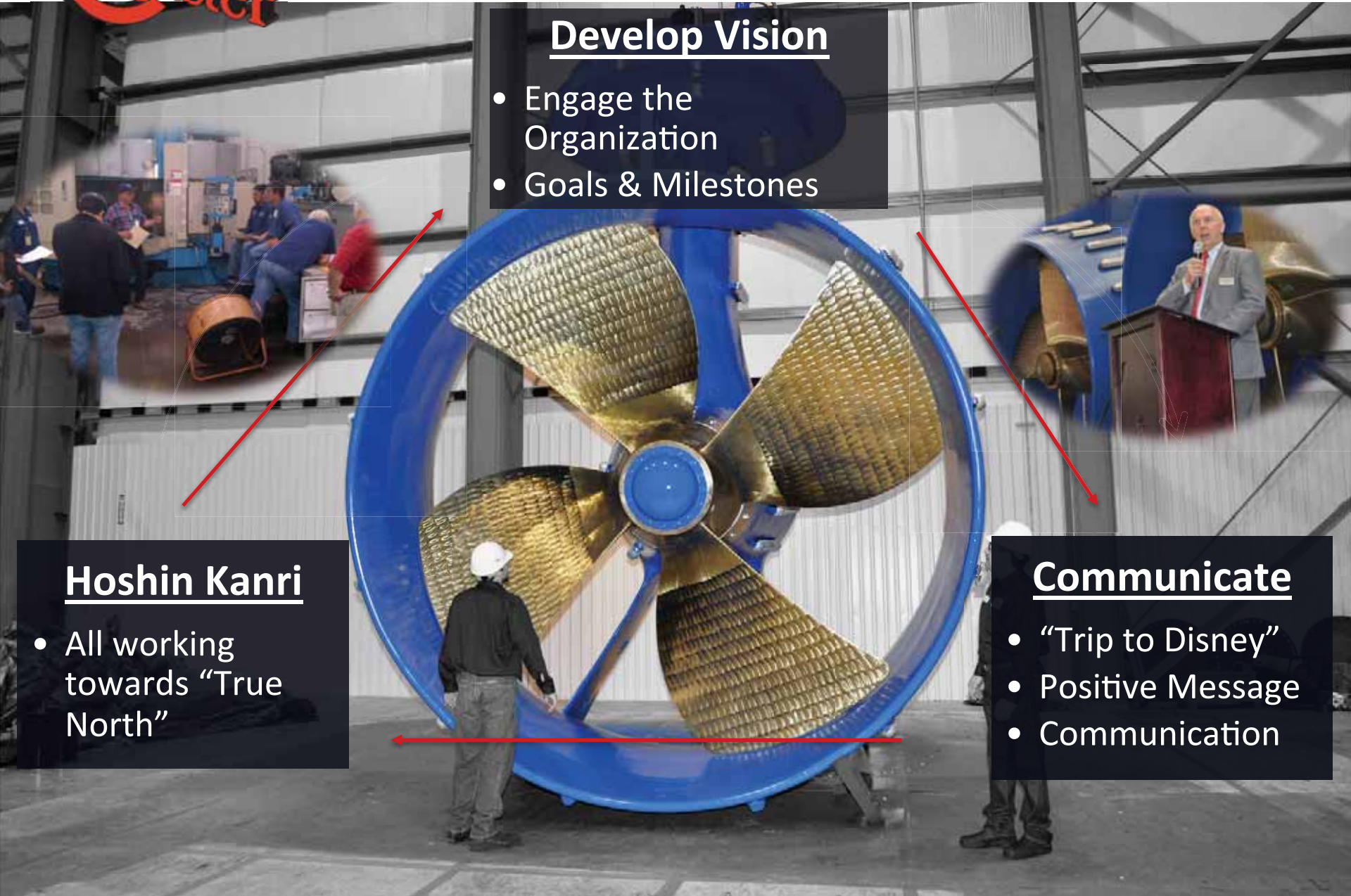
- Engage the Organization
- Goals & Milestones

Communicate

- “Trip to Disney”
- Positive Message
- Communication

Hoshin Kanri

- All working towards “True North”





Thrustmaster's Vision

“To be a World-Class Manufacturer, Safely Producing the Highest Quality Products, Delivered On-Time, while meeting or exceeding all Customer Expectations at a Fair Cost.”



Vision Focus

SAFETY

(<.15 TRIR)

QUALITY

(FPY 90%)

ON-TME DELIVERY

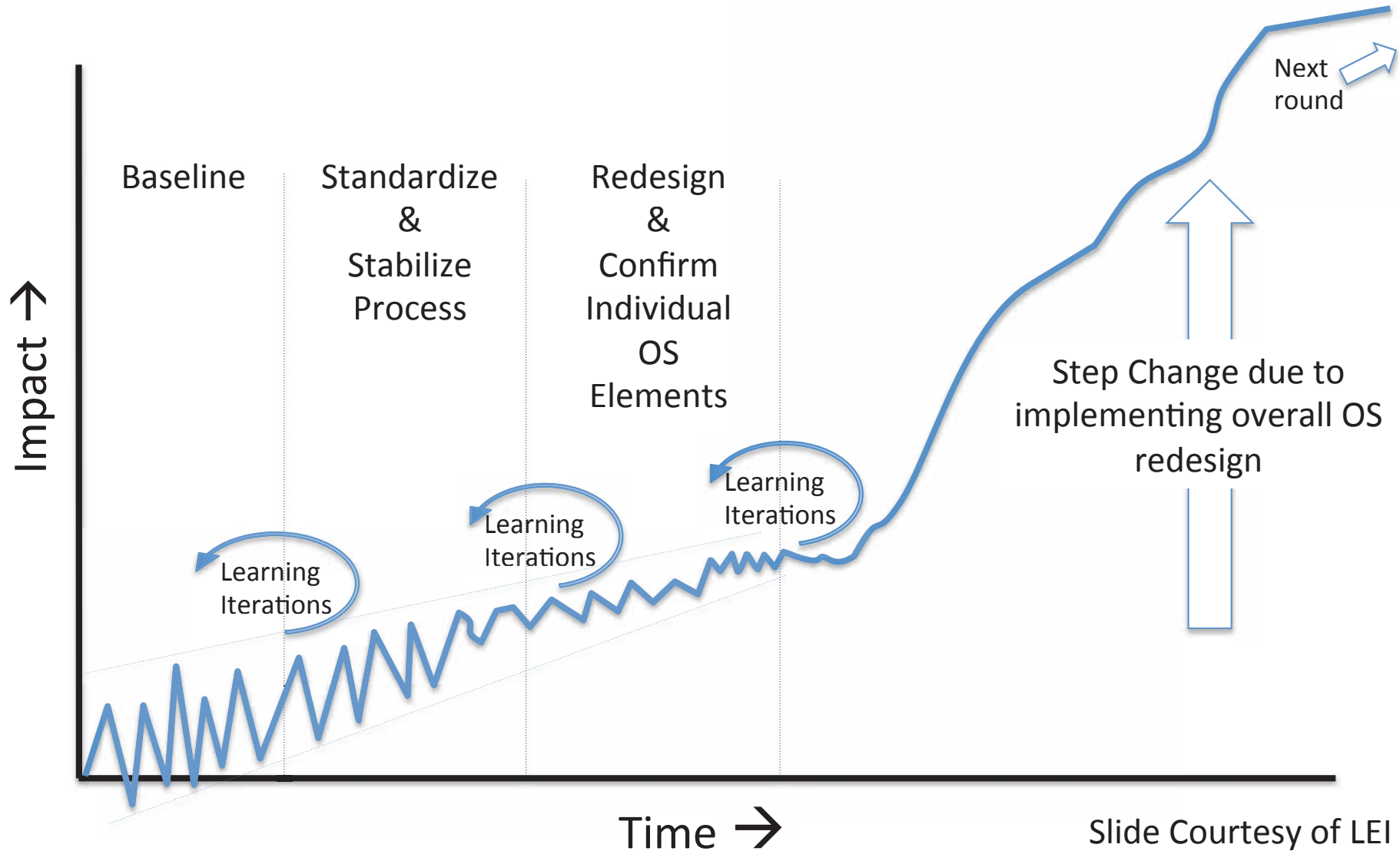
(90%)

COST

(<=100% of Target Cost)

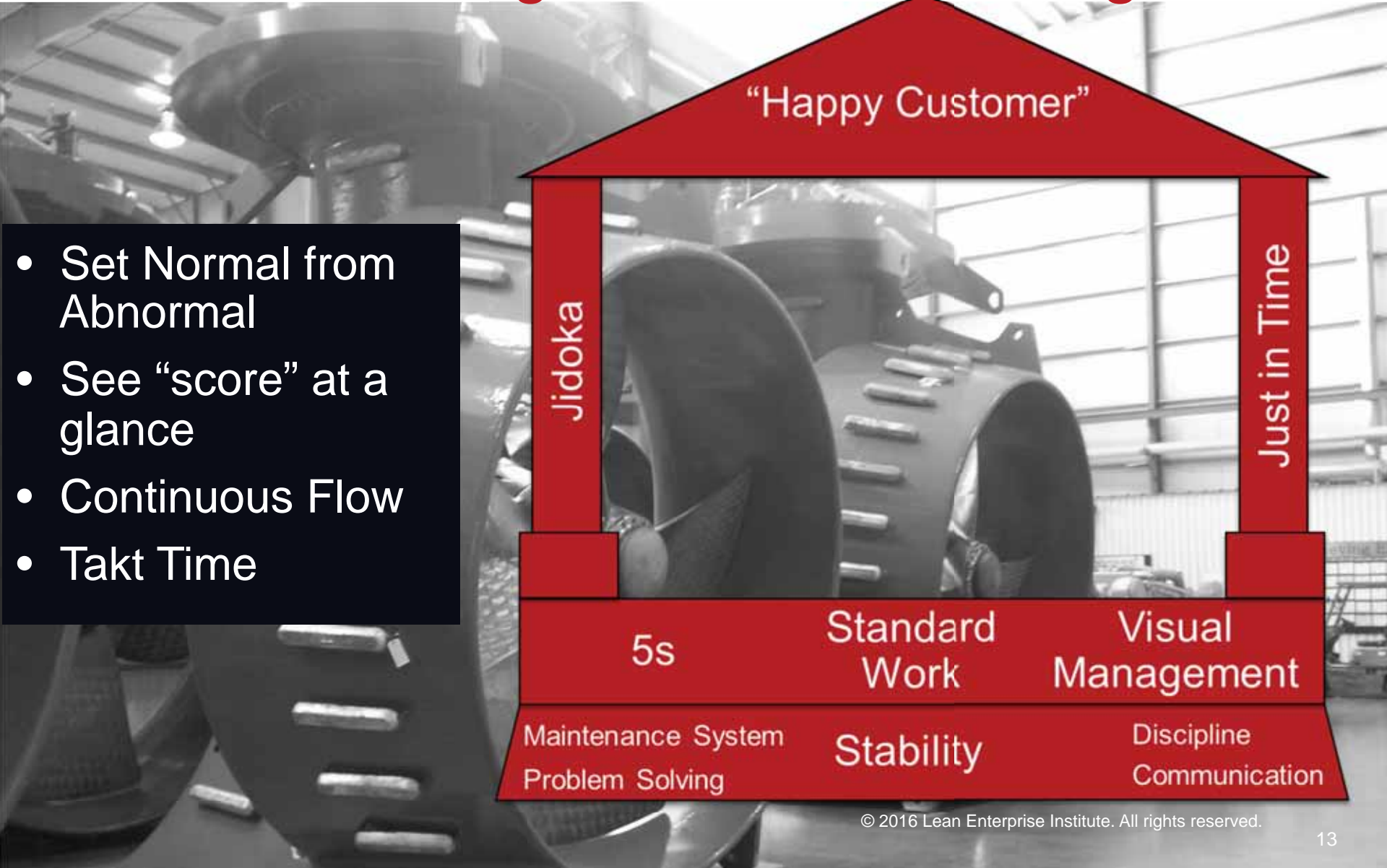


Lean Transformation Model – Change Phases and Progression





Lean Transformation Model – Change Phases and Progression



- Set Normal from Abnormal
- See “score” at a glance
- Continuous Flow
- Takt Time



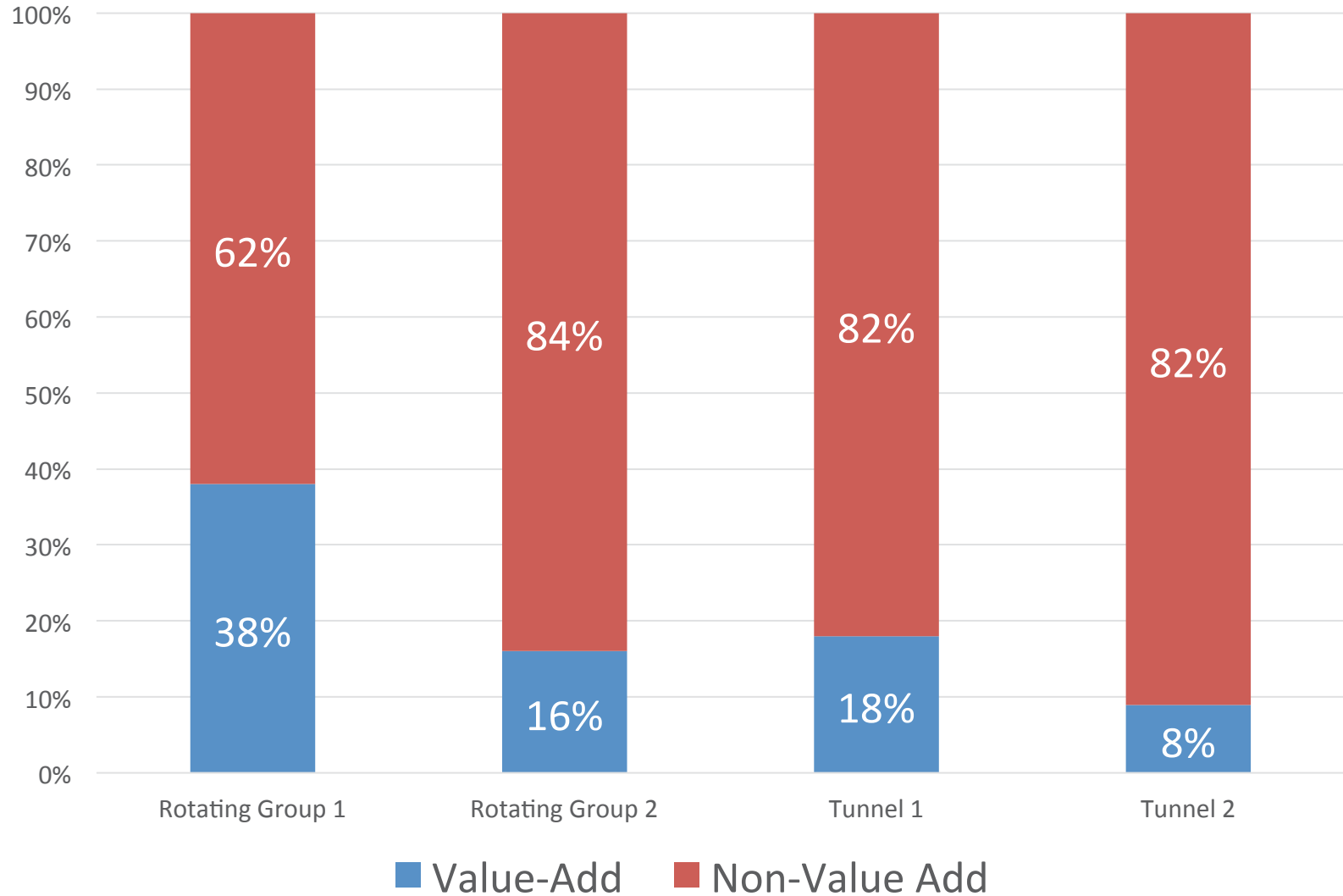
Go to the Gemba



- No Standard Work or work area's
- No flow or pace
- Cannot see normal from abnormal



Observe, Ask Why and Quantify





Non-Value Add Example



- Interference issue
- Problem/defect absorbed into the assembly process (became normal)





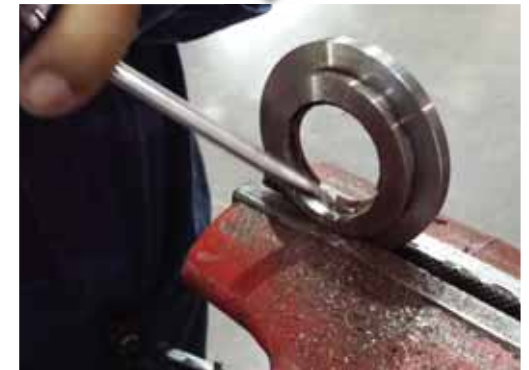
Non-Value Add Example 2



- Lost 30-minutes



Non-Value Add Example 3



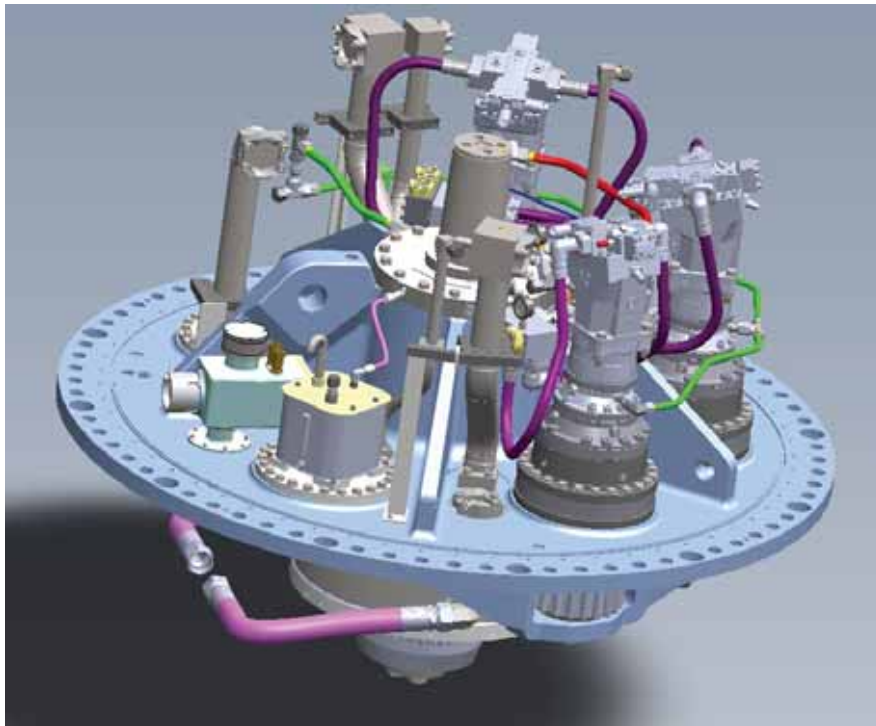
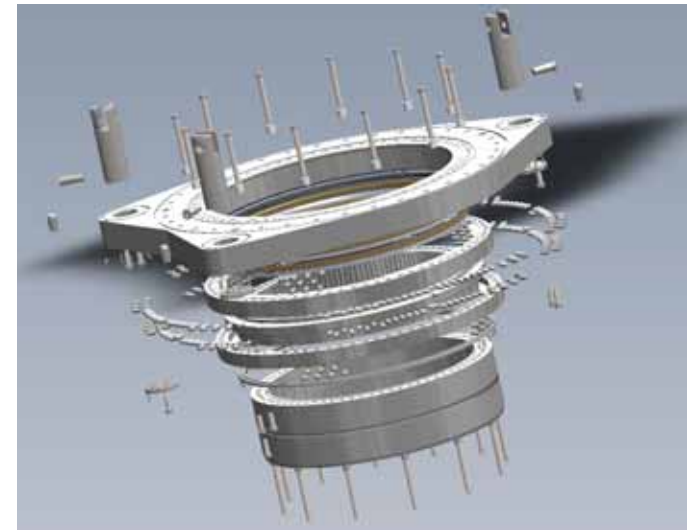
- Sealed motor, but seal not required
- 20 minutes lost
- High potential to damage part



Standard Work

Flange Mount

- > 1,200 components
- No time-based assembly procedures



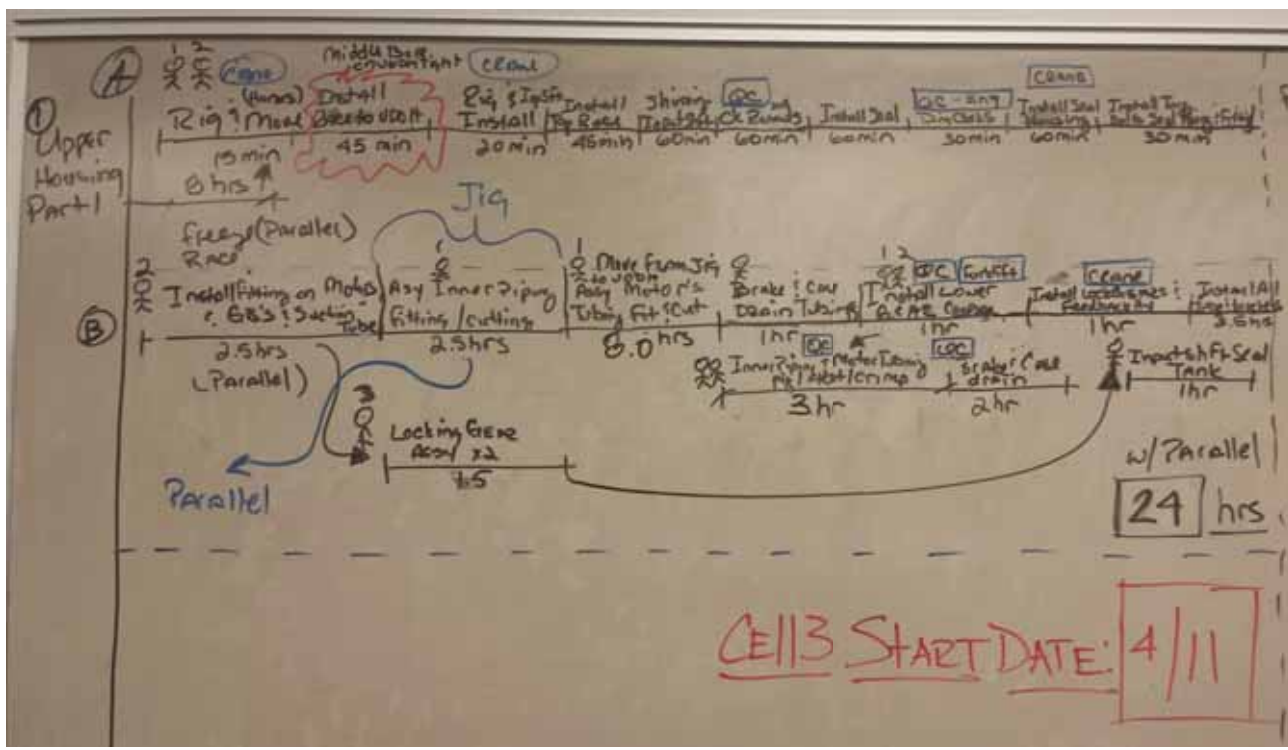
Upper Housing

- Complex assembly
- > 1,500 components
- Low FPY
- Process time 8-10 days



Standard Work: Time-based Work Sequence

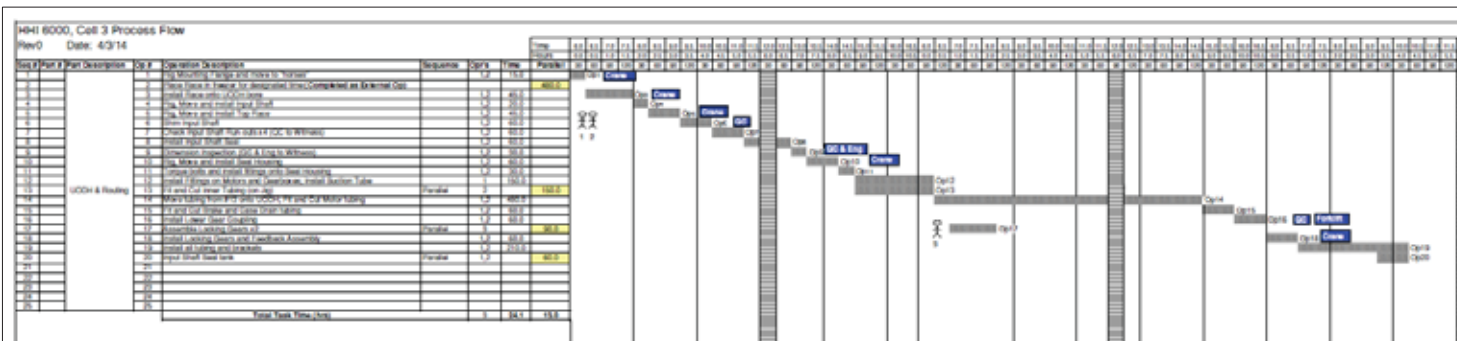
- Developed workflow and process time
- Gave visibility to the type and quantity of resources needed
- Process Time = 24 man-hours (reduction of ~5-days)





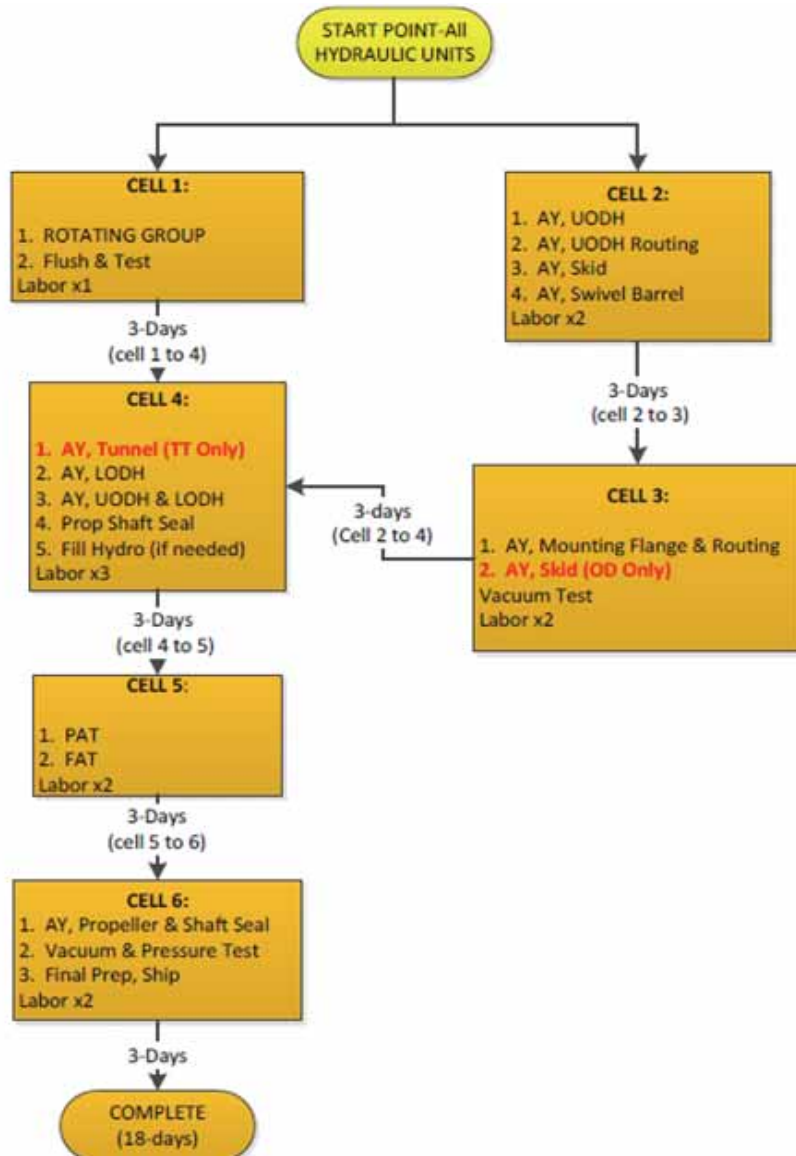
Standard Work: Time-based Work Sequence Developed

HHI 6000, Cell 3 Process Flow								Time		
Rev0 Date: 4/3/14								Hours		
Seq #	Part #	Part Description	Op #	Operation Description	Sequence	Opr's	Time	Parallel		
1			1	Rig Mounting Flange and move to "horses"		1,2	15.0			
2			2	Place Race in freezer for designated time (Completed as External Op)				480.0		
3			3	Install Race onto UODH bore		1,2	45.0			
4			4	Rig, Move and install Input Shaft		1,2	20.0			
5			5	Rig, Move and Install Top Race		1,2	45.0			
6			6	Shim Input Shaft		1,2	60.0			
7			7	Check Input Shaft Run-outs x4 (QC to Witness)		1,2	60.0			
8			8	Install Input Shaft Seal		1,2	60.0			
9			9	Dimension Inspection (QC & Eng to Witness)		1,2	30.0			
10			10	Rig, Move and Install Seal Housing		1,2	60.0			
11			11	Torque bolts and install fittings onto Seal Housing		1,2	30.0			
12			12	Install Fittings on Motors and Gearboxes; Install Suction Tube		1	150.0			
13		UODH & Routing	13	Fit and Cut Inner Tubing (on Jig)	Parallel	2		150.0		
14			14	Move tubing from #13 onto UODH; Fit and Cut Motor tubing		1,2	480.0			
15			15	Fit and Cut Brake and Case Drain tubing		1,2	60.0			
16			16	Install Lower Gear Coupling		1,2	60.0			
17			17	Assemble Locking Gears x2	Parallel	3		90.0		
18			18	Install Locking Gears and Feedback Assembly		1,2	60.0			
19			19	Install all tubing and brackets		1,2	210.0			
20			20	Input Shaft Seal tank	Parallel	1,2		60.0		
21			21							
22			22							
23		23								
24		24								
25		25								
Total Task Time (hrs)						3	24.1	13.0		





Standard Work: Assembly Process Flow



- Assembly cells are well defined with posted standard work
- Ability to “see” flow



Workplace Organization: Assembly Layout- Before





Workplace Organization: Assembly Layout- After





Workplace Organization: Assembly Layout- After



- Assembly cells are well demarcated with posted standard work
- Clear Locations for inbound and outbound materials



Workplace Organization: Assembly Layout- Before





Workplace Organization: Assembly Layout- Before

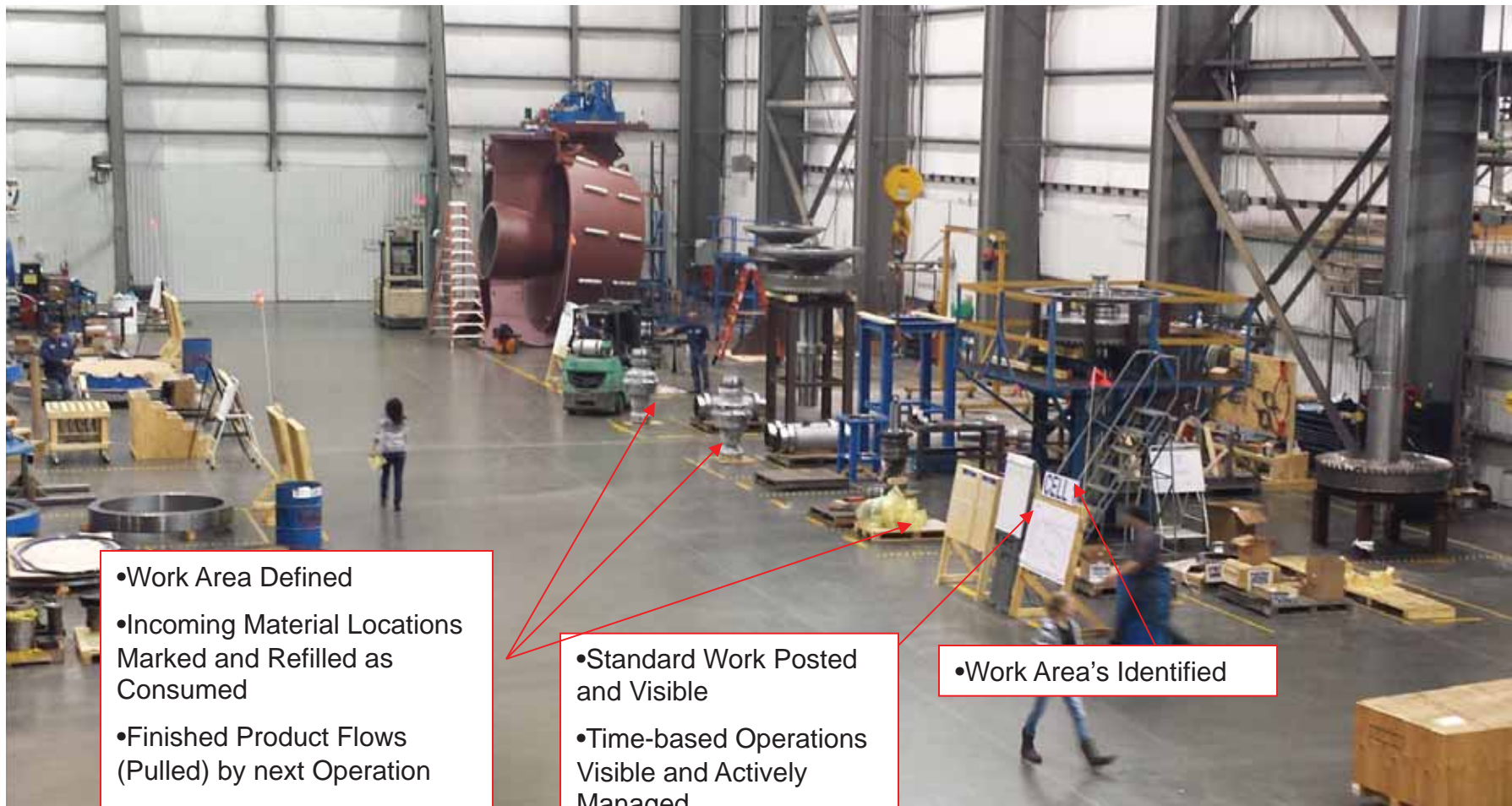


- Work Flow Not Visible
- Work Area's not Defined
- Time-Based Tasks Unable to be Measured
- No Standard Work Present

- Could not distinguish between WIP or Finished Product
- WIP Between Operations Not Quantifiable
- Current Operation or Work Status Unknown Visually
- Labor Resources per Operation Unknown Visually



Workplace Organization: Assembly Layout- After



- Work Area Defined
- Incoming Material Locations Marked and Refilled as Consumed
- Finished Product Flows (Pulled) by next Operation
- WIP Between Operations able to be counted easily

- Standard Work Posted and Visible
- Time-based Operations Visible and Actively Managed
- Labor Resources Per Cell established and Managed

- Work Area's Identified



Visual Management



Operations KPI's

- Quality
- On-Time Delivery
- 5s
- Schedule Attainment
- PO on Time %
- Cost/Unit/Project %
- Budgets/WC
- Direct Labor Vs Indirect

Assembly Schedule



Visual Schedule

Visual Machine Schedule

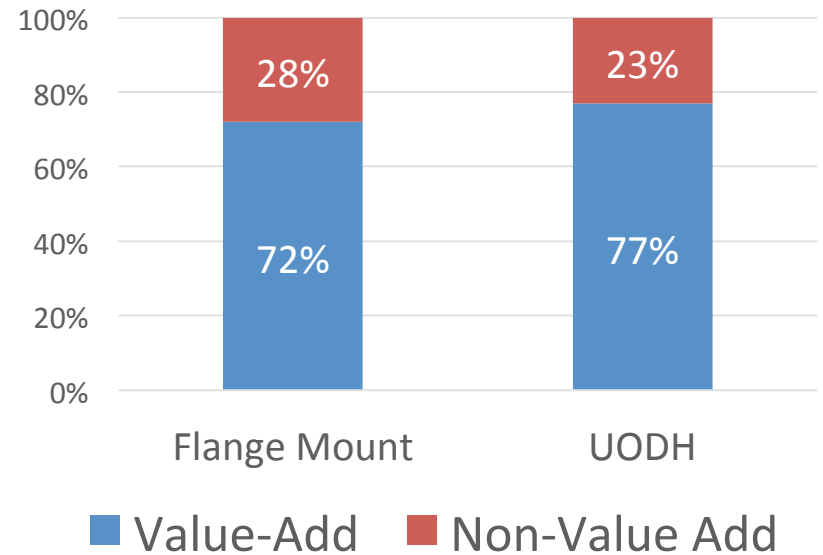


Visual Flags



Quick Wins

- Reduced Non-Value Add Activity
- Reduced assembly process time by 50% on Flange Mount
- Able to clearly see normal from abnormal
- Flow was visible
- Increased OTD by 67% in less than 6-months





Workplace Organization: Before and After Kaizen Event



Before



After

Before/After

Schedule Attainment: 30% to 80%



Workplace Organization: Part Presentation

Before



After





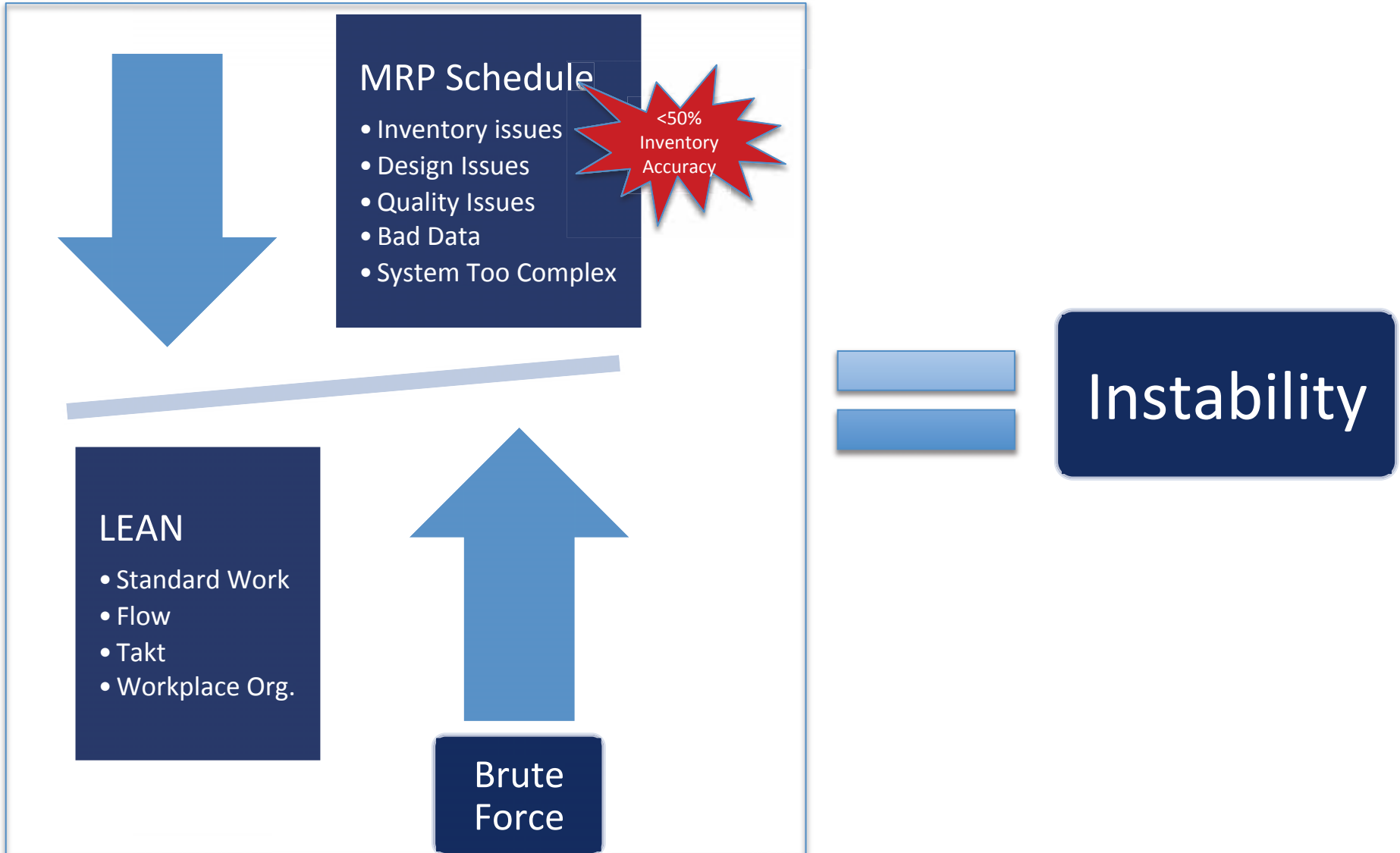
Workplace Organization: Tools

After





Visual Schedule: MRP Scheduling





Visual Schedule: Process Flow





Visual Schedule: Process Flow

- Mat'l Validated and Staged
- S/O move to Mach. Queue

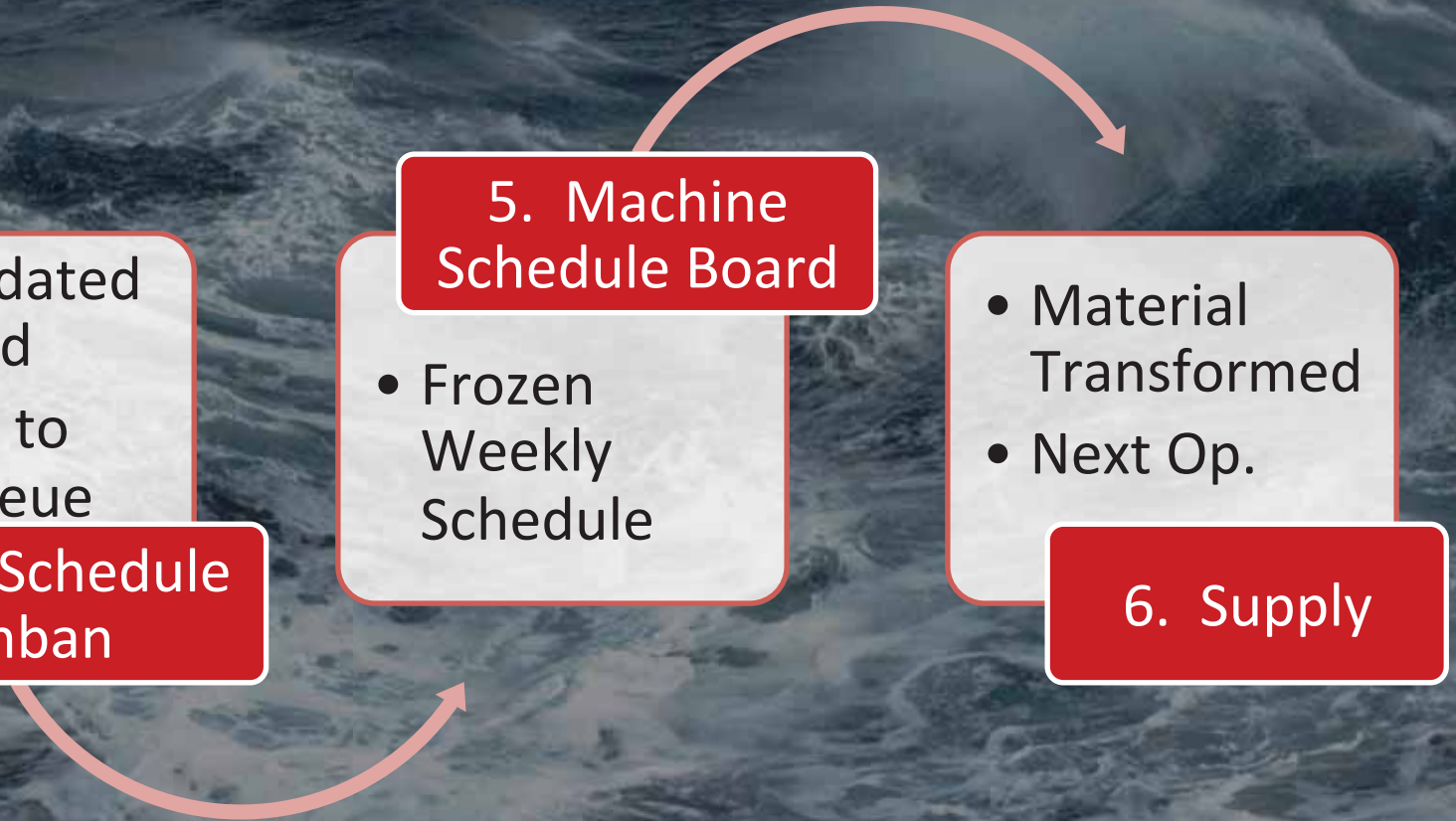
4. Mfg Schedule Kanban

5. Machine Schedule Board

- Frozen Weekly Schedule

- Material Transformed
- Next Op.

6. Supply



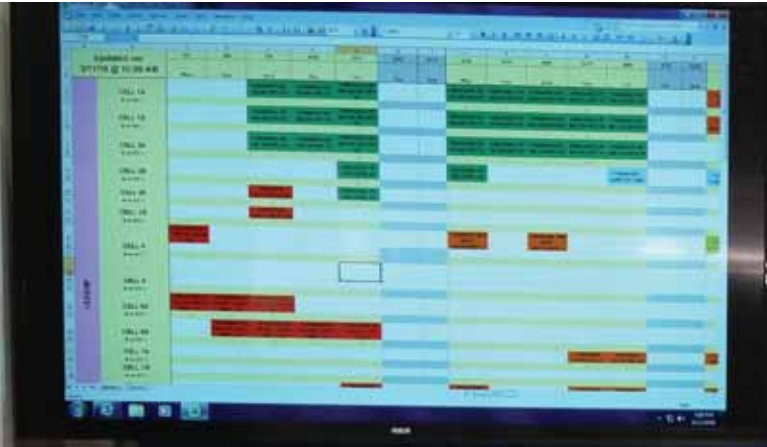


Visual Schedule: Purchasing Kanban





Visual Schedule: Production Control Kanban



A white sheet of paper with a grid or table, likely a detailed production control sheet or a list of tasks, is pinned to the blue wall below the main screen.

A white sheet of paper with text and a list, possibly instructions or a key, is pinned to the blue wall to the right of the main screen.

Two vertical racks of papers or documents are mounted on the blue wall. The left rack is labeled "Job # 1/5024" and the right rack is labeled "Job # 1/5024 P2". Both racks contain numerous sheets of paper, likely representing individual production orders or kanbans.

EXIT

Six horizontal racks of papers or documents are mounted on the blue wall. Each rack is labeled with a job number: "Job # 1/5024", "Job # 1/5024 P2", "Job # 1/5024 P3", "Job # 1/5024 P4", "Job # 1/5024 P5", and "INCOMING SHOP ORDERS". The racks contain various colored papers, likely representing different stages or types of production orders.





Visual Schedule: Manufacturing Kanban

MACHINE SHOP PRODUCTION BOARD

A large black production board with a grid of 24 slots (3 rows by 8 columns). Each slot contains a white Kanban card with a machine ID and a schedule diagram. The board is color-coded: green for most slots, yellow for 'MATERIAL VALIDATED', orange for 'SHOP ORDERS PRIORITIZED', and red for 'NCR REPORTS'. A fire extinguisher is visible on the left wall, and a '5S Level' chart is on the right wall.

Row	Column	Machine ID	Color
1	1	INCOMING SHOP ORDERS-NOT PRIORITIZED	Black
1	2	WC: RS-2800M O-N VTC	Green
1	3	WC: RS-6100M CNC UNION	Green
1	4	WC: RS-5800M CNC KURAKI 1a.2	Green
1	5	WC: RS-3200M/3500M MANUAL HGM	Green
1	6	WC: RS-5700M CNC DM-800	Green
1	7	WC: RS-3300M CNC HAAS	Green
1	8	WC: RS-4300M FURUKA 703	Green
2	1	SHOP ORDERS PRIORITIZED	Orange
2	2	MATERIAL VALIDATED	Yellow
2	3	WC: RS-4500M CNC OKUMA	Green
2	4	WC: RS-4700M HANOOK VTC	Green
2	5	WC: RS-5000M K&L BEEM	Green
2	6	WC: RS-6400M CNC LARUN	Green
2	7	WC: RS-4900M K&L VTC	Green
2	8	WC: RS-5000M HANOOK MACHINE	Green
3	1	WC: RS-6200L NCR REPORTS	Red

A chart titled '5S Level' with a table showing levels 1 through 5 and their corresponding 'SORT' status. The chart is partially visible on the right side of the image.

LEVEL	SORT
5	...
4	...
3	...
2	...
1	...



Visual Schedule: Machine Schedule

#25 - ISMAEL

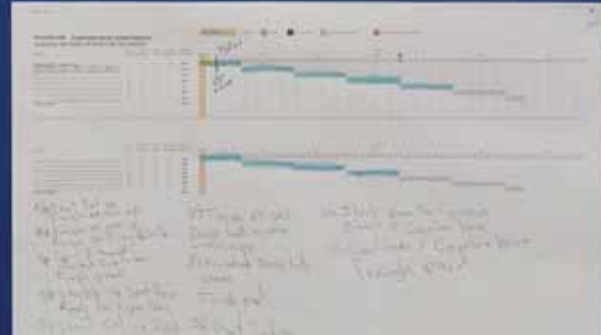
DATE: 2-29-16 / 3-7-16

JOB SEQUENCE BOARD

JOB #	MON	TUE	WED	THU	FRI	SAT	MON
	ERN/SCH/ACT						
Y15031110-1150	8/8/8	8/8/8	8/8/8	8/8/8	3/5/3	✓	
Y15031110-1074						✓	
Y150706210-120					3		6.52
ATTAINMENT	ERN/SCH						
WORK EFFICIENCY	ERN/ACT						
SCHEDULE HOURS	8	8	8	8	3/2		
ATTAINMENT	100%	100%	100%	100%	160%		
WORK EFFICIENCY	100%	100%	100%	100%	160%		
HRS/DAY							
ATTAINMENT							
MACHINE HOURS							

WORK ORDERS Y150706-1001
NAME ISMAEL

WC: RG-2800M
O-M VTC





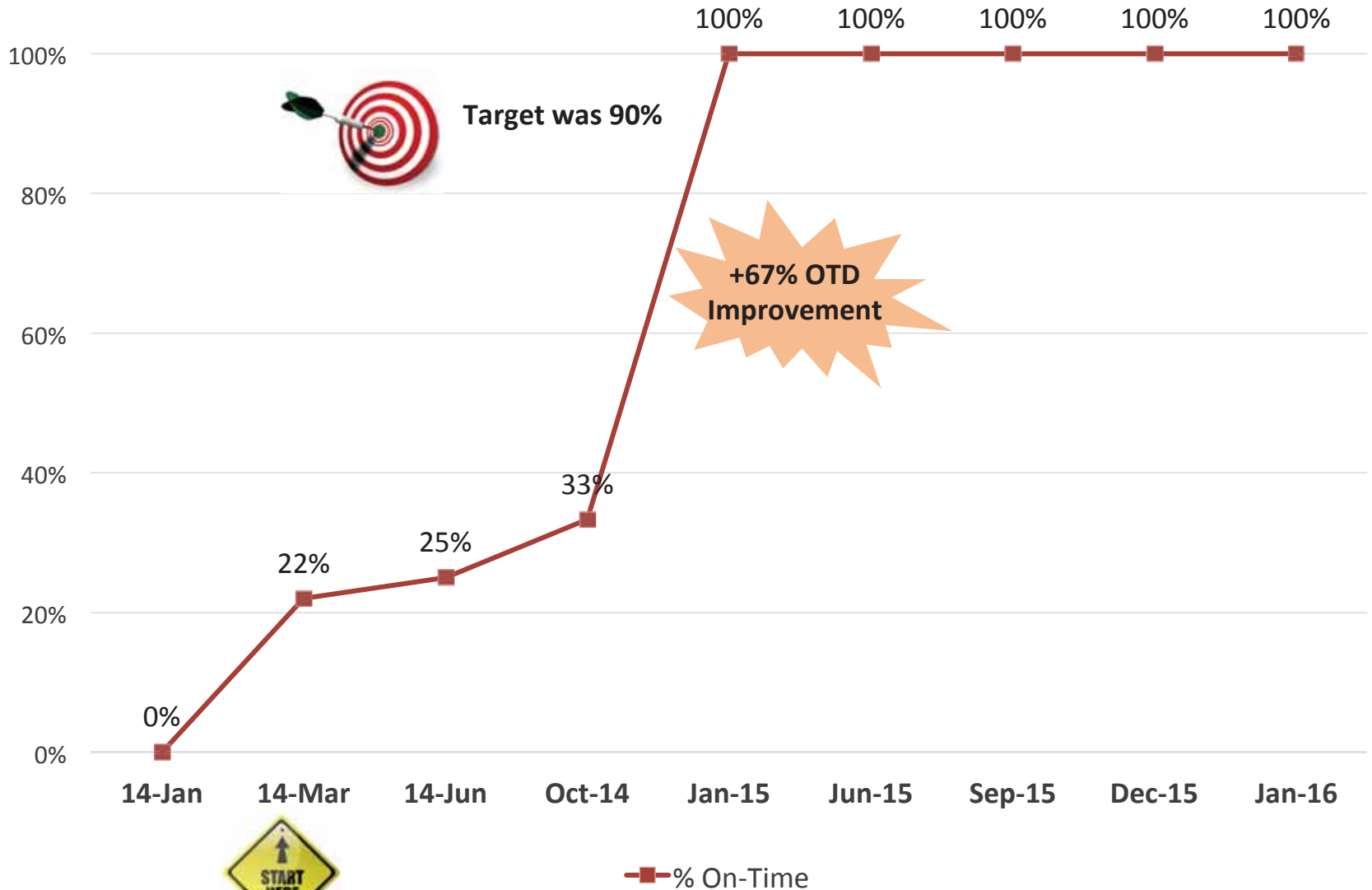
Visual Schedule: Assembly Schedule



Updated on: 11/05/2014		No of Res.	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8
			Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Cell1	ROTATING GRP	1		Y130661 UNIT 1		Y130661 UNIT 2	Y130661 UNIT 3	Y130661 UNIT 4	ON TIME	Y130661 UNIT 6	Y130661 UNIT 7
Cell1	Overflow Cell 1	1				LATE JOB	Y140155 UNIT 1	Y140155 UNIT 1	Y140155 UNIT 2	Y140155 UNIT 2	Y140155 UNIT 2
Cell2	TECH LODH	1						Y130661 UNIT 1	ON TIME	Y130661 UNIT 2	Y130661 UNIT 3
Cell3	T & TTML AY	1							LATE JOB	Y140155 UNIT 1	Y140155 UNIT 1
Cell3	Overflow Cell 3	1								Y130661 UNIT 1	Y130661 UNIT 2
Cell4	I, OD, WM, HD AY	2	Y140164 UNIT 3	Y140164 UNIT 3				Y140189	Y140189	LATE JOB	Y130661 UNIT 1
Cell4	Overflow Cell 4	2	Y140164 UNIT 4	Y140164 UNIT 4							Y130661 UNIT 2
Cell5	T / FAT	2	Y140164 UNIT 1	Y140164 UNIT 1	Y140164 UNIT 3	Y140164 UNIT 3	Y140164 UNIT 3	LATE JOB		Y140189	Y140189
Cell5	Overflow Cell 5	2	Y140164 UNIT 2	Y140164 UNIT 2	Y140164 UNIT 4	Y140164 UNIT 4	Y140164 UNIT 4				
Cell6	al AY & Ship Prep	2	Y140185 UNIT 1	Y140185 UNIT 1	Y140185 UNIT 3	Y140185 UNIT 3	Y140185 UNIT 3			Y140164 UNIT 1	Y140164 UNIT 1
Cell6	Overflow Cell 6	2	Y140185 UNIT 2	Y140185 UNIT 2					ON TIME	Y140164 UNIT 2	Y140164 UNIT 2



Results: On-Time Delivery





Results: Actual Job Cost vs. Target Cost





Problem Solving: Team Board Meeting





Problem Solving: Moved Support Services to Shop Floor

1. Support Services were relocated to the Gemba
 - Manufacturing Engineers
 - Schedulers
 - Design Engineer (Rotation)
2. Created CI Teams, Kaizen Teams and Mentored potential future leaders
3. Instituted A3's as the standard problem-solving methodology; Trained and deployed
4. Fostered an "Open" door culture.



Problem Solving at the Gemba





Problem Solving: Communication Board





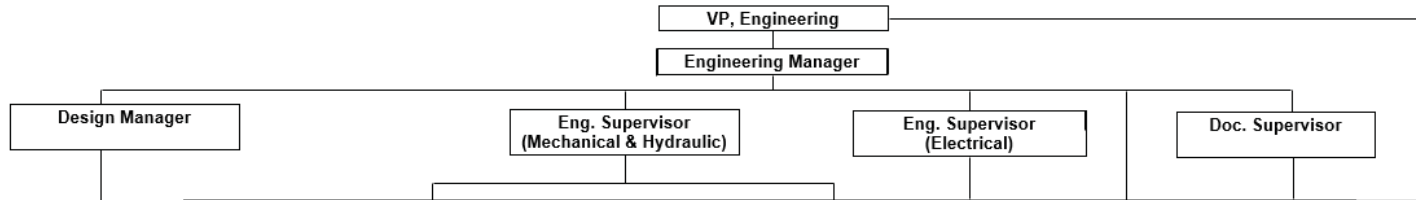
Problem Solving: Communication Board





Lean Product Development

ENG. FUNCTIONAL EXPERT CHART



Functional Area	Project Drawings	Phase 1			Phase 2	Phase 3	Class	Documentation/ Manuals	New Product Development (R&D)
		Structural	Lower Assemblies	Upper Assemblies	HPU/AUX Assemblies	Electrical/ Control Systems			
Functions	Thruster GAs	Props Nozzle Receptacles Canisters Thruster Mounts Wells Platforms Thruster Skids Coating	Props Nozzles LODH Spiral Bevels Rotating Groups Prop Seals Rope Guards Line Cutters Coating	UODH Slewing Bearings Steering Feedback Upper Gears Couplings Shaftlines Clutches PTO's Plumbing/Routing Stems Floating Shafts Swivels Cylinders Latches Guidebars Coating	Power Units (Electric Motor & Engine Driven) Steering Hpu's Lube Oil Systems Head Tanks Seal Oil Tanks HPU Skids Filter Separators Heat Exchangers Plumbing/Routing GAs P&IDs HP&Ds Coating	Controls Panels VFDs Electric Motors Interfaces GAs Schematics Functional-Descriptions (FDS)	Applicable Class to the Project/Job Scope of Supply - Drawing		
Engineers	-	1. Tang* 2. Shaw	1. Kenner* 2. Jacek 3. Tang	1. Linzy* 2. Garrett	1. Nagur*	1. Chandan* 2. Venkat	1. Venkat	1. Elisa* 2. Mike	1. Shaw (Thruster)* 2. Venkat (Controls)
Designers	1. Jim Levy	1. Orlando	1. Erik 2. Chris	1. Erik 2. Chris	1. Chirs 2. Erik	-	-	-	1. Orlando

Functional Group Member Responsibilities

- Complete Design
- Standardization
- Define input/output for each functional group
- Improve quality of work

*Functional Group Lead



Lean Product Development

Design Eng.-WORKPLAN; Wk#

FUNCTIONAL AREA

-STRUCTURAL

-LOWER ASSEMBLY

-UPPER ASSEMBLY

-HPU/AUX ASSEMBLY

-ELECTRICAL &
CONTROL SYSTEM

Assignment Sheet

Incoming Inventory	In Progress	Outgoing Inventory
<p>Task 1: Design of structural components for the lower assembly.</p>	<p>Task 2: Review of design specifications for the upper assembly.</p>	<p>Task 3: Final review of the HPU/Aux assembly design.</p>
<p>Task 4: Development of electrical control system architecture.</p>	<p>Task 5: Integration of structural and electrical designs.</p>	<p>Task 6: Preparation of final design reports and drawings.</p>
<p>Task 7: Testing and validation of the control system.</p>	<p>Task 8: Review of the overall product development process.</p>	<p>Task 9: Final approval and handover to manufacturing.</p>



LEAN JOURNEY ROADMAP



Azimuth Thrusters

L-Drives

Z-Drives

Retractable

Tunnel Thrusters

Thank you, Questions?

Learn more at Thrustmaster.net

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Houston, Texas 77041

USA



THRUSTMASTER.NET