



3P in New Product Development and Operational Transformation

Paul Betley
3P Coach
Ingersoll Rand





Our Climate Businesses

COMMERCIAL HVAC



Air conditioning systems, services and solutions. Innovative solutions geared toward making high-performance buildings reliable and safe, as well as healthy, comfortable and efficient



RESIDENTIAL HVAC & SUPPLY



Heating, cooling, thermostat controls and home automation for the residential market and a complete selection of innovative parts, options and accessories for optimal performance and reliability



TRANSPORT REFRIGERATION



Manufacturing and innovation of transport temperature control systems for a variety of mobile applications, including trailers, truck bodies, buses, shipboard containers and rail cars





Our Industrial Businesses

COMPRESSION TECHNOLOGIES AND SERVICES



Rotary, centrifugal and reciprocating air compressors, and treatment products with comprehensive multi-year service agreements, audits, parts, and accessories



CLUB CAR



Consumer, commercial and golf vehicles that provide efficient and reliable transportation



POWER TOOLS



Professional tools for fastening, drilling and surface preparation



MATERIAL HANDLING



Hoists, winches and systems for moving and positioning loads



FLUID MANAGEMENT



Pumps and systems for fluid handling, transfer and application



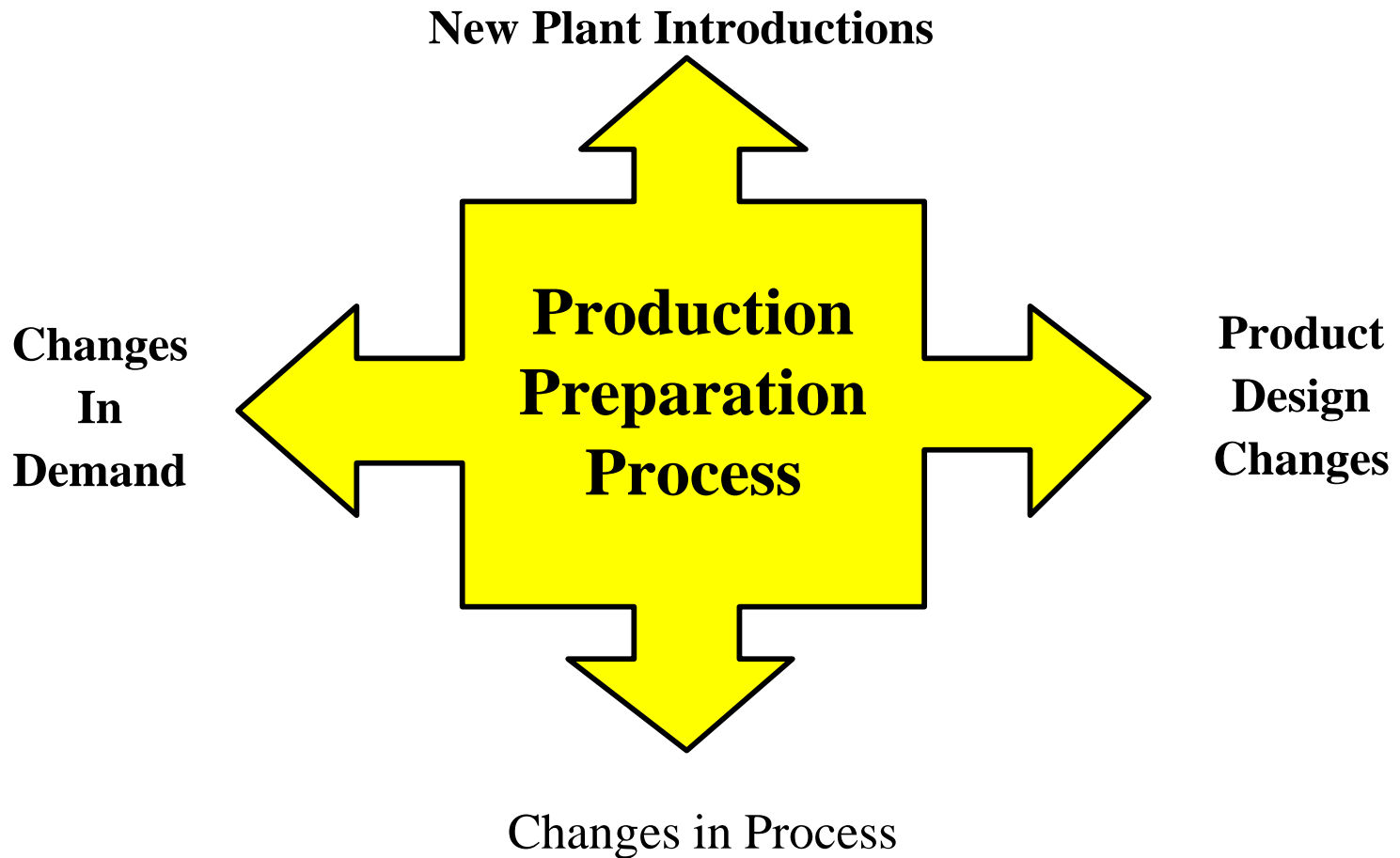


3P Story at IR

- “Throw it Over the Wall” NPD
- 2010 Thermo King Product Redesign
- New Leadership with 3P Experience
- Hired 3P Experts to show us how
- 3P now Standard Work for NPD
- Beginning using 3P to enhance OpEx journey



3P – Production Preparation Process





Core Elements of 3P

- Kaikaku – Radical Change
- Fix all known problems
- Dedicated, co-located cross functional teams
- Develop multiple solutions
- Spend most effort in planning
- Simulate, Kaizen, repeat!!





Foundation 3-5 Ton Light Commercial Project

Carlos Arroniz

AME NPD Lead

Ingersoll Rand – Trane – México





Concurrent Engineering

- USA-MEXICO-INDIA-CHINA
- Work same place at same time (Obeya)
- Design for Manufacturing & Service
- 7 ways simulations
- Democratic solutions → Customer wins





Engineering Build Fishbone - Mockup



Fishbone – Line Assembly Strategy



Small Scale 1/10 mockup



1st Prototyping Assembly Line



Prototyping Assembly



Obeya & Visual Management



Obeya Room in Mty



Target Sheet



Yamazumi Chart



Station Boards



Count Down



Scale Mockup 1/10





Simulations

Visualize in advance possible risk that operator can face in real life.

Kaizen since beginning reduce possibility of wrong investment.





Training Prior To Production



Disassembly



Assembly

- More than 300 Simulations
- Knowledge of Assembly Risk (Safety)
- Knowledge of Product (Quality)
- Faster Ramp-up Efficiency (Delivery)
- Kaizen during Simulations (Productivity)



Production Launch

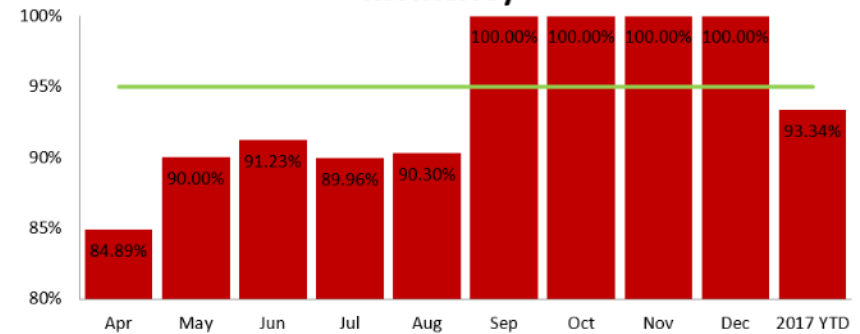




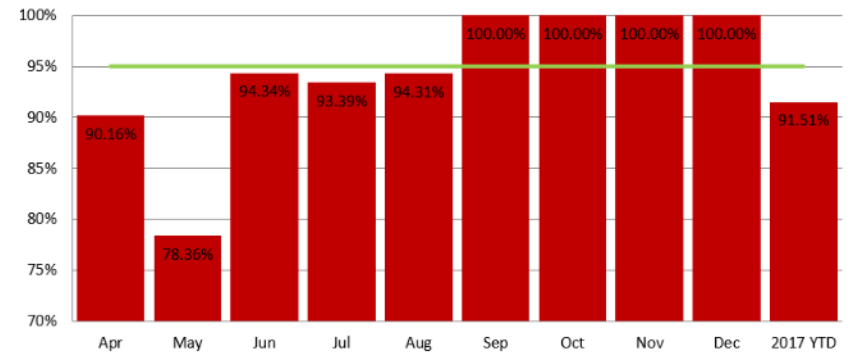
Results

- 10% Under Budget Target.
- 5% Below HPU Target.
- FPY up to 90% after 1st Month.
- Efficiency up to 90%

**FPY Small Foundation 2017
 Monterrey**



**Efficiency Small Foundation 2017
 Monterrey**





Lessons Learned

- Went Well
 - Manufacturing engagement since design concept
 - Communication through all countries
- Improvement Opportunities
 - Improve materials replenishment system
 - More experienced resources for materials
 - Design flaw escape
 - Suppliers equipment capacity review



9/8” Coil Operation Transformation

Larry Neal Smyth
Value Stream Coach
Ingersoll Rand





Reason for Action

- Aftermarket Business OTS Performance
- Product Lead Time variation at 100%
- 985% Work Content Variation
- Unpredictable flow or Repeatable
- Job Shop Layout connected by Conveyor
- Manufacturing Cycle Time Reduction





Target State

- Work Content Variation $\leq 200\%$
- 1 Piece Flow
- 60% Mfg. Cycle Time Reduction
- Total Sq. Ft Utilization reduced by 50%
- On-Time Shipping $\geq 95\%$
- 20% Productivity Improvement





Identifying the Gaps

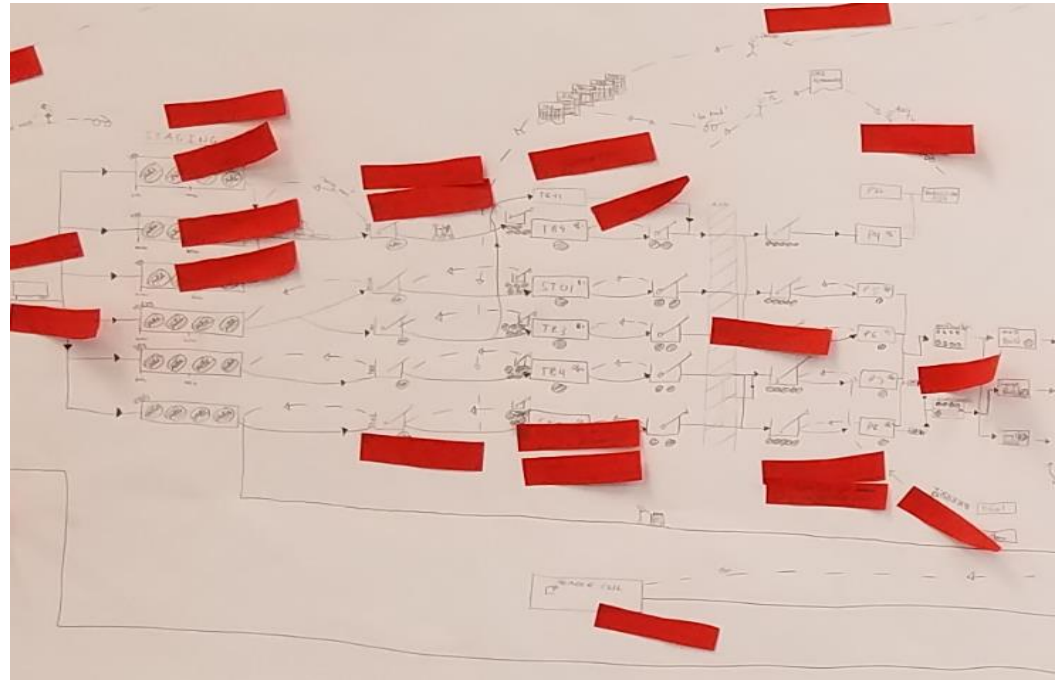
- Thorough Analysis of Demand Data
- Pace Setter (cube vs. braze)





Identifying the Gaps

- Material and Information Flow Map – Current State
 - Feeds Kaizen Newspaper
 - Promotes future state
 - Cycle Time Breakdown





Solution Approach

- Hypothesis- split into 3 Lines
 - Work Content <200% Variation

Handwritten table showing a breakdown of work content by type and category. The table is organized into columns for Type I, Type II, Type III, and Type IV. Rows list various activities like Setup, U-beads, Verification, Heat soak, etc., with associated numerical values and percentages.

	Type I	Type II	Type III	Type IV
234/44 - 5				
123/52 - 6				
Setup	356			
Setup U-beads	50			
Verification	45			
Heat soak	45			
Light Leak	120			
Brace U-beads	70			
Huber Setup	86			
Huber (4 sub)	30			
Brace Huber	0			
Cross Leak Repair	45			
Scan Out	24			
Misc Cost				
CZ	849	696	849	849
VZ	144	2,286	7,286	13,362
TOTAL	993	2,982	8,135	14,211
Work	50%	17%	15%	18%

Additional handwritten notes and calculations at the bottom of the page:

U-bead = 14
 Huber = 16 > 16
 Ont =

CT = 849 + (16 x + 2x)

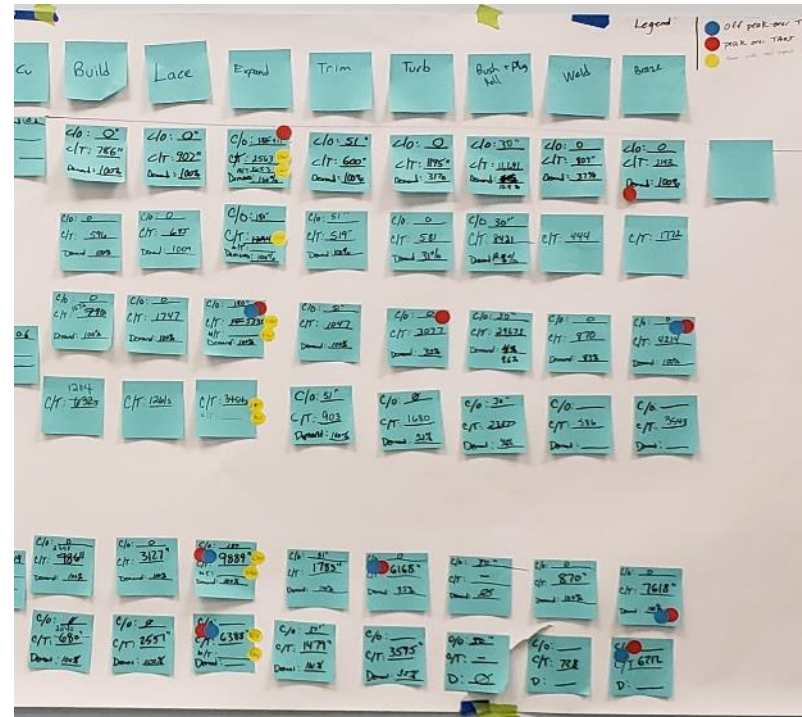
993 - 200 = 793

177 60% 1574 - 4722 4722 - 14211



Solution Approach

Part Quantity Process Routing (capacity) Cycle Time Calculator

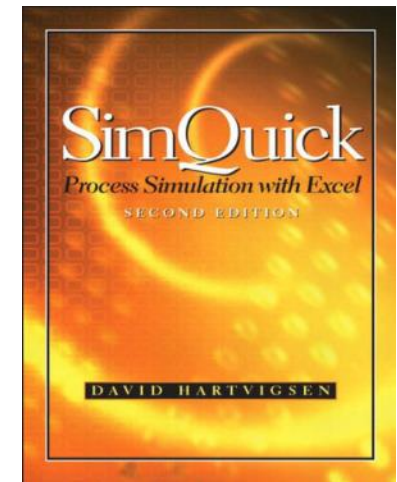


multipliers	Single pc Time	Total Time
na	-	295
191	4	764
na	-	32
66	6.6	1260.6
na	-	53
(in sec)	Total Cycle Time	1091 327
(in sec)	Total Cycle Time	1314 53

multipliers	Single pc Time	Total Time
91	-	91
191	3	58
191	15	859.5
	-	24
191	62	3552.6
	-	74
191	30	1719
	-	300 *need clarity
191	43	3463.0



Rapid Experiments - Simulations



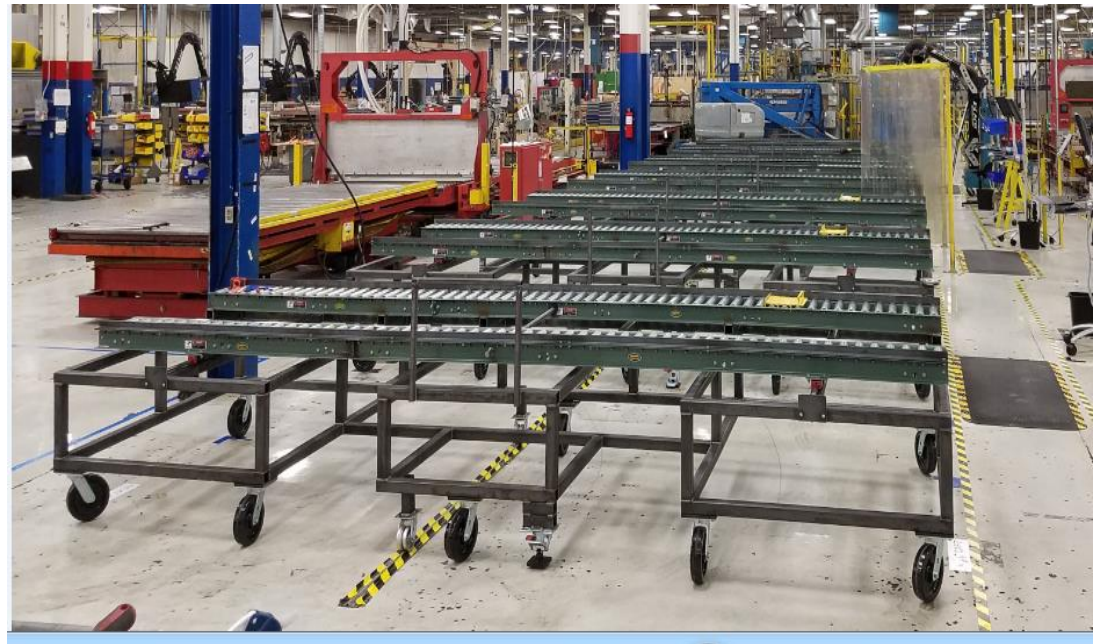


Small Scale Mock-up





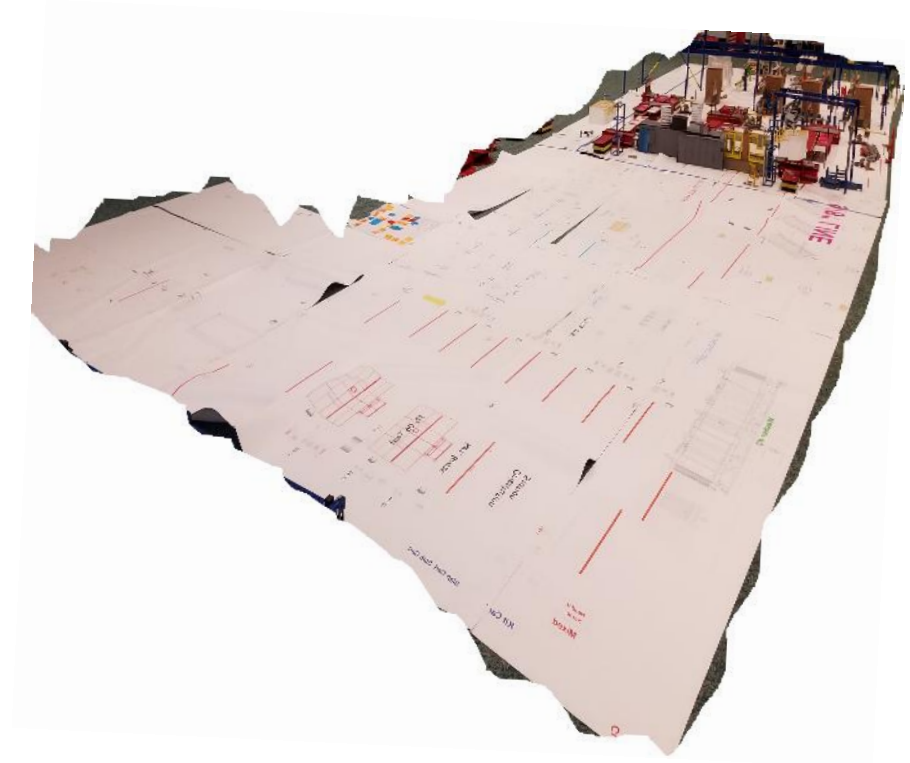
Moonshining Solutions





Results

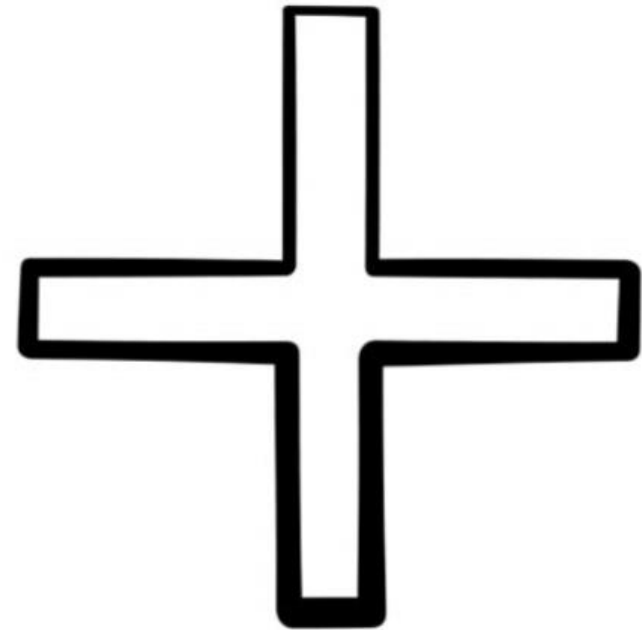
- Work Content Variation = 100%
- 1 Piece Flow Introduced
- 50% Mfg. Cycle Time Reduction
- Total Sq. Ft Utilization reduced by 50%
- On-Time Shipping Improved by XX%
or Late orders reduced by XX
- 20% Productivity Improvement





Reflections

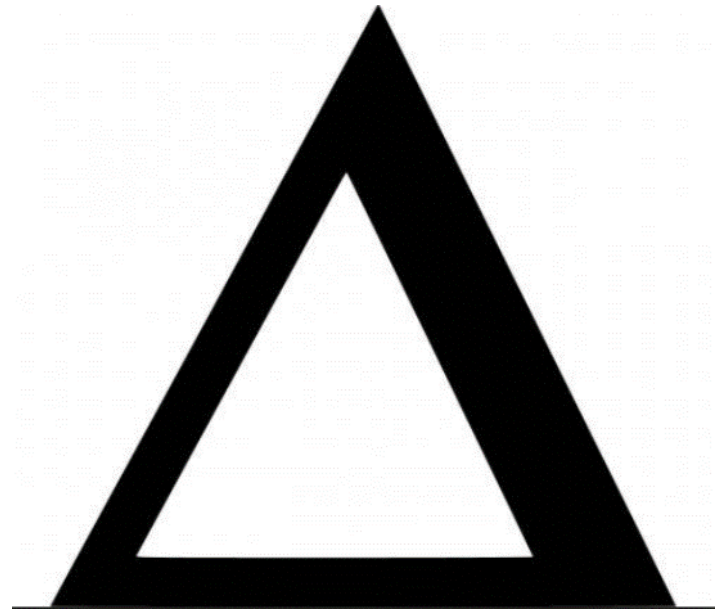
- 3P is a very powerful if you stay true to the process
- Endure the struggles - the pain is temporary, the reward is a lifetime
- Even if you get 75% improvements, DO IT!





Reflections

- Don't be a One-Man Band with 3P
- Miss-judged Sub-Assembly Impact





Q & A



Thank You!

Your opinion is important to us!

Please take a moment to complete the survey using the conference mobile app.

Session No: ThS/46

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