Workflow Management, ‘Pull’ Through the Engineering Value Stream

Howard Kinkade, Mgr. Gas Compressor Products Management

Solar Turbines

Designing the Future Summit 2019

lppd Lean Product & Process Development

SOLAR TURBINES

Solar Turbines
A Caterpillar Company

World's Largest Manufacturer of Industrial Gas Turbines
(1 to 23 MW)

Subsidiary of Caterpillar Inc.
Since 1981

15,000+
Gas Turbines Sold

6,000+
Gas Compressors Sold

Installations in 100+ Countries

Direct End-to End Sales and Service

65
Sales and Service Locations

Global Workforce
8,000+
Employees

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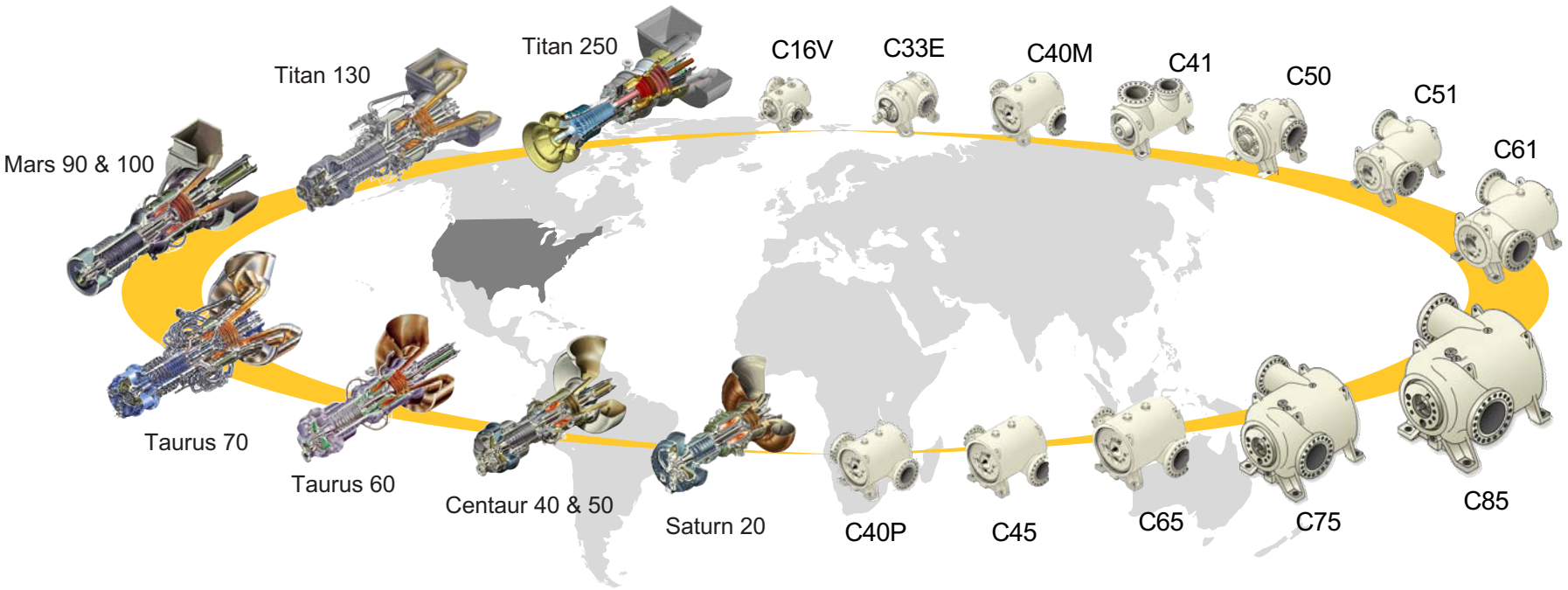
A World Leader in Gas Turbines and Gas Compressors



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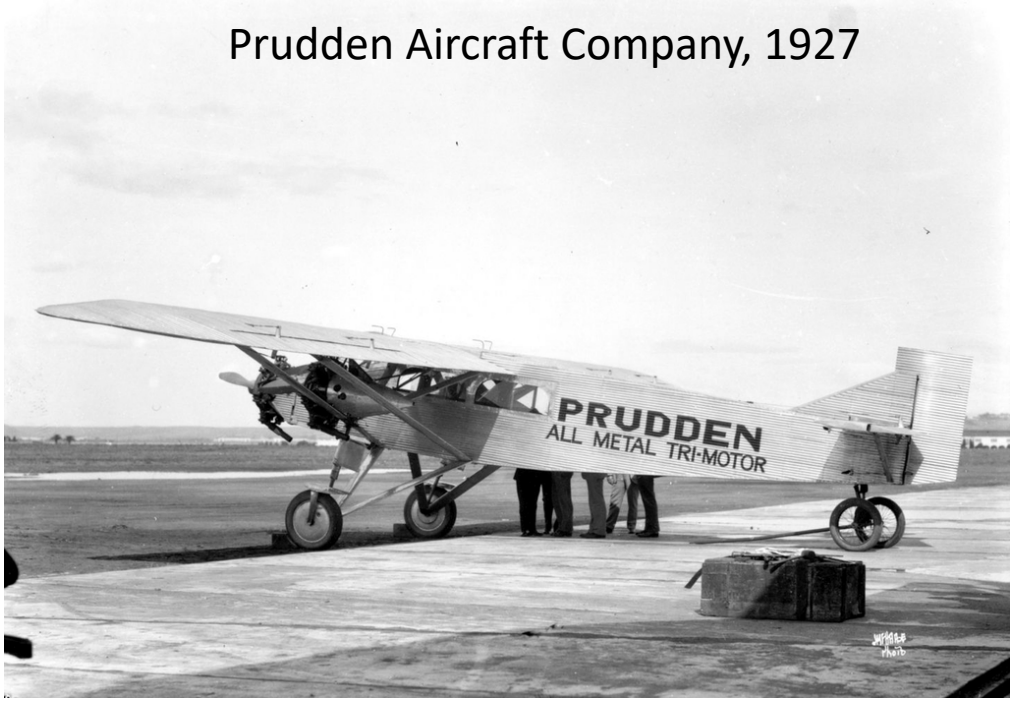

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Power Generation

Oil & Gas

Applications:

- Power Generation – Industrial, University, Hospital . . .
- Oil & Gas - Transmission
- Oil & Gas - Production

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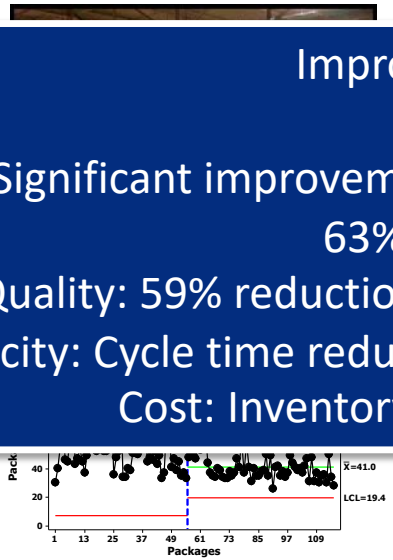
Lean History

Manufacturing 20+ Years

- Lean 6-Sigma – People, Quality, Velocity, Cost (PQVC)

Value Stream Alignment
PQVC



Push to Pull

Improvements

People: Significant improvements in safety, engagement index 63% to 92%

Quality: 59% reduction of ‘Cost of Poor Quality’

Velocity: Cycle time reduced >50% (Gas Compressors)

Cost: Inventory turns doubled. . .

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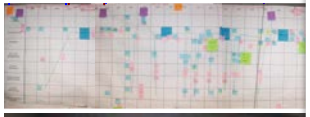
Lean History

Manufacturing 20+ Years
Product Development 10+ years:

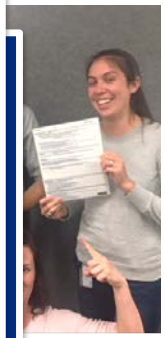


Value Stream Ma

Yet . . .

Process improvements slowly regressed.

The waste reduction process couldn't keep up with the 'Waste Factory'.



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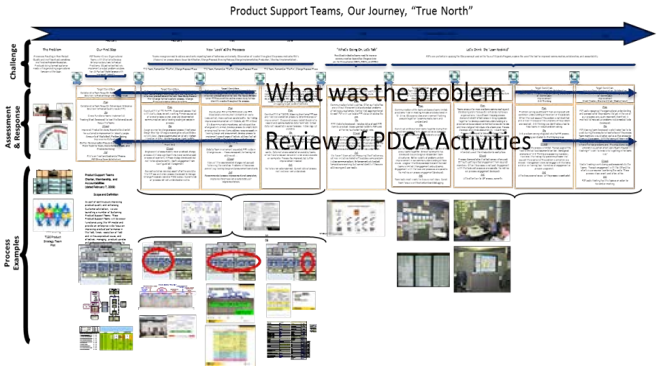
The ‘Big Chill’ and the ‘6th Why’

PDCA (Reflection on reflection events)

- ‘Check’ step not sustained
  - Didn’t consistently follow standard work
- ‘Waiting’ was always the dominant waste
  - Workflow management, ‘Push’



Nine PDCA Cycles Reviewed

The 6th Why

- Cultural values / Behaviors didn’t support PDCA process
  - Standard work improvement cycle needed
- More important to say ‘yes’ to work, than manage it
  - Workflow Management, transition to ‘Pull’

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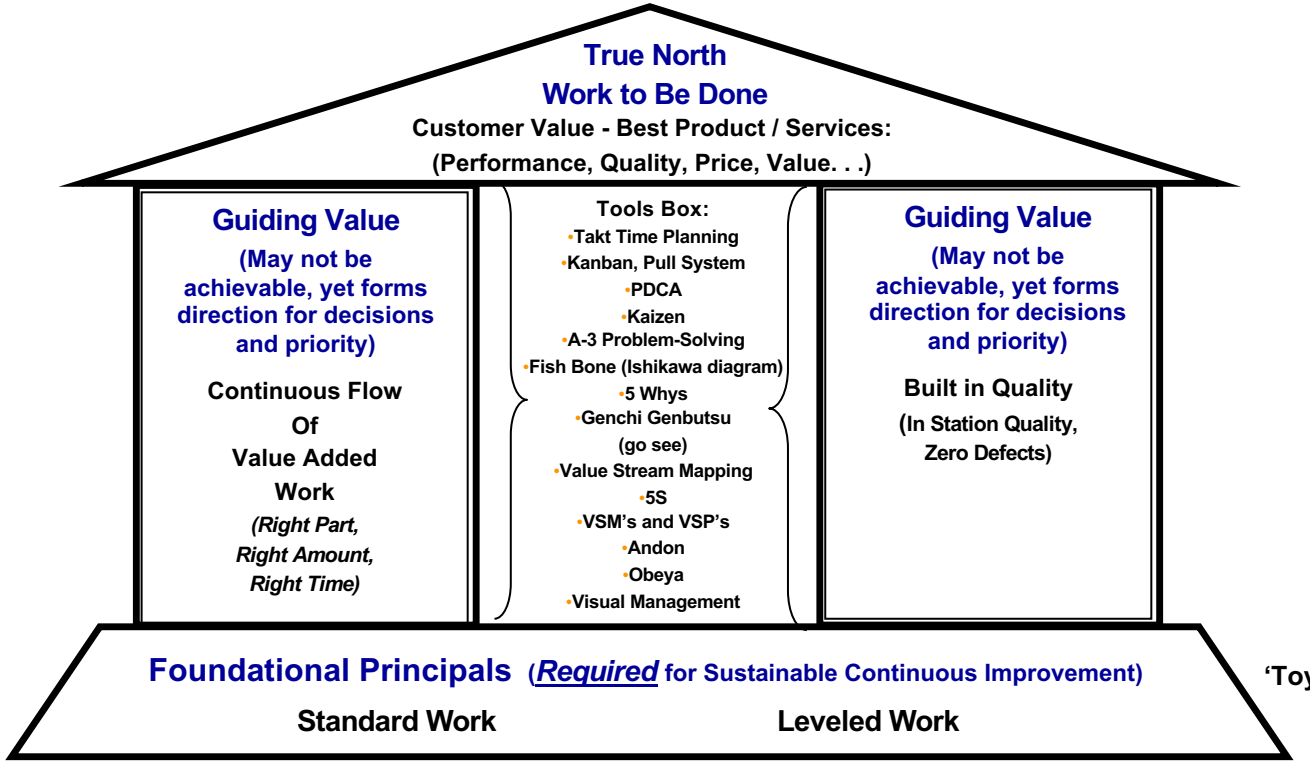
The ‘Big Chill’ and the ‘6th Why’



Adapted From Liker, ‘Toyota Production System’, THE TOYOTA WAY

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Gas Compressors, Cultural Transformation

Gas Compressor Engineering,
Looking for ~~Change~~
Culture Change

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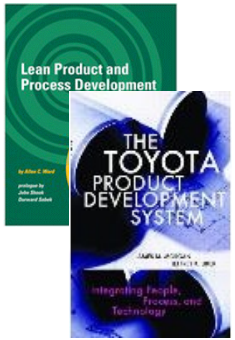

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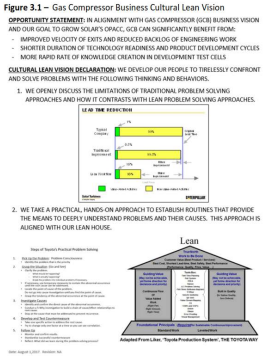

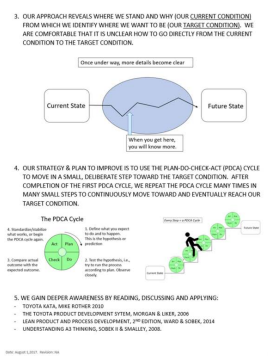

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Gas Compressors, Cultural Transformation

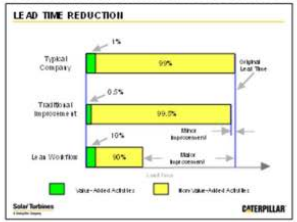
Figure 3.1 – Gas Compressor Business Cultural Lean Vision

OPPORTUNITY STATEMENT: IN ALIGNMENT WITH GAS COMPRESSOR (GCB) BUSINESS VISION AND OUR GOAL TO GROW SOLAR'S OPACC, GCB CAN SIGNIFICANTLY BENEFIT FROM:

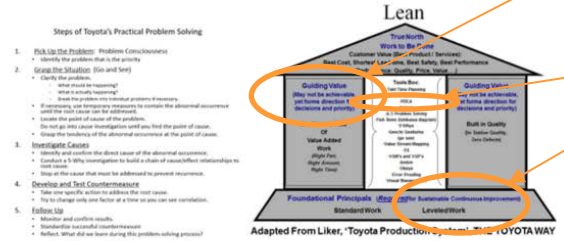
- IMPROVED VELOCITY OF EXITS AND REDUCED BACKLOG OF ENGINEERING WORK
- SHORTER DURATION OF TECHNOLOGY READINESS AND PRODUCT DEVELOPMENT CYCLES
- MORE RAPID RATE OF KNOWLEDGE CREATION IN DEVELOPMENT TEST CELLS

CULTURAL LEAN VISION DECLARATION: WE DEVELOP OUR PEOPLE TO TIRELESSLY CONFRONT AND SOLVE PROBLEMS WITH THE FOLLOWING THINKING AND BEHAVIORS.

1. WE OPENLY DISCUSS THE LIMITATIONS OF TRADITIONAL PROBLEM SOLVING APPROACHES AND HOW IT CONTRASTS WITH LEAN PROBLEM SOLVING APPROACHES.



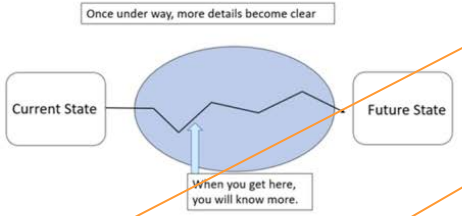
2. WE TAKE A PRACTICAL, HANDS-ON APPROACH TO ESTABLISH ROUTINES THAT PROVIDE THE MEANS TO DEEPLY UNDERSTAND PROBLEMS AND THEIR CAUSES. THIS APPROACH IS ALIGNED WITH OUR LEAN HOUSE.



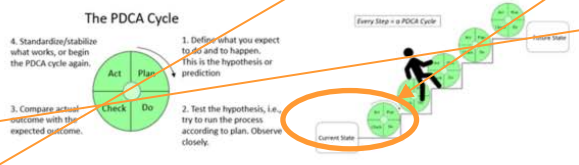
Adapted From Liker, 'Toyota Production ... THE TOYOTA WAY

Date: August 1,2017. Revision: NA

3. OUR APPROACH REVEALS WHERE WE STAND AND WHY (OUR CURRENT CONDITION) FROM WHICH WE IDENTIFY WHERE WE WANT TO BE (OUR TARGET CONDITION). WE ARE COMFORTABLE THAT IT IS UNCLEAR HOW TO GO DIRECTLY FROM THE CURRENT CONDITION TO THE TARGET CONDITION.



4. OUR STRATEGY & PLAN TO IMPROVE IS TO USE THE PLAN-DO-CHECK-ACT (PDCA) CYCLE TO MOVE IN A SMALL, DELIBERATE STEP TOWARD THE TARGET CONDITION. AFTER COMPLETION OF THE FIRST PDCA CYCLE, WE REPEAT THE PDCA CYCLE MANY TIMES IN MANY SMALL STEPS TO CONTINUOUSLY MOVE TOWARD AND EVENTUALLY REACH OUR TARGET CONDITION.



5. WE GAIN DEEPER AWARENESS BY READING, DISCUSSING AND APPLYING:
   - TOYOTA KATA, MIKE ROTHER 2010
   - THE TOYOTA PRODUCT DEVELOPMENT SYTEM, MORGAN & LIKER, 2006
   - LEAN PRODUCT AND PROCESS DEVELOPMENT, 2ND EDITION, WARD & SOBEK, 2014
   - UNDERSTANDING A3 THINKING, SOBEK II & SMALLEY, 2008.

Date: August 1,2017. Revision: NA

'True North'

- Continuous Flow of Value Added Work
- Leveled Work

Continuous Improvement

- Experiment with Kanban

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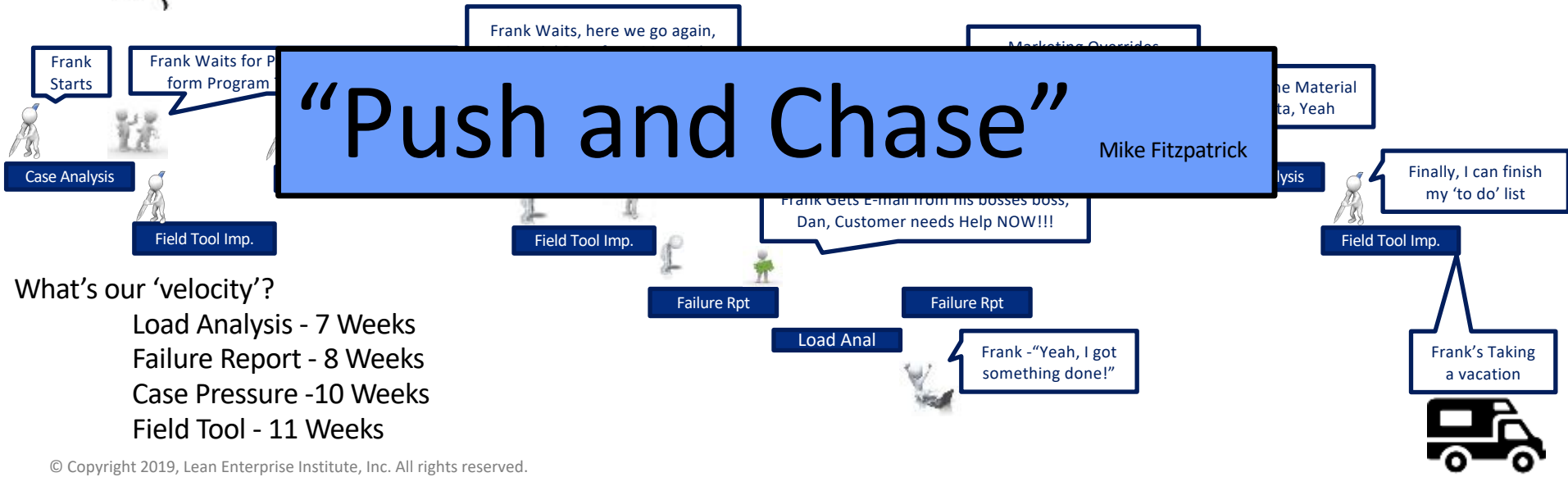
Frank the Extraordinaire Engineer

Meet Frank

Frank has created a ‘to do’ list, in order of priority (According to his best judgement):

#1 - Gas Compressor **Case Analysis**, New Product (4 Tasks: 2 One Week Long, 1 Two Week Long)
#2 – Concept Development, **Field Tool Improvement** (3 Tasks: 1 Week Long Each)
#3 – Write Impeller **Failure Analysis Report** (2 Tasks, 1 Week Long Each)
#1A - Stop Work, **Customer Review of Load Analysis** (1 Week Task)

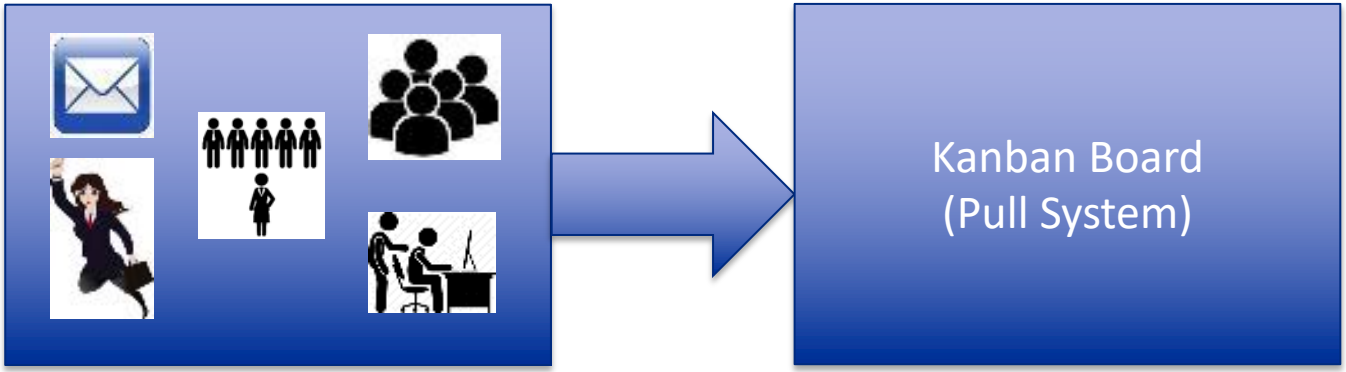


“Push and Chase” Mike Fitzpatrick

What’s our ‘velocity’?

- Load Analysis - 7 Weeks
- Failure Report - 8 Weeks
- Case Pressure -10 Weeks
- Field Tool - 11 Weeks

Frank the Extraordinaire Engineer



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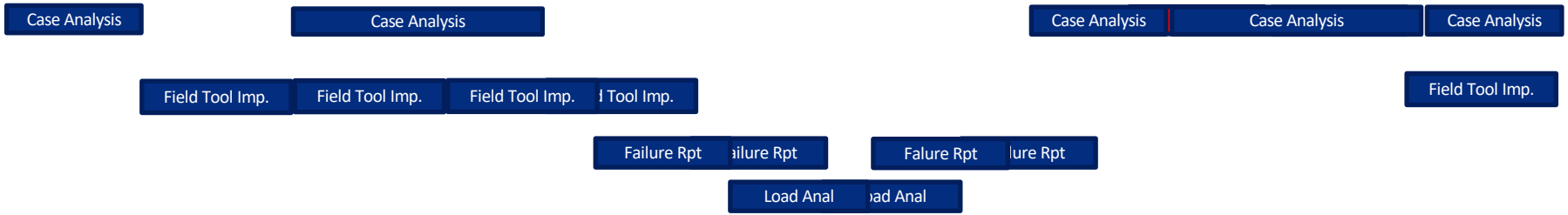
Frank the Extraordinaire Engineer

Some Kanban Rules:

Prioritize work
Don't pull in work that you don't have all the necessary ingredients to complete the assignment
Pull Work in ONLY when you have completed an assignment, consistent with priorities, and within WIP Cap
OK, Sometimes there's something really important that needs to get done, NOW (Silver Bullet)

How does Frank's work life change, what happens to velocity?



What's our 'velocity' now?

Field Tool - 3 vs 11 Weeks
Load Analysis - 5 vs 7 Weeks
Failure Report - 6 vs 8 Weeks
Case Analysis - 10 vs 10 Weeks

. . . But, the best part is Frank enjoys work much more and doesn't want to take vacation

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Frank the Extraordinaire Engineer

What Happens Here s for each task!)

Push (including 25% efficiency loss):

Load Analysis – 8.75 Weeks
Failure Report - 10 Weeks
Case Pressure -12.5 Weeks
Field Tool – 13.75 Weeks

Pull

Load Analysis – 5 Weeks
Failure Report - 6 Weeks
Case Pressure -10 Weeks
Field Tool – 3 Weeks

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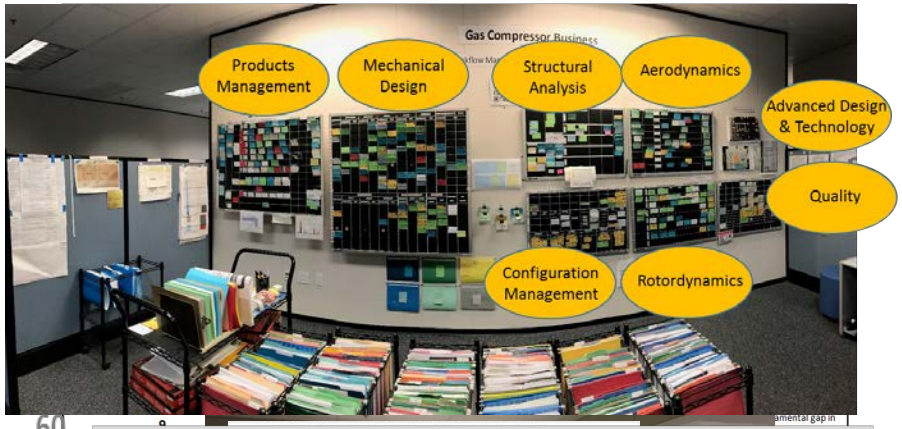
Solar Turbines, Gas Compressor Engineering – Kanban

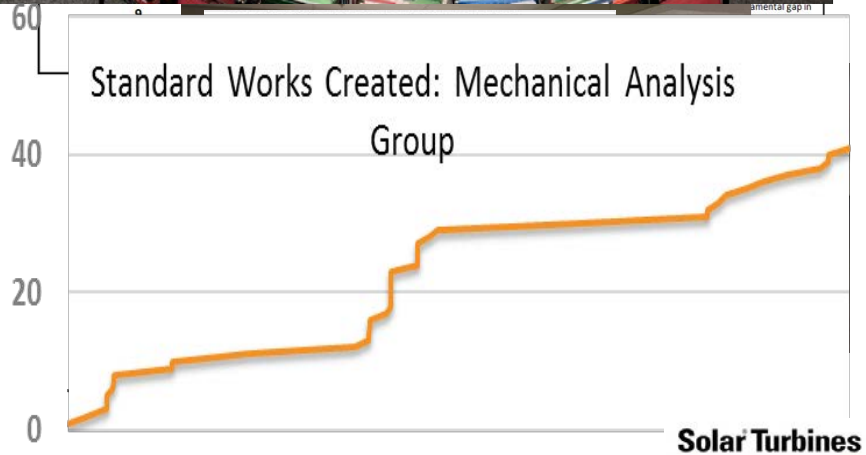
Humble Beginning (Nov. 2016)

- Kanban Board for each organization
- All work prioritized
- WIP caps set
- Pull criteria set



Current State

- Weekly process reflection events
- Dozens of PDCA improvement cycles
- 'Standard Work', sustains improvement cycles
- Process expanding across Solar



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Kanban and Pull Fundamentals

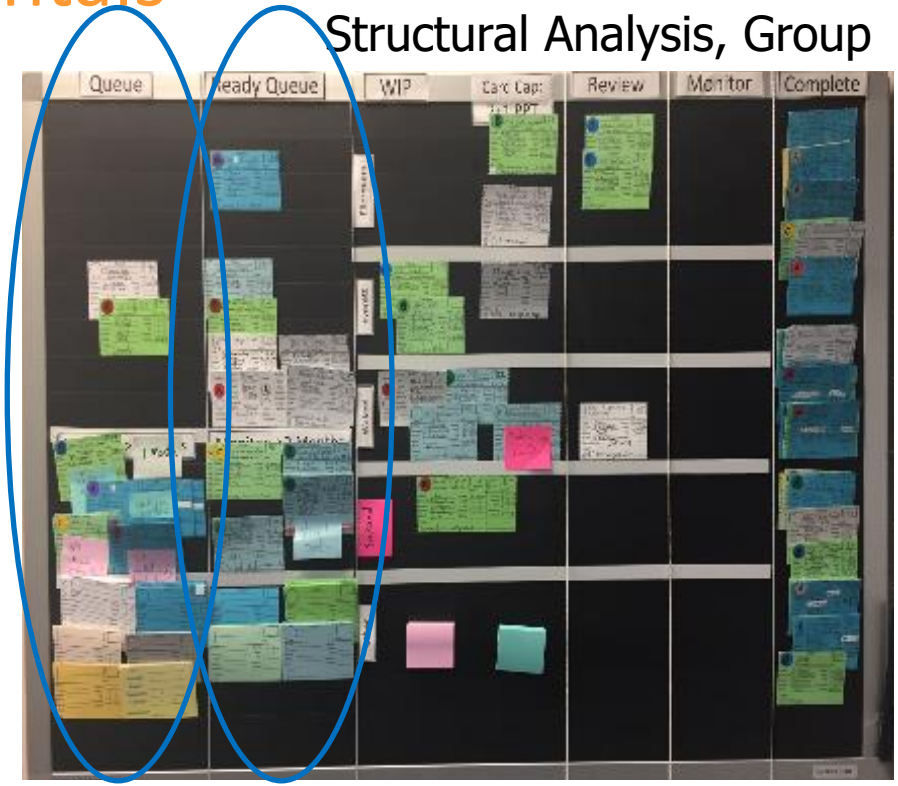
Queue, Push

- All Work added (pushed) to queue
- Scope defined, draft
- Priority scored, preliminary

Ready Queue, Pull Criteria

- Scope finalized, stakeholder alignment
- Final prioritization
- All supporting data available

Structural Analysis, Group



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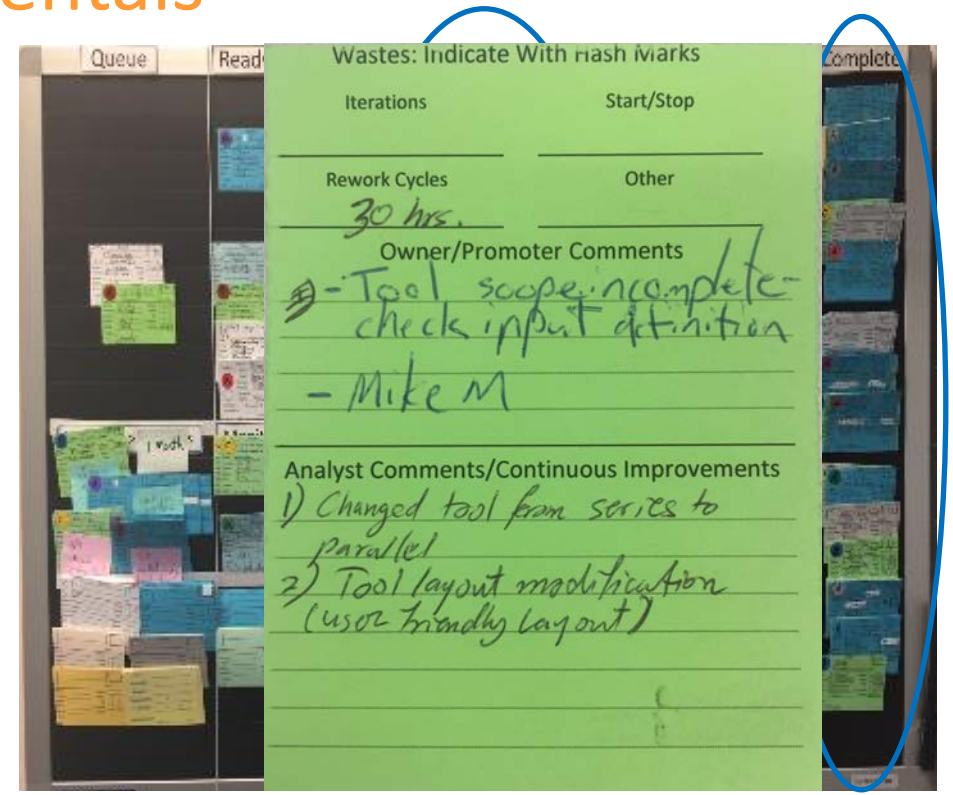
Kanban and Pull Fundamentals

WIP, Pull Criteria

- Available capacity, within WIP cap
- Pulled consistent with priority

Continuous Improvement Cycles

- Reflection events
  - Single piece flow
  - Continuous flow of value added work



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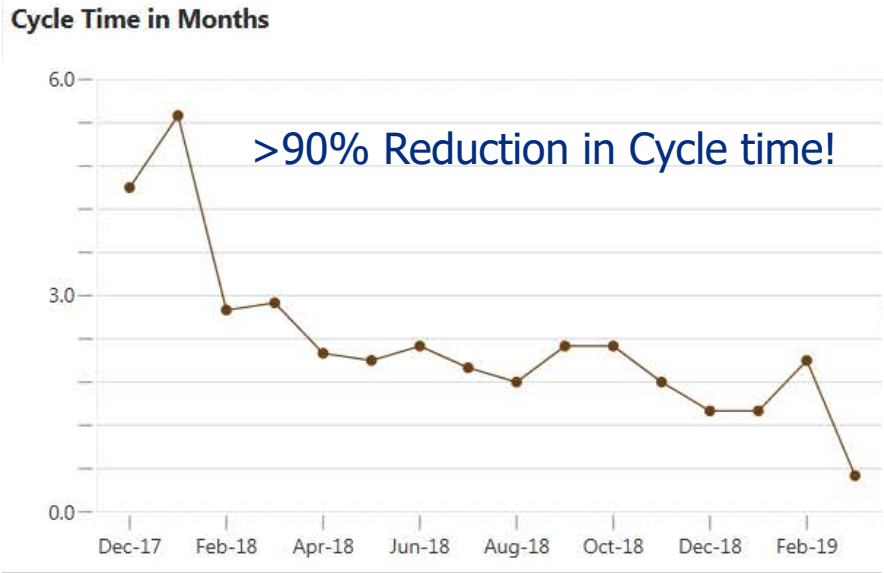
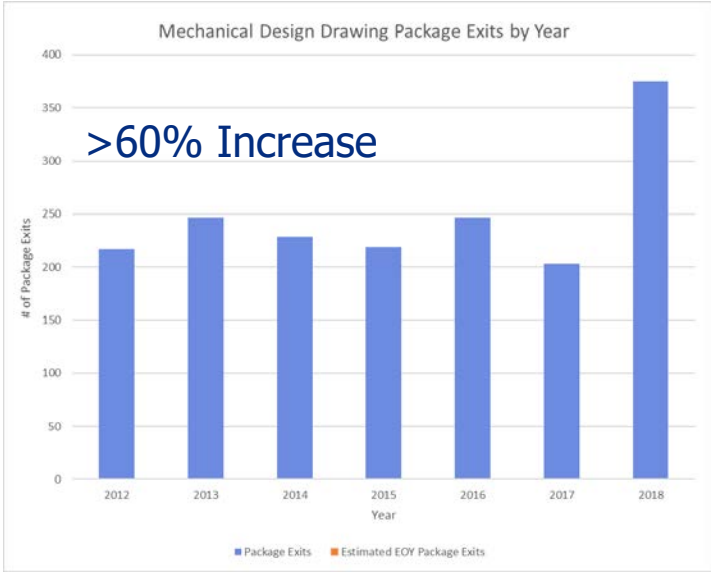
Kanban and Pull, It Works

Configuration Management, Cycle Time:



Drawing Packet, Exits/Year:



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Kanban and Pull, Implementation Strategy

- Start small, Kanban a complete value stream or value stream segment
- Confirm leadership support / engagement exists
- Initial foundational ‘rules’
    - All work prioritized
    - All work managed through Kanban*
    - Work pulled to ready queue when inputs available to complete task
    - Set WIP Caps
    - Pull work into WIP according to priorities and within WIP caps

Kanban and Pull, Implementation Strategy

- Initial Foundational ‘Rules’ (Cont.)
  - Work stays in process until complete
  - Create standard work
  - Reflect and improve standard work, continuously

* . . . Unplanned work greater four hours

Kanban and Pull, Lessons Learned

Problem:

- Process ambiguity
- Prioritization problems
- Continuous improvement & problem paralysis

Counter Measure:

- KanBan Standard Work
- Weekly Process Meetings
- Revise Algorithm, Run an experiment, Avoid ‘Workarounds’
- Allow process changes to evolve into process, experiment then standardize
- Run fast and small PDCA cycles

Kanban and Pull, Lessons Learned

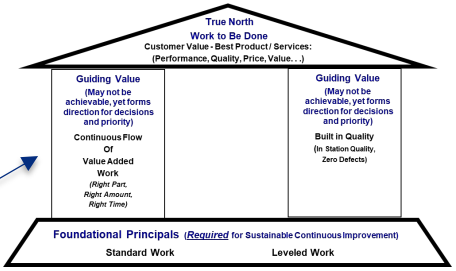
Problem (cont.):

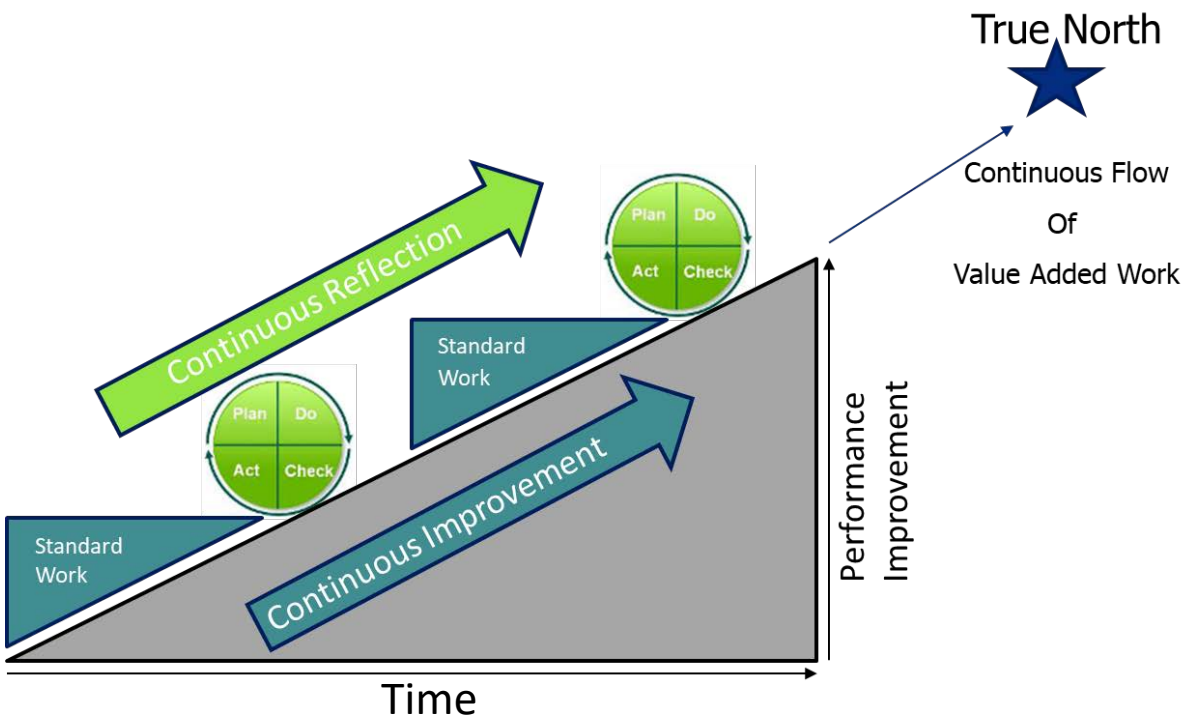
- Candy and broccoli (i.e. personal preference)
- Digital affliction (pixel paralysis)
- Queueing in front of individuals

Counter Measure:

- Respect human tendencies, but add visibility to ‘work stoppage’
- Avoid temptation to go digital, slows improvement cycles and learning
- Develop employees skills to be able to manage people to work rather than work to people

Kanban and Pull, Lessons Learned





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‘Pull’ Through the Engineering Value Stream Workflow Management

Questions and Discussion

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