Lean Aerospace Initiative
Plenary Workshop

Cycle Time Reduction with Part Synchronization

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Research Sponsored By LAI
Outline

- Context
- Design and management of complex manufacturing systems
- Engine sector research
- Engine Study results
- System characteristics
- Observations
Achieving Lean:

Some Accepted Wisdom

- **Customer satisfaction**
  - Produce to actual demand
  - Provide predictable output & rapid response to undesired events
  - Desired quality

- **Continuous Improvement**
  - Systemic
  - Iterative
Customer Satisfaction

- Produce to actual demand
  - On time delivery

- Provide predictable output & rapid response to undesired events
  - Low variability in throughput time
  - Ability to recover schedule

- Desired quality
  - Fitness to standard
  - Fitness to use
  - Fitness to cost
Continuous Improvement

Continuous Improvement = Systemic Improvement + Iterative Improvement

- **Aspects**
  - Action based on facts/data
  - Focus on the vital few
Key Aspects of Continuous Improvement

- **Action based on facts**
  - Understanding of the process
    - Example: Flow chart
  - Use data as the basis for decision making
    - Example: Check sheet (how often do certain events happen)

- **Focus on the vital few**
  - Identify causes
  - Address the biggest problem first
Key Questions
- What enables flow optimization to reduce cycle time?
- What are other manufacturing system elements that enable this reduced cycle time?

Method
- Investigate similar products in each sector
- Focus on assembly operations
- Measure key performance metrics

Progress
- Engine sector completed
- Airframe sector under study
Engine Sector Research

- Three sites
- Studied final assembly of engines
- Research focus
  - Build times
  - Sources of delay
  - Delivery history
  - Manufacturing system performance
- Subsequent investigation of supplier network
**Customer Satisfaction = On Time Delivery**

**Delivery history**

<table>
<thead>
<tr>
<th>Site</th>
<th>Late</th>
<th>On Time</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>35%</td>
<td>65%</td>
</tr>
<tr>
<td>B</td>
<td>30%</td>
<td>70%</td>
</tr>
<tr>
<td>C</td>
<td>0%</td>
<td>100%</td>
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</table>
Engine Sector Study Results (Con’t)

- Key attributes of superior performance:
  - Build on time
  - Predictable build time

![Diagram showing part count and normalized build time for different engine lines (B1, B2, A1, A2, C2, C1). The diagram includes markers for average build time, shortest build time, and longest build time.](image-url)
<table>
<thead>
<tr>
<th></th>
<th>A¹</th>
<th>B²</th>
<th>C</th>
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<tbody>
<tr>
<td>Nonattributable</td>
<td>47%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Parts shortage</td>
<td>38%</td>
<td>70%</td>
<td>3%</td>
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<tr>
<td>Quality</td>
<td>13%</td>
<td>16%</td>
<td>97%</td>
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<tr>
<td>Resources</td>
<td>2%</td>
<td>14%</td>
<td>0%</td>
</tr>
</tbody>
</table>

- Sites A & B did not track build time or sources of delay
- Site C did track build time and other data

¹ Based on weekly measurements of delay sources
² Based on perceptions from multiple levels
What Will Improve the Part Shortage Problem?

- **Part synchronization to assembly ops**
  - Don’t start until all parts available
  - Ensure all parts are available when needed

- **Systemic factors**
  - Planning
  - Scheduling
  - Supplier networks
    - Long term agreements
    - Certified suppliers
Part Synchronization

Key:
- Supplier
- Warehouse
- Assembly Plant

A - Push
- MRP
- Monthly Batches

B - Push
- MRP

C - 80% Pull
- Kanban
  - 80% of parts value
- Kanban

Lean Aerospace Initiative
Observations

- Systemic attack on part synchronization yields major benefits to on time build
- Must have information to focus actions
- Cycle time continues to be important metric
- Production synchronization with suppliers requires steps beyond long term agreements and certified suppliers