This document does not contain Technical Data or Technology as defined in the ITAR Part 120.10 or EAR Part 772
Agenda

Moog – When Performance Really Matters™

DDMRP Journey
June 2017...

DDMRP Results

Next Steps
Moog – When Performance Really Matters™

https://www.youtube.com/watch?v=cLAQCzJEEcI
Moog – When Performance Really Matters™

- Founded in 1951 by Bill Moog
- Headquarters in East Aurora, NY
- Multi-national Company
  - Over 100 locations in 28 Countries
- Over 11,000 Employees Worldwide
- $2.5 Billion in Revenue (FY 2017)
- Aerospace, Defense, Industrial, Medical
- Precision Control System Provider
- Traded on the New York Stock Exchange (MOG-A)
- People-oriented environment with emphasis on individual responsibility
3 Operating Groups, Multiple Markets

2017 Revenue = $2.5B

**Aircraft Group**
- Military Aircraft
- Commercial Aircraft
- Business Jets
- Rotorcraft
- Unmanned Systems
- Navigation and Surveillance
- Global Support
- Engine Controls

$1125M / 45% of total revenue

**Space and Defense Group**
- Military Vehicles
- Missiles
- Naval Platforms
- Air Defense
- Launch Vehicles
- Spacecraft Surveillance

$529M / 21% of total revenue

**Industrial Group**
- Wind Energy
- Industrial Production
- Simulation and Test
- Marine Systems
- Medical Equipment
- Motorsports

$843M / 34% of total revenue

FY’17 Sales / % of Total
DDMRP Journey

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DDMRP Journey

June 2017...

DDMRP Results

Next Steps
Why begin the Journey?

Inventory ↑, OTD ↔, Freight Expedites ↑, Late Delivery Fees ↑

“What if we don’t change at all … and something magical just happens?”
Why begin the Journey?

“Are we making the right parts at the right time in the right amount?” asked V.P. Moog Aircraft Operations
DDMRP Strategy

Lean efforts to reduce lead-times and MOQ’s; strategically place buffers using DDMRP methodology.
## DDMRP Pilots

<table>
<thead>
<tr>
<th>SITE</th>
<th>KAIZEN</th>
<th>GO LIVE</th>
<th>PART(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 US Site 1</td>
<td>Multiple</td>
<td>Jan 2018</td>
<td>Commercial Aircraft Pumps</td>
</tr>
<tr>
<td>2 US Site 1</td>
<td>Multiple</td>
<td>Jan 2018</td>
<td>Military Aircraft Rudder</td>
</tr>
<tr>
<td>3 US Site 1</td>
<td>Feb 2018</td>
<td>Mar 2018</td>
<td>Military Aircraft Servo</td>
</tr>
<tr>
<td>4 UK Site 1</td>
<td>Feb 2018</td>
<td>Feb 2018</td>
<td>Aerospace Rotatable Stock</td>
</tr>
<tr>
<td>5 UK Site 2</td>
<td>Feb 2018</td>
<td>Feb 2018</td>
<td>Military Aircraft Bearing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Swivel Module</td>
</tr>
<tr>
<td>6 Asia Site</td>
<td>Mar 2018</td>
<td>Apr 2018</td>
<td>Commercial Aircraft AGB</td>
</tr>
<tr>
<td>7 Asia Site</td>
<td>Mar 2018</td>
<td>Apr 2018</td>
<td>Commercial Aircraft Servomods</td>
</tr>
<tr>
<td>8 Asia Site</td>
<td>Mar 2018</td>
<td>May 2018</td>
<td>Commercial Aircraft Gearboxes</td>
</tr>
<tr>
<td>9 Asia Site</td>
<td>Mar 2018</td>
<td>Apr 2018</td>
<td>Supplier 1</td>
</tr>
<tr>
<td>10 US Site 2</td>
<td>Apr 2018</td>
<td>Jun 2018</td>
<td>Military Aircraft Wingfolds</td>
</tr>
</tbody>
</table>

**AG Pilots on Schedule – Controlled Learning**
DDMRP Monitoring

• Phase I: Early Pilot Monitoring
  • Value Stream Improvement Plans
  • Bi-Modal Distribution
  • Daily Stand Ups

• Phase 2: System Metrics Created
  • On Hand Buffer History
  • Planning Buffer History
  • On Hand Run Chart

• Phase 3: System Metrics/Trends
  • Actions for Dark Reds
  • Actions for Blues

• Phase 4: How to prioritize
  • Work-Order Prioritization Tool
  • P.O. Prioritization Tool
DDMRP Journey Lessons Learned

- Change Management
- Executive Champion
- Training – lots of it!
- Lean Maturity
- Protecting the customer downstream $$$, often unachievable Safety Stock
- Buffers should be placed near to the process that creates them: Accountability, Visibility, Continuous Improvement
- Supplier and Operations communication; the build up of buffers takes planning
- Buffer Size greatly dependent on Lead-time and/or MOQ: Validate & Challenge
  - LT accuracy (e.g., Vendor Schedule), opportunity for multiple LT’s: New Order versus Replenished
  - MOQ updates – Data Maintenance (e.g., based on Long Term Agreements)
- Standardized metrics / tools / standard work (Kaizen Event through Stabilization)
- Build Allies / Supporters
- DDMRP will not fix quality / delivery issues but the metrics will highlight where to focus attention
- Learning and Adapting – Change Management
DDMRP Journey Lessons Learned

Change Management – DDMRP Home Page
DDMRP Results

Moog – When Performance Really Matters™

DDMRP Journey
June 2017...

DDMRP Results

Next Steps
Commercial Aircraft Primary Flight Controls

Primary Flight Control Actuation

- Spoiler EHA Quantity = 2
- Spoiler Quantity = 12
- Outboard Aileron Quantity = 4
- Rudder Quantity = 2
- Rudder EHA Quantity = 1
- Inboard Aileron Quantity = 2
- Inboard Aileron EHA Quantity = 2
- Elevator Quantity = 2
- Elevator EHA Quantity = 2

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## DDMRP Results - Lead-time

<table>
<thead>
<tr>
<th>SITE</th>
<th>PART(S)</th>
<th>CURRENT CUM LT</th>
<th>TARGET DECOUPLED LT</th>
<th>% CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Site 1</td>
<td>Commercial Aircraft Pumps</td>
<td>295</td>
<td>15</td>
<td>-95%</td>
</tr>
<tr>
<td>US Site 1</td>
<td>Military Aircraft Rudder</td>
<td>331</td>
<td>92</td>
<td>-72%</td>
</tr>
<tr>
<td>US Site 1</td>
<td>Military Aircraft Servo</td>
<td>198 - 437</td>
<td>5 - 123</td>
<td>-43% to -98%</td>
</tr>
<tr>
<td>UK Site 1</td>
<td>Aerospace Rotatable Stock</td>
<td>173</td>
<td>12</td>
<td>-93%</td>
</tr>
<tr>
<td>UK Site 2</td>
<td>Military Aircraft Bearing Swivel Module</td>
<td>333</td>
<td>98</td>
<td>-71%</td>
</tr>
<tr>
<td>Asia Site</td>
<td>Commercial Aircraft AGB</td>
<td>338</td>
<td>97</td>
<td>-71%</td>
</tr>
<tr>
<td>Asia Site</td>
<td>Commercial Aircraft Servomods</td>
<td>549-551</td>
<td>18-20</td>
<td>-96%</td>
</tr>
<tr>
<td>Asia Site</td>
<td>Commercial Aircraft Gearboxes</td>
<td>314</td>
<td>20</td>
<td>-94%</td>
</tr>
<tr>
<td>Asia Site</td>
<td>Supplier 1</td>
<td>110-234</td>
<td>72</td>
<td>-35% to -69%</td>
</tr>
<tr>
<td>US Site 2</td>
<td>Military Aircraft Wingfolds</td>
<td>266</td>
<td>20</td>
<td>-92%</td>
</tr>
</tbody>
</table>

**Significant Lead-time Improvement**
## DDMRP Results - Inventory

<table>
<thead>
<tr>
<th>SITE</th>
<th>PART(S)</th>
<th>INVENTORY CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Site 1</td>
<td>Commercial Aircraft Pumps</td>
<td>-27%</td>
</tr>
<tr>
<td>US Site 1</td>
<td>Military Aircraft Rudder</td>
<td>-13%</td>
</tr>
<tr>
<td>US Site 1</td>
<td>Military Aircraft Servo</td>
<td>-31%</td>
</tr>
<tr>
<td>UK Site 1</td>
<td>Aerospace Rotatable Stock</td>
<td>-3%</td>
</tr>
<tr>
<td>UK Site 2</td>
<td>Military Aircraft Bearing Swivel Module</td>
<td>-18%</td>
</tr>
<tr>
<td>Asia Site</td>
<td>Commercial Aircraft AGB</td>
<td>-4%</td>
</tr>
<tr>
<td>Asia Site</td>
<td>Commercial Aircraft Servomods</td>
<td>-4%</td>
</tr>
<tr>
<td>Asia Site</td>
<td>Commercial Aircraft Gearboxes</td>
<td>-29%</td>
</tr>
<tr>
<td>Asia Site</td>
<td>Supplier 1</td>
<td>-49%</td>
</tr>
<tr>
<td>US Site 2</td>
<td>Military Aircraft Wingfolds</td>
<td>-9%</td>
</tr>
</tbody>
</table>

**Lead-time reduction + Flow improvement = Decreased Inventory**
Commercial Aircraft Pilot – Pumps support 4 Models

- DDMRP Go Live on Pump assemblies
- Various Make and Purchased Part Issues

Assembled in
US Site 1
(M/P parts);
shipped to
Asia Site

Pumps on
DDMRP

Model not on
DDMRP

Other Make
Parts not on
DDMRP

Other
Purchased Parts
Not on DDMRP

Assembled in
Asia Site
(M/P parts)
**DDMRP Receiving Site: Asia Site**

- Initial buffer only at Receiving Site – Manufacturing Site did not hold inventory – Push system; DDMRP signals not reacted to; ADU learnings.

- Current State: Buffer built and maintained with ZERO stock-outs

![Chart showing Commercial Aircraft Models A & B: Pump 1 with 1 in stock at a specific time point.](chart.png)
DDMRP Manufacturing Site: US Site 1

- **On-Hand Buffer:** It took a while to believe in signals and then create buffer but ZERO stock-outs at receiving / customer site.

- **Current State:** Each site now responsible for their own buffer status.

---

**Commercial Aircraft Models A & B: Pump 1**

![Chart showing time series data for commercial aircraft models A & B: Pump 1.](chart.png)
DDMRP RESULTS

- Transformation from Push to Pull Signals
- Standardized Planner / Buyer Signals and Monitoring
- Stabilized Demand Signals at Lead-time
- Standardized Metrics and Visualization
- When Executed it Builds Protection into our Complex System
Next Steps

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DDMRP Journey
June 2017...

DDMRP Results

Next Steps
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## DDMRP Implementation Tracking

<table>
<thead>
<tr>
<th>Site</th>
<th>DDMRP Go Live Parts</th>
<th>Strategic Buffers</th>
<th>Healthy Buffers (&gt;50% RED OH)</th>
<th>Stocked Out Strategic Buffers (Dark Red)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASIA Site</td>
<td>2%</td>
<td>70%</td>
<td>53%</td>
<td>13%</td>
</tr>
<tr>
<td>UK Site 1</td>
<td>60%</td>
<td>48%</td>
<td>52%</td>
<td>8%</td>
</tr>
<tr>
<td>UK Site 2</td>
<td>2%</td>
<td>93%</td>
<td>58%</td>
<td>16%</td>
</tr>
<tr>
<td>US Site 1</td>
<td>7%</td>
<td>28%</td>
<td>59%</td>
<td>13%</td>
</tr>
<tr>
<td>US Site 2</td>
<td>5%</td>
<td>76%</td>
<td>56%</td>
<td>8%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>9%</td>
<td>42%</td>
<td>55%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Commitment to Demand Driven: Shop – Suppliers – A&T
DDMRP Automated Tracking by Site

% DDMRP GO LIVE OF ACTIVE PARTS

BUFFER TYPE BREAKDOWN OF DDMRP GO LIVE PARTS

ON HAND BUFFER HEALTH OF ALL STRATEGIC (DD, RO) PARTS
Next Steps / Challenges

UK Site 2 Machine Shop Future State:
Pulling value to customer demand.
Ensuring parts are available, in stock, ready for build!

Future State

- Training – New employees & continuous education
- Software Developments
  - Supermarkets
  - Multi-Site / Multi-Stockroom
  - Finite Scheduling

Functional Area Engagement

- Manufacturing Engineers
- Finance
- Supply Chain

DDS&OP / Standard Work

Change Management – KPI’s
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✔ Thank you! Danke schön!