How Will You Interoperate Without Operations

Kevin Mitchell
Northrop Grumman,
Sector Vice President, Global Operations
09/17/2019
Kevin Mitchell

Sector Vice President of Global Operations
Kevin Mitchell is sector vice president, Global Operations, at Northrop Grumman Aerospace Systems, a premier provider of military aircraft, autonomous and space systems and next-generation solutions to assist our customers worldwide, preserve freedom and advance human discovery.

Education/Certification
Masters of Science: Global supply chain management, University of Southern California
Masters of Bus Admin: Business administration, Global management, University of Phoenix
Bachelors of Science: Business administration, University of Phoenix
Executive programs: Harvard University, creating corporate advantage
Executive Certificate: University of Washington: Aerospace manufacturing
Executive Certificate: Stanford University, Global supply chain management strategies
Certificate: Six Sigma Green Belt, UCLA

Current Responsibilities
• 31 years of success in managing large-scale operations
• Mitchell leads a team of approximately 6,000 people that produce, procure and facilitate some of the world’s most capable and technologically advanced aerospace systems
  – Oversee Global Supply Chain, Manufacturing Center of Excellence, Facilities and Environmental, Safety, Health and Medical organizations across the sector
  – Responsible for developing strategies, new innovative and affordable solutions to enhance the efficiency and productivity of Aerospace Systems Supply Chain & manufacturing activities around the globe
Our Vision

Preserving Freedom

Advancing Human Discovery
Four Operating Sectors

**Aerospace Systems**
Premier provider of military aircraft, autonomous and space systems and next-generation solutions to assist our customers worldwide, preserve freedom and advance human discovery.

**Innovation Systems**
Global leader in affordable, reliable and innovative space, defense and flight systems that are designed to enable national security, civil government and commercial customers to achieve their critical missions.

**Mission Systems**
Leading global provider, manufacturer and integrator of advanced, secure and agile software-defined systems and solutions. Our differentiated C4ISR and cyber solutions deliver timely, mission-enabling information and provide superior situational awareness and understanding to protect the U.S. and its global allies.

**Technology Services**
Global provider of innovative, cost effective solutions. From sustainment and modernization, supply chain management, training and simulation, and high technology services, we offer a full-spectrum of support.
Deliver the World’s Most Capable & Technologically Advanced Aerospace Systems

NGAS Global Operations - Centers of Excellence/Sites
A&D Manufacturing Base Challenges

- Global Footprint & Foreign Reliance
- Differing OEM Requirements
- Adequate Visibility Into Lower Tier
- Cyber Security, Data Rights & Different Systems

- Commercial Industry Volumes
- Shrinking Supply Chain & Sole Source
- Capitalization with Uncertain Demand
- Acquisition Practices

Values are Foundational to Address Challenges and Enable Performance
A&D Supply Chain Risk Mitigation - Opportunities

- Setting up Suppliers for Success
- Supplier Partnerships & Industry Days
- Focus on Risk Reduction & Reward Performance
- Digital Thread & Real-Time Visibility
- Advanced Analytics
- Advanced Manufacturing Capabilities
- Ability to In-load

Digital Thread Enhances Capability & Capacity
Bending the Curve - Change the Way You Design

**Up to 85% of Costs are committed during design and development** – At Milestone B, up to 90% of costs could be locked in!

**A true Design to Cost approach**
- Engage Manufacturing Organization Early in Process
- Add Less Manufacturing Automation
- Design Products with Less Manufacturing Hour Content

**Fundamental Changes in our Approach to Development are Essential**

**DTC = PTW Investments**
- Design with Bonded Assembly
- Design for Automation
- Model Based Enterprise
- Digital Thread
- Reuse (5R’s)
- Process Validation
- Material Improvement
- Improved Op Model
- Simulation

**Historical T1 & Improvement Curve**

**Design-to-Cost T1 & Improvement Curve**

**Hours Savings**

**Source:** DARPA Rapid Design Exploration and Optimization (RaDEO) Project

© 2019 Northrop Grumman Systems Corporation. All Rights Reserved.
Digital Technologies Driving Cultural Shift

Traditional Method to Reduce Risk: Physical
- Physical Mockups
- Hand Posturing Mannequins
- Best Practices / Operator Knowledge

New Technologies to Reduce Risk: Digital
- Utilize Virtual Mockups
- Virtual Reality and Motion Capture Technology
- Digital Thread / Twin Enablers
Model Based Manufacturing Simulations

Highly Immersive Virtual Environment (HIVE)

Virtual Manufacturing & VR to Build and Deliver the Optimal Product
Augmented Reality (AR): Real-world environment whose elements are augmented (or supplemented) by software-generated sensory input

Virtual Reality (VR): Software-generated sensory input to replicate a real-world environment & simulates a user's presence in this environment

Motion Capture (MoCap): Recording movements of objects/people to animate digital objects & characters in 2D/3D generated environments
Fastener Insertion Live Link System (FILLS) Overview

- Developed by Variation Reduction Solutions, Inc., Delta Sigma Corporation and Northrop Grumman in collaboration with the U.S. Air Force Research Laboratory
- Implemented on the F-35 Integrated Assembly Line (IAL) in 2015
- 2012 Defense Manufacturing Technology Achievement Award, outstanding technological achievement

Benefits

- Eliminates the manual recording of fastener grip length on assembly
- Electronically records as-built fastener kit
- Low cost optical projectors coupled with 3-D model allows production flexibility to as-built conditions

Fundamental Change for High Precision & Complex Aircraft Assembly
Extending Model Based Manufacturing into Production

Opportunity Exists but Hardware & Software Need to Mature
- Battery Life & Form Factor
- Integration w Business Systems, PLM tools, & Supply Chain
- Cyber Security & DoD Environments

Production Operators are the End Users
Elements of the Smart Factory

**Smart Factories**

- Automated machine health, maintenance, and quality reports
- Automated alerts and notifications
- Automated maintenance recommendations and appropriate corrective action
- Repository/Warehouse for Maintenance and Quality Data
- Recommendations for optimized operations and maintenance schedules

**Real-time Visibility Driving Operational Efficiencies Within the Factory**

**Real-time Visibility Driving Operational Efficiencies Within the Factory**

**Advanced Analytics**

**Advanced Automation**

© 2019 Northrop Grumman Systems Corporation. All Rights Reserved.
Design To Cost Design for Manufacturing - Simulations

Benefits

Customers: Greater Engagement, Buy-in, & Sponsorship
Engineering: Optimized Configurations, Improved Producibility
Manufacturing: Reduced Risk, Tags, Injuries & Less Disruption
Quality: First Time Quality, Fewer Tags & Less Change
Sustainment: Operational Readiness

Cost, Weight, Delivery & Systems Performance

Simulations for Production and Sustainment Operations
Design out Manufacturing and Sustainment Challenges While Delivering 3D Work Instructions to the Operators

Significant Savings – Design Cost Out
Winning Objective - Traditional Design Vs Design to Cost

**Traditional Design**

- Elements of Realization (Variance Factor)
- Personal Fatigue & Delay (PFD)
- Complexity
- Engineered Standards Data (Stds)

**Design for Automation**

- Reduced Crane Moves, Automated Drilling = Minor Standards and Elements Reduction
- 14% Lower Manufacturing Cost

**Design to Cost**

- DTC Significantly Reduces the Standards and the Elements of Realization
- Lower Manufacturing Cost = 39%
- 21.4% Lower Manufacturing Cost

**Design To Cost (DTC)**

Reduce Std Work (SOW) Examples

- Design for Manufacturability
- Automation
- Improved Design
- Non Traditional Materials & Processes
- Additive Mfg

Reduce Elements of Realization Inefficiencies

- Automation
- Reduced Change
- Reduced Rework
- Improved Knowledge Transfer
- 3D Planning & Work Instructions
- Optimized Work Flow
- Reduced Part Shortages
- Tooling
- Producibility
- Reduced Waste

**Performace**

DTC: Reduces Standards – Drives Out Significant Variance Factor
Interoperate With Operations

Lower Manufacturing Cost

Driving Manufacturing to the Left
- Design to Cost Principles
- Manufacturing Simulations
- Virtual & Augmented Reality
- Smart Factory
- Advanced Analytics
- Digital Thread / Twin

Production Operations

Advanced Automated Assembly
Earned 100% in the Human Rights Campaign Foundations’ 2018 Corporate Quality Index and the Distinction of Best Places to Work for LGBTQ Equality

Ranked #23 on DiversityInc’s Top 50 Companies for Diversity

Received 100% on the Disability Equality Index as the Best Place to Work

2019 Quality Plant of the Year
Top Aerospace & Defense Company on DiversityInc’s Top 50, 9 Years in a Row

2019 Manufacturing Leadership Award: Analytics-Enabled Complex Assemblies

#1 Top-Rated Workplace by Millennials on Indeed.com

2018 MEEK Award
2015 Dwight D. Eisenhower Award for Excellence

2018 Catalyst Award for Commitment to Women in Leadership

National Aerospace Awards:
John R. Alison, Theodore von Karman Award,
Gen George Kenney Award

2018 MEEK Award
Ranked #9 of 15 Companies for Work-Life Balance on Indeed.com

2019 Manufacturing Leadership Award for Assembly Metadata Integration

Ranked #1 on DiversityInc’s Top 18 Companies for Veterans

Zero Waste Certification - Silver
Earned 100% in the Human Rights Campaign Foundations’ 2018 Corporate Quality Index and the Distinction of Best Places to Work for LGBTQ Equality

Ranked #23 on DiversityInc’s Top 50 Companies for Diversity

Received 100% on the Disability Equality Index as the Best Place to Work

2019 Quality Plant of the Year
Top Aerospace & Defense Company on DiversityInc’s Top 50, 9 Years in a Row

2019 Manufacturing Leadership Award: Analytics-Enabled Complex Assemblies

#1 Top-Rated Workplace by Millennials on Indeed.com

2018 MEEK Award
2015 Dwight D. Eisenhower Award for Excellence

2018 Catalyst Award for Commitment to Women in Leadership

National Aerospace Awards:
John R. Alison, Theodore von Karman Award,
Gen George Kenney Award

Ranked #2 on DiversityInc’s Top 20 Companies for Executive Diversity
Ranked #9 of 15 Companies for Work-Life Balance on Indeed.com

2019 Manufacturing Leadership Award for Assembly Metadata Integration

Ranked #1 on DiversityInc’s Top 18 Companies for Veterans

Zero Waste Certification - Silver
THE VALUE OF PERFORMANCE.

NORTHROP GRUMMAN