

How Will You Interoperate Without Operations

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

GLOBAL PRODUCT DATA
INTEROPERABILITY
S U M M I T
2019





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



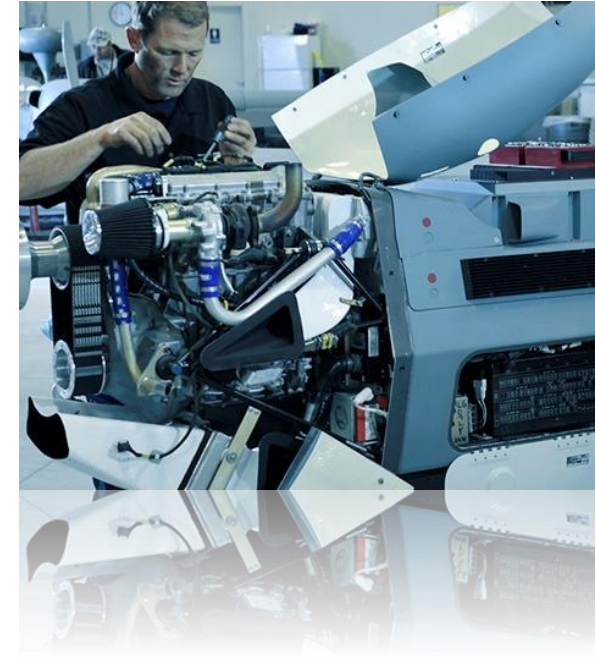
Global leader in affordable, reliable and innovative space, defense and flight systems that are designed to enable national security, civil government and commercial customers to achieve their critical missions.

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.

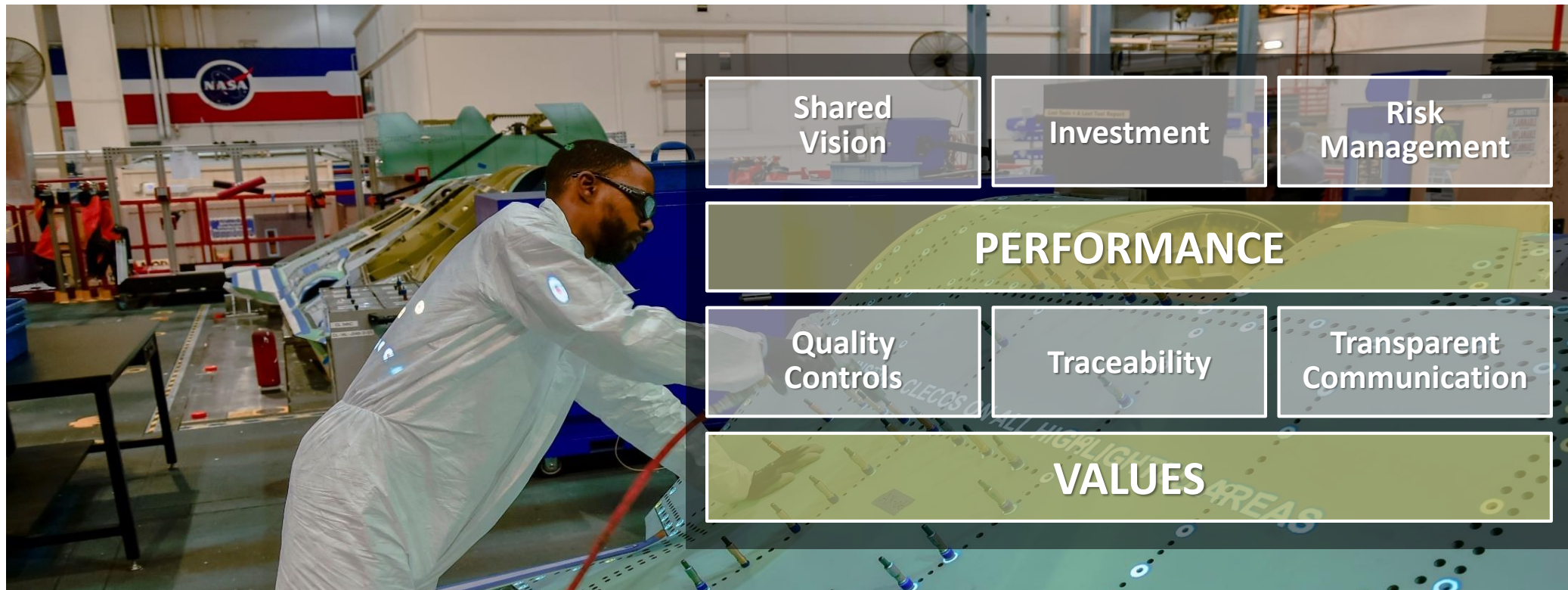
NGAS Global Operations - *Centers of Excellence/Sites*



Deliver the World's Most Capable & Technologically Advanced Aerospace Systems

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

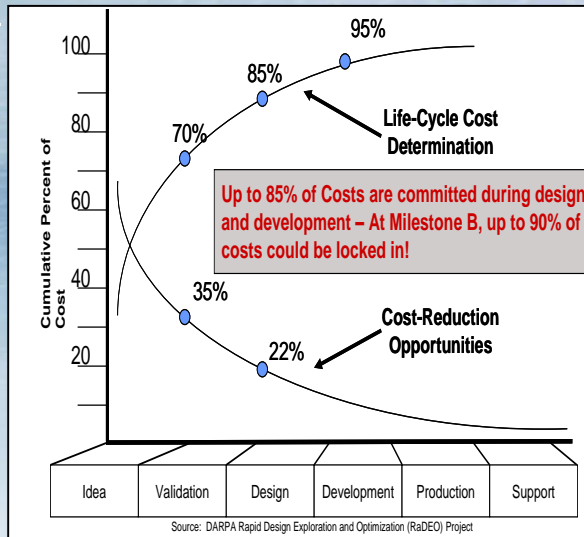
A&D Supply Chain Risk Mitigation - Opportunities

- 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



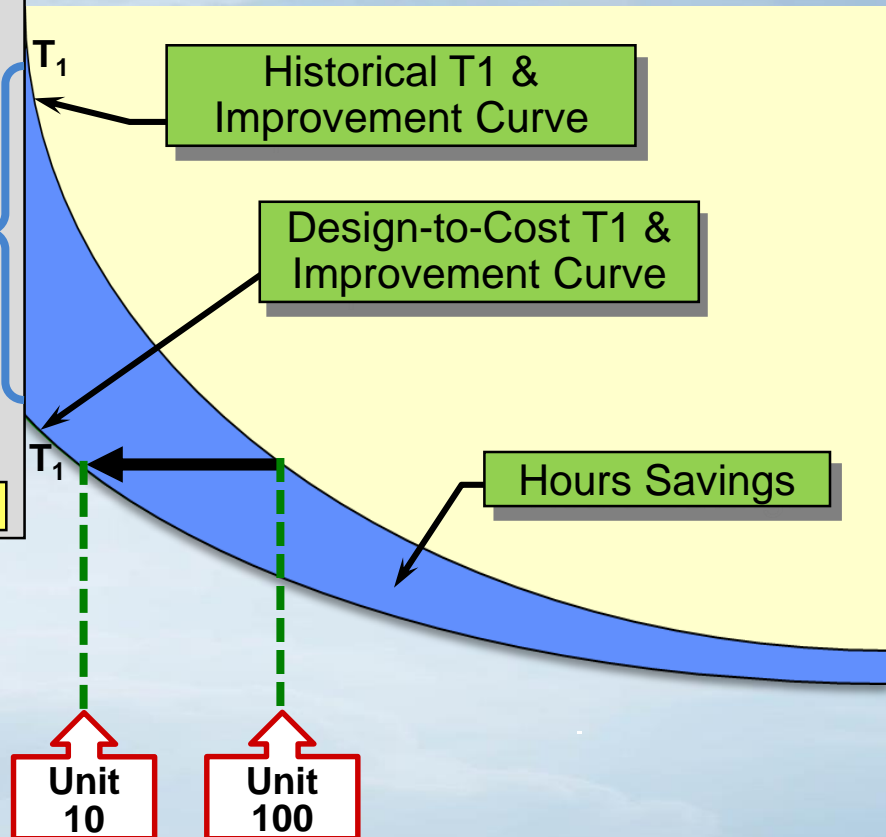
A true Design to Cost approach

- Engage Manufacturing Organization Early in Process
- Add Less Manufacturing Automation
- Design Products with Less Manufacturing Hour Content

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

Pre-Award



Fundamental Changes in our Approach to Development are Essential

Digital Technologies Driving Cultural Shift



Traditional Method to Reduce Risk: Physical

- *Physical Mockups*
- *Hand Posturing Mannequins*
- *Best Practices / Operator Knowledge*

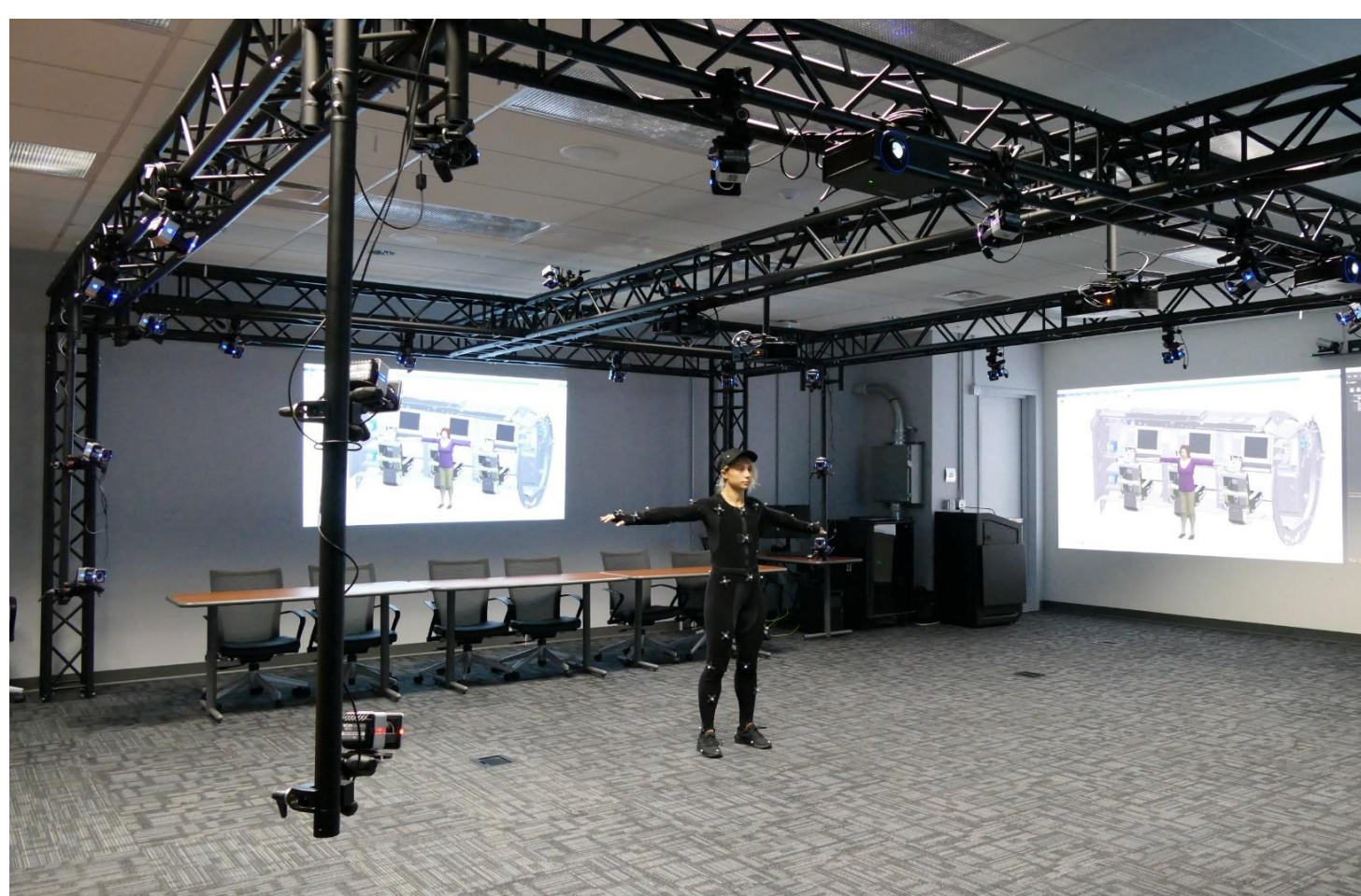
New Technologies to Reduce Risk: Digital

- *Utilize Virtual Mockups*
- *Virtual Reality and Motion Capture Technology*
- *Digital Thread / Twin Enablers*



Model Based Manufacturing Simulations

Highly Immersive Virtual Environment (HIVE)



VICON NANTAGE



Virtual Manufacturing & VR to Build and Deliver the Optimal Product

HIVE Technologies

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



Real Environment

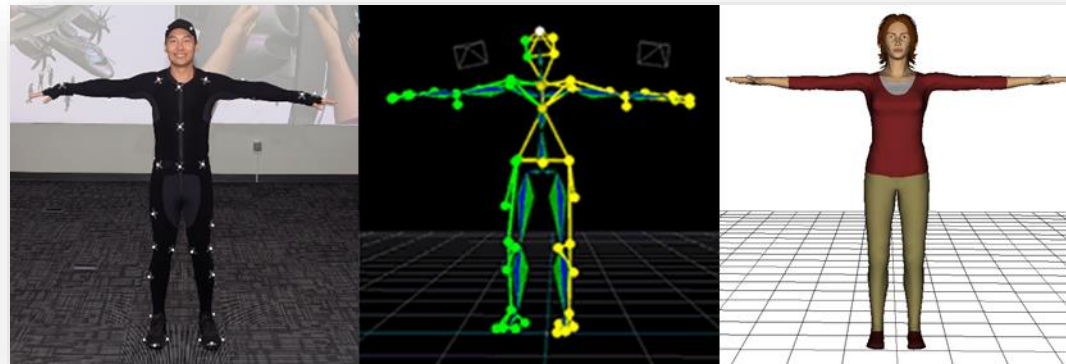


**Augmented Reality
(AR)**



**Virtual Reality
(VR)**

Motion Capture (MoCap): Recording movements of objects/ people to animate digital objects & characters in 2D/3D generated environments



Virtual Model Interaction at Northrop Grumman

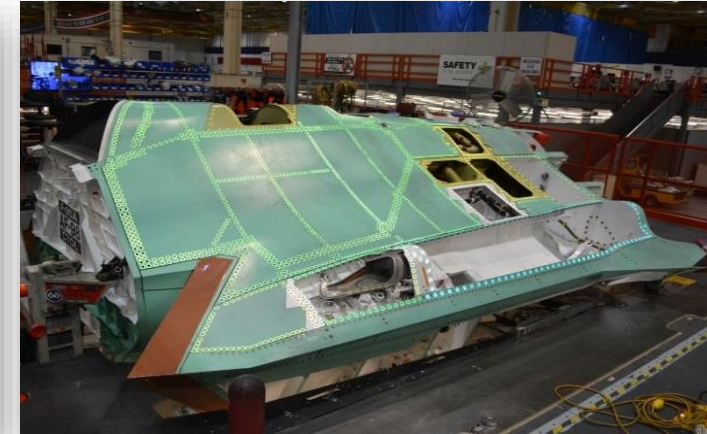


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Model Based Manufacturing Accelerating into Production

NORTHROP GRUMMAN

Fastener Insertion Live Link System (FILLS) Overview



Fastener Insertion Live Link System (FILLS)

- 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**

Model Based Manufacturing Accelerating into Production

NORTHROP GRUMMAN

FILLS VIDEO

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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



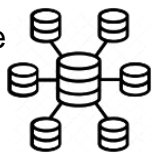
Automated alerts and notifications



Automated maintenance recommendations and appropriate corrective action



Repository/Warehouse for Maintenance and Quality Data



Recommendations for optimized operations and maintenance schedules



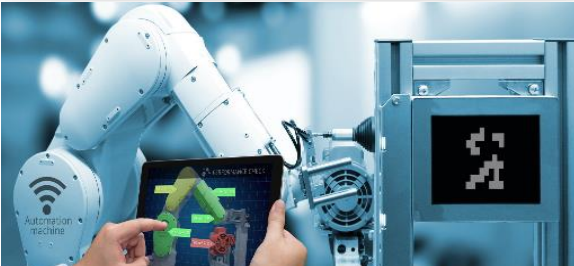
Real-time Visibility Driving Operational Efficiencies Within the Factory



Real-time Visibility



Advanced Analytics



Advanced Automation

Design To Cost Design for Manufacturing - Simulations

F-35 Joint Strike Fighter Integrated Automated Assembly Line (IAL)



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

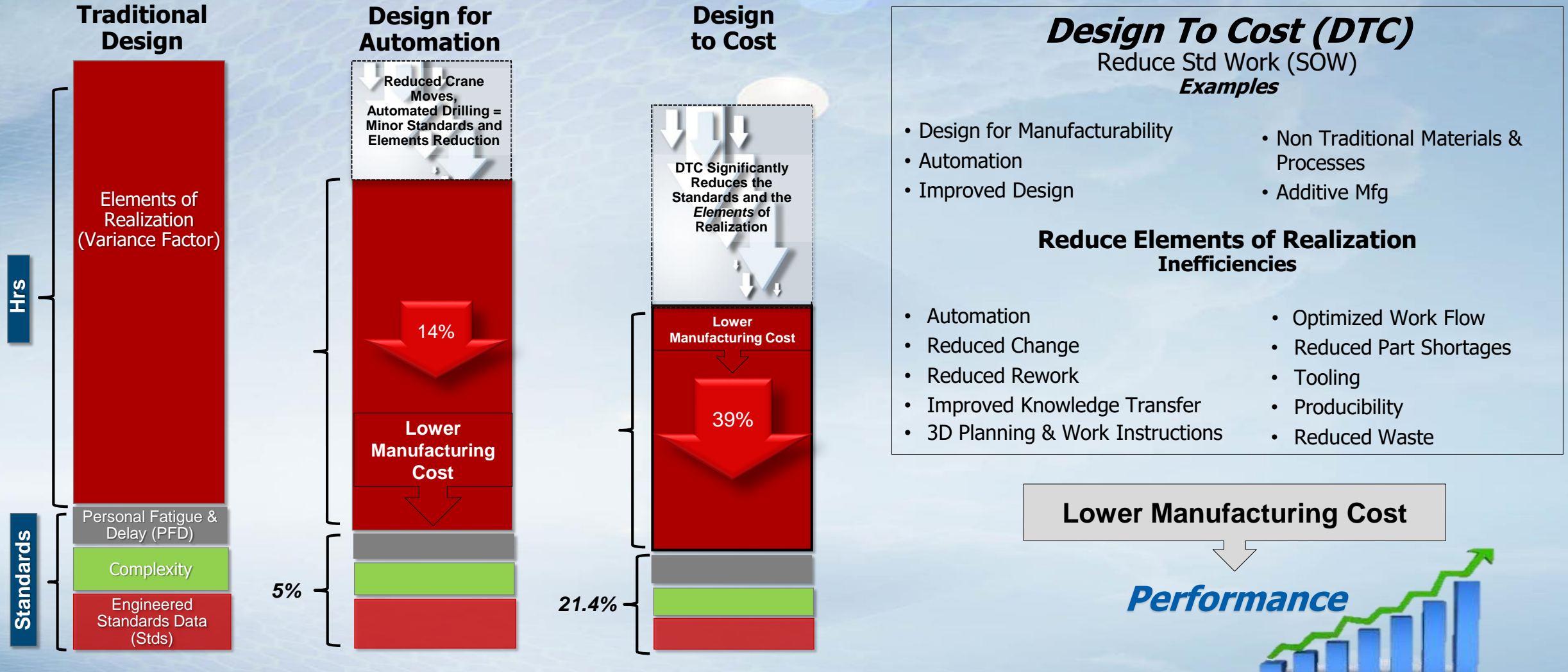
Simulations for Production and Sustainment Operations

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



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

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*National Aerospace Awards:
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Gen George Kenney Award*

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Top 20 Companies for Executive Diversity*

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THE VALUE OF PERFORMANCE.

NORTHROP GRUMMAN

