“Capability creates the unexpected”

Gen Jon M. Davis, USMC, AHS Forum 73 keynote

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

Never wait for a spare part again
Customize capability in the field

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

Embracing Complexity, Enabling the Unexpected:

(Next Generation Agile Manufacturing to Enable "Point of Use" Customization for Complex Vehicles)

Bill Harris
with Jonathan Hartman

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

Art of the Possible Concepts

Move to “add on” instead of “built in”
Move to “point of use” instead of “fixed factory”
Move to qualification during manufacture

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

“Add on” instead of “build in”

Capability with limits

Easily added flexibility

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

Move the factory to “point of use”

Driven by economics and technical expertise

Driven by functionality and customer need

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

Qualification as part of manufacture

Process data = physical characteristics = performance

When in doubt, add a gauge, within reason

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

Catalysts

Additive manufacturing
A Comprehensive “Digital Twin”
Remote presence, real time cooperation

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

Additive Manufacturing

Complexity and variety are advantages
Little or no assembly required
Near zero lead time
Unlimited design space
Less waste
Customizable replication

But,

Limited build volumes and material selection
Limited material property knowledge
Limited in situ process monitoring/ability to replicate

This presentation has been publicly released

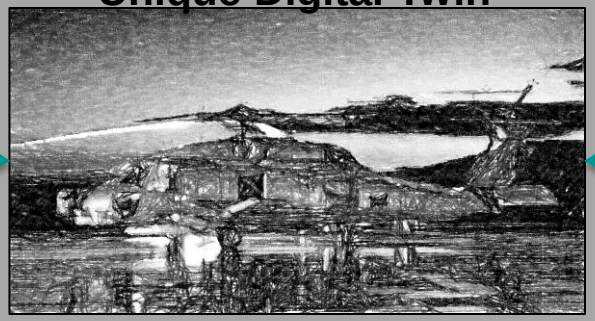
© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

A Comprehensive “Digital Twin”

Real Time, Tail Number Specific Data

Historical Model Test Data

Adaptive, Evolving, Unique Digital Twin



Assess, anticipate, and adapt the aircraft and its parts with low risk using real time and historical data

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

Remote presence, real time cooperation

Aircraft Data
Manufacturing Capability

Manufacturing Instructions

Modeling Tools

Crew Chiefs
&
Maintainers

Manufacturing Visualization
Problem Solving

Technical
Experts

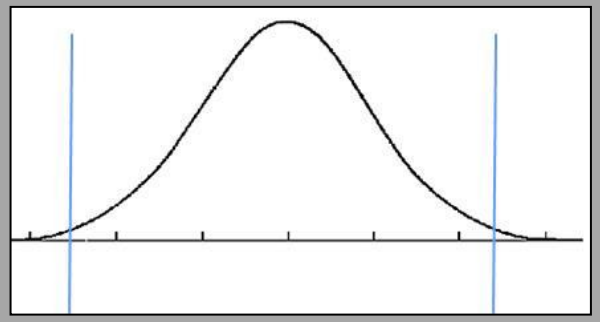
Secure, interactive, collaborative data exchange between humans and automated quality processes

This presentation has been publicly released

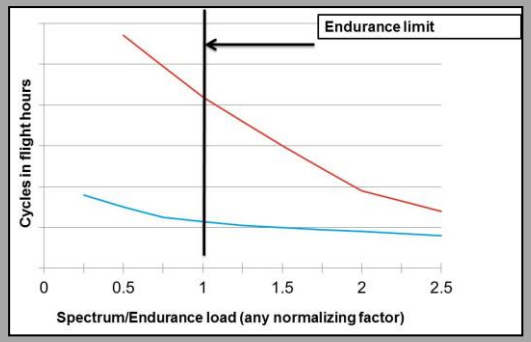
© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

Rapidly maturing enablers

Statistically capable processes



High pedigree material and its performance data



Secure, high powered computational resources

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

But We're Not There Yet

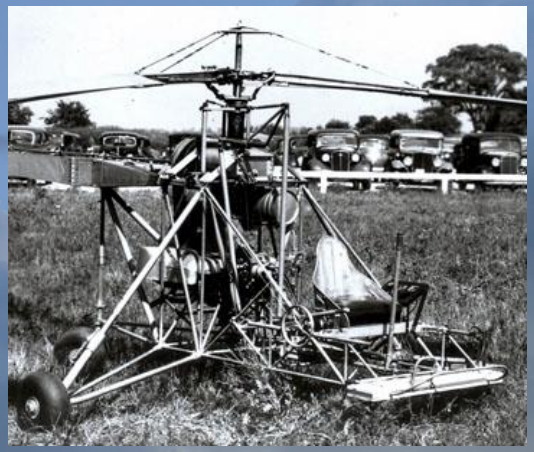
- Machines and Materials
- Fluid configuration management of vehicle and manufacturing capability
- Warranty, liability and business model
- Data security
- Ability to deal with uncertainty and noise
- Moving Technical Experts to 'On' Instead of 'In' the Loop
- Certification and Quality Standards

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

Evidence it can work

Version 1
September 1939



2 models
4 versions
6 modifications

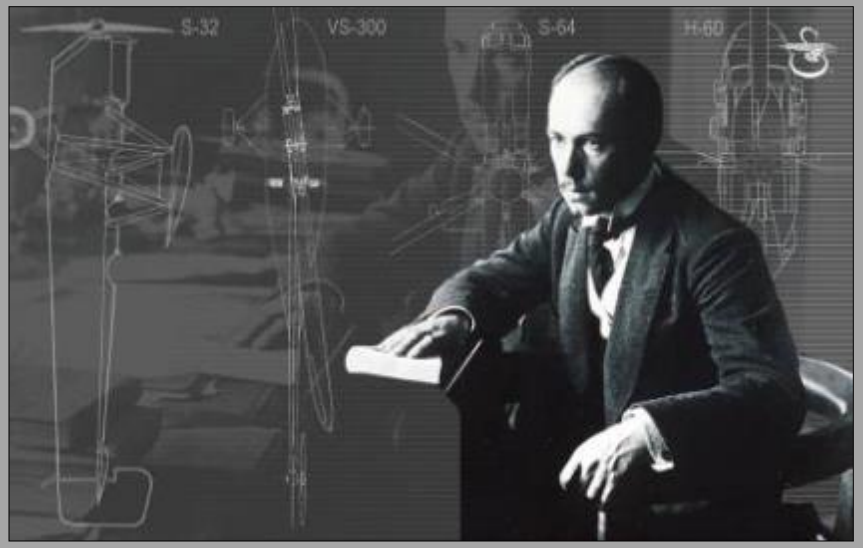
Version 4
December 1941

Local design team
Onsite manufacturing
Full certification authority

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

The Story of Sikorsky and Working Towards the Future



Use the greatest caution when combining the words Impossible and Aviation

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved.

This presentation has been publicly released

© Unpublished Work, Lockheed Martin Corporation 2017. All Rights Reserved