



# Digital Tapestry

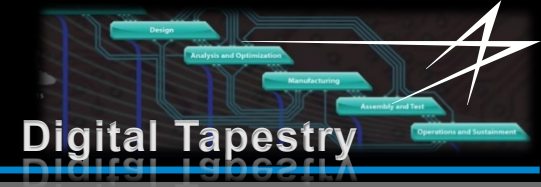
Lockheed Martin Space Systems Company

Paul Embry

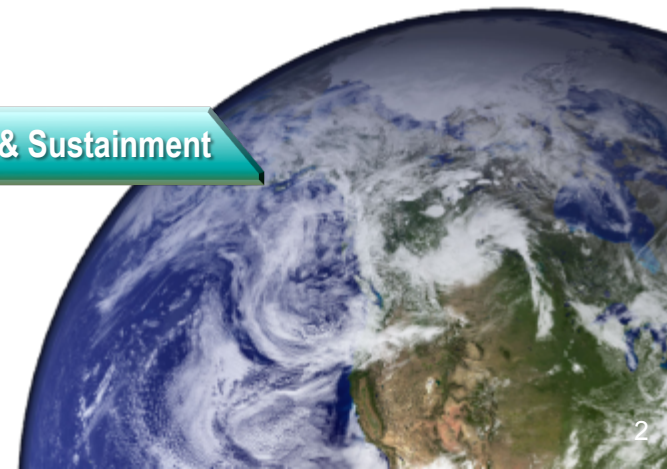
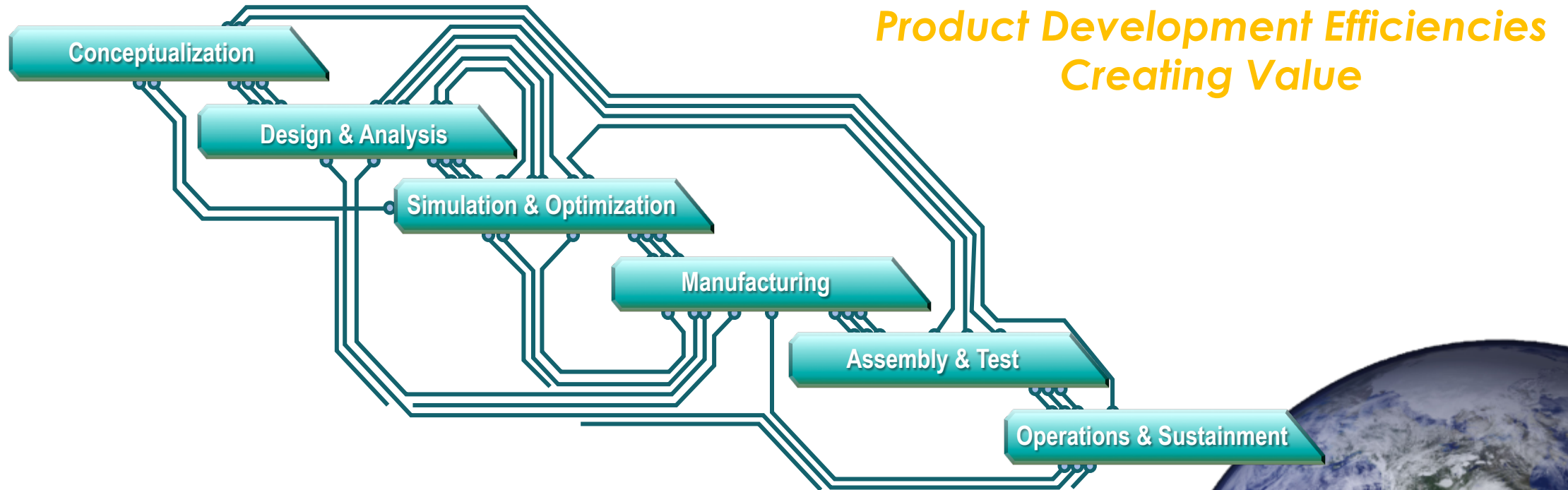
Digital Tapestry Lead

February 2016

# Digital Tapestry



The Digital Tapestry is LM's interconnected environment  
data becomes information and information becomes decisions that create  
value



# The Progression to Digital Tapestry



## Document Centric

Traditional Document Focus Only

Cross-Domain Communicate with Docs

User Level Models

Tribal Knowledge

## Model Centric

Models Used To Create Documentation

Minimal Cross-Domain Integration

Domain Level Models

Pockets Of Excellence

## Model Based

Models Configuration Controlled With Documents

“One Off” Cross-Domain Sharing

Domain Reuse of Models

Best Practices Captured

## Digital Tapestry

Models Are the Sole Record of Authority; Documents are visual aids

Cross-Domain Integration the Focus

Direct Reuse of Models

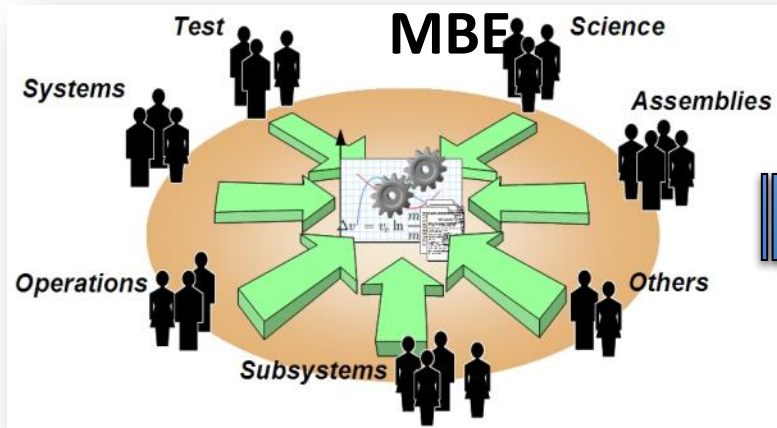
Standard Tools & Processes

2001-2009

2010-2013

2014 and beyond

# Space Systems Company's Organic Growth



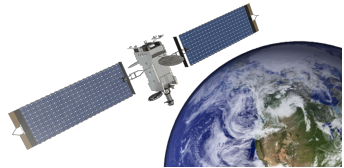
## Functional Organizations



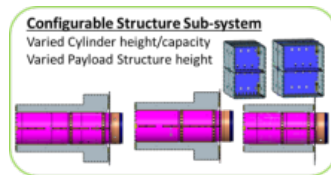
## Programs/LOB's



# Space Systems Company – Focus Areas



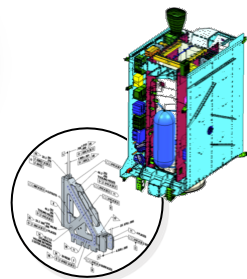
**Simulation Based Mission Validation, Trades & Optimization**



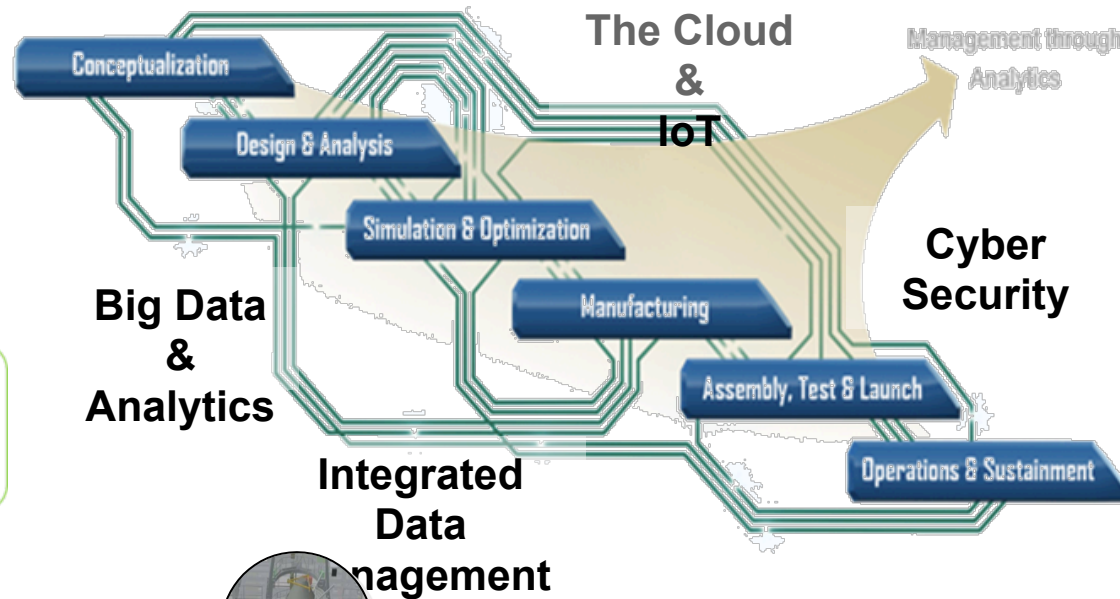
**Standard Products Integrated into Configurable Platforms - MBSE**



**Graphical Software Design & Auto Coding**



**Model Based Design with Integral Analysis**



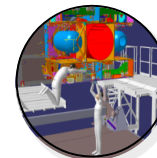
**Integrated Enterprise Planning**



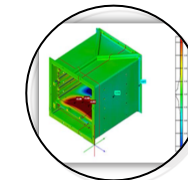
**Data-Driven Supply Chain**



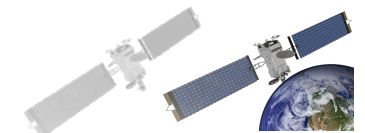
**Simulation Based Production Planning & Factory Optimization**



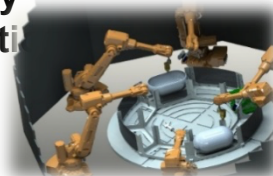
**Virtual Build**



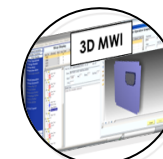
**Advanced Quality Inspection**



**Digital Twin**



**Digitally Integrated Factory & Additive Manufacturing**

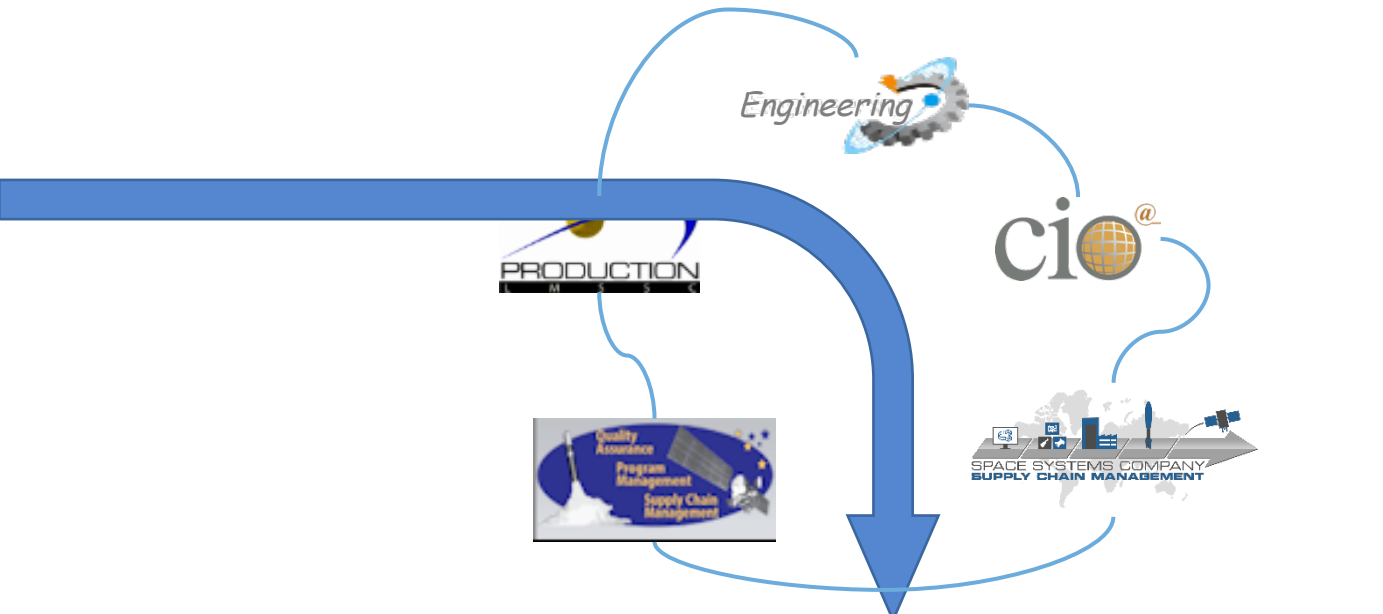
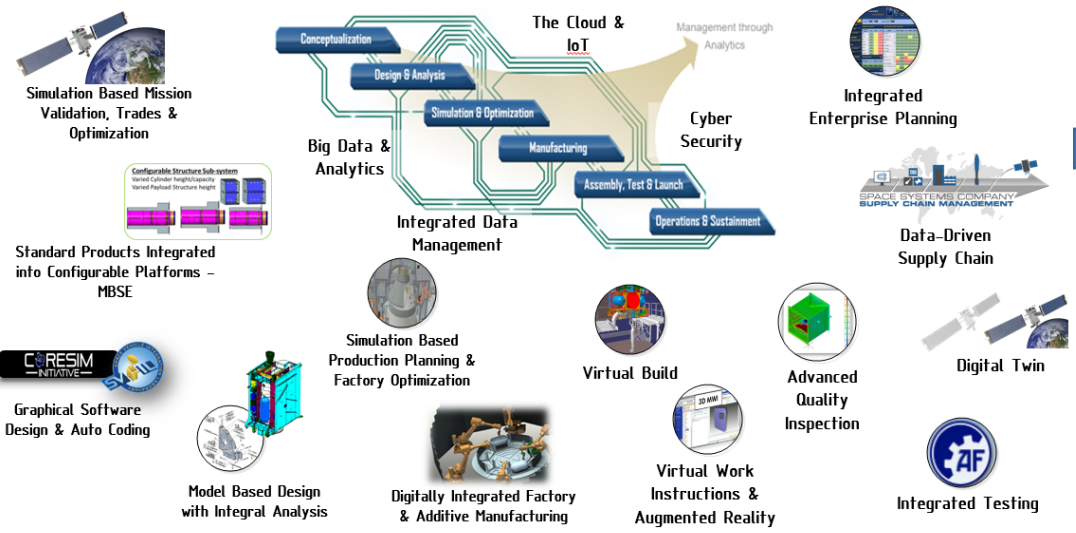


**Virtual Work Instructions & Augmented Reality**

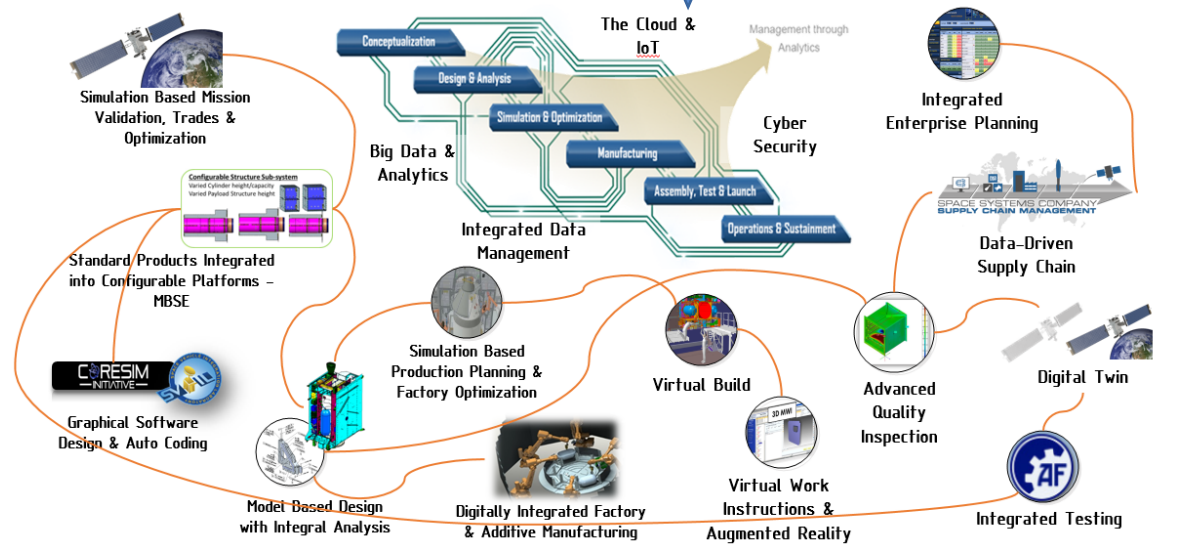


**Integrated Testing**

# LM SSC's Digital Tapestry – Integration



- In Order To Achieve The Full Vision, A Multitude Of Threads Must Be Woven Across Each Domain
- The Digital Tapestry Must Be Managed As A *System*
- As Such, The *Architecture* Requires Up-front, Top-down Design To Ensure Functionality Is Allocated In The Most Efficient Manner Possible
- This Vision Does Not Align With Organizational Structures of Programs or Companies



# Digital Tapestry Integrated Team



## Lockheed Martin's Digital Tapestry Vision

Executive Steering Committee

Executive VP's

Leadership Champions

VP's & Directors

Chief Engineers

Integrated Team

Business Development

Engineering & Mission Operations

Production

Quality

Information Technology

Program Management

Supply Chain

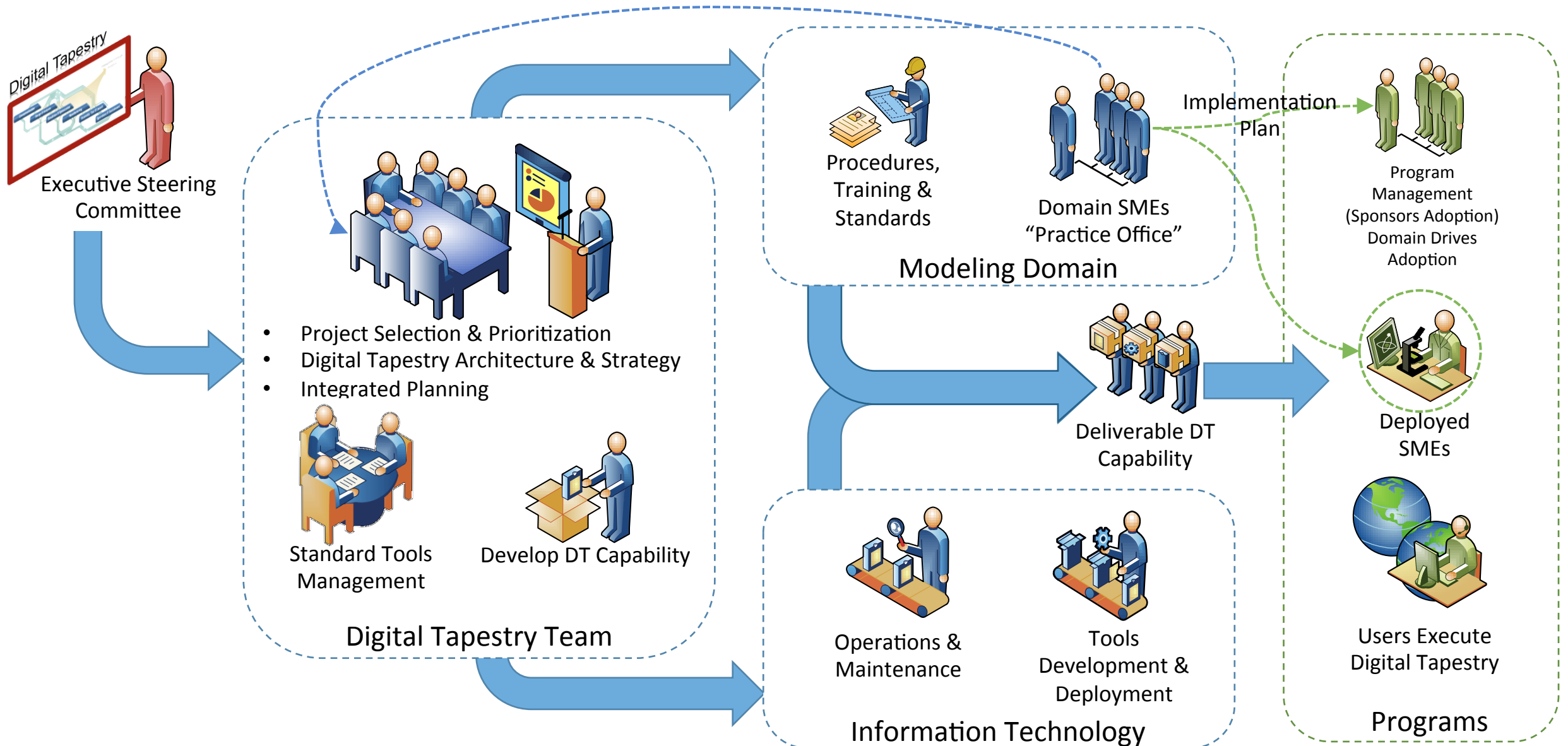
## Digital Tapestry Team's Products

- Projects - ID, Prioritize, Select & Integrate – Ensure Success!
- Standard Tools Strategy & Selection
- Multi-Function Coordination & Integration
- Program Engagement
- Metrics Collection & Reporting
- Cost/Schedule Savings Quantification
- Implementation of Capabilities & Program Insertion
- Coordinated Communications & Branding
- Integration with External Organizations and Proposals

## Project Implementation Strategy



# Digital Tapestry Operations



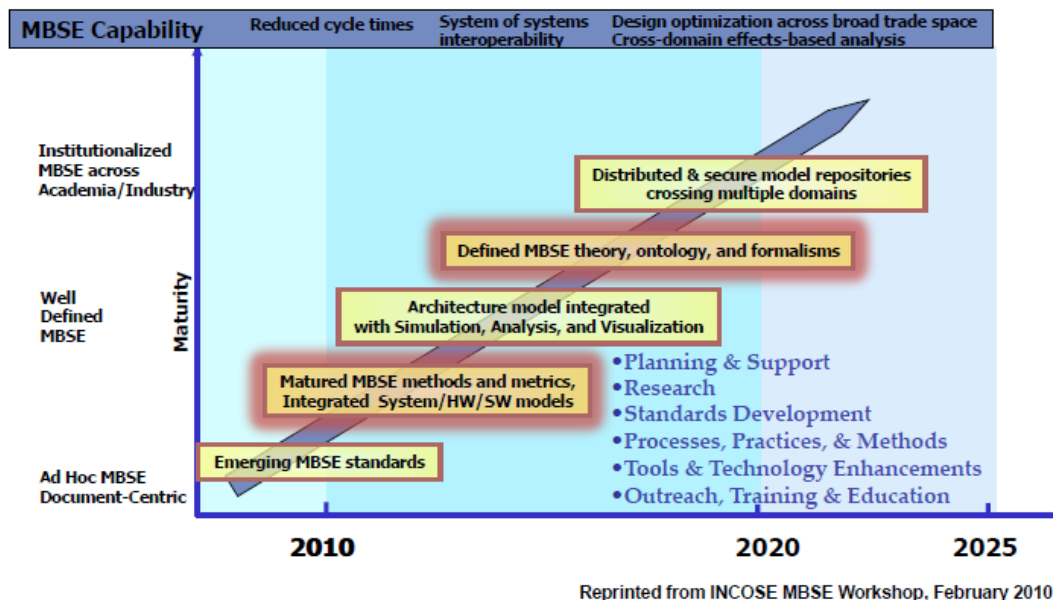


# Challenges & Opportunities



- Current Technology Imposes Challenges With Weaving “Threads”
  - Many Integrations Are Point To Point With “Middleware”
    - Mixture Of Commercial Off The Shelf & Homegrown
  - COTS Integrations Often Require Translations or Data Copies With Little Attention To Configuration & Change Management
    - Data Interfaces with CDM Awareness or Direct Access, Eliminating Copies Is Ideal
- Customer/Supplier Interfaces Are Ad Hoc
  - Government Data Rights May Not Drive Model Based Interfaces Alone
  - Contract Deliverables – Most Are Still “Docu-centric” In Nature, And Inhibiting Model Based In Some Areas
  - Other Deliverables – Opportunity Space For Developing DID’s That Are Model Deliveries Abstracted For Their Intended Use
    - Developing Simplified Data Requirements For Intended Use/Leverage Has High Potential To Save Cost And Drive Efficiencies
    - While Data Rights May Allow For “Full model Deliveries” It May Not Achieve the Goals In The Most Efficient Manner
- Influencing Standards And Tool Suppliers Is Key To Long Term Success

# MBSE Industry & SSC Transition Models

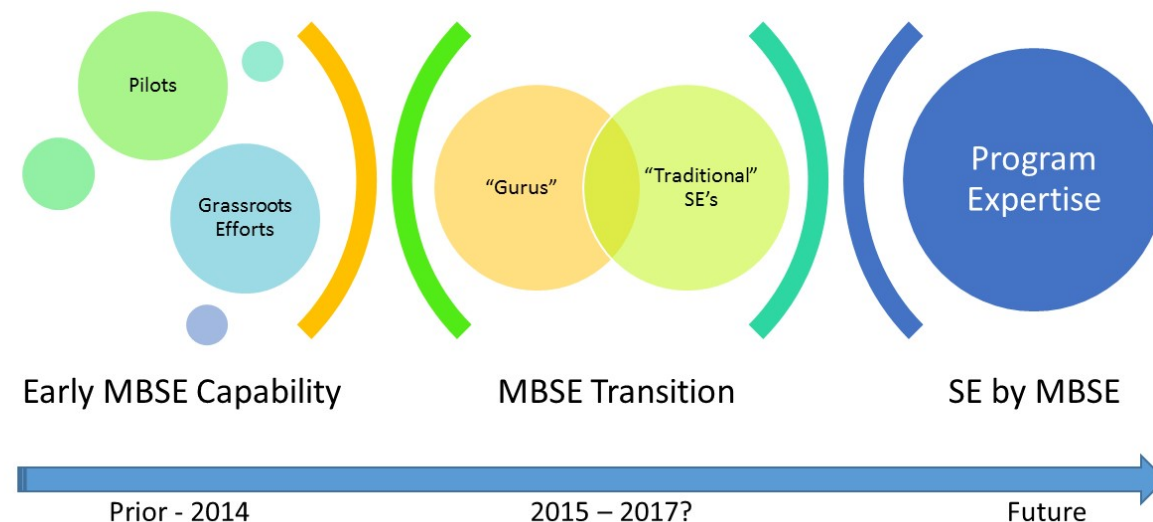


## MBSE Current State (Industry & LM SSC)

- Maturing MBSE Methods and Practice
- Moving to integrated SE/HW/SW/EE Models
- Extending with Patterns, Ontologies
- Vision – Federated & Secure Digital System Models (Digital Tapestry)

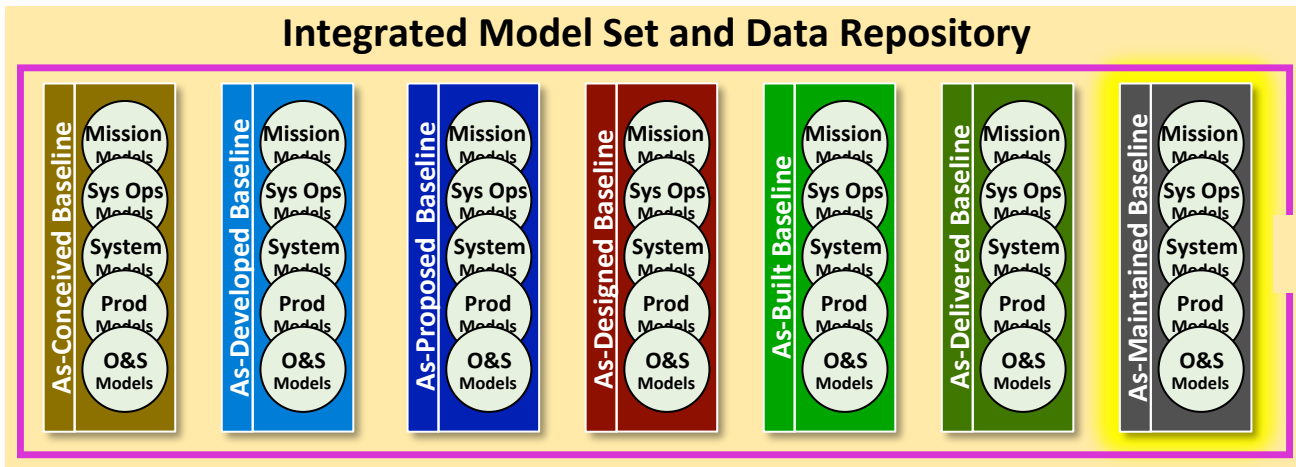
## MBSE Capability Transition (Our Journey)

- Pilot to “Productized” Capabilities
- Small numbers of experienced MBSE’s
- Engagements Increasing (Customer- and Program-Driven)
- Knowledge transfer by Guru/Program SE pairings
- Continued practice maturity



**Continue to mature MBSE practice, while developing talent on program engagements**

# Process – Integrated Modeling Beyond the “V”



- Beyond As-Designed
- Matured Data-Set throughout Life-Cycle
- Fully Integrated, Delivered, Maintained

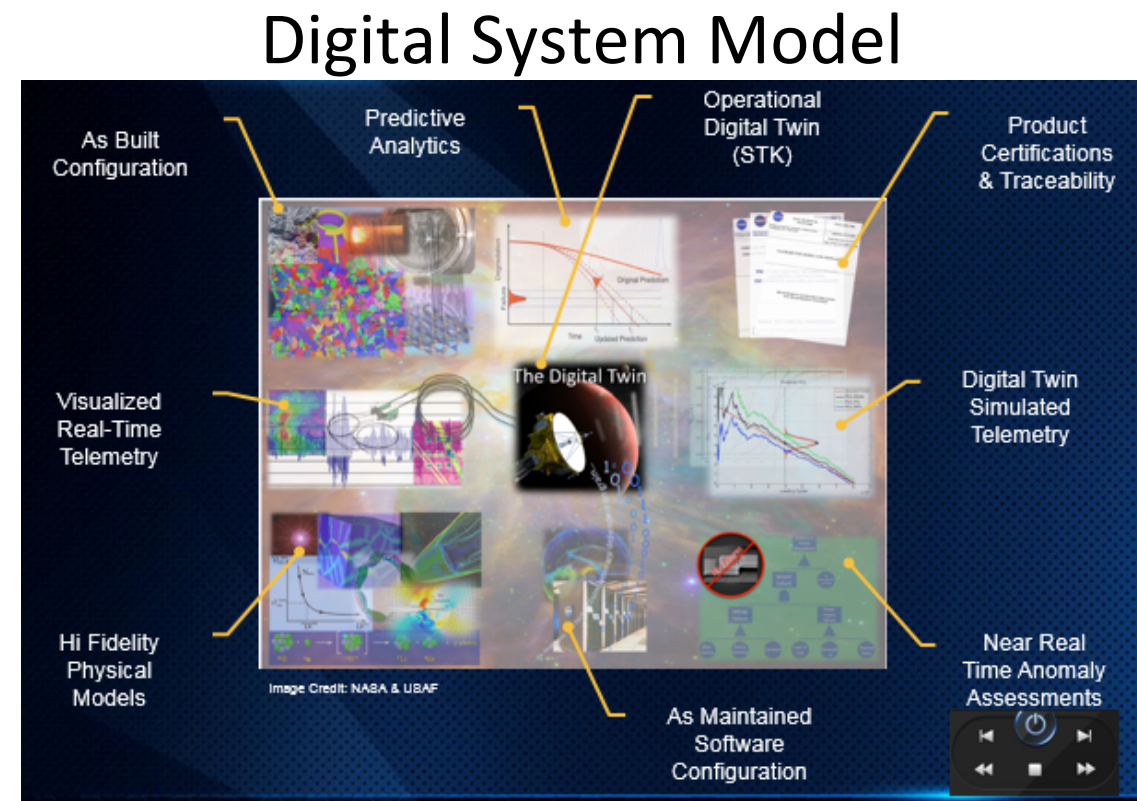


Image Credit: NASA & USAF  
“The Digital Twin Paradigm for Future NASA and U.S. Air Force Vehicles”

***Incorporate Modeling Across the Entire SE Process to Integrate with Digital Tapestry***

