

Raytheon Technologies

Creating a Digital Foundation Through the Development of a Digital Thread

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Introduction
Defining the Approach

- Model-Based Engineering (MBE) and Digital Engineering are the starting point for creating a digital product. Understanding these approaches helps us define how we “start”.

- **Model-Based Engineering (MBE) – NDIA said it best!**

“An approach to engineering that uses models as an integral part of the technical baseline…throughout the acquisition life cycle [1].”

- **Digital Engineering – SE&A’s Definition**

“An integrated digital approach using authoritative sources of system data and models… Takes advantage of computational technology, modeling, analytics, and data science [2].”

Introduction
Benefits of a Digital Product

- Tackling sustainability, moving away from reinventing the wheel, simplified traceability, etc. all this narrows down to two key things

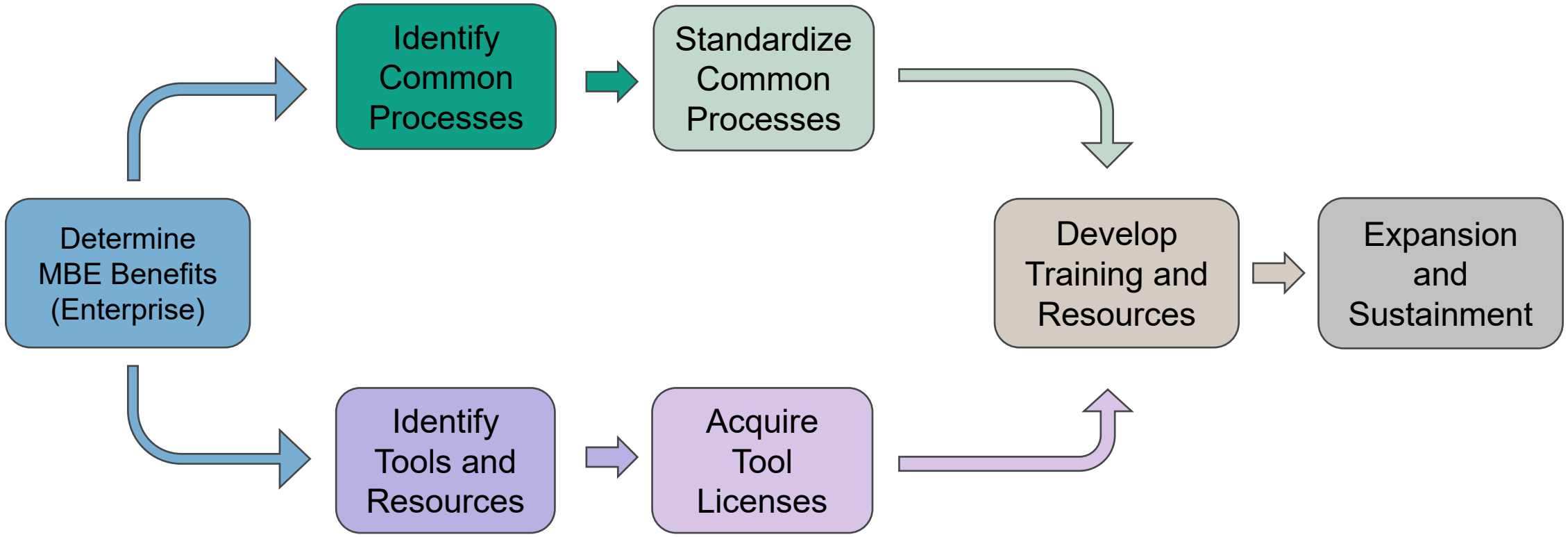
- **Digital Twin:**

" A virtual model designed to accurately reflect a physical object [3]."

- **Digital Thread:**

"Data-Driven architecture that links together information generated from across the product lifecycle [4]."

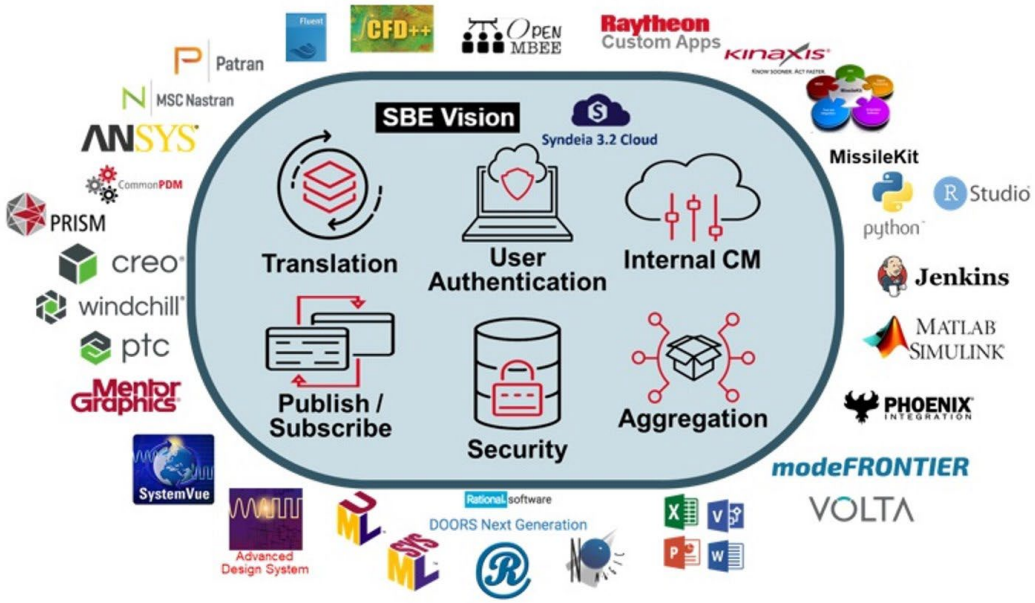
Building a Foundation
Where to Start



- Getting started means understanding the benefits available and where those benefits can be used in a business model.

Building a Foundation
Products and Guidance

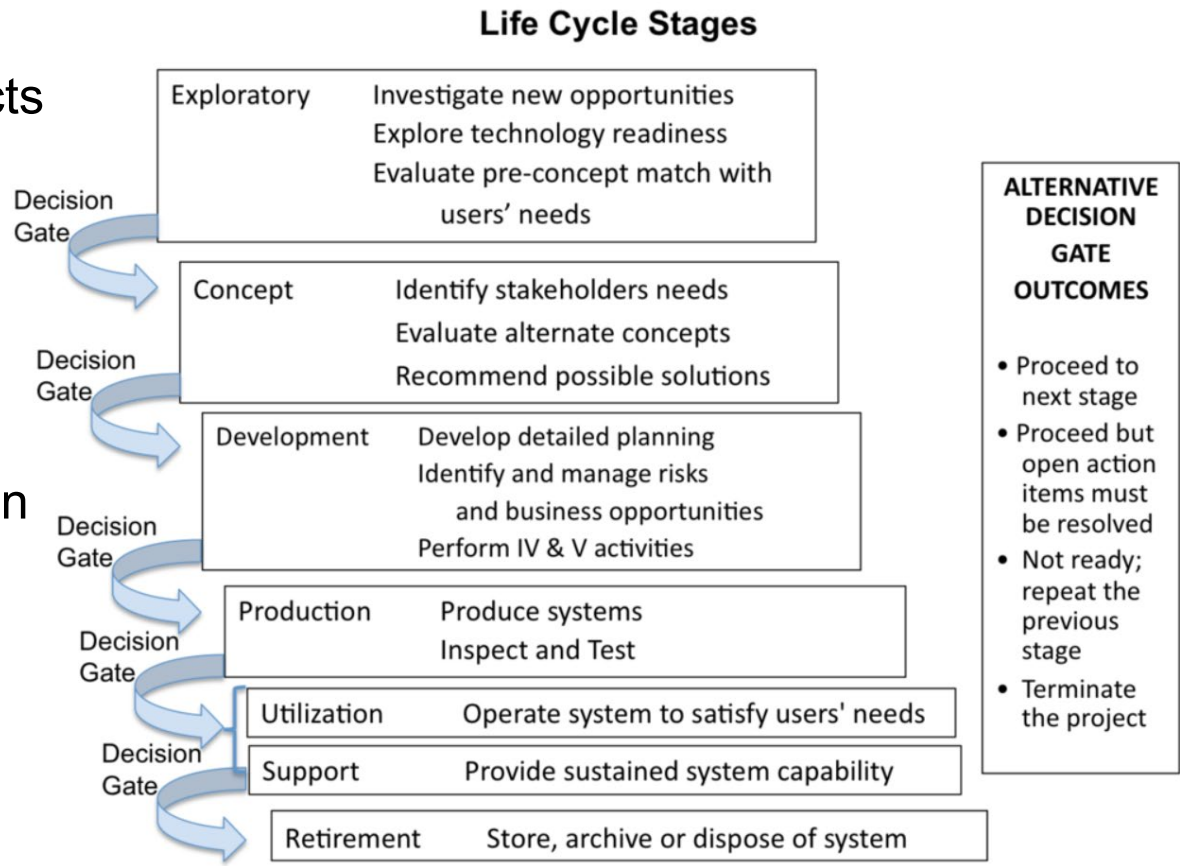
- **Process**
  - Where does Model Based Engineering fit in?
  - Identify and implement a common process for product development and delivery
  - Identify and implement common standards for product design
- **Tools and Resources**
  - Based on the identified process what tools can work together?
  - Ex. MagicDraw, DxDesigner, ELM tools, Rhapsody, MATLAB, Creo, etc.



"The interconnected infrastructure, environment, and methodology (process, methods, and tools) used to store, access, analyze, and visualize evolving systems' data and models to address the needs of the stakeholders." [5]

Building a Foundation
How Systems Engineering Plays a Roll

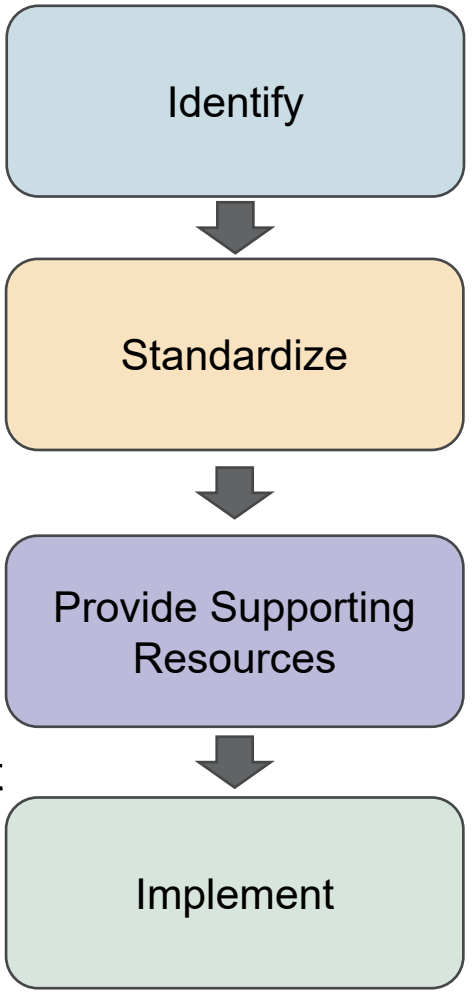
- **Development and Planning**
  - System of Systems down to individual products
  - Understanding the need and requirements
  - Working with stakeholders to define the best routes for product development
- **Alignment with MBE Practices**
  - Understanding and identifying where MBE can make the biggest impact
  - Identifying resources and paths for MBE implementations to benefit product and/or system of systems development



Referenced from [6]

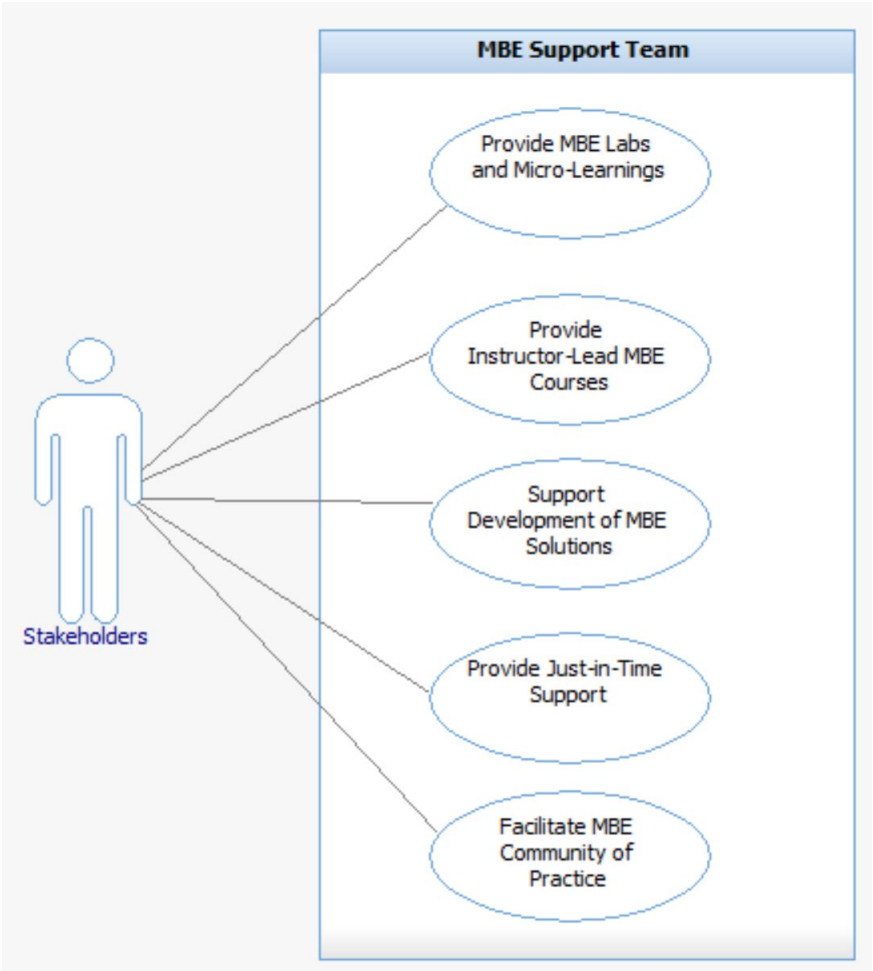
Building a Foundation
Early Start to Long Term Solutions

- **Standardization**
  - What can be made common?
  - What resources will employees need to be successful?
- **Resources and Guides**
  - Training
    - Instructor lead courses geared toward work efforts
  - Starting Point Models
    - Common baseline: model uniformity
  - Learning Aids
    - Labs, Micro-Learnings: sustained learning to bolster instructor lead content
  - Defined Lifecycle Process
    - Employees executing to the same product development process



Building a Foundation
Supporting the Building Blocks

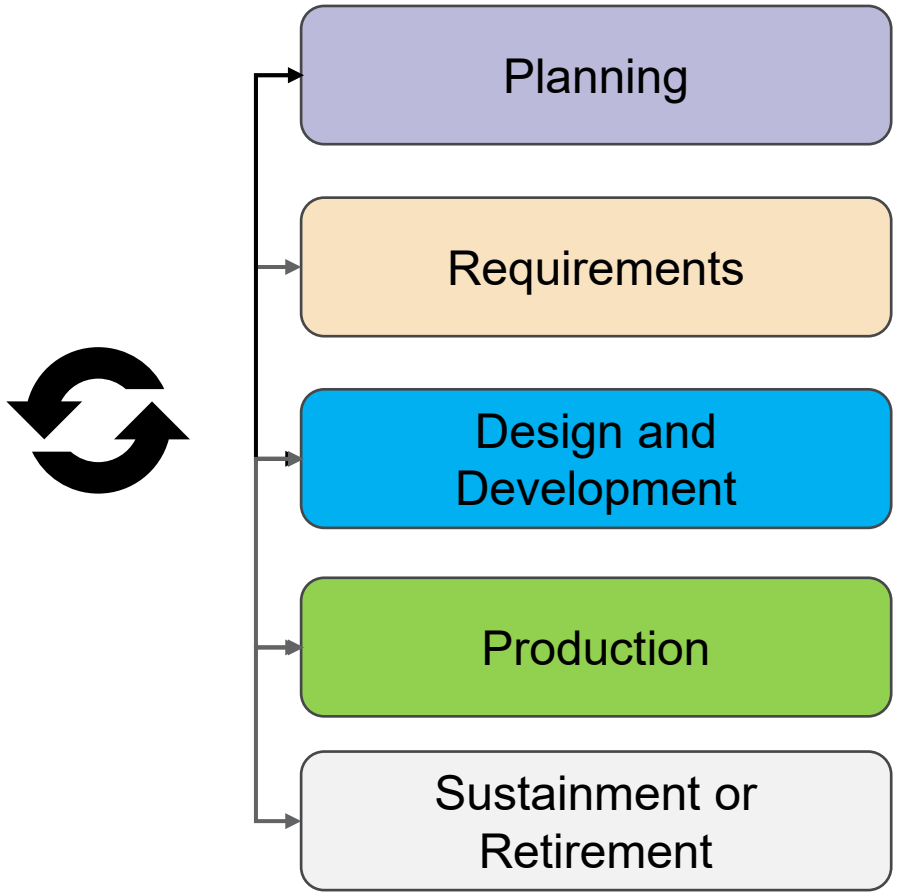
- **Implementation**
  - Enforcing the defined process
  - Creating the resources for success
- **Just in Time Support**
  - Experts available to help reach product deadlines
  - Reinforce learned materials
- **Community and Outreach**
  - Information in the hands of decision makers
  - Keeping up with Industry knowledge and MBE applications



Teams dedicated to the development and sustainment of MBE can keep an enterprise aligned with best practices.

Developing the Thread
Linking it Together

- **Creating the Digital Thread**
  - Linking it all together
  - Collaboration
  - Showing traceability
  - Sustainment



Digital Threads are not limited to product development, like MBE they can apply to many things.

Questions?

References

[1] NDIA Systems Engineering Division M&S Committee, “Final Report of the Model Based Engineering (MBE) Subcommittee,” Feb. 2011.

[2] “Digital Engineering,” *digital_engineering – DCTO(MC).* [Online]. Available: https://ac.cto.mil/digital_engineering. [Accessed: 20-Sep-2022].

[3] “What is ad digital twin?,” *Ibm.com.* [Online]. Available: https://www.ibm.com/topics/what-is-a-digital-twin. [Accessed: 20-Sep-2022].

[4] V. Singh and K.E. Willcox, “Engineering Design with Digital Thread,” *AIAA J.,* vol. 56, no. 11, pp. 4515-4528, 2018.

[5] “digital engineering ecosystem,” *Dau.edu.* [Online]. Available: https://www.dau.edu/glossary/Pages/GlossaryContent.aspx?itemid=27346. [Accessed: 20-Sep-2022].

[6] “System lifecycle process models: VEE,” *Sebowiki.org.* [Online]. Available: https://www.sebokwiki.org/wiki/System_Lifecycle_Process_Models:_Vee. [Accessed: 20-Sep-2022]