The System Engineering Vee - is it Still Relevant in the Digital Age?

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**Summary**

- The SE “V” symbol is an intuitive and instructive framework for depicting product development.

- However, this linear representation fails to depict the real-time interchange of data and information in a Model Based Enterprise (MBE).

A new symbol is needed to better reflect the increased complexity of an MBE ecosystem.

SOURCE: US Department of Transportation Federal Highway Administration

Background - The Traditional SE “V” Symbol

- **Product** focused development
- **Implies a sequential process**
- **“Document-centric” focus**

- Fails to depict **integrative & iterative nature of product development**

- **Historical attempts to update the “V” symbol increased complexity**

- A **new symbol** is needed that better represents the complex interactions of an MBE ecosystem

*SOURCE: The Boeing Company*
Tenets for Depicting the SE Process in an MBE

- Represent MBE as a multi-dimensional, iterative process encompassing both physical and virtual implementations

- Reflect the integrated nature of MBE, linked with feedback to related lifecycle elements

- Show relationships spanning business domains (e.g. Product, Production, Service & Support)

- Communicate how SE process is different by using MBE

- Easy to understand, but flexible and tailorable
Option 1 - Time-Based SE with Feedback Across “V”

- Increased level of detail, to identify specific processes, products and prescribed timing
- Doesn't address known weaknesses of SE “V” symbol to represent MBE
- Introduces several additional issues related to complexity

SOURCE: The Boeing Company
Option 2 - SE of Product and Production System

- Illustrates Product Domain and Production Domain in context to each other over the development lifecycle

- Circular arrows indicate iterative approach

- Depiction of additional domains (e.g. Services & Support) is challenging
Option 3 - System and Detailed Design in MBE

- Describes MBE process, similar to the SE “V”
- Emphasis on central MBE linking information/design throughout the lifecycle
- MBE links all development states around outside of the Diamond

SOURCE: The Boeing Company
Option 5 - Cyber-Physical MBE

- The bottom-half of the Diamond represents Physical System (retaining traditional SE “V” flow)

- The top-half of the Diamond represents the “Digital Twins” (i.e. the virtual representation of the physical systems)

- The interior of the Diamond represents the “Digital Thread” linking models/simulations (Digital Twins) to the design of the physical systems

SOURCE: The Boeing Company
Option 6 - Model-Centric Product Realization

- Depicts MBE as a series of 2-way arrows radiating from a central “Model and Analyze” activity.

- Each spoke represents a major activity in the product lifecycle starting with definition and proceeding through delivery and operations.

SOURCE: The Boeing Company

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Summary

SE "V" Symbol

Proposed MBE Tenets

- Represent MBE as a multi-dimensional, iterative process
- Reflect the integrated nature of MBE, linked with feedback to related lifecycle elements
- Show relationships spanning business domains (e.g. Product, Production, Service & Support)
- Communicate how SE process is different by using MBE
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MBE "Symbol" Options