The System Engineering "V" - Is It Still Relevant In the Digital Age?

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GLOBAL PRODUCT DATA INTEROPERABILITY
SUMMIT
2018

ELYSIUM Parker Aerospace NORTHROP GRUMMAN BOEING

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Dan Seal - Biography

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Dan Seal

- 35 years at Boeing
- Senior Manager in PLM at Boeing Defense, Space & Security in St. Louis MO
- Working Digital Transformation and Model Based Engineering
- Lead Boeing Immersive Development (ImDev) activity leveraging the Digital Thread and Digital Twin to drive step change improvements
- Former functional manager in Systems Engineering
- BSEE from Rose-Hulman Institute of Technology

The Fourth Industrial Revolution is Underway

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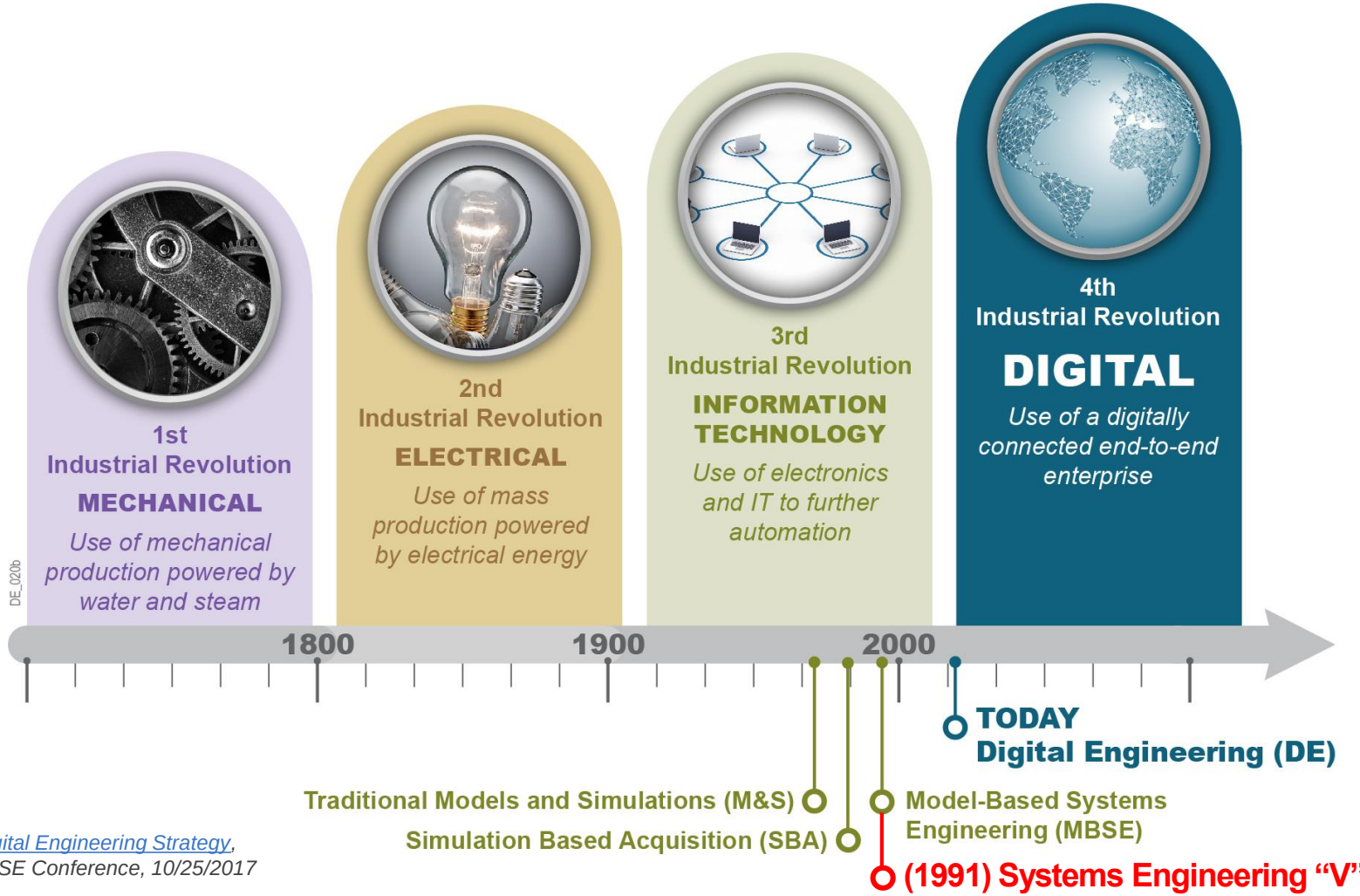

Source: DoD Digital Engineering Strategy, 20th Annual NDIA SE Conference, 10/25/2017

The Digital Engineering Transformation

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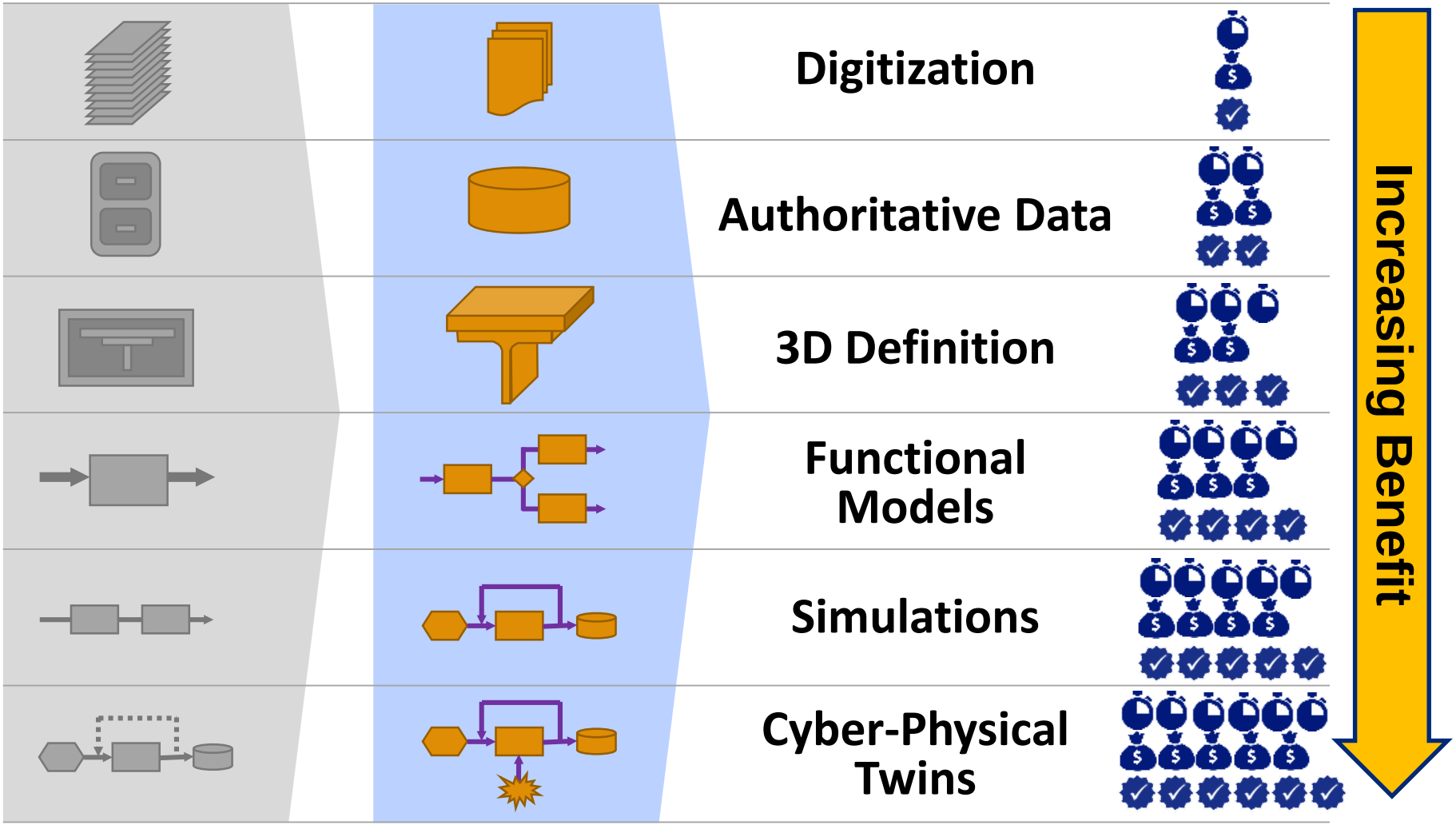
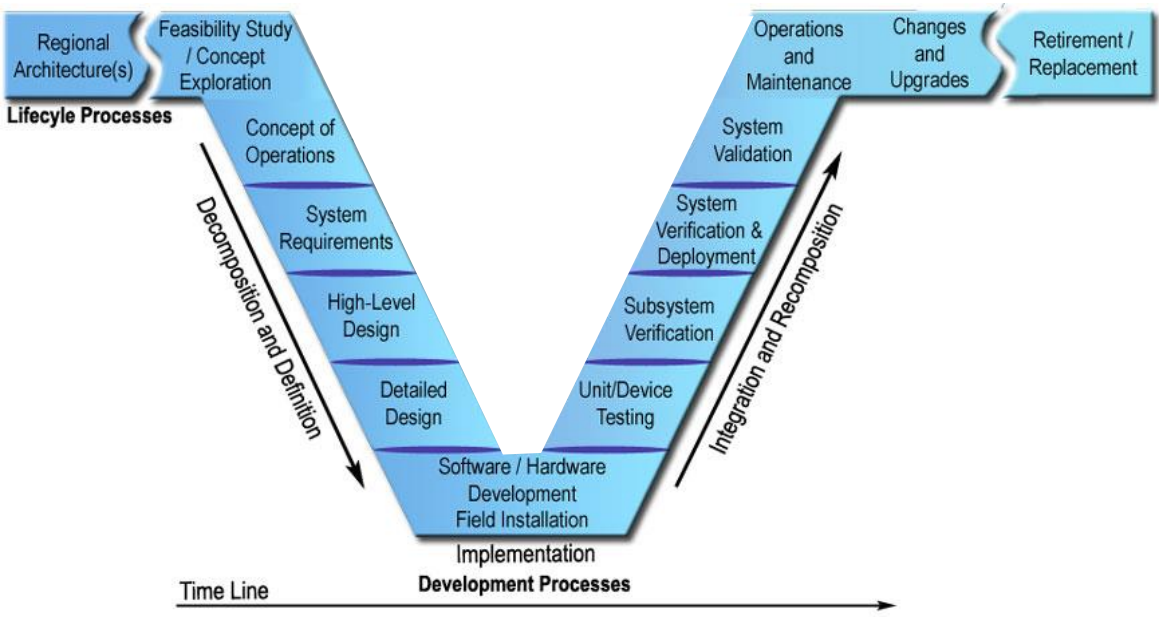


Source: Boeing

Relevance of the SE "V" Model in an MBE Environment

- **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 DE / MBE Environment**

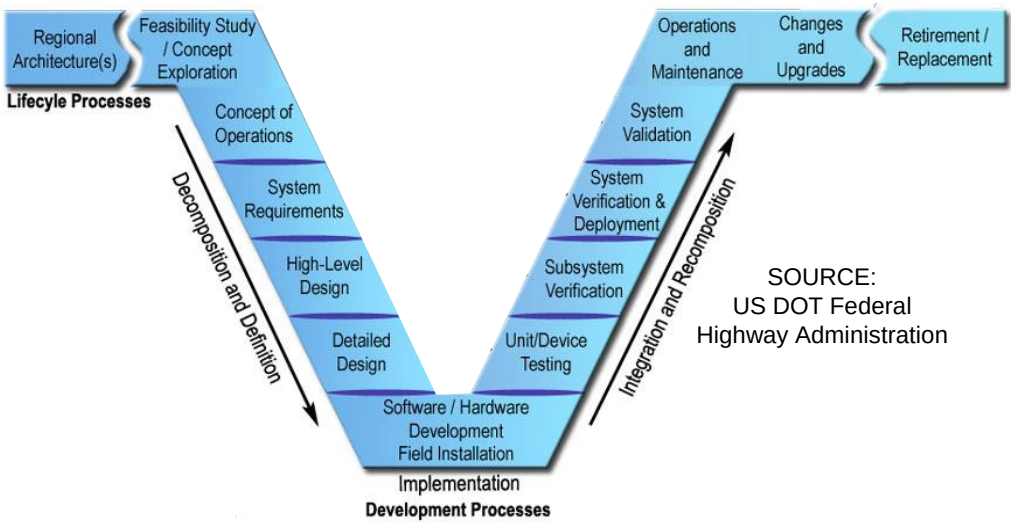
SOURCE: US Department of Transportation Federal Highway Administration
https://ops.fhwa.dot.gov/publications/seitsguide/section3.htm



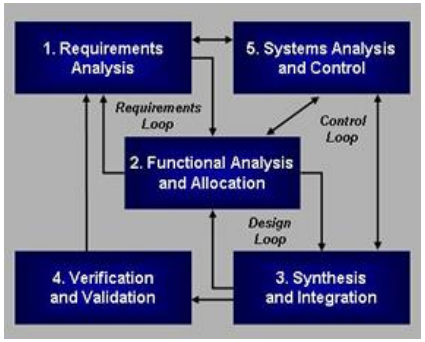
A new symbol is needed to better reflect the increased complexity of an MBE ecosystem.

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:
US DOT Federal Highway Administration



SOURCE:
The Boeing Company

The Systems Engineering "Engine"

Tenets for Depicting the SE Process in an MBE Environment

- **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**

Evolution from SE to MBE

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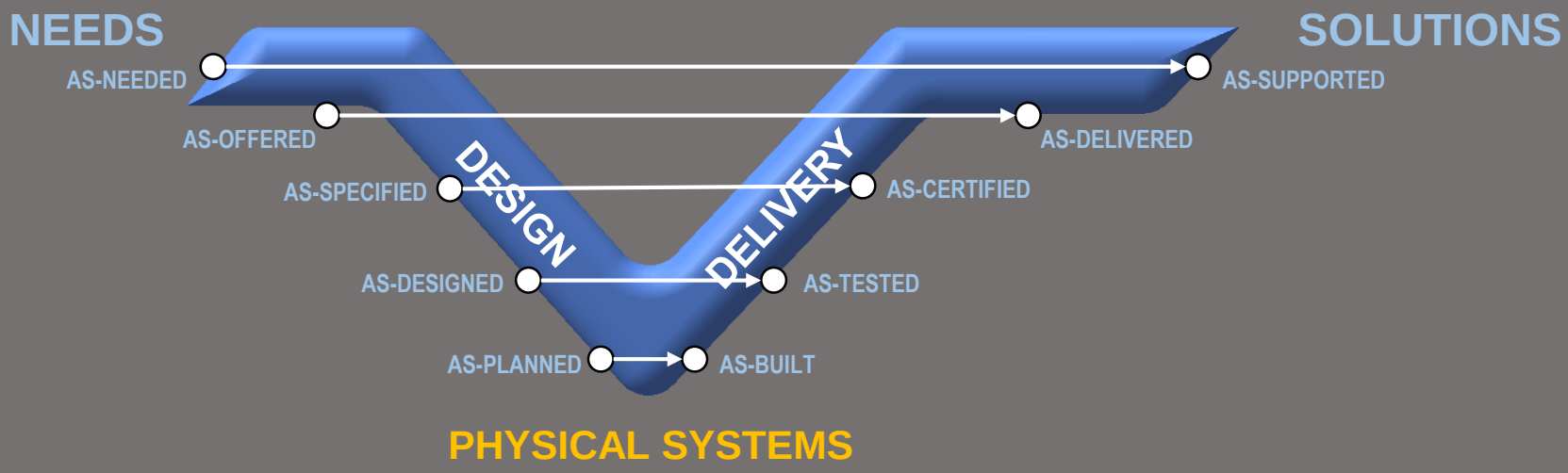

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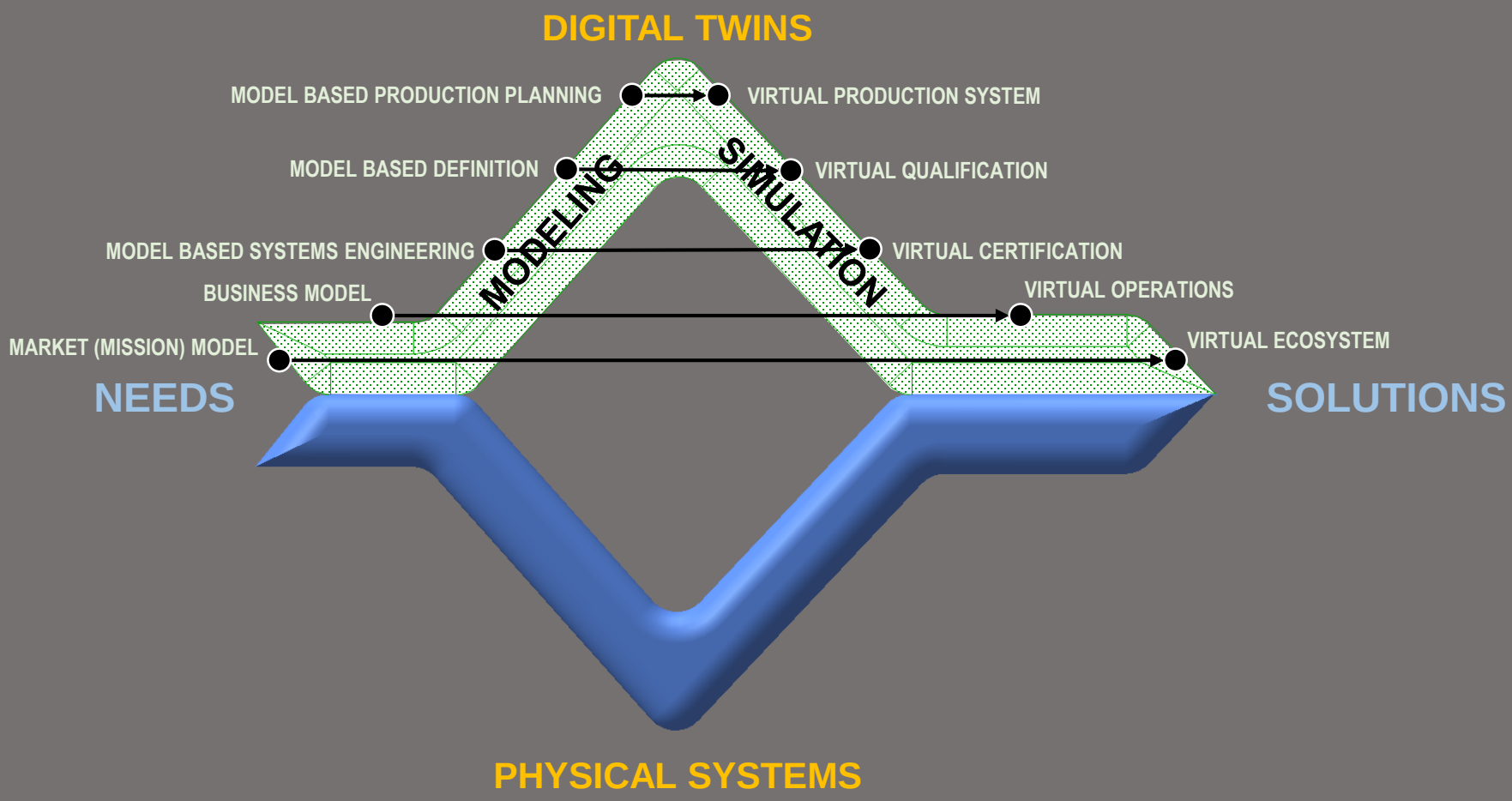

Evolution from SE to MBE

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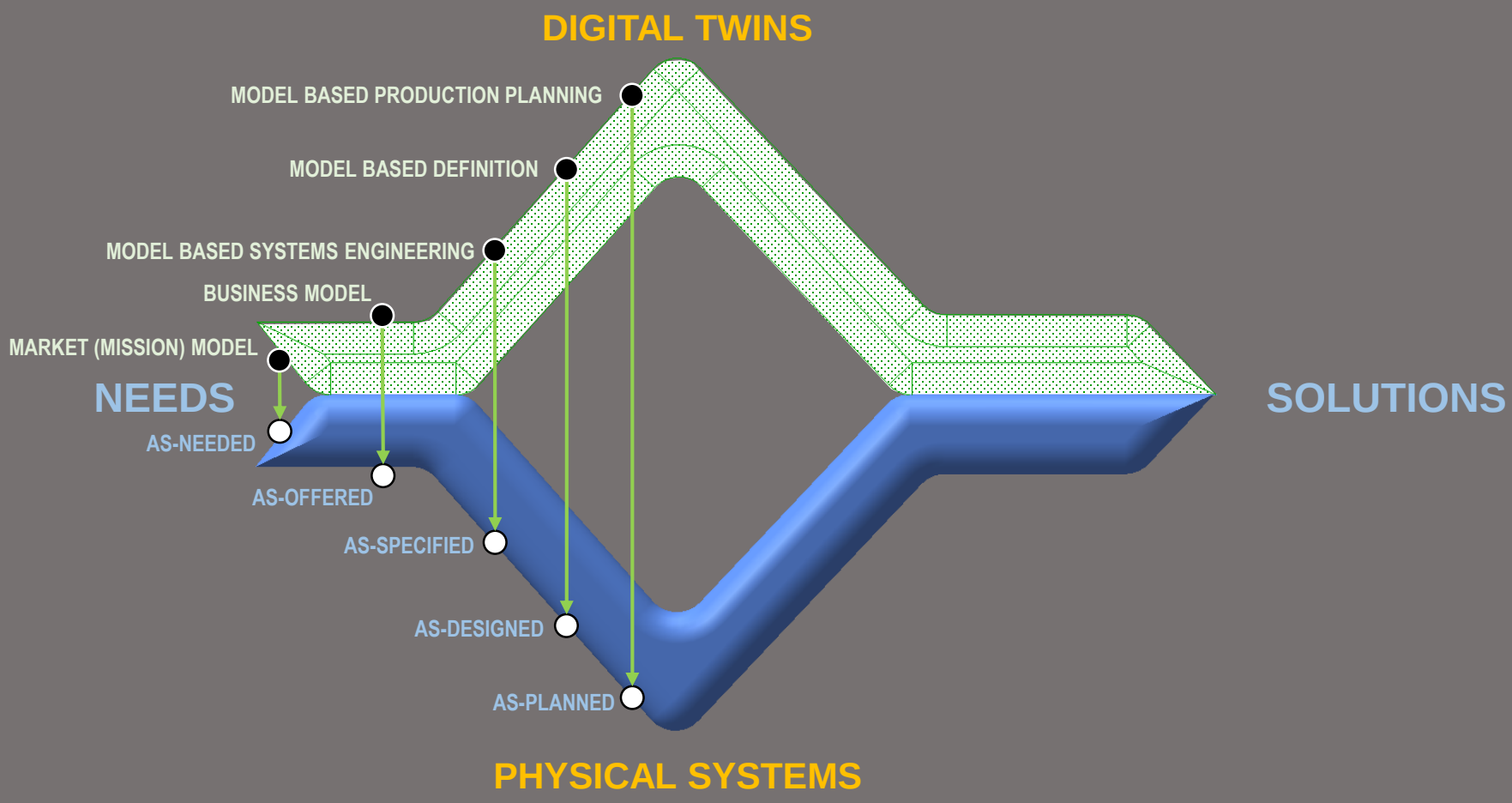

Evolution from SE to MBE

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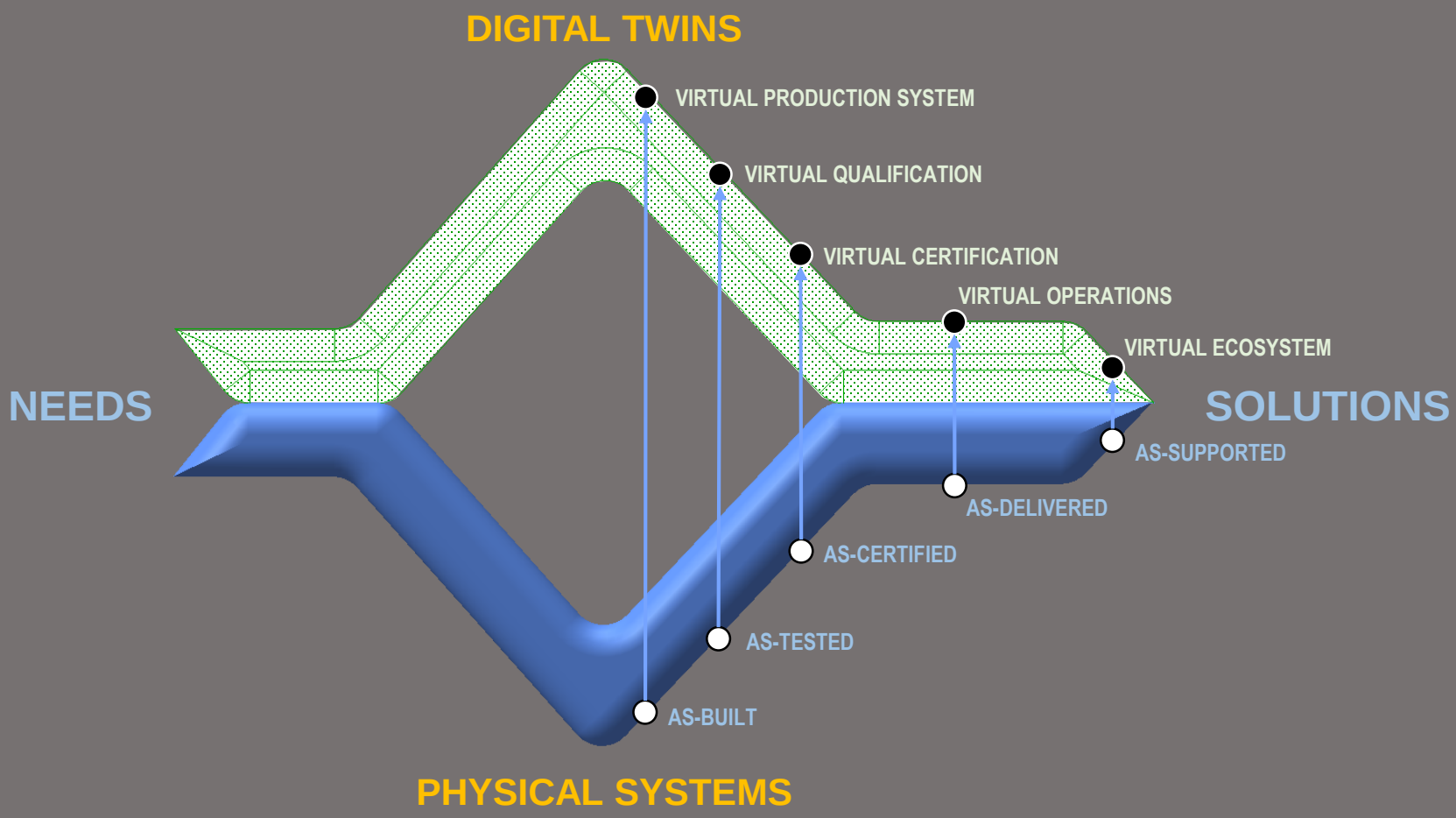

Evolution from SE to MBE

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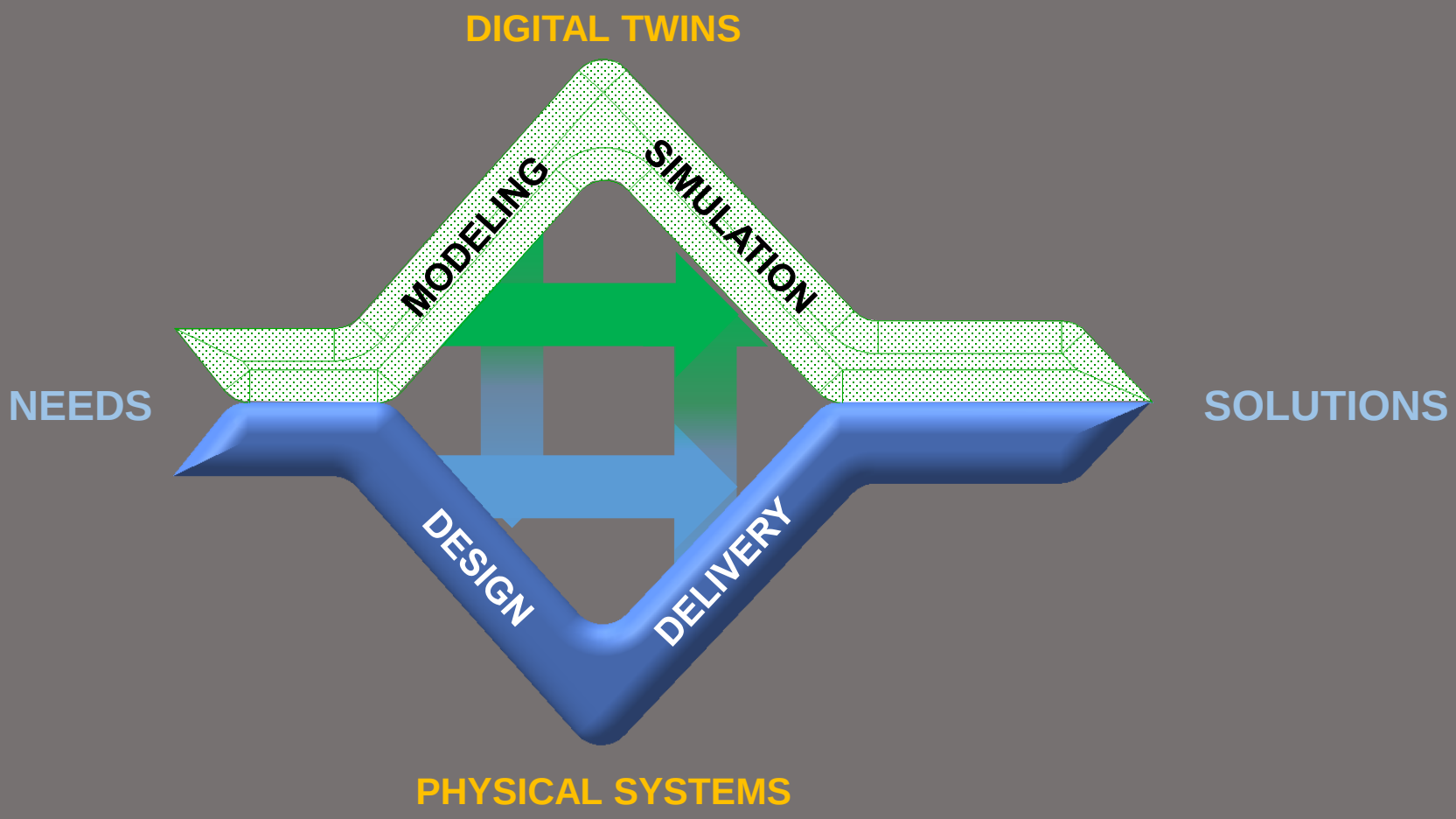
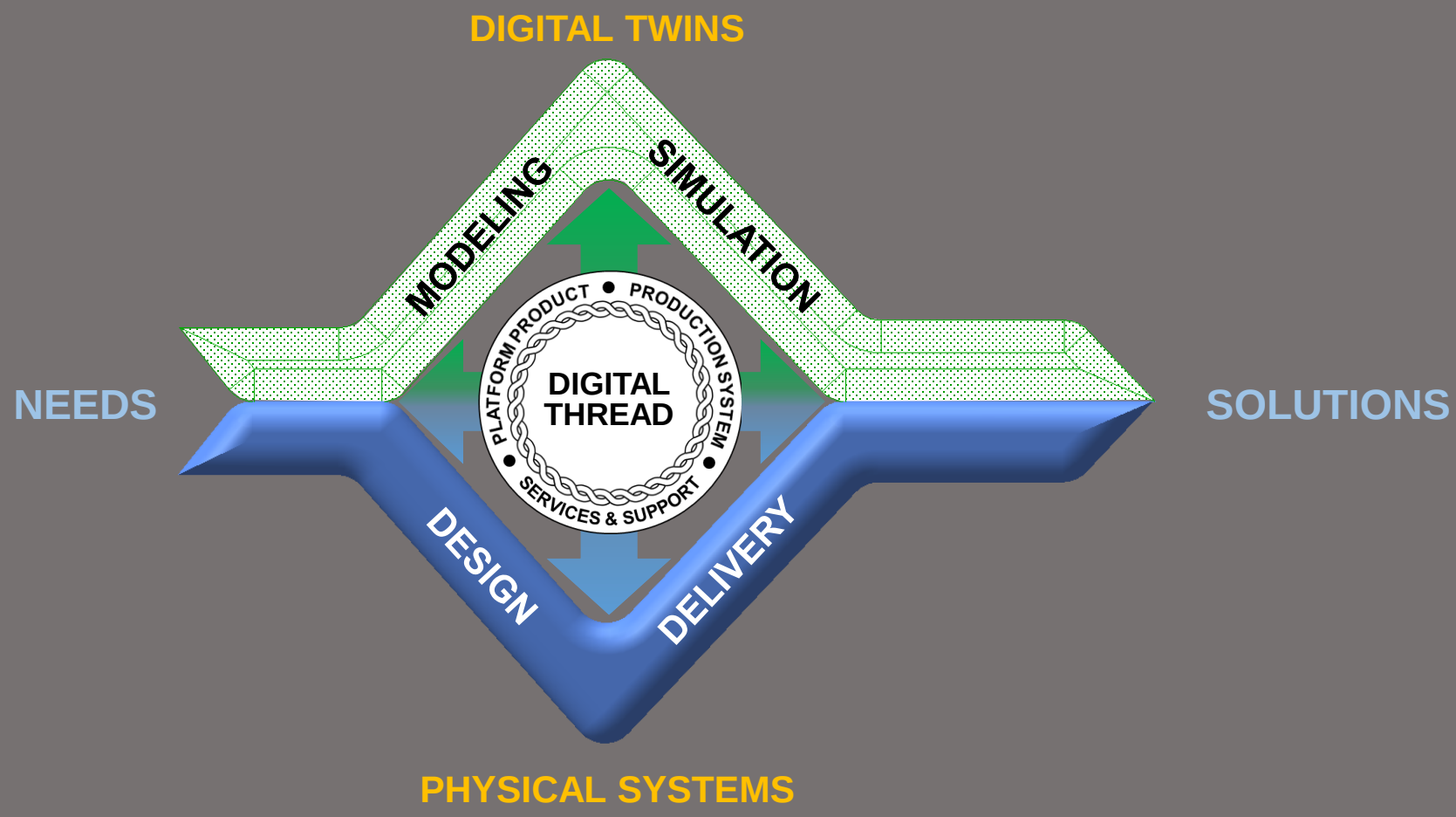


Proposed MBE “Diamond” Symbol



Proposed MBE “Diamond” Symbol - Talking Points

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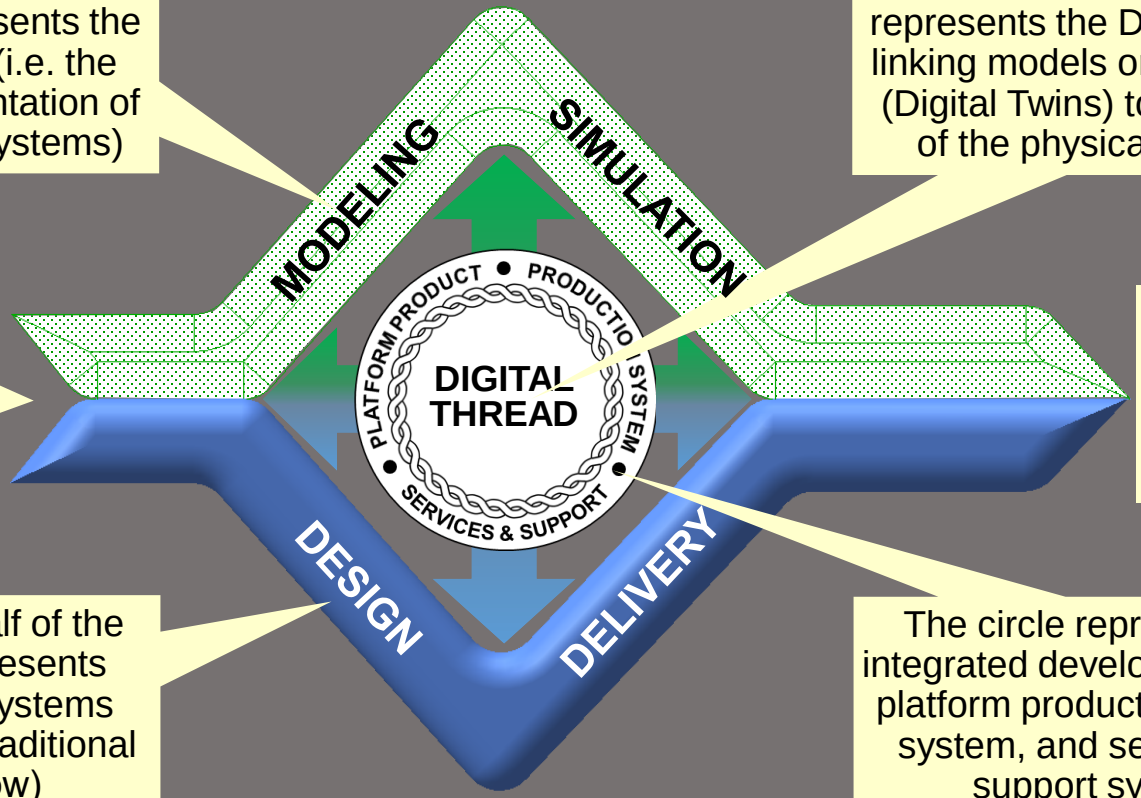

The top-half of the diamond represents the Digital Twins (i.e. the virtual representation of the physical systems)

The interior of the diamond represents the Digital Thread linking models or simulations (Digital Twins) to the design of the physical systems

Integrated physical and virtual development is represent from left to right.

The Digital and Physical Twins are concurrent paths that inform each other across the lifecycle

The bottom-half of the diamond represents the physical systems (retaining the traditional SE “V” flow)

The circle represents the integrated development of the platform product, production system, and services and support systems

Proposed MBE "Diamond" Symbol - Detailed View

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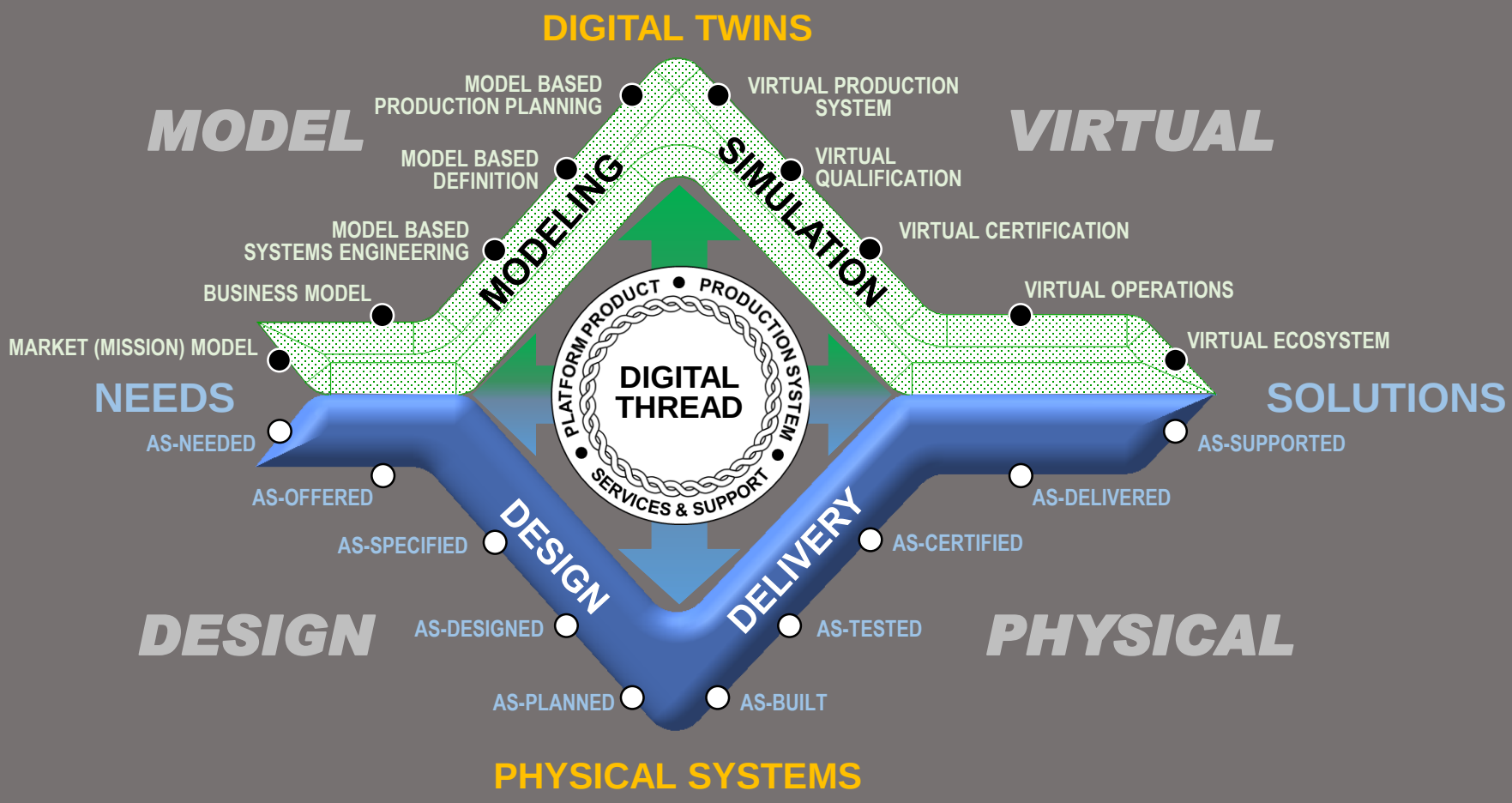

Transforming Systems Engineering to an MBE Environment

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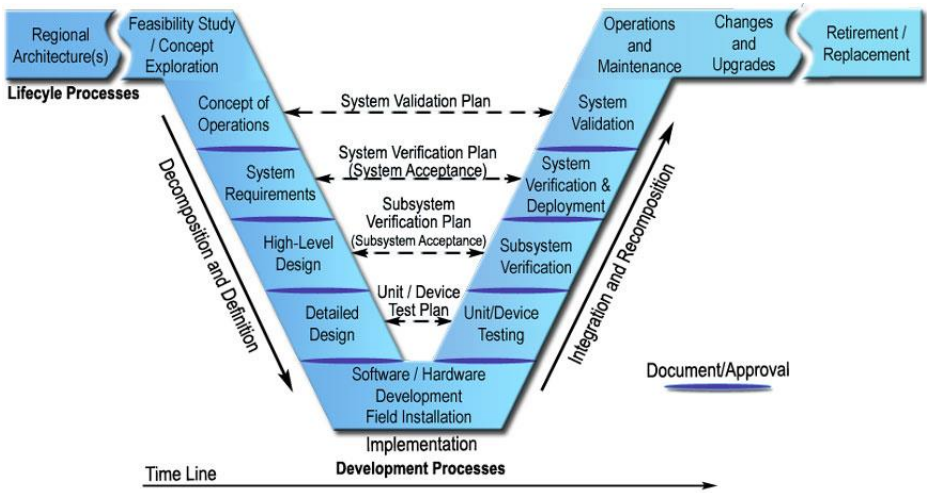
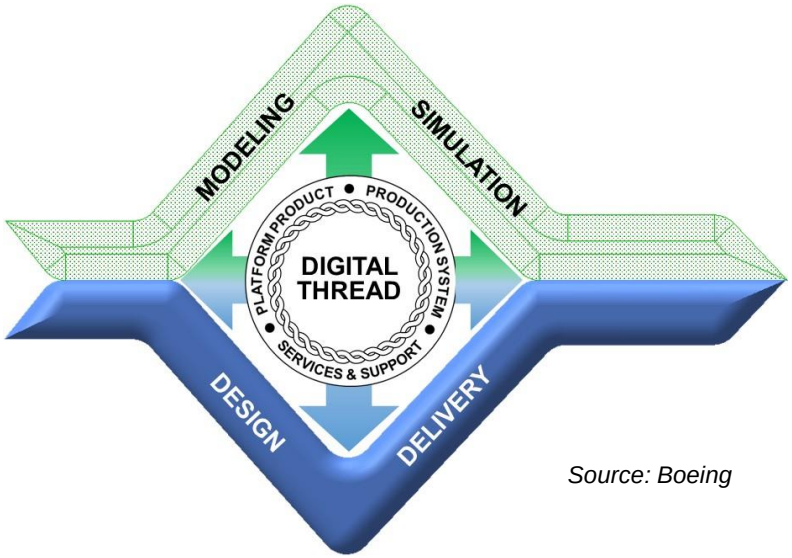
1990s SE V



SOURCE: US Department of Transportation Federal Highway Administration
https://ops.fhwa.dot.gov/publications/seitsguide/section3.htm

2020s MBE Diamond



Source: Boeing

Transitioning from a document-focused mindset to a digital engineering mindset that leverages information flow across the lifecycle.

Questions?

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SOURCE: https://knowyourmeme.com/photos/1346065-steven-crowders-change-my-mind-campus-sign