

Is Digital Transformation the end of PDF?

Kenny Swope

Engineering, Test & Technology

September 13, 2022

Kenneth (Kenny) Swope

Senior Manager, Enterprise Interoperability Standards

Professional Experience

- Office of the Enterprise Functional Chief Engineer for Systems Engineering
- 27 Years with The Boeing Company in Manufacturing Research, Factory Operations, Program Management, and Engineering
- Chair of ISO/TC 184/SC 4 – Industrial data
- CFO of PDES, Inc. a consortium focused on the development of interoperability data standards

Education

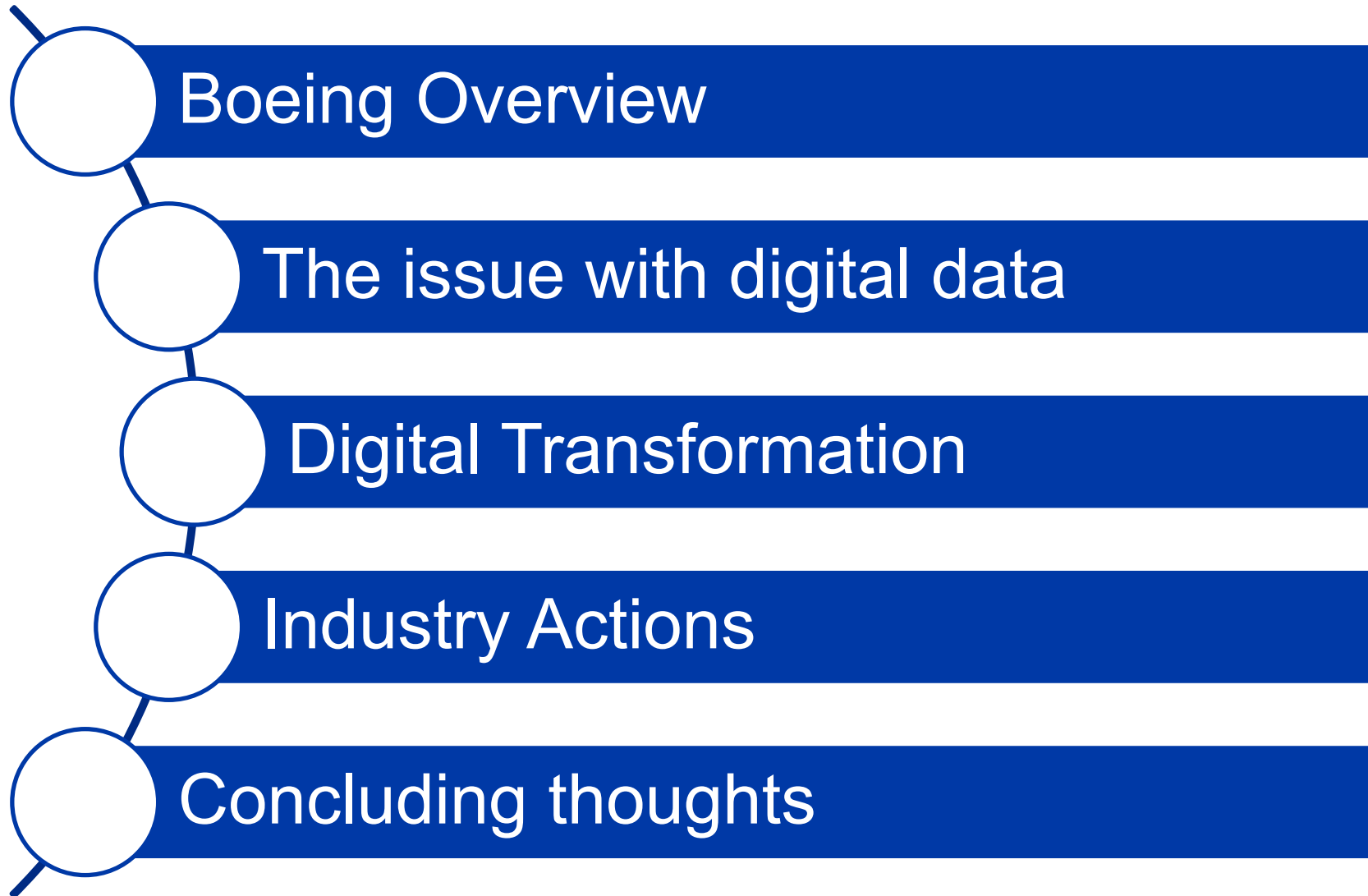
- Master's Degree in Engineering Management from Washington State University
- Bachelor's Degree in Mechanical Engineering from the Missouri University of Science & Technology
- Bachelor's Degree in Physics from the University of Central Missouri

Personal Sharing

- Married for 25 years with three children
- Active in 4-H and FIRST Robotics STEM programs



Agenda



Founded in 1916 in the Puget Sound region of Washington State in the U.S.

Became a leading producer of military and commercial aircraft

Completed a series of strategic mergers and acquisitions to become a leading global aerospace company





COMMERCIAL AIRPLANES

A complete family of the world's most versatile commercial airplanes



DEFENSE, SPACE & SECURITY

The world's leader in providing the most digitally advanced, simply and efficiently produced and intelligently supported solutions to its customers



GLOBAL SERVICES

A dedicated, digital-first services business focused on the needs of global commercial, defense and space customers



BOEING CAPITAL CORPORATION

Global expertise in innovative aerospace financing solutions



WHERE WE ARE



**\$62.3
BILLION**
in 2021 revenues

Products and services support
to customers in more than
150 COUNTRIES



Manufacturing, service and
technology partnerships with
companies around the world

Contracts with more than
12,000
suppliers globally

More than
**140,000
BOEING
EMPLOYEES**

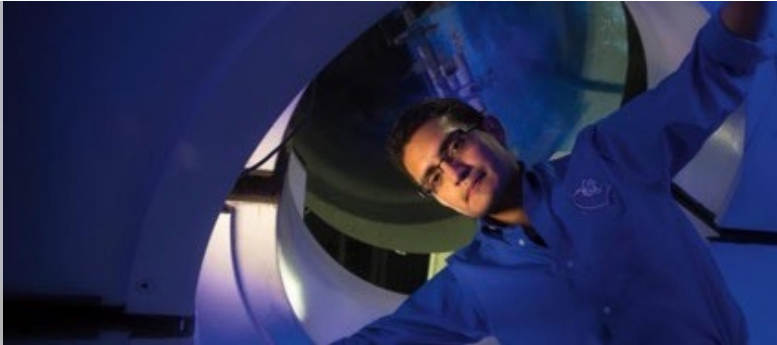


across the United States
and in more than
65 COUNTRIES

Research, design and
technology-development
centers and programs in
multiple countries

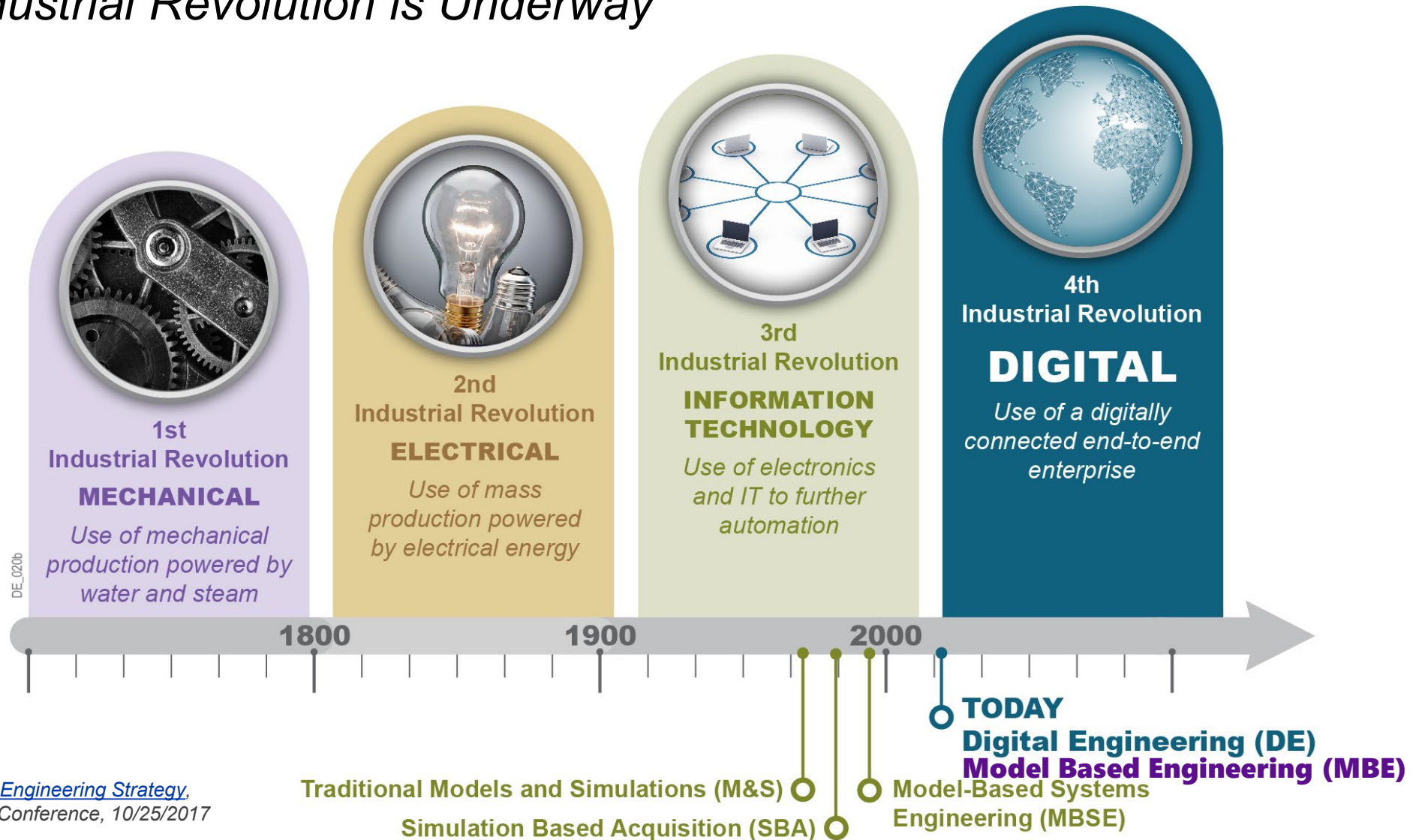


of commercial
airplane revenue
historically
from customers
outside the United
States



Our World is Changing...

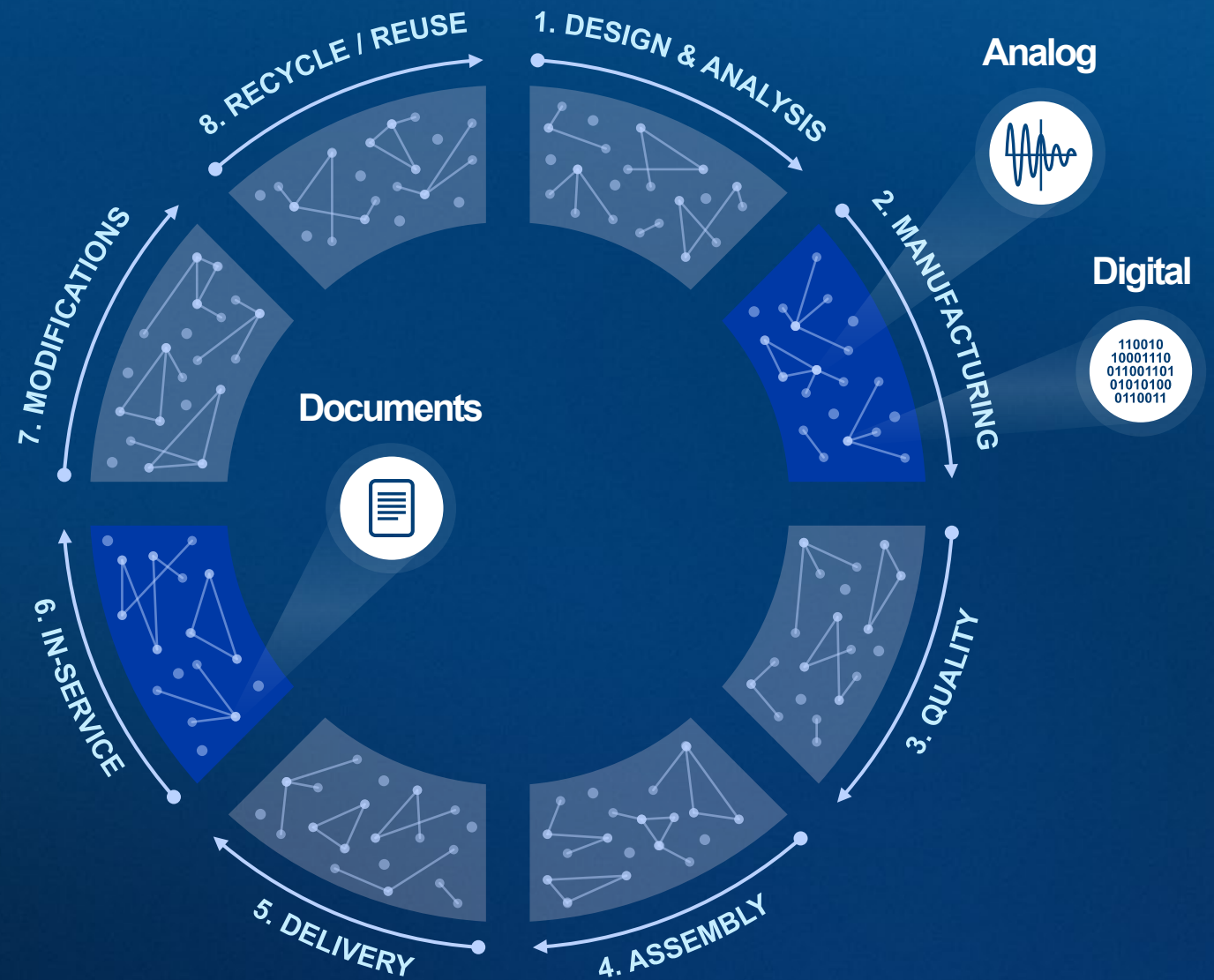
The 4th Industrial Revolution is Underway



Source: [DoD Digital Engineering Strategy](#),
20th Annual NDIA SE Conference, 10/25/2017

The Current State of Data in Boeing

- **VARIED**
- SILOED
- UNDERUTILIZED



The Current State of Data in Boeing

VARIED
► **SILOED**
UNDERUTILIZED



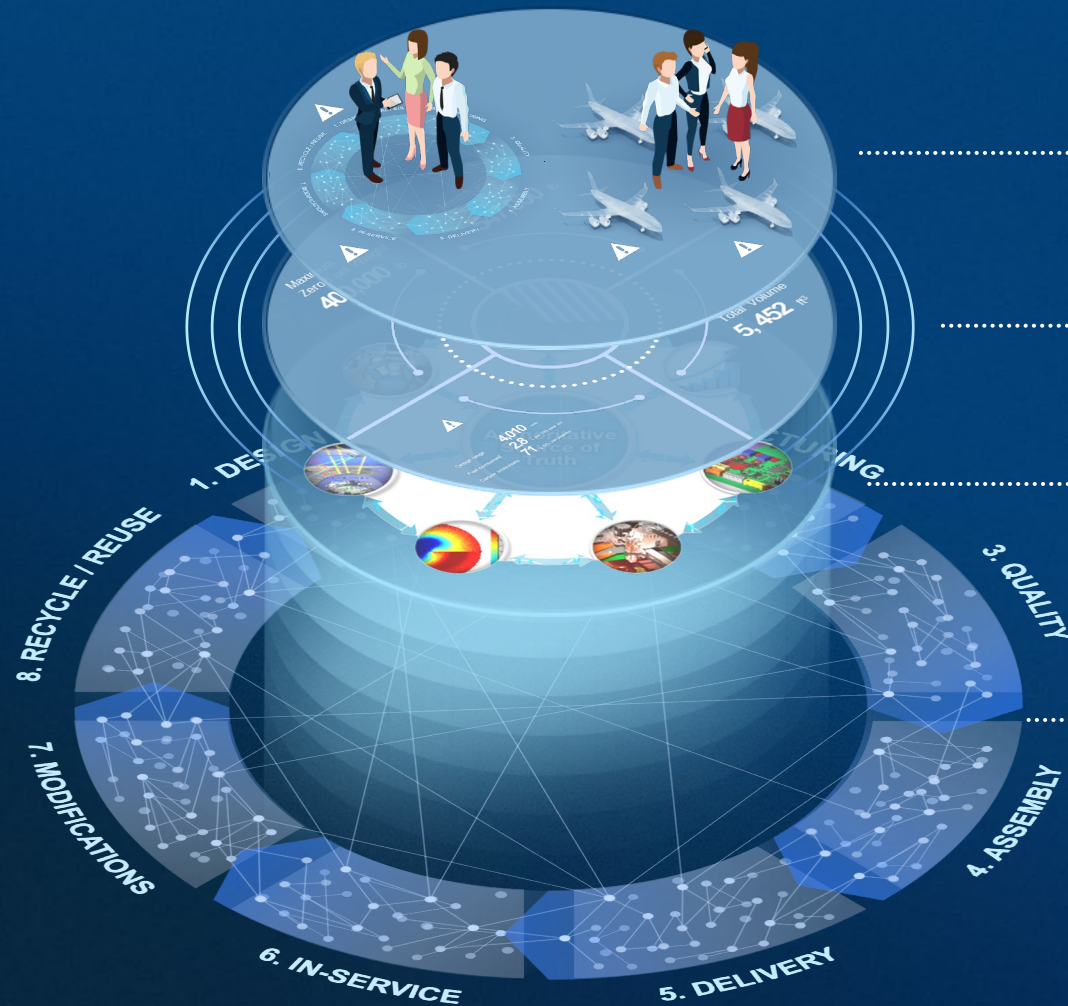
The Current State of Data in Boeing

SILOED

VARIED

► UNDERUTILIZED





DATA-DRIVEN DECISION MAKING

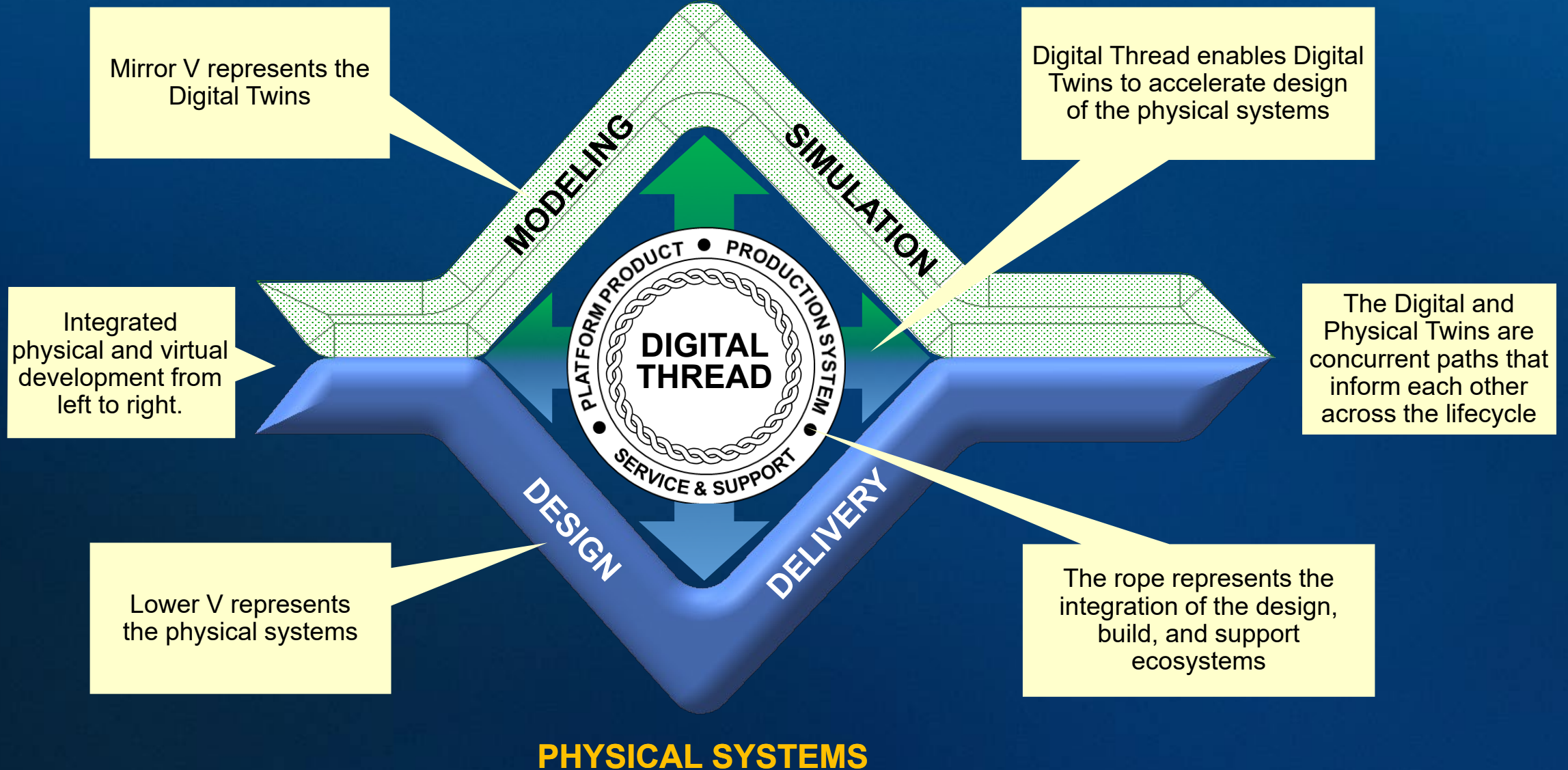
DATA ANALYTICS (INSIGHT)

DIGITAL TWINS (INTELLIGENCE)

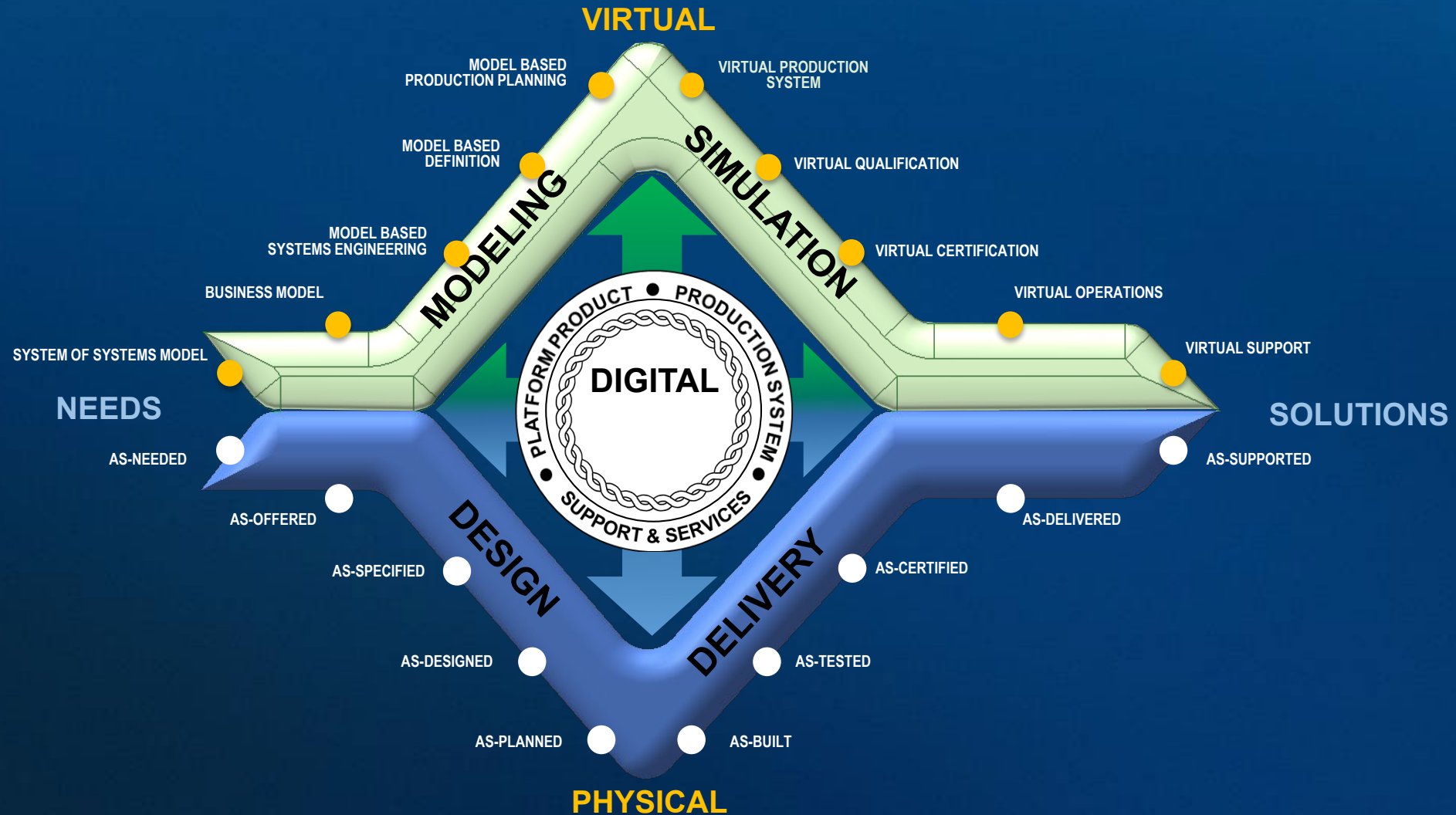
DIGITAL THREAD (CONNECTIVITY)

The Digital Value Chain

DIGITAL TWINS



MBE Diamond Symbol



Boeing Model Based Enterprise Taxonomy (Elements)

MODEL BASED ENTERPRISE

Rev A: 8/13/19

MODEL BASED ENGINEERING

PRODUCT LIFECYCLE MANAGEMENT



PRODUCT LINE ENGINEERING



MODEL-BASED SYSTEM
ENGINEERING (MBSE)



MODEL
BASED
DEFINITION



PRODUCT
ANALYSIS &
SIMULATION



MODEL BASED
PRODUCTION
PLANNING



PRODUCTION
SYSTEM
ANALYSIS &
SIMULATION



CYBER
SYSTEMS,
NETWORKS
& EMBEDDED
SOFTWARE



PRODUCT SUPPORT
AND SERVICES
ANALYSIS &
SIMULATION



ELECTRICAL
AND
ELECTRONICS



TEST AND
CERTIFICATION

SUPPLY CHAIN SIMULATION



PRODUCTION / SUPPLY CHAIN
OPERATIONS



SUPPORT AND SERVICES



FINANCIAL MODEL



101000100
110001001

DIGITAL SYSTEM MODELS



DIGITAL TWINS

DIGITAL THREAD



INFORMATION TECHNOLOGY AND DATA ANALYTICS

MBE Starter Kits



People /
Training



Processes



Tools / Apps



Data








Enabling
Architectures

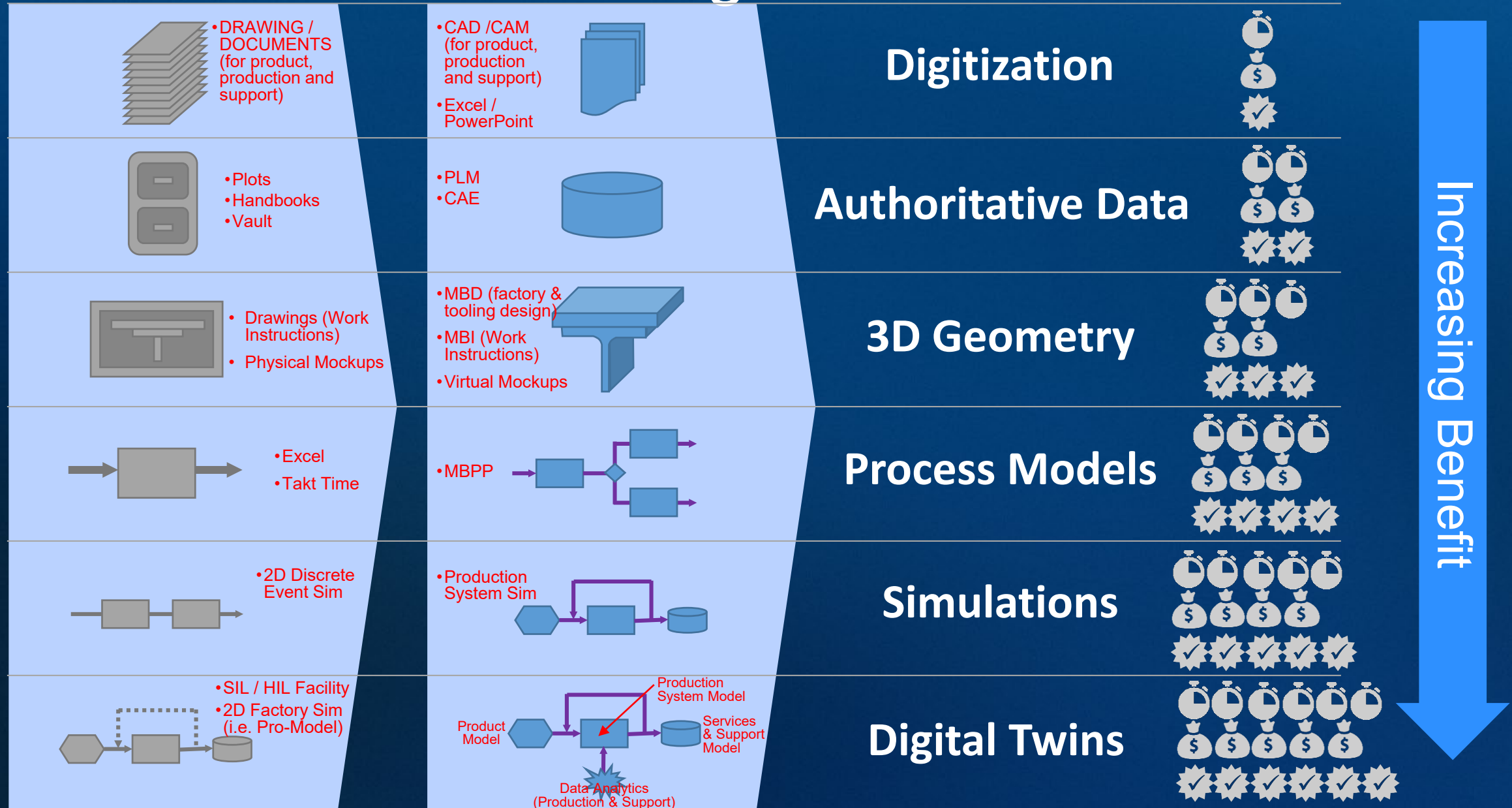


Reusable
Models

Legend

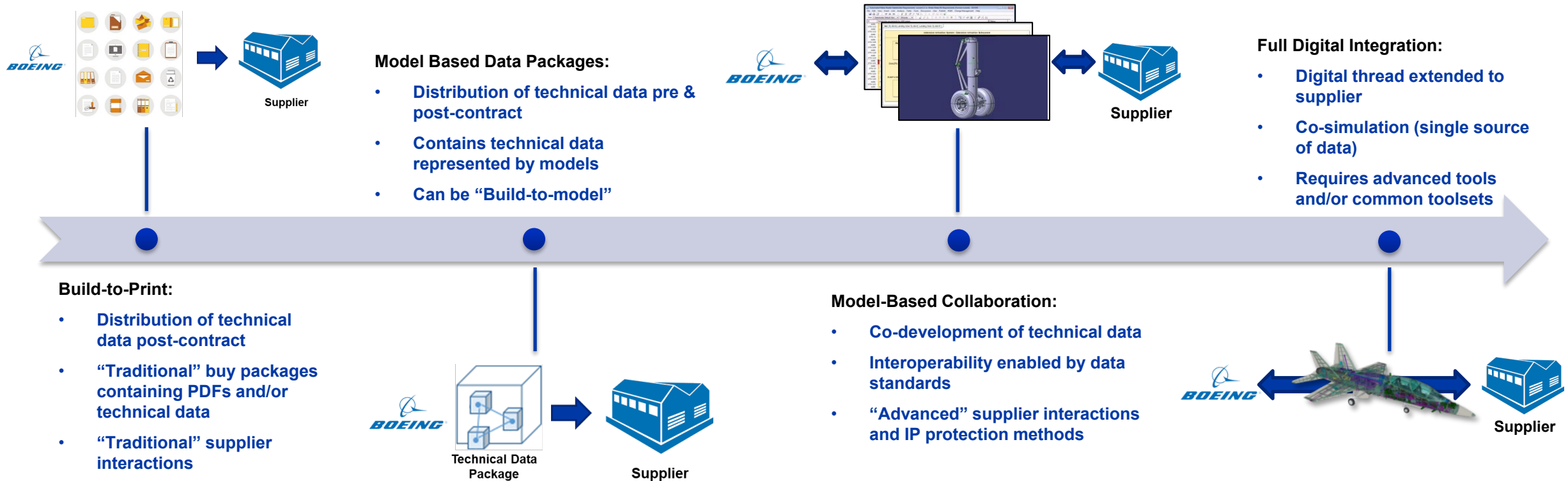
-  Product Lifecycle Management
-  Domain Engineering
-  Operations Management
-  Support & Services
-  Enterprise Services

Transformational Change at the data level



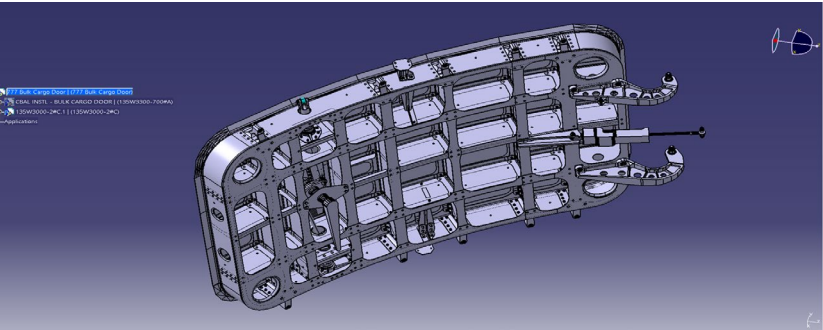
Supply Chain Model Based Engineering

Leveraging MBE to promote collaboration between Boeing and Suppliers/Partners



Collaboration needs will drive increasingly complex interactions between Boeing and Suppliers

Engineering Data today



Engineering data set in CAD

Help | my List | Options | Get Prizm | Contact Us | Logoff

REDARS
Engineering Information Delivery

Home | Drawing Searches | Part Searches

Part Number Search

At least 1 non-wildcard character is required in the Part Number field.

Model

Customer Code * ☒ All customer codes

Part Number *

Part Name

To change the customer code deselect the "All customer codes" checkbox.

Airplane ID Type Line number

From airplane find airplane to

Part Type ALL

Usage Effectivity Source Production

* Required field

Home | Help | Contact Us | Content Owner | Inside Boeing | Logoff

Copyright © 2022 Boeing. All rights reserved.

Engineering data made available in a repository

PICTURE SHEET	BOEING	CORPORATE OFFICES SEATTLE, WA 98124	EXPORT CONTROL COM	CAGE 81205	NUMBER 135W3000 SHEET DL	REV J	SHEET OF 7
DATA LIST	LIST TITLE	MODEL	CONTRACT NUMBER	DATE			
BULK CARGO DOOR INSTALLATION				11-11-2019			

FLAGNOTES AND GEOMETRY RELATED NOTES IN THIS REPORT SUPERSEDE THE DRAWING SHEET PL FOR THIS DRAWING

Parts lists, supplier specs, and manufacturing requirements

3D PDF with a Light Weight Graphic

Illustrations

Authoritative models

Copyright © 2021 Boeing. All rights reserved.

Author, 9/8/2022, Filename.ppt | 18

PDF in the Aerospace Industry

LOTAR – Long Term Archiving and Retrieval

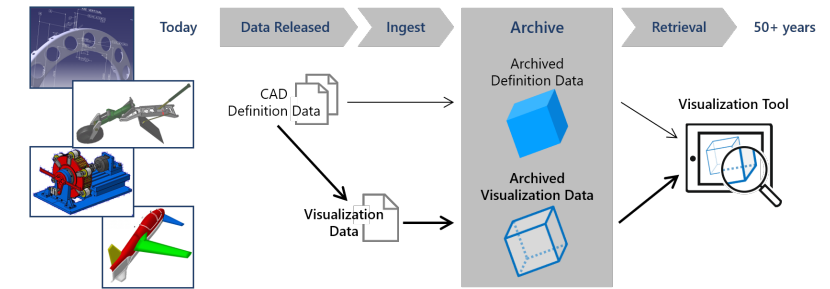
- A response to regulators that engineering data shall be maintained and accessible for the life of the product +
- Visualization and production data are in scope

ISO Partnerships to develop standards

- ISO/TC 184/SC 4 & ISO/TC 171/SC 2
- Additions to PDF to accommodate engineering data

DoD Mil Std 31000B Technical Data Package

- A revision in 2018 to include 3D data
- Now available as a contract option



Welcome to LOTAR International

LOTAR is an international consortium of Aerospace manufacturers, jointly facilitated by AIA, ASD-STAR, AFNet, prostep i/vp and PDS, Inc.



ISO/TC 171

ISO/TC 171/SC 2

Document file formats, EDMS systems and authenticity of information

ISO/TC 184

ISO/TC 184/SC 4

Industrial data

MIL-STD-31000B

3. DEFINITIONS.

3.1 For the purposes of this standard, the following definitions apply:

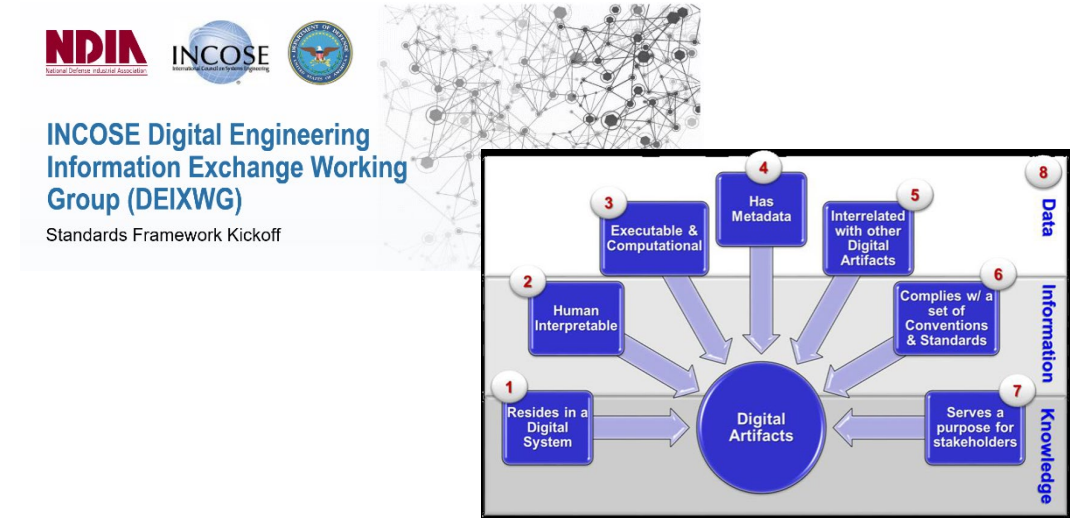
3.1.1 **3-Dimensional Intelligent (3Di) technical data.** A 3-dimensional viewable representation of an item provided in a widely available software format (e.g. ISO 32000-1 Portable Document Format (PDF)). This representation details the complete technical description of the required design configuration to include but not limited to geometry, topology, relationships, tolerances, attributes, metadata and other features necessary to define a component or assembly.

Digital model exchange in standards

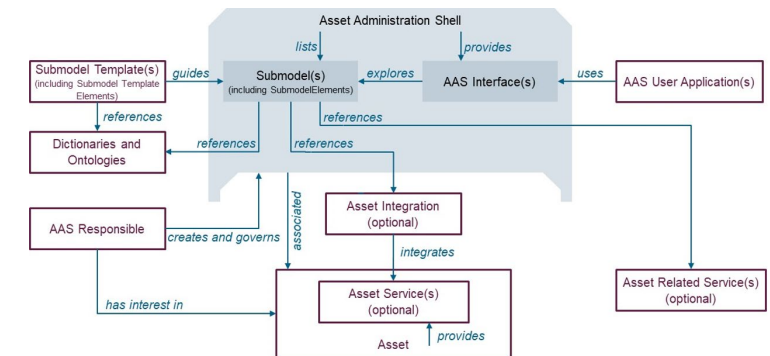
Many organizations are working on the refactoring of data package exchange envisioning model data and its meta-data.

NDIA, INCOSE, and DoD – Drafting a Digital Viewpoint concept model aimed at interoperability of models

IEC TC 65 WG 24 - Developing the Asset Administration Shell as a means to identify and exchange models in the Industry 4.0 framework



IEC IEC TC65 WG 24 Asset Administration Shell for Industrial Applications



Complex engineering models require a portable format

Concluding thoughts

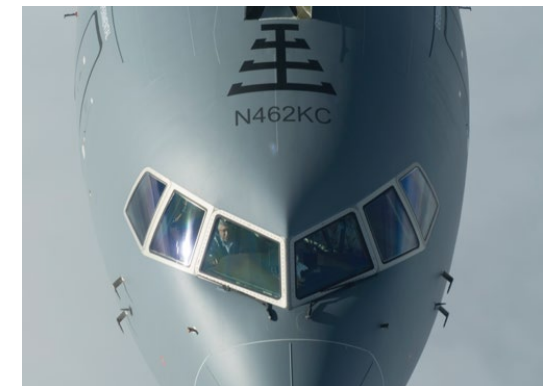
Digital Transformation is past the hype; industry is pursuing the value capture

The management of data is becoming one of the key points of inflection – reimagining the role of the human will be key

The propagation of model data will extend far beyond engineering and become another component of smart products

Documents as a term will persist and take on a different role than it has in the past

Will Digital Transformation be the end of PDF? No, but it will be different



Digital Transformation

WHERE WILL IT TAKE US...?



