

# ASME Model-Based Enterprise Standards Development



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1

1

## ASME Model-Based Enterprise (MBE)

➤ **Charter:** *Develop standards or related products that provide rules, guidance, and examples for the creation, use and reuse of model-based datasets, data models, and related topics within a Model-Based Enterprise.*

➤ **Areas of Concentration:**

- Types of models and their intended uses
- Rules for representing requirements and constraints
- Types of features and data elements for model-based datasets
- Schemas for datasets
- Management of links between product definition and process definition
- Rules governing data quality
- Creation, management, and use of product definition and process definition data
- Management of discrepancies between existing standards affecting MBE and MBD



2

2

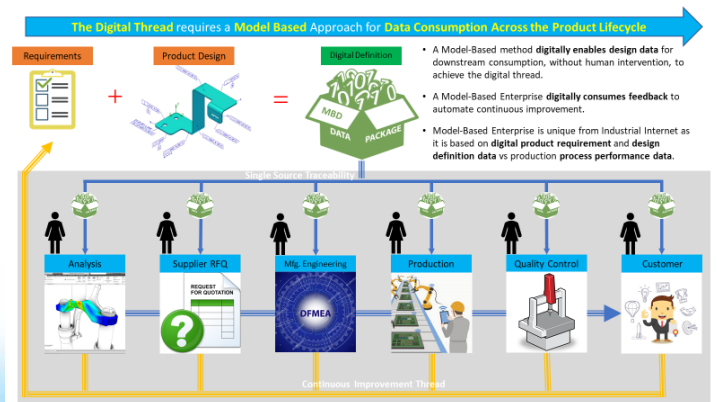
## Goal: Standardize the Digital Thread

The Objective is to use an accepted set of data to obtain an integrated information flow that connects all phases of the product lifecycle.

Each product lifecycle phase includes requirements capture, computational analysis, design, manufacturing, quality assurance, sustainment, and more.

Continuous improvement will utilize data in new ways as the future marches on.

Increase the integration between different components of the standard and speed up the development and release of standards.



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3

3

## ASME Mission & Vision

### MISSION STATEMENTS

“To serve **diverse global communities** by advancing, disseminating and applying **engineering knowledge** for **improving the quality of life** — and communicating the **excitement of engineering.**”

### VISION STATEMENTS

“**To be the essential resource** for mechanical engineers and other technical professionals throughout the world for **solutions that benefit humankind.**”



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4

## ASME at-a-Glance

- **130,000+ members in 100+ countries**
  - Includes 34,000+ students
- **600+ code and standards**
- **Offices: US – Europe – Asia**
  - HQ: New York City
  - Little Falls (NJ); Houston (TX); Washington DC
  - Brussels (EU); Beijing (China); New Delhi (India)
- **Digital Library with journals, proceedings & ASME Press e-books, including:**
  - 220,000 technical papers (~1.7 million pages)
  - ~30+ conference proceedings published annually (80 volumes, ~10,000 papers, 70,000-100,000 pages)



- **ASME.org: ASME's worldwide social network:**
  - Participant groups tailored to professional interest
  - ASME contacts & networking, online activities, purchases
  - Personal dashboard provides optimizable user gateway to online experience



5

5

## Codes & Standards: Why Do We Need Them?

Promote innovation

**Safety, uniformity, consistency, reliability, productivity, and efficiency**

Help communication between producers and users

**Product design and manufacturing**

Considered a “common language”

**Allows groups to communicate even when they are of different nationality**

Promote interchangeability

**Dimensioning is consistent**

Allow for more flexibility for designers

**Design creativity is not infringed by use of standards**

Satisfy safety, performance, and economic goals

**Provides for a “level playing field”**



6

6

## History

**ASME was founded in 1880 to address issues with industrialization and mechanization.**

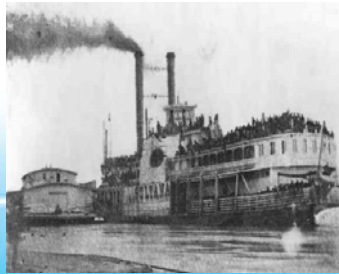
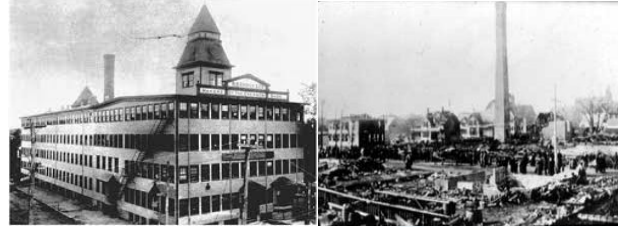
Industrial revolution was fueled by novel applications of steam power

Between 1898 and 1903 alone, over **1200** people were killed in the U.S. in **~1900** separate boiler explosions

**Key problem:** Lack of understanding, consistency, and safety features in boiler **design and operation**

Steamship Sultana: Boiler explosion killed approximately 1800 people on April 27, 1865, in the single largest loss of life due to boiler explosion

Grover Shoe Factory Brockton, MA 1905



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7

7

## ASME C&S Consensus Process

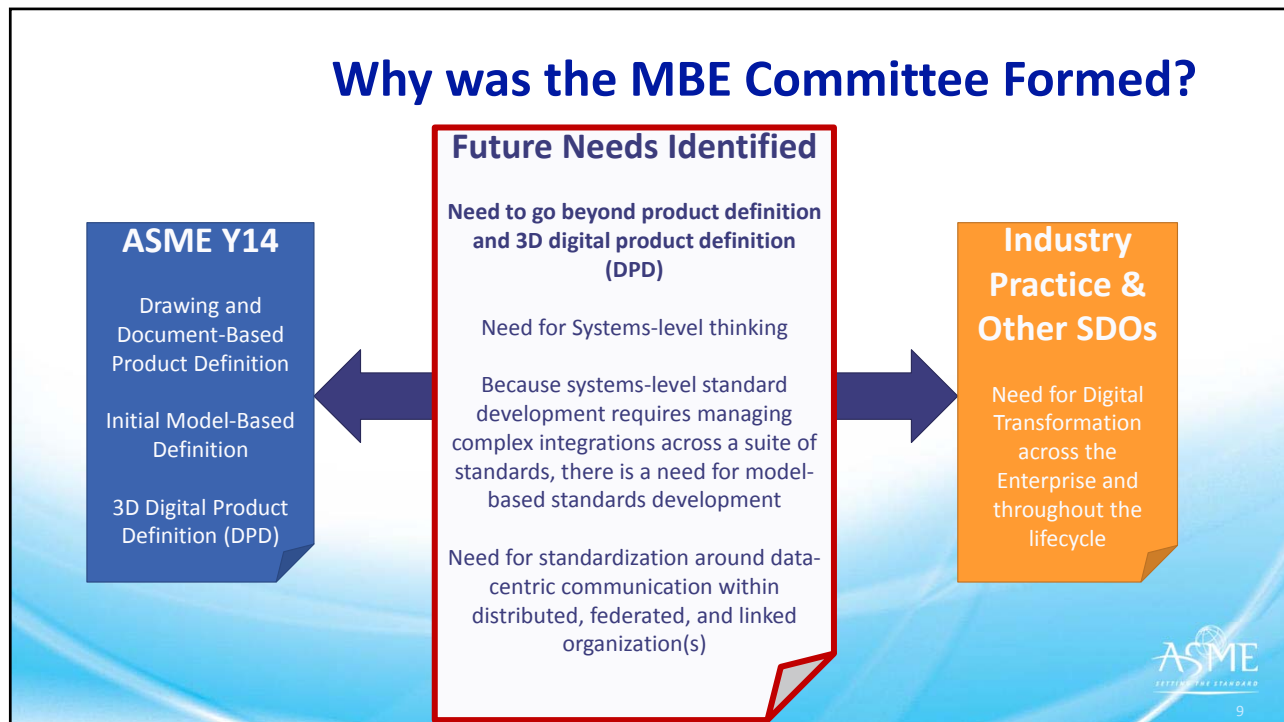
### ➤ What is consensus?

- **Substantial agreement by affected stakeholders**
- Consideration of views and attempted resolution
- Unanimity is not required
- ASME provides neutral forum
- **Openness, Transparency, Balance of Interest, Due Process**
- Accredited by the American National Standards Institute (ANSI)
- Consistent with principles of World Trade Organization (WTO) Technical Barriers to Trade Agreement
- **ASME does not 'approve', 'rate' or 'endorse' any item, construction, proprietary device, or activity.**

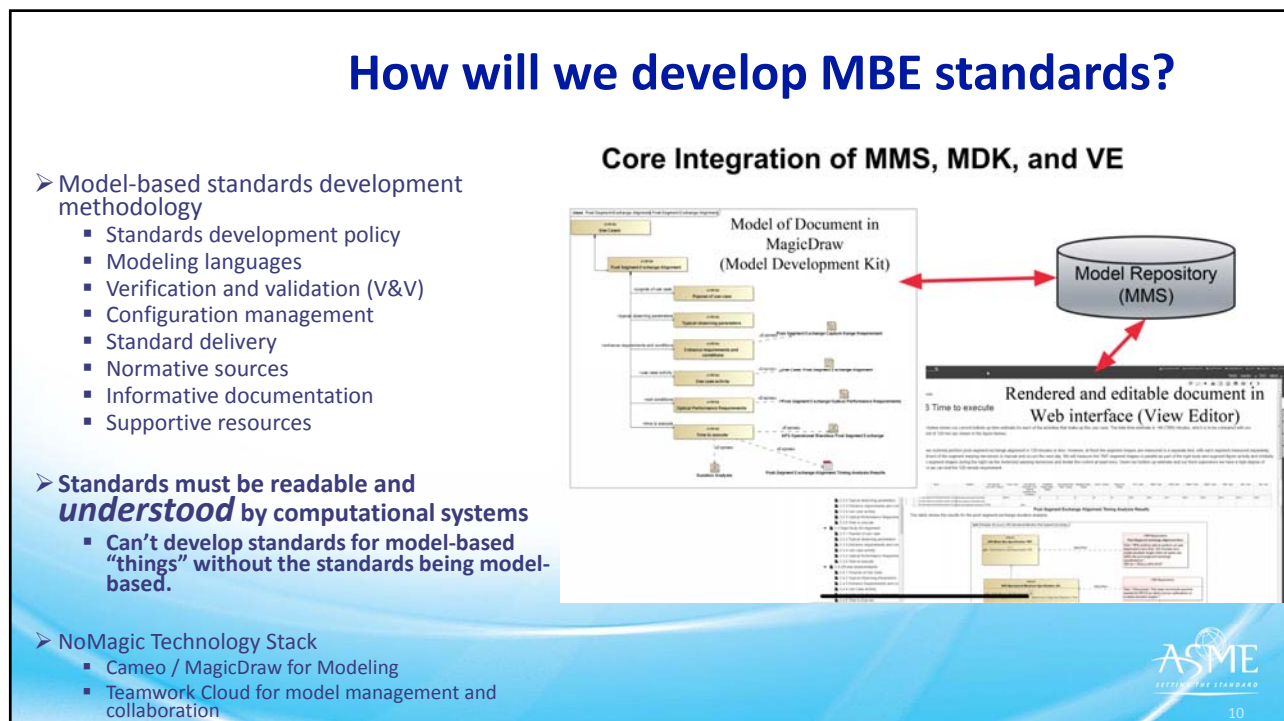
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8

8



9



10

## ASME MBE Recommendation Report

### ➤ A Starting Point for MBE Standards Activities

- Developed by the ASME MBE Steering Group, which consisted of 8 existing ASME volunteers and 2 new members
- Establishes direction, activities, priorities, and organizational structure of the ASME MBE Standards Committee and its subcommittees
- Provides methodology for developing MBE standards using a model-based approach
- Outlines a roadmap for the MBE standards development process
- Describes a marketing and adoption strategy for MBE

*“MBE will transform industry by increasing productivity, quality, profitability, and types of products, and by reducing wasted effort, wasted time, non-value-added work, lost information, missed opportunities, and time to market.”*

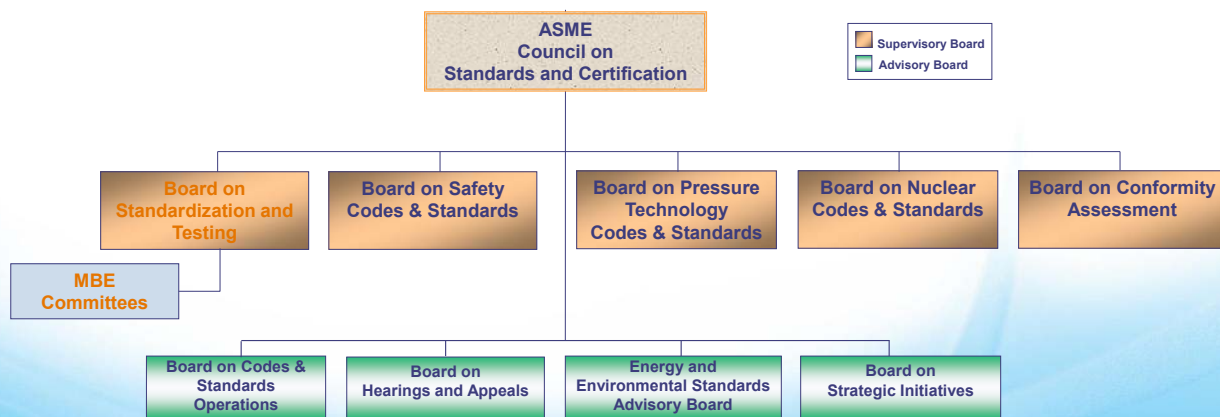


Download:  
[go.asme.org/MBEreport](http://go.asme.org/MBEreport)

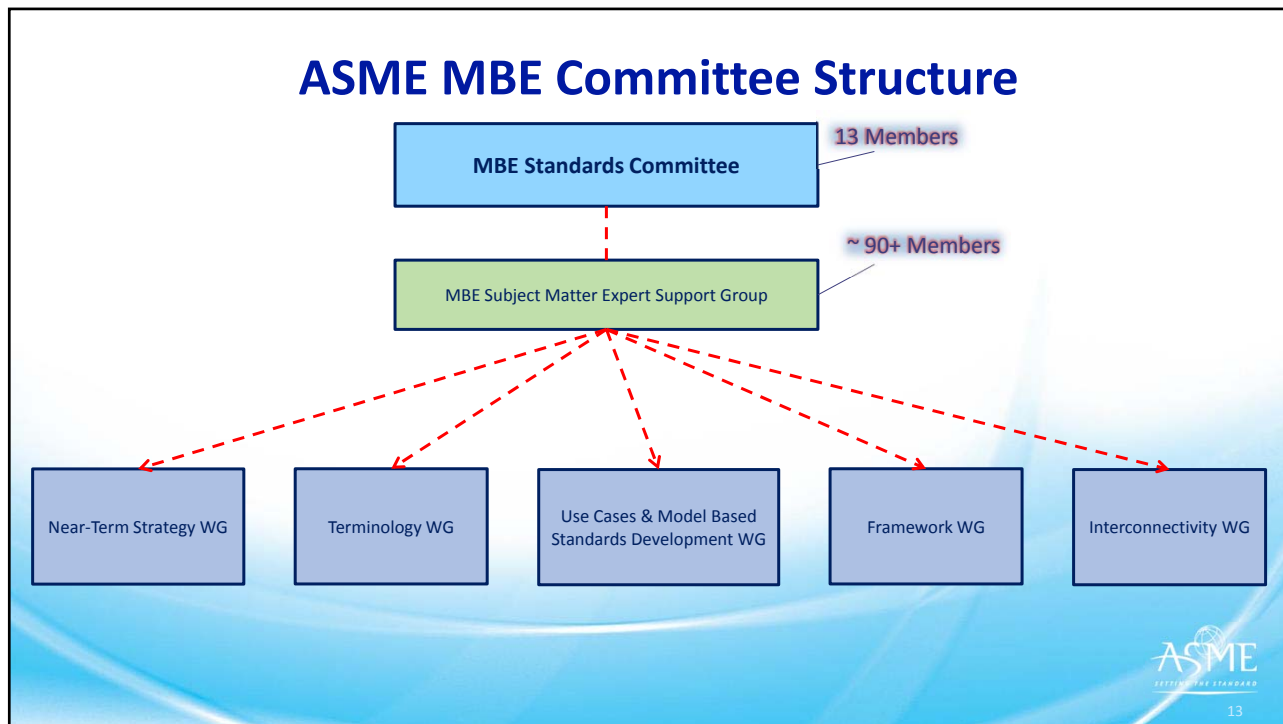


11

## ASME S&C Organization Chart




12



13

## Organizations Represented in ASME MBE

3D PDF Consortium	Elysium	John Deere	Purdue University	Tenneco
Action Engineering	FDA	JSL Innovations Inc.	Raytheon Technologies	Texas A&M University
Allison Transmission	Ford	LMI	Ribose Inc.	UNC Charlotte
Anautics	GE Appliances	Lockheed Martin	Rolls-Royce	Univ of Maryland
Boeing Co.	Hexagon Manufacturing Intelligence	Mitutoyo	Science Applications International Corporation	Univ of Ontario Institute of Tech
Cadenas PARTsolutions	Honda Aircraft Co.	MRIIOT LLC	Sandia	US Air Force
Capvidia	Honeywell FM&T	National Nuclear Security Administration	Siemens	US Army
Caterpillar Inc.	ICTT Systems Sciences	Newport News Shipbuilding	Sigmatrrix	US Navy
Colab	I-Infusion Inc.	NIST	Sony	Woodward Inc.
Commonwealth Center For Advanced Manufacturing	Industry for Process Excellence	Nvariate Inc.	Sub-Zero Group	XSB Inc.
Dassault Systems	ITI – International Technegroup	Penn State University	Tech Azul	Youngtown State

  
14

14

## Terminology

➤ **Purpose:** Collect, source, manage, and validate terms, acronyms, and abbreviations for use in MBE Standards enabling MBE practitioners to collaborate with precision and ease.

➤ **Scope:**

- Use a model-based approach to define, document and maintain core MBE terms, definitions, acronyms, and abbreviations in a normative online repository
- Identify, prove and test preferred terms among equivalent definitions within the MBE community
- Adjudicate changes to terms, definitions, acronyms, and abbreviations

➤ **Status:**

- Developed a “model proof” technique to diagram each term with relationships to other terms
- Gathered and proofed approximately 64 terms with a broad definition and a model proof
- Received feedback on 8 high priority terms and now working to understand how these 8 terms fit within the framework proposed by the Framework Working Group



15

15

## Use Cases & Model-Based Standards Dev

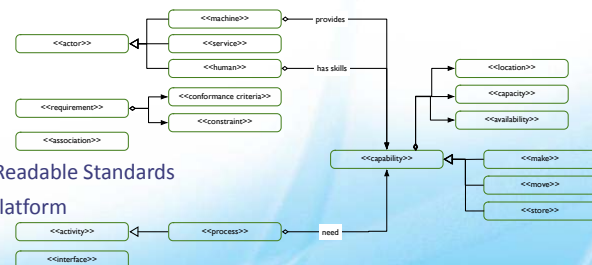
➤ **Purpose:** Focus on system architectural concerns for various viewpoints to create electronic models and artifacts that define the MBE standards, and can be interpreted by an automated system.

➤ **Scope:**

- Ascertain priority, risk, and complexity of use cases
- Recommend MBSD methods and tools
- Recommend practices for the generation of use cases
- Interface with ANSI Strategic Advisory Group on Machine Readable Standards
- Recommend reference architecture for a MBSD system / platform

➤ **Status:**

- Developed, Sent, Analyzed a Request for Information (RFI)
- Rolled out Agile process and defined initial ways to collaborate on released standards
- Created a draft of a reference modeling methodology



16

16

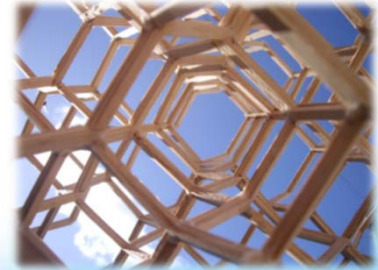


## Framework

➤ **Purpose:** Define the concept of a model-based enterprise by providing a high-level structural definition.

➤ **Scope:**

- Collaborate with Terms WG to develop a narrative MBE definition and description
- Collaborate with Use Cases and MBSD WG to use a methodical model-based approach to define the architecture of an MBE
- Investigate and recommend the best available Framework approach.
- Survey of current "CONOPS, frameworks, taxonomies, etc."
- Collect, document, and moderate the structural definition of core MBE components (e.g., people, processes, information, technology)



➤ **Status:**

- Surveyed existing Concept of Operations, Frameworks, Taxonomies, and more
- Created version 1 of a baseline framework

17

## Interconnectivity

➤ **Purpose:** The MBE Interconnectivity Working Group is to define the connections and exchange of information between enterprise domains and process activities

➤ **Scope:**

- Identify use cases required to define the activity and data flows required for MBE
- Analyze use-case requirements with the goal of creating composable, interoperable services
- Document protocol, syntactic, and semantic interoperability requirements
- Document data flows, standards interfaces, and process activity
- Identify trustworthiness concerns and document the requirements for addressing the various areas, with specific attention to provenance, access, and information integrity



➤ **Status:**

- Working group formed in January 2021
- Kick-off meeting held 11 February 2021

18

## Near-Term Strategy

➤ **Purpose:** Identify challenges, gaps, and problems inhibiting understanding and adoption of model-based methods.

➤ **Scope:**

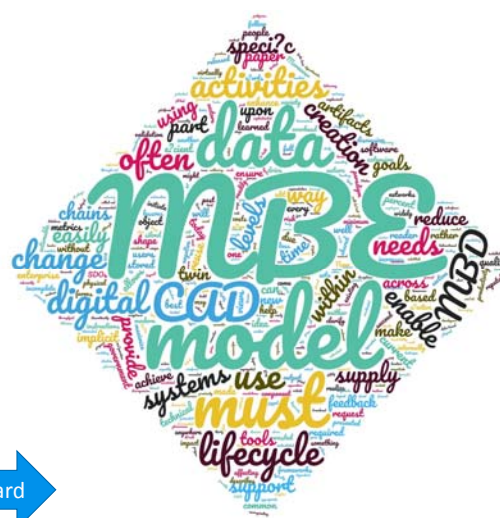
- Develop proposals for priorities, activities, documents, standards, products, etc. needed by industry in the short term
- Review current industry issues and trends, evaluate and prioritize industry activities, and examine timeframe, difficulty, and cost of implementing initial actions
- Identify and mitigate barriers in MBD and MBE understanding and implementation

➤ **Status:**

- Issued a call for participation seeking design engineers and systems engineers
- Planning material explaining MBD and MBE and their value propositions along with recommended practices to facilitate acceptance and lessen risks
- Planning material explaining inefficiencies of current document-based, siloed work processes with disconnected and redundant information

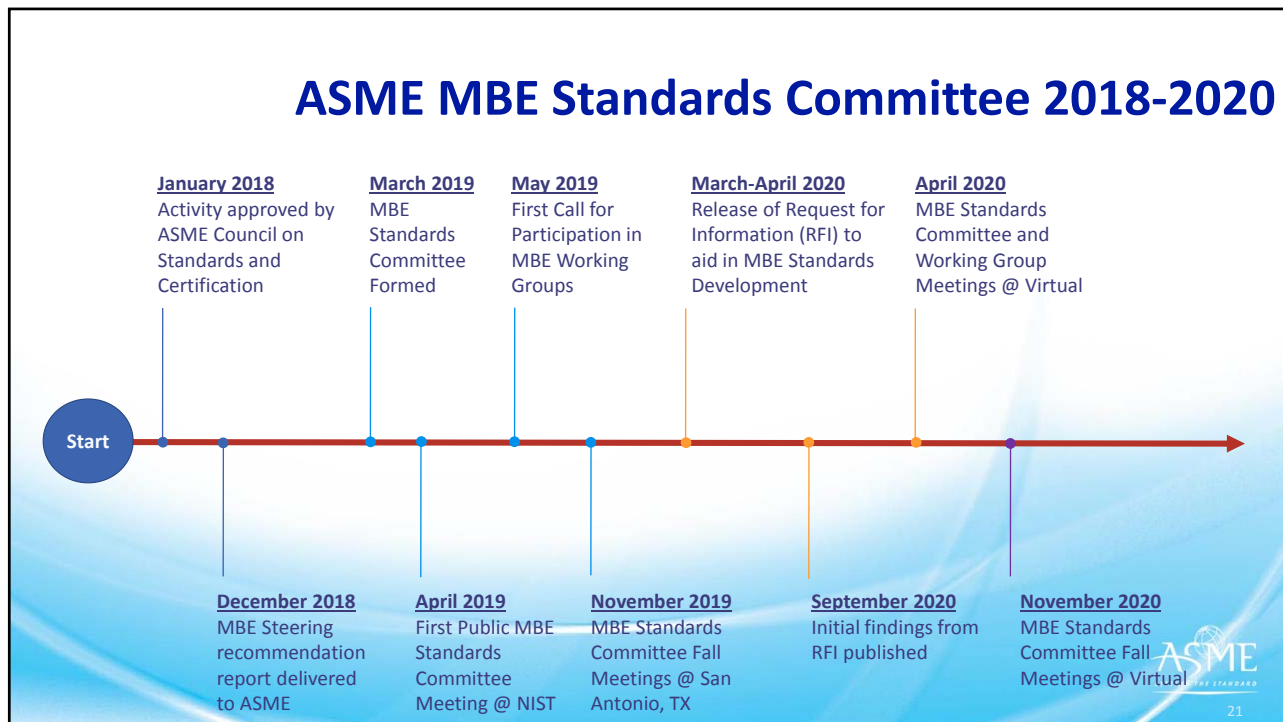


Comments gathered from Near Term WG

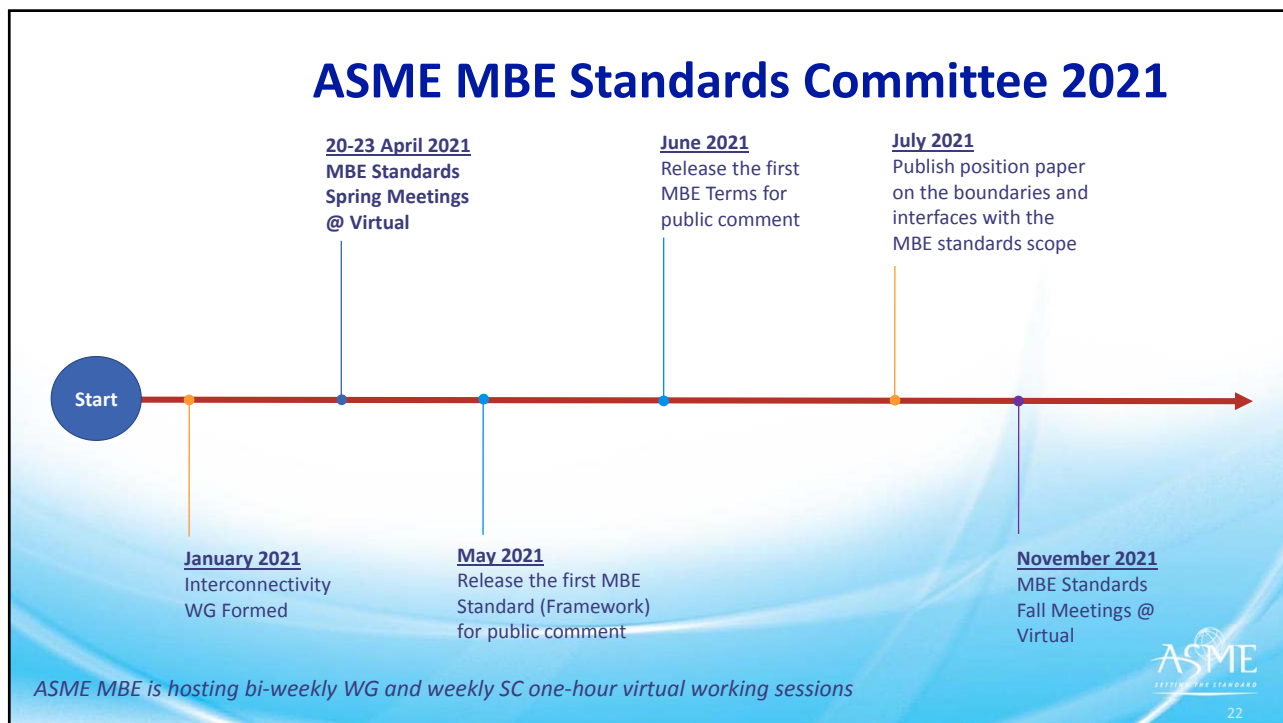


From page 2 thru 6 of ASME MBE Recommendation Report





21



22

## Industry Experts and Liaisonhip

- Current MBE SC and SMEs are heavily affiliated with
  - Aerospace and Defense industry
  - Design / Product development roles
  
- The SC wants to recruit other industry sectors, e.g.:
  - Oil and Gas
  - Automotive
  - Medical / Biomedical
  - Infrastructure



- **Experts Wanted: Enterprise Architects with modeling expertise**



23

23

## Additional MBE Solutions

- Support DoD's Digital Strategy
- Collaboration with related organizations
  - Japan Electronics and Information Technology Association (JEITA)
  - International Council on Systems Engineering (INCOSE)
  - Digital Metrology Standards Consortium (DMSC)
  
- **ASME MBE Spring 2021 Meetings**
  - Date: 20-23 April 2021
  - Location: Virtual
  - Free and open to guests without registration



24

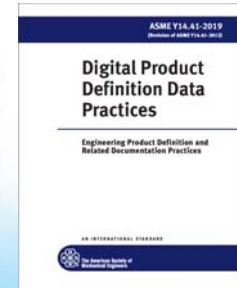
24

## ASME Y14.41 Digital Product Definition Data

➤ **Scope:** *Establishes requirements, defines exceptions, and references documents applicable to the preparation and revision of digital product definition data, referred to as data set(s) or graphic sheet(s) in digital format.*

- ❖ Product Definition Data denotes the totality of data elements required to completely define a product.
- **Model based applications** and examples added
- New chapters on **Surface Finish** and **Weld Symbols** applied to a model
- Added **non-uniform profile tolerance zone** example and explanation
- Guidance on limiting the application of GD&T with notes
- Help identifying user requirements and what can be easily consumed by automation

**Published September 2019**



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25

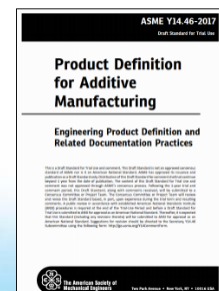
25

## ASME Y14.46 for Additive Manufacturing

➤ **Scope:** *Establishes definitions of terms and features unique to additive manufacturing (AM) with recommendations for their uniform specification in product definition data sets and related documents.*

- ❖ Provides a method of controlling product definition directly in the model using annotations that are human and machine readable and associated to the feature geometry they represent.
- Leverage **model-based product definitions** for AM
- Includes definition of 3D geometry for the end item and for process control
- Provides **data package bundling details** for AM
- Assists in specifying the geometric placement of material and material gradients
- Includes **theoretical supplemental surface** for identifying supplemental geometry

**Published as Draft Standard for Trial Use December 2017**



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26

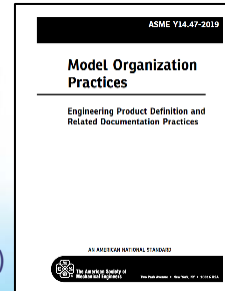
26

## ASME Y14.47 Model Organization Practices

➤ **Scope:** Establishes a schema for organizing a three-dimensional (3D) model and other associated information within the context of a digital product definition data set that enables a model-based enterprise.

- ❖ Standardizes the exchange of 3D model data used to define an item for manufacturing and procurement.
- Intended as a foundation for design development efforts in a model-based enterprise
- Formed from **MIL-STD-31000A Appendix B** to define a 3D technical data package (TDP)
- Includes **organizational framework** requirements for model-based definition (MBD)
- Application and examples of **data set completeness states**
- Includes a **3D PDF enabled** figure

Published February 2019



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27

27

## ASME VVUQ 50 Computational Modeling for Advanced Manufacturing

➤ **Charter:** Provide procedures for verification, validation, and uncertainty quantification (VVUQ) in **modeling and computational simulation for advanced manufacturing**.

➤ **V&V 50 Subgroups:**

- Terminology, Concepts, Relationships and Taxonomy
- Interactions with the Model Life Cycle
- Applications in Process Technology
- Methods in Data-driven and Hybrid Models
- Challenges and Methods in Systems of Models

➤ **Verification and Validation Symposium**

- Dates: 19-20 May 2021
- Location: Virtual
- Website: [event.asme.org/V-V](https://event.asme.org/V-V)

V&V 10	Computational Solid Mechanics
V&V 20	Computational Fluid Dynamics and Heat Transfer
V&V 30	Computational Simulation of Nuclear System Thermal Fluids Behavior
V&V 40	Computational Modeling of Medical Devices
<b>V&amp;V 50</b>	<b>Computational Modeling for Advanced Manufacturing</b>
V&V 60	Computational Modeling for Energy Systems
V&V 70	Machine Learning Applied to Mechanistic & Process Modeling

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28

28

## We Welcome You to Join ASME's Model-Based Journey!

- Complete the ASME Participation Acknowledgement Form (PAF) and the Personnel Form (PF-1) to begin.

➤ Then you will:

- **become a member** of the MBE Subject Matter Expert Support Group;
- be granted **access to C&S Connect** and the **MBE Collaboration Site**;
- be able to **participate and vote** on Working Groups activities.



Join an ASME Standards & Certification Committee



29

29

## Questions?



Get on the mailing list...

The MBE Standards Committee sends a periodic newsletter



Scan Me: Collaboration Site

## Thank you for your kind attention!

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ASME MBE Standards Committee C&S Connect Page

- <https://bit.ly/2K2mgXL>

ASME MBE Redmine Collaboration Site

- <https://projects.mbe.institute/projects/asme-mbe-public-page>



30

30