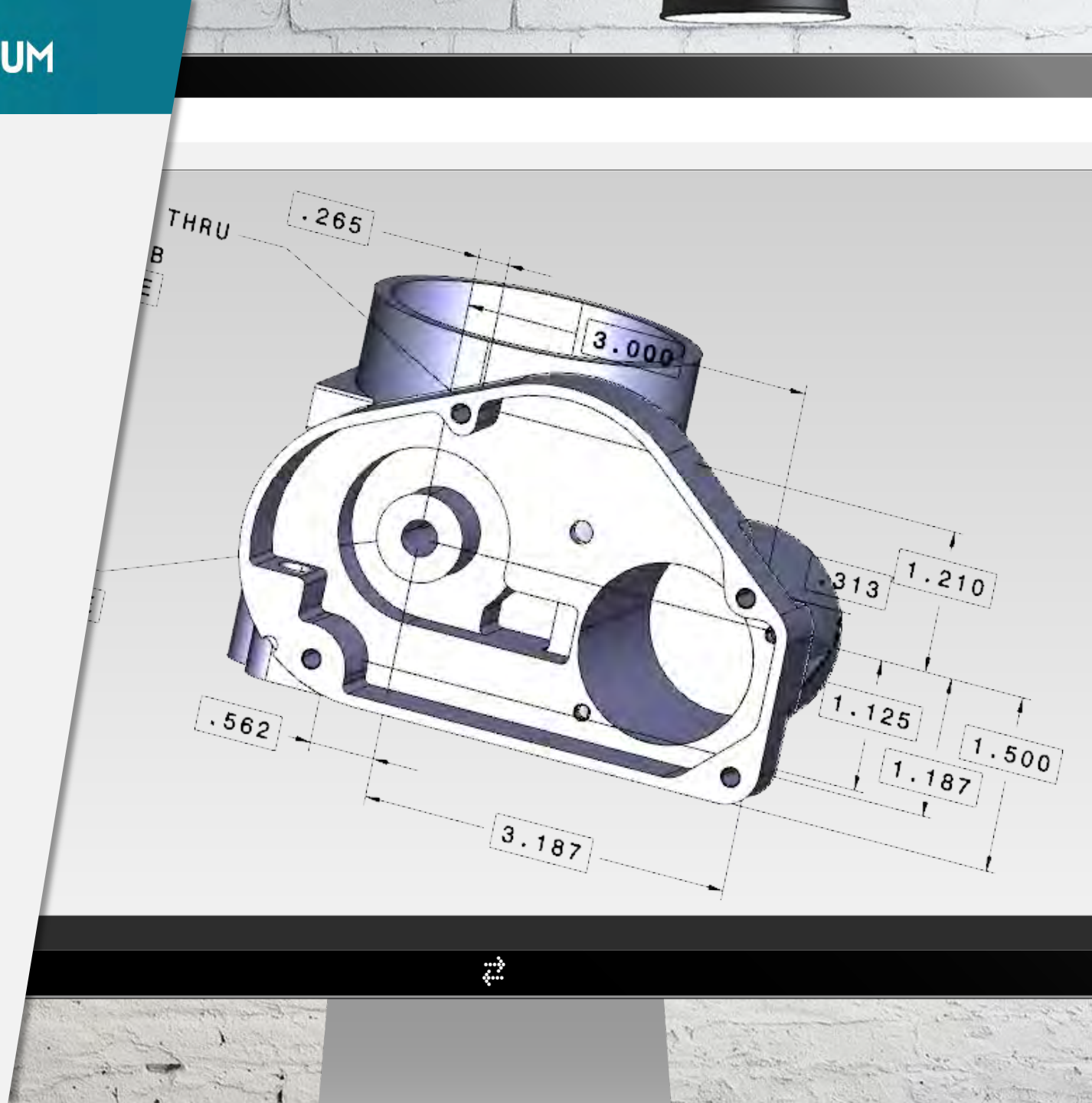
ELYSIUM

MBE Workshop

# MBE/MBD Explained

## Recent History of MBE



# DEFINITIONS OF MBE AND MBD

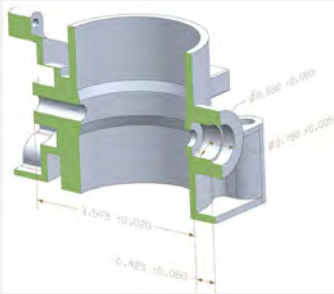
How is MBE & MBD Defined

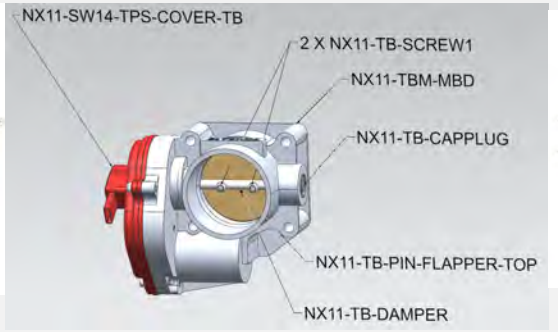
## MBE – Model-Based Enterprise

- An integrated and collaborative environment, founded on 3D product definition shared across the enterprise, enabling rapid, seamless, and affordable deployment of products from concept to disposal.
  (Jim Payne, BAE Systems 2007)
  - One principal idea within the MBE is to reuse as much existing data as is possible in order to reduce the cost of the product lifecycle.
  - The product lifecycle owner will sacrifice expense in an early stage to reduce overall program cost in the complete lifecycle.

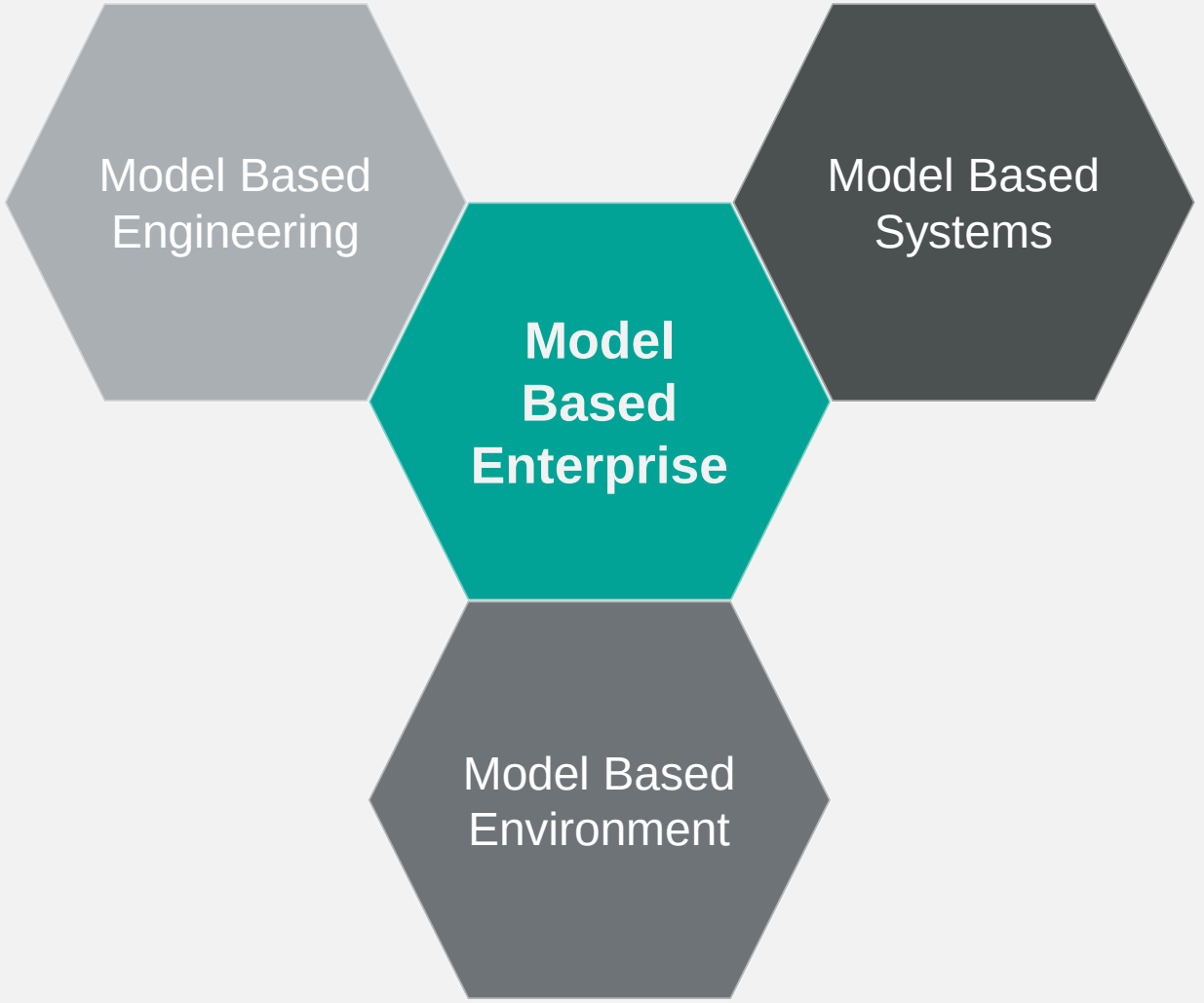
## MBD – Model-Based Definition

- A method of creating and organizing CAD product models (both part and assembly) so that complete product definition is evident within each model.
  - An MBD model is a component of the MBE
  - An MBD model can replace the need for a 2D drawing






# MBE?



# A FUNNY THING HAPPENED IN 2008

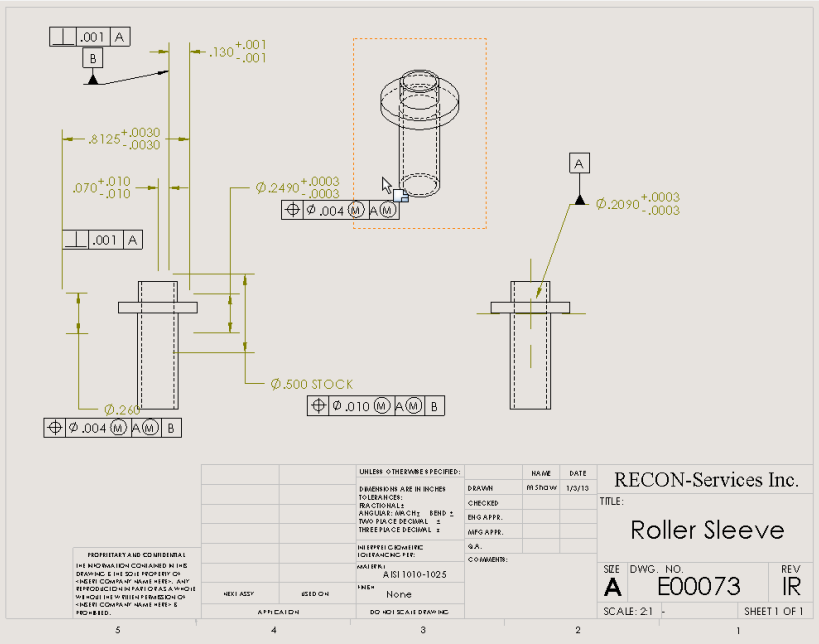
Model Based Environment

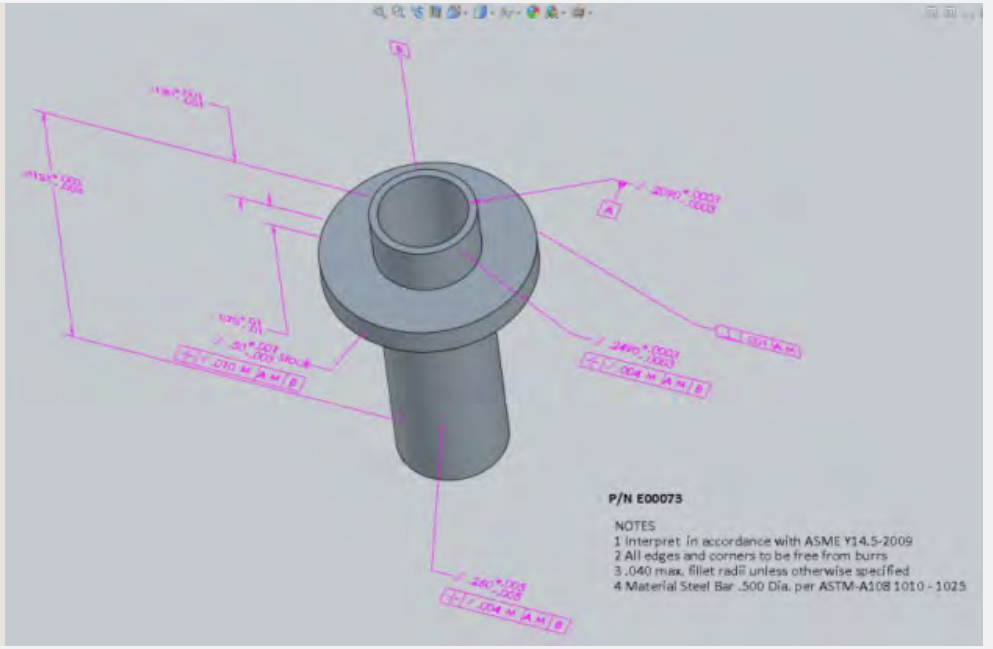
**Model Based Enterprise**

*Originally called Model Based Environment*


A video was created for the Defense Manufacturing Conference, so the MBE MANTECH team could present their accomplishments.
The name was mistakenly changed in the video by the production company. The result came to light two weeks prior to the conference.
The MBE Team discussed what to do to mitigate the issue and the compromise to change the name to Model Based Enterprise was achieved.
There are still about ~40 copies of early presentations created prior to the name change.

# Model-Based Enterprise

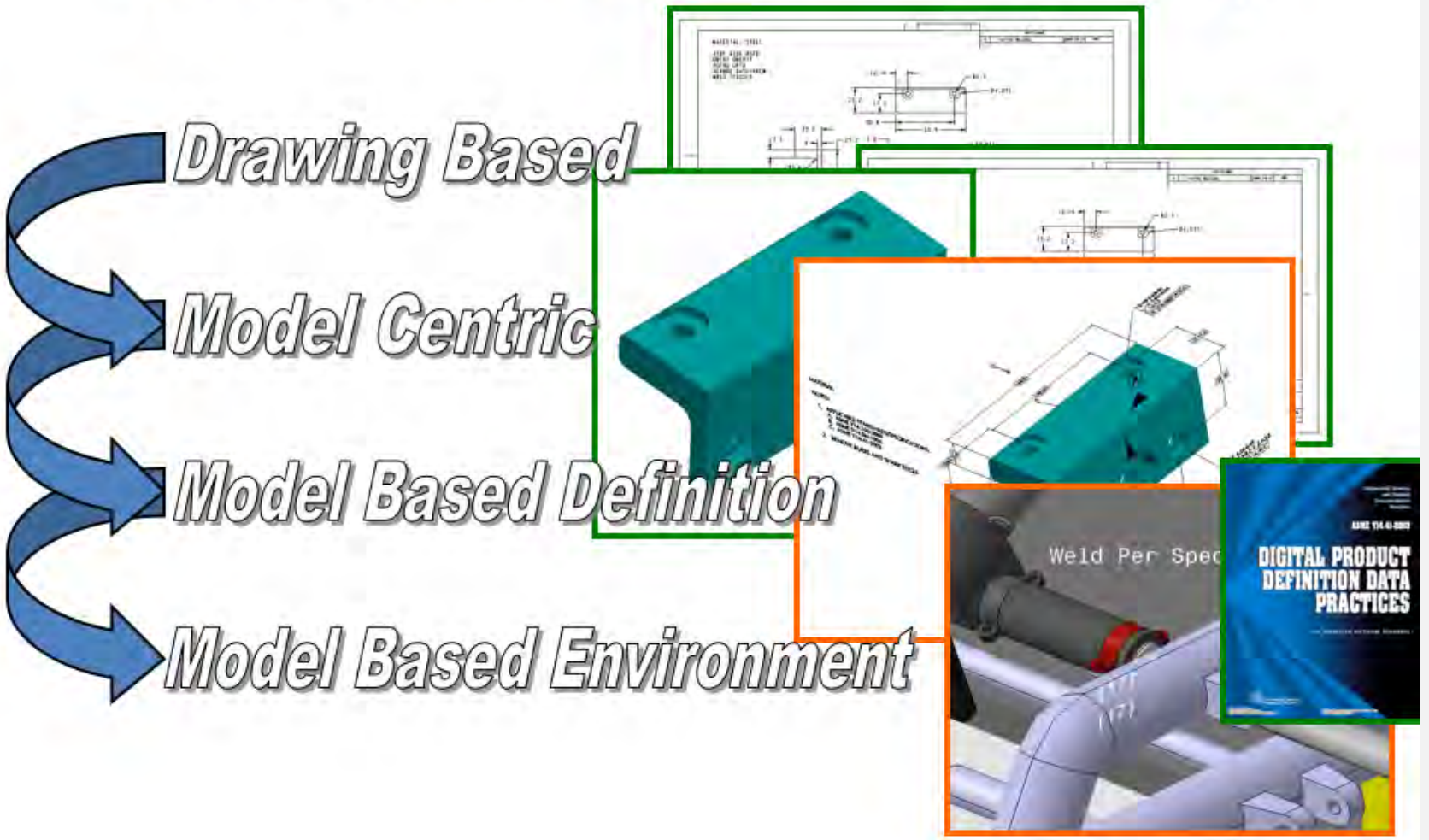



MBD Models promise to eliminate the need for 2D drawings

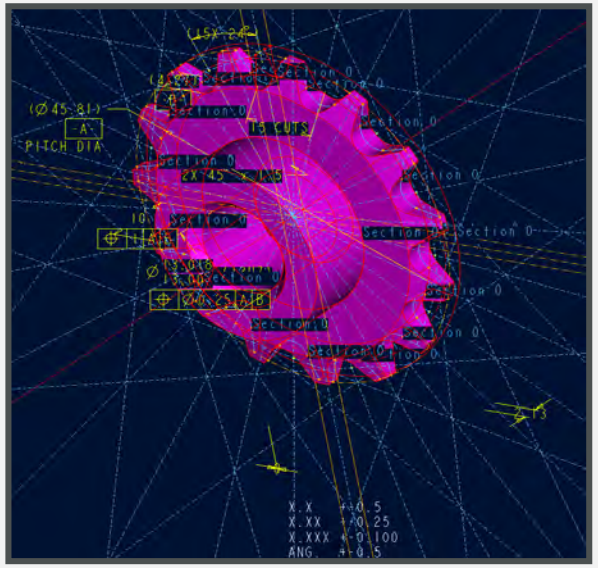
To what extent they will be implemented is up to the consumer

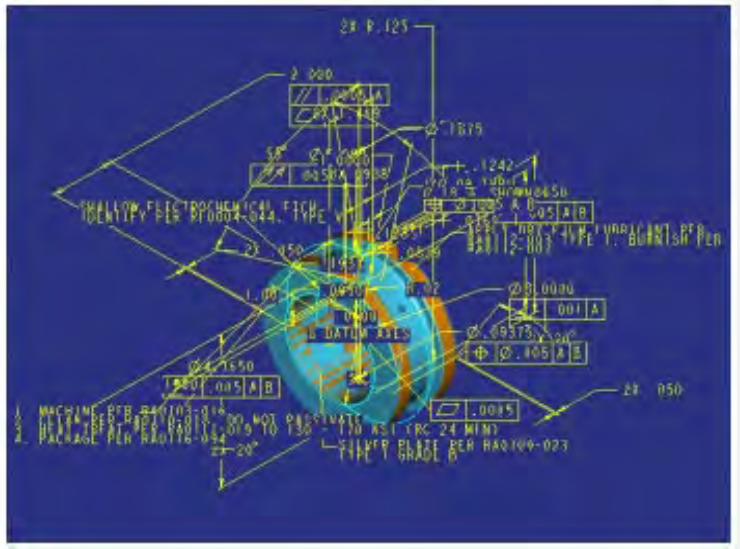
# Model Based Definition is a Journey



# Model Based Definition

If you look at the raw CAD model you might see a “Furball”.



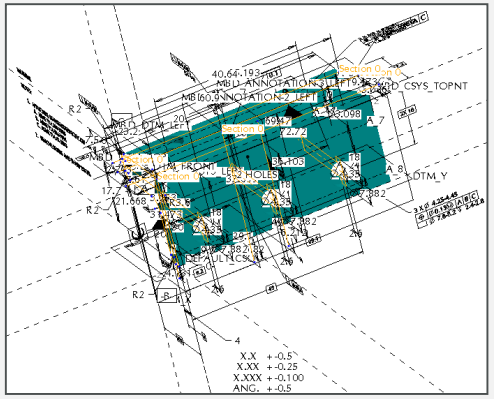
This appearance of a “Furball” needs to be “Tamed”

# MBD SCHEMA

ASME Y14.47-2019

**Model Organization Practices**

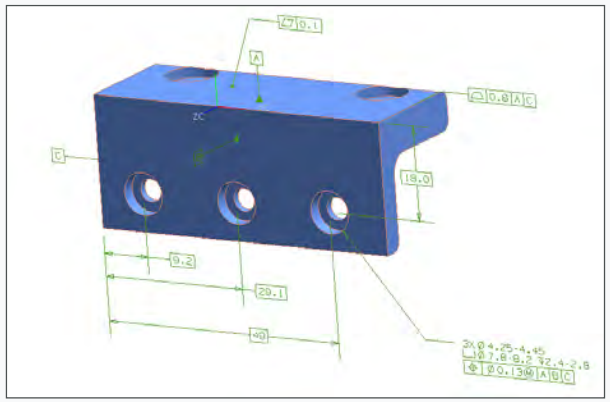
**Engineering Product Definition and Related Documentation Practices**

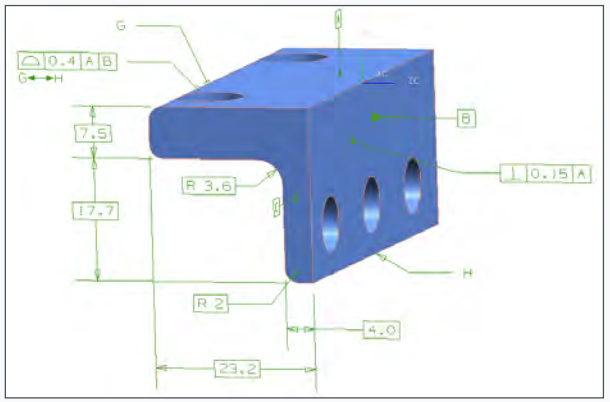


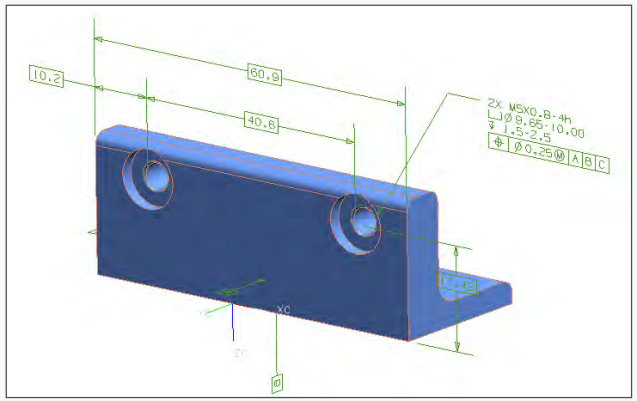
CAD File Furball

A method of organizing the CAD model.

An MBD Schema applied to “Tame” the Furball

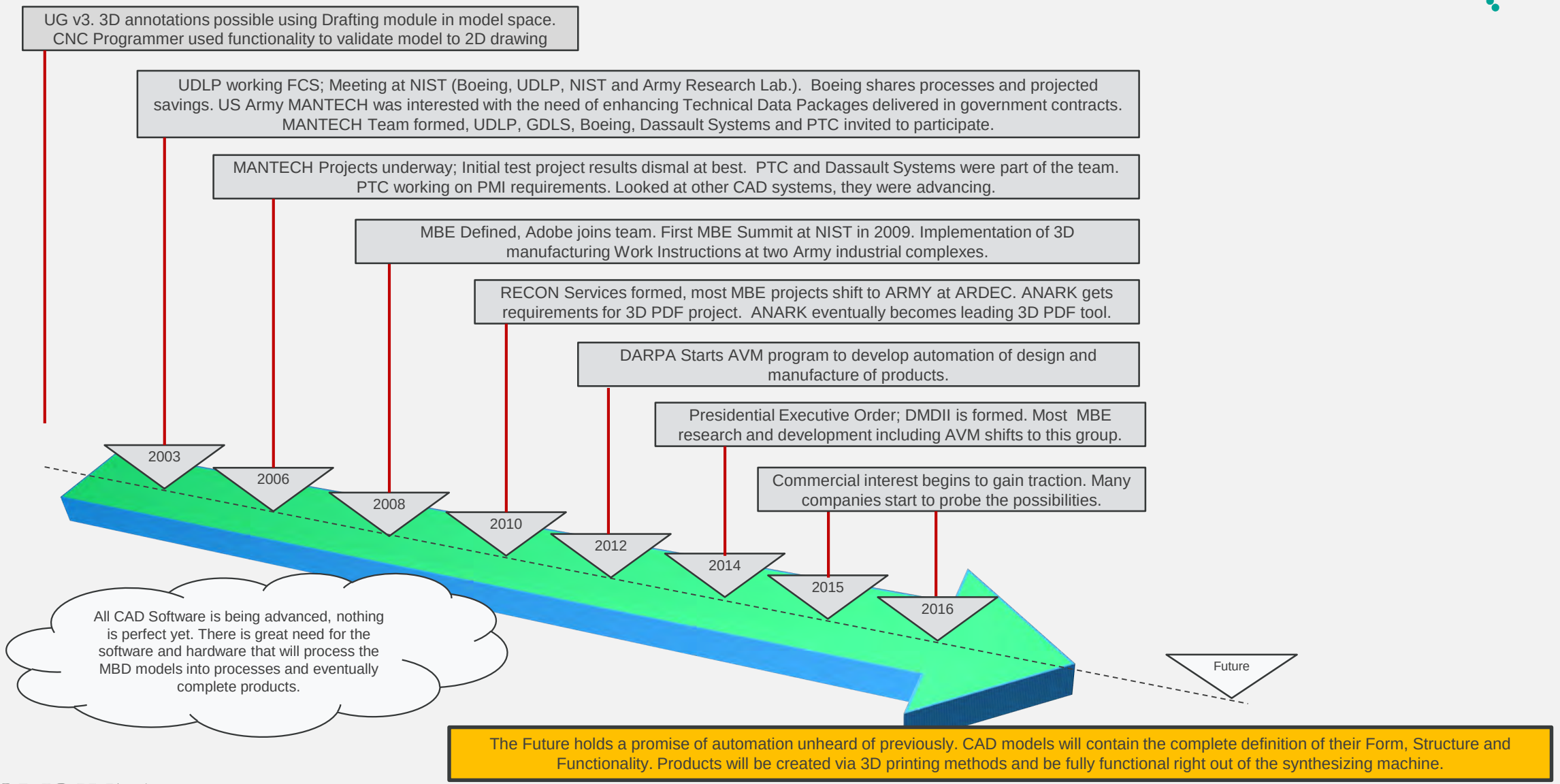






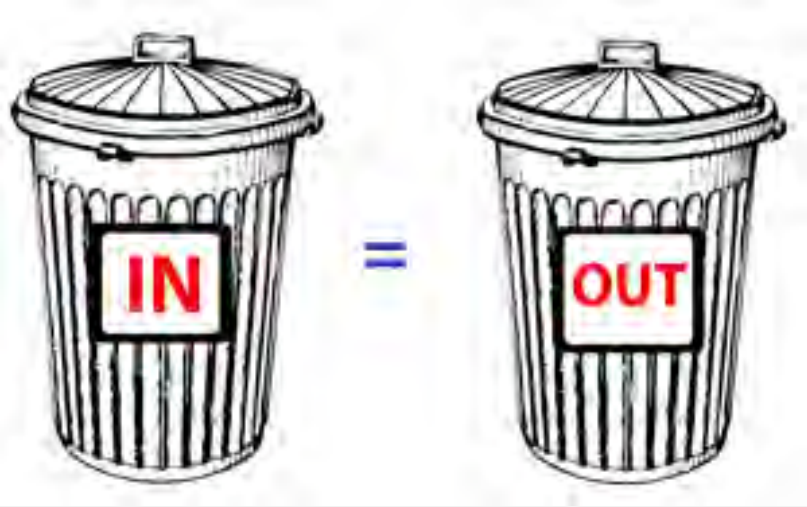
“Furball” transformation complete?

# SHORT HISTORY



# How do we use it?

- Design
- Manufacturing
- Quality
- Shipping/Receiving
- Purchasing
- Sustainment
- End of Lifecycle

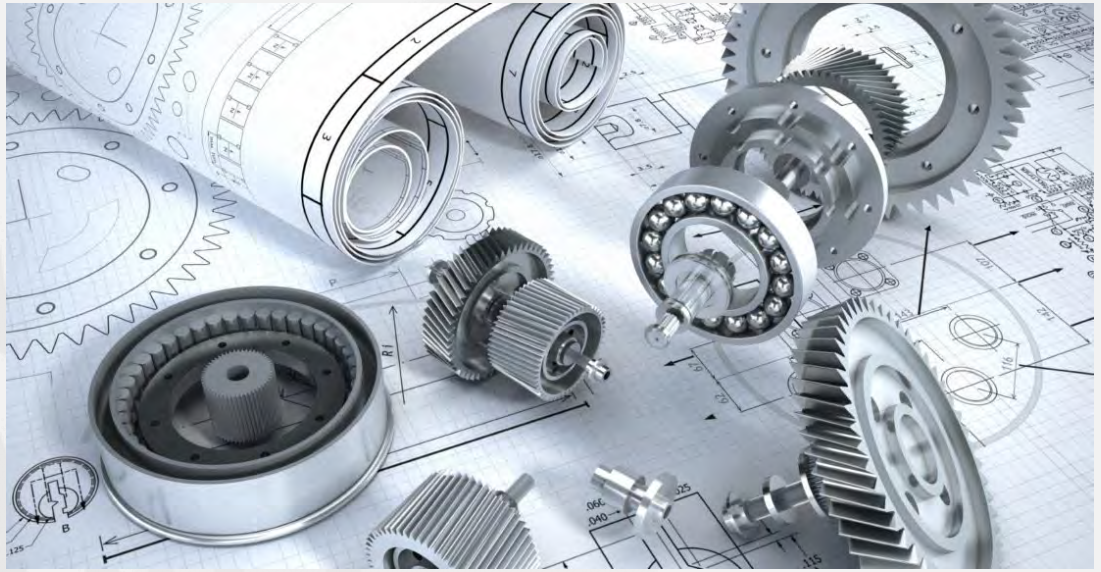


# How do we use it? Reuse it!

- Most savings begin as you reuse the data rather than re-create or re-enter anything for any reason.
- Any time data is entered into any system, it should be available for reuse in any subsequent process.
  - Design Engineering
  - Manufacturing
  - Quality Engineering
  - Packaging Engineering and operations
  - Receiving
  - Logistics
  - Supply Chain
  - Sales
  - Support

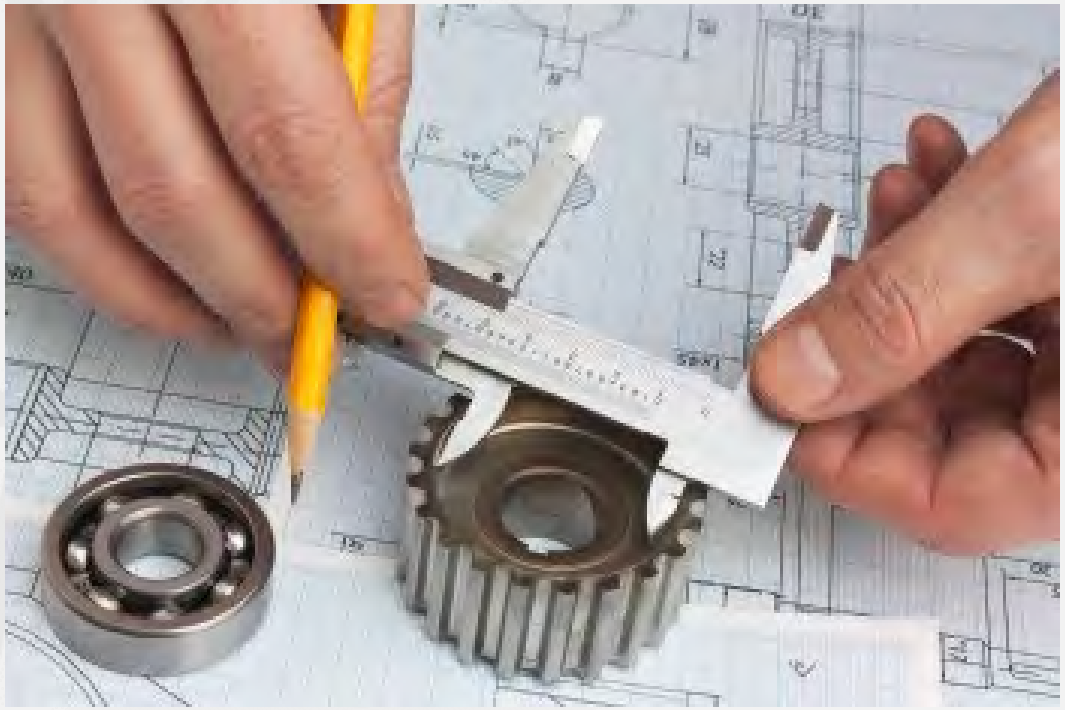
# How do we use it? Reuse it!

- Design Engineering
  - Design Reviews
  - Reuse components for other programs
- Manufacturing
  - Reuse geometry to determine processes and program CNC machines to machine parts
  - Reuse tolerances and geometry to determine process and tooling
  - Create Work Instructions using Lightweight 3D formats



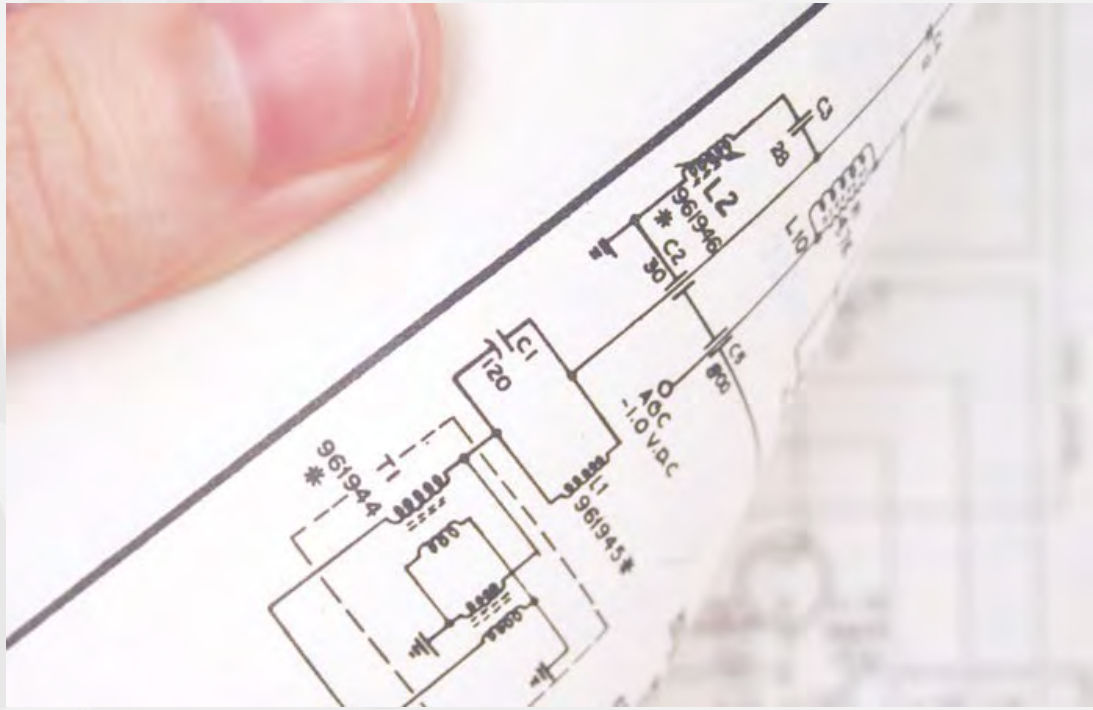
# How do we use it? Reuse it!

- Quality Engineering
  - Quality Plans (Overall products and individual Parts and Assemblies)
  - CMM programming (Both Manual and Automatic)
  - First Article Inspection (Key and Critical requirements as well as Complete product requirements)
  - Compiling inspection results into reports.
  - Maintaining As Built records
- Packaging Engineering and Operations
  - Reuse geometry to determine packaging design
  - Reuse geometry to define packaging processes
- Receiving
  - Determine receiving process requirements (equipment (Tow Motor), storage facilities (racks, shelves, bins))
  - Determine delivery destinations like quality for receiving inspection



# How do we use it? Reuse it!

- Logistics
  - Spare Parts BOMs
  - Technical Manual creation (Service, Parts Breakdown, Assembly of kits)
- Purchasing
  - Part Envelope (bigger than a bread basket) to determine list of eligible suppliers
  - Provide Bid-To data packages.
  - Provide Build-To data packages.
- Supply Chain
  - Manufacturing Plans, CNC Programs, Quality Inspection requirements
- Sales
  - Sales Brochures
- Support
  - Support Planning and Documentation



# How do we use it? Reuse it!

- Very often the base CAD Model is reused to create Derivative files for consumer usage.
  - PDF, JT, HTML, STEP, IGES and Other CAD are used in Manufacturing, when a supplier or customer needs a CAD format outside of their “master” format, or are used in Product Definition
    - Often Product Definition is associated with “2D Drawing Replacement or Supplement”
  - Sometimes TDP, “Bid To” and “Build To” packages are created to provide CAD content in other formats to customers and suppliers
- Reasons of reuse, Internal to the design company
  - Design Reviews for non-CAD users on the Design Review Team (Product definition files could be reviewed by anyone)

# WHERE IS MBE CURRENTLY?

- CAD Software  (All CAD that has MBD functionality, also each have some issues, in most cases they are being addressed.)
  - Be Aware, most CAD systems require special license for PMI generation and functionality
- Lightweight Viewing (List of lightweight viewing format, Full functionality is sometimes limited based on file type)
  - HTML
  - 3D PDF
  - JT
  - 3D XML
  - E-Drawings 3D file
  - Others
- Individual CAD MBD Schema instructions should be reviewed for things to be aware of as MBD implementations is completed.

# STEP AP242

- STEP
  - STEP 242 Support is claimed by most CAD systems
  - We need to be aware that even though STEP is an international standard, there are still flavors of its interpretation
  - We need to continue to evaluate each translator's abilities


http://www.ap242.org/edition-2

# Data, Planning and Execution

Manufacturing Execution Systems (MES)

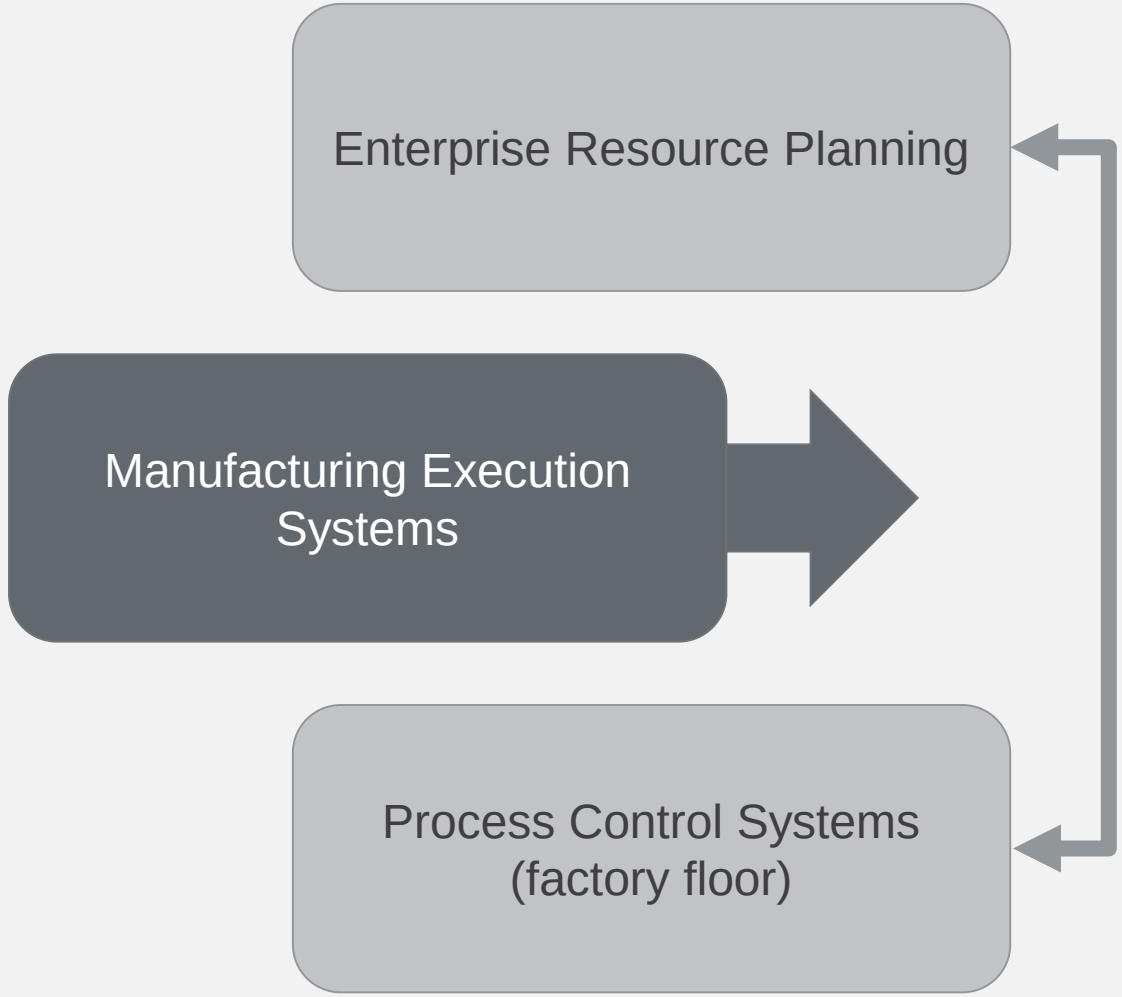
- Helps control complex manufacturing systems
- Gathers data from all portions of the lifecycle
- Serves as the functional layer between ERP and factory floor

Enterprise Resource Planning (ERP)

- Integrates all essential processes needed to run a company into one single system

Quality Planning and Execution

- Several tools exist (CAD supported is limited) (Semantic PMI required)
- QIF standard supports this through neutral format. Activity was starting at last look.



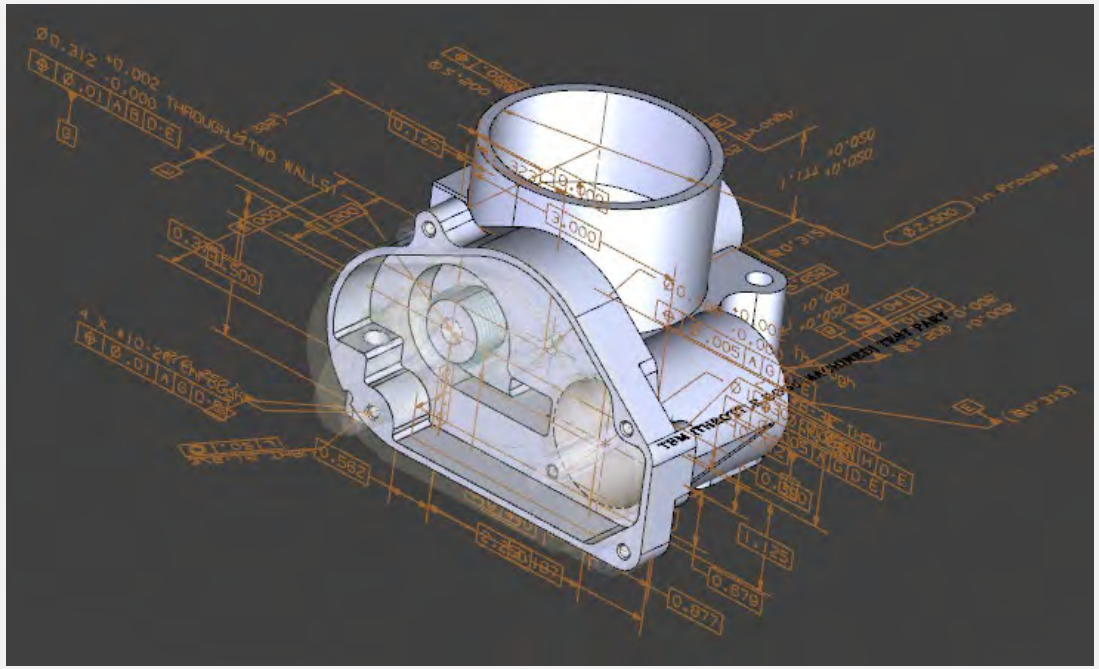
# PMI, PMI, **PMI**

**Product Manufacturing Information (PMI)**

- Contains information such as Geometric Dimensions and Tolerances (GD&T), 3D Annotations (floating text), Surface Finish, Material Specifications, etc.

**PMI Entities**

- Entity types within CAD include a PMI Type. PMI type entities include more than 3D Annotations.
- PMI entities should include all entities that need to be visibly controlled by MBD View State controls, with the intention of communicating Product Definition.
- Some reference geometry needs to have its visibility controlled by the MBD View State controls.
  - Datum Target Points, Datum Target Regions also need this same ability.
  - This is not possible in every CAD system.
- Result is other methods might need to be used to communicate “Complete Product Definition”.



** Each CAD system has different functional abilities and different conformance to standards

# Cost Savings!

- Within MBE, the continual reuse of previously entered data will provide cost savings over the product life cycle.
- Some MBD practices might be more costly in the early part of the product lifecycle.
- We have seen this case reverse itself with time and experience.
- In these “Early Days” of technology adoption, the visualization of 3D product data certainly is easier than 2D Drawings.
- As presentation of product definition is overtaken by representation of product definition the programmatic extraction and use of that definition will begin to provide unbelievable cost benefits.
- Eventually the MBD Model will be able to have the definition of how it is to be manufactured flow from it to allow AI software routines to build manufacturing and QC plans. Perhaps even execute those plans.

With MBE/MBD methods being implemented there is a promise of tremendous cost savings being realized.

# Lessons Learned (so far)

- MBD is a cultural change, not just a new process.
- Top level buy-in is essential.
- Plan big, start small.
- Include downstream data users in your initial planning.
- Document your current process and data usage first, plan accordingly.
- Team with your vendors and suppliers.

Plan big, start small.

# Contact Information


## Jesse Zahner

jesse.zahner@elysiuminc.com

(248) 436-1309

## Rich Eckenrode

rich.eckenrode@elysiuminc.com

(717) 476-5900