Optimizing Process-Definition Datasets

Using 3D Product Definition to Improve and Automate Downstream Processes

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MBD360 LLC

Training – Consulting – R&D

- **3D Model-Based Product Definition (3D MBD)**
- **3D Model-Based Business Processes (3D MBx)**
- **3D MBx Implementation & Optimization**
- **Drawing and Modeling Standards**
- **Product Definition & Development**
- **PMI, GD&T, and Tolerance Analysis**

About Us

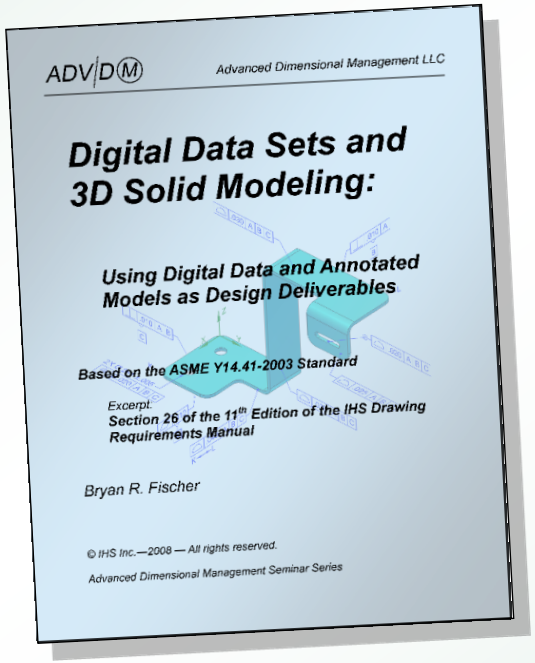
3D Model-Based Materials

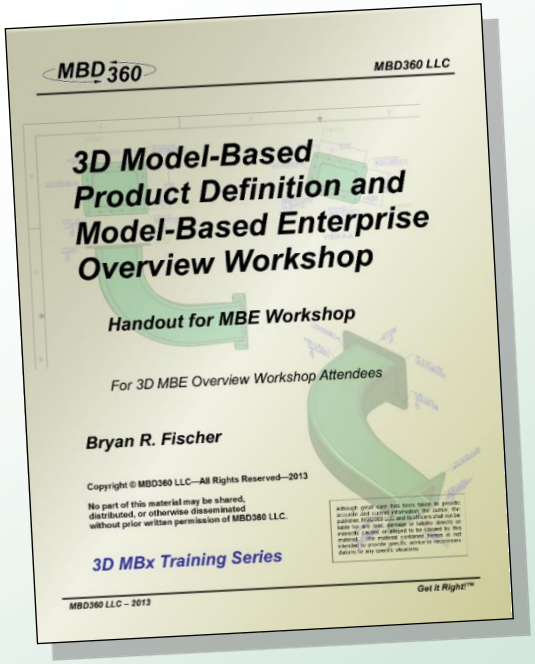
"Digital Data Sets and 3D Solid Modeling"

from IHS Global Drawing Requirements Manual, 11th ed., 2008

"3D Model-Based Product Definition and Model-Based Enterprise Overview Workshop"

MBD360 LLC, 2013





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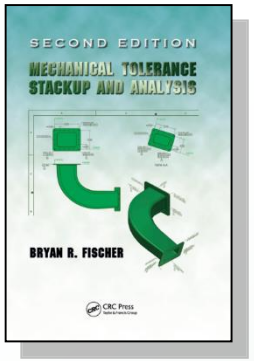
Other Major Works

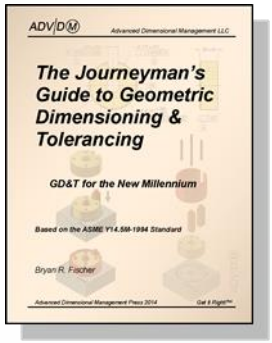
"Mechanical Tolerance Stackup and Analysis"

CRC Press



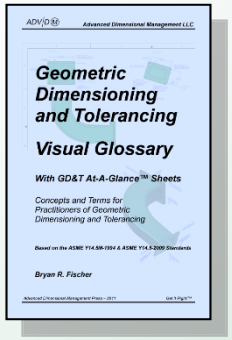
"The Journeyman's Guide to GD&T"

Advanced Dimensional Management Press



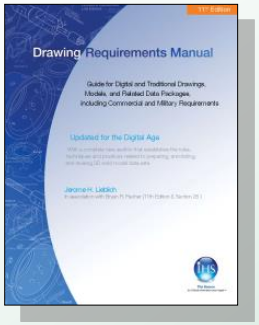
"GD&T Visual Glossaries"

Advanced Dimensional Management Press



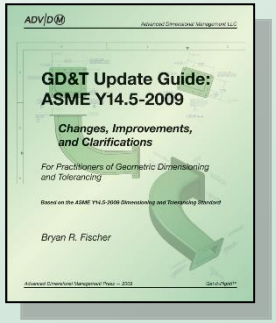
"Drawing Requirements Manual"

11th Ed., IHS Global



"GD&T Update Guide: ASME Y14.5-2009"

Advanced Dimensional Management Press



About Us

Definitions

Product Definition Data

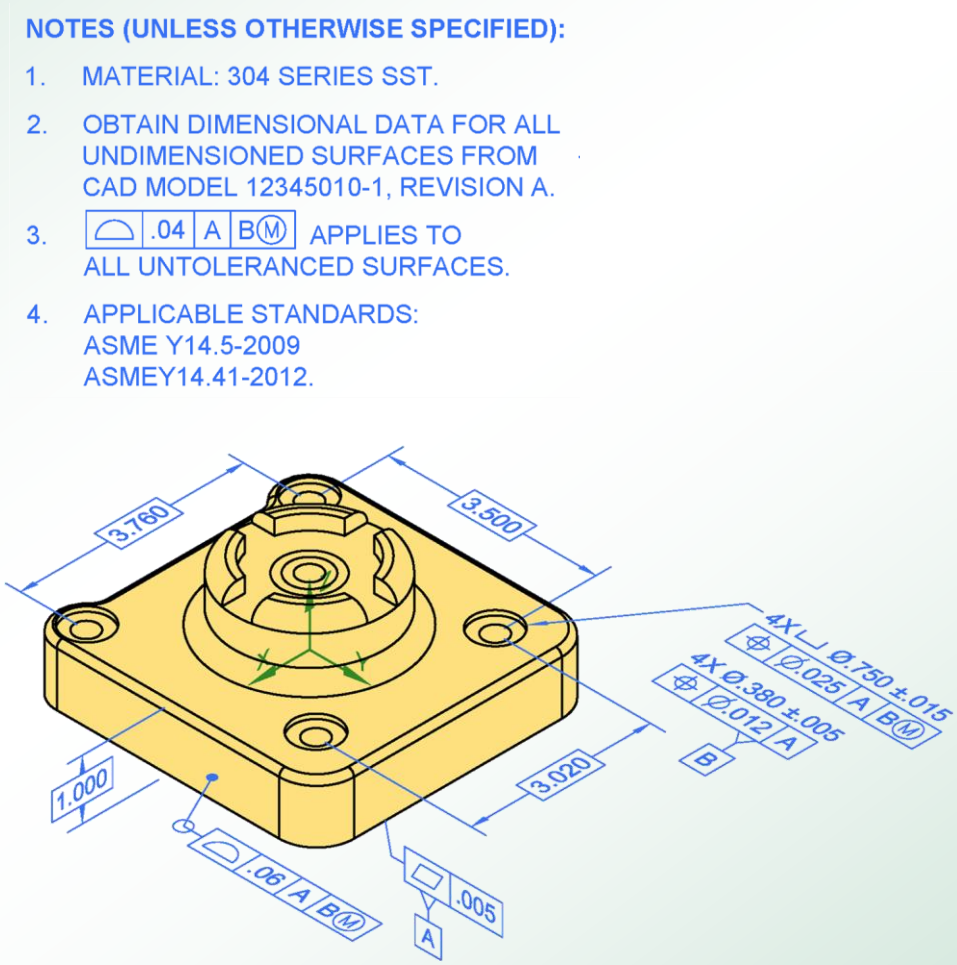
Defines a product and its requirements

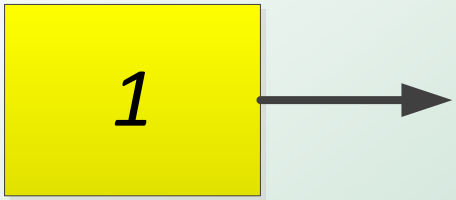
Not how it is made, used, etc.

Product Definition Dataset

Computer files that define a product and its requirements

Primary Authoring





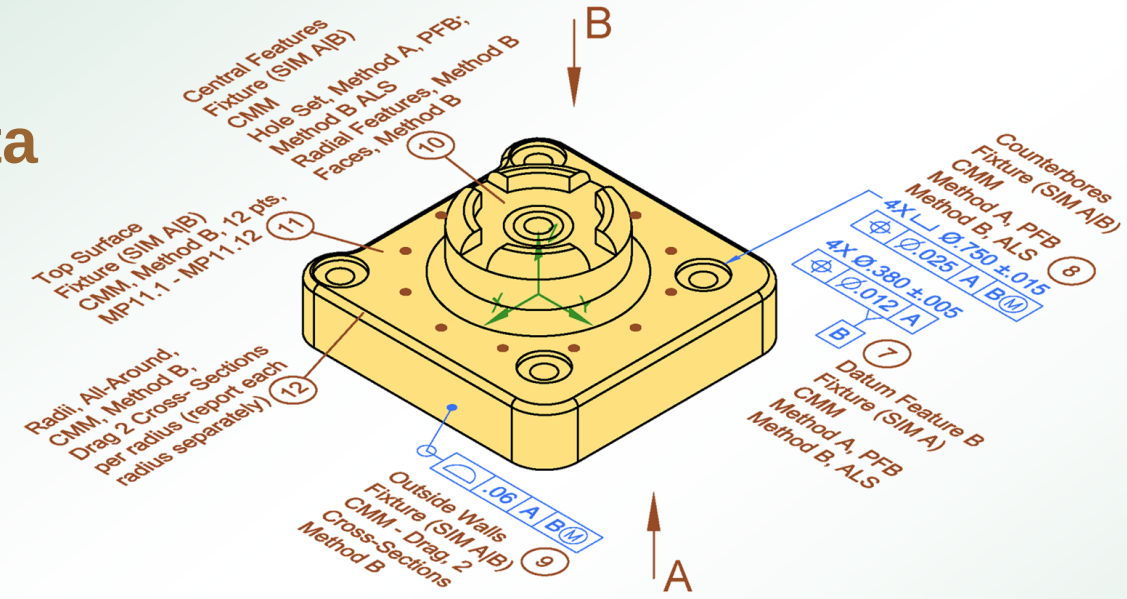
Definitions

Process Definition Data

Defines a process related to a product

Process Definition Dataset

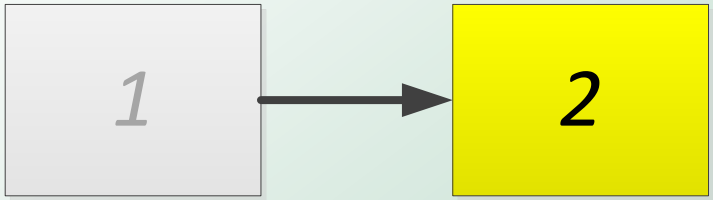
Computer files that define a process



Inspection Plan

- Procurement
- Estimating
- Planning
- Analysis
- Manufacturing
- Inspection
- Assembly
- Tooling
- Operation
- Maintenance
- Project Management
- Etc.

Secondary Authoring



A lot of work has been done on
Product Definition Data and Product Definition Datasets

- **Standardization**
- **R&D**
- **Testing**
- **etc.**

CAD-to-CAD is important, but it is only the first step

Highest Priority
How to use Product Definition Data

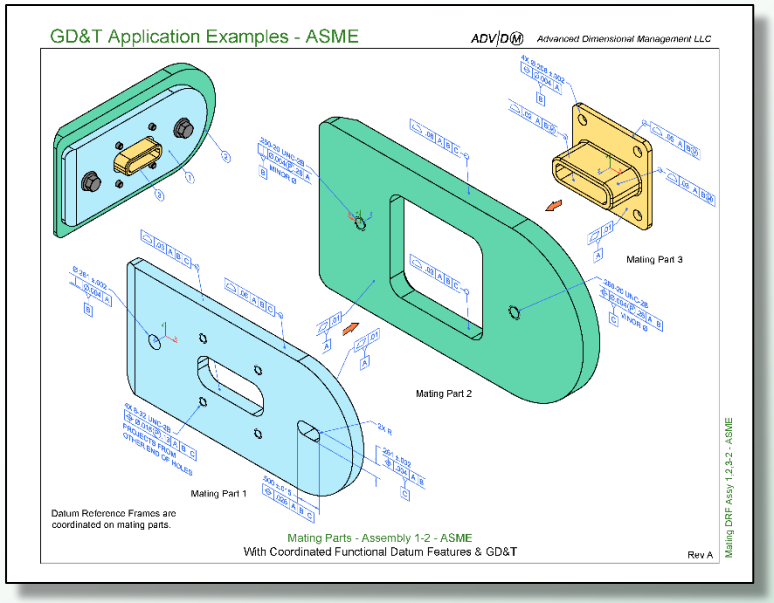
There are right ways and wrong ways to use this data

Examples of Product Definition Data

Part Definition Datasets

Assembly Definition Datasets

Installation Definition Datasets

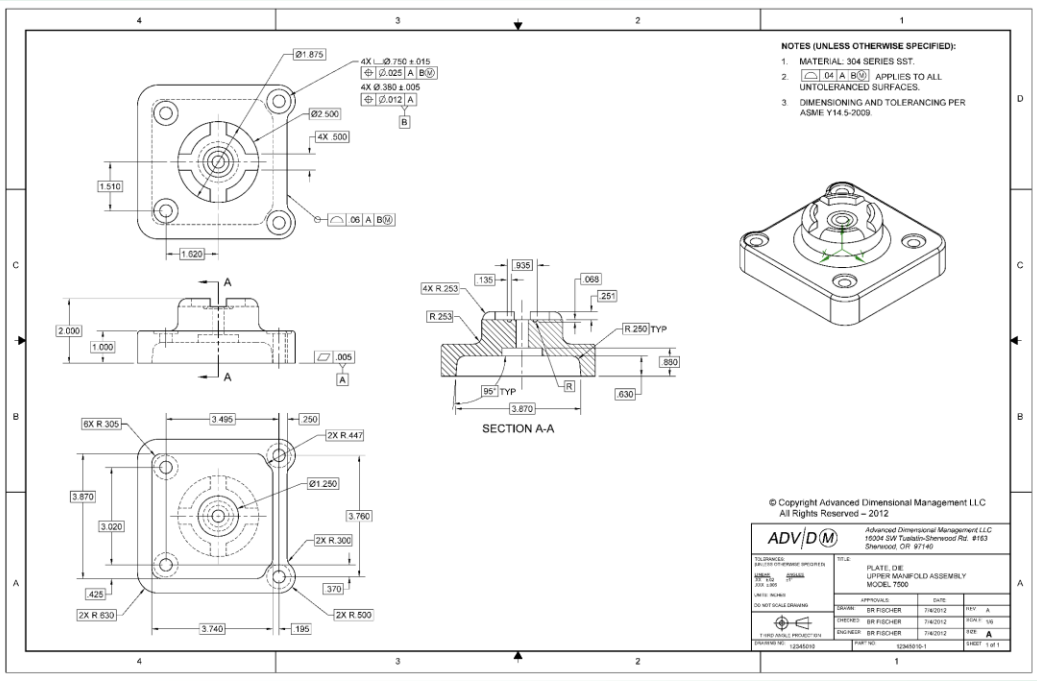


Part and Assembly Dataset Examples

Semantically-Modeled PMI
vs.
Visually-Displayed PMI

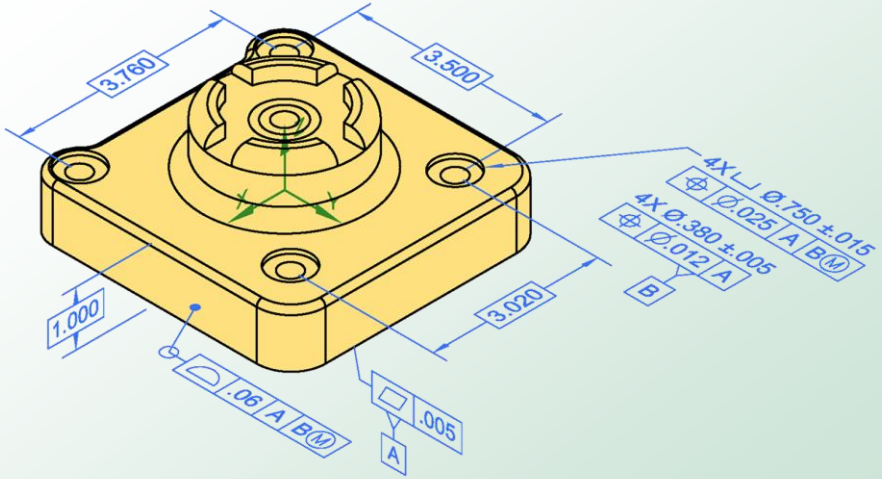
Visually-Displayed PMI / Annotation

- Defined on 2D drawings or improperly in 3D
- Visual content only



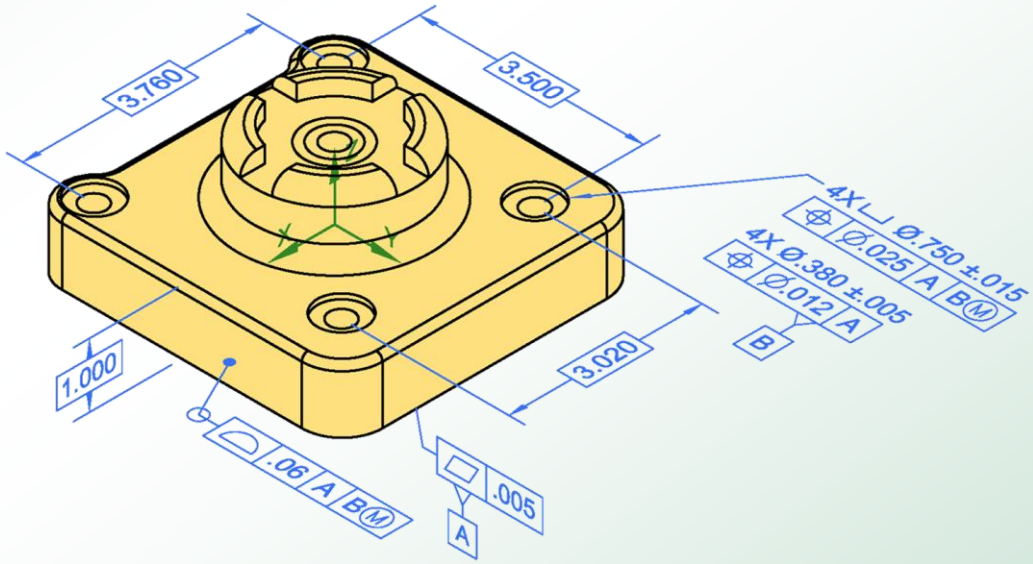
Semantically-Modeled PMI

- Properly associated to model
- Defined in predictable, understandable structure
- Computer sensible

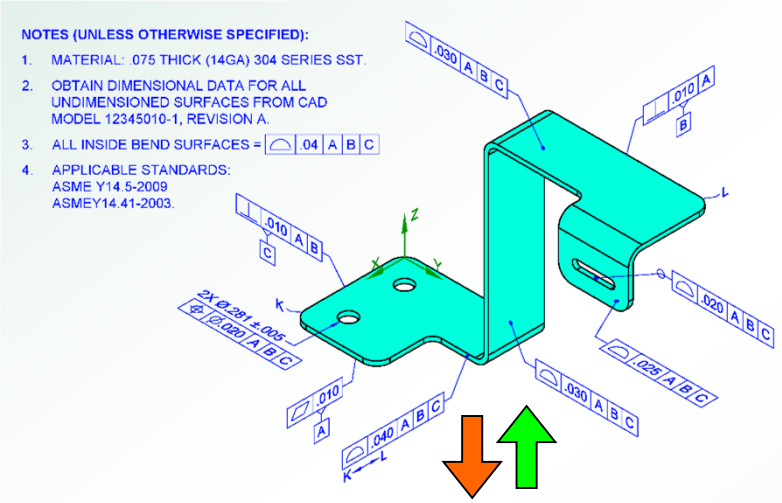


Main Benefits of Semantically-Modeled PMI

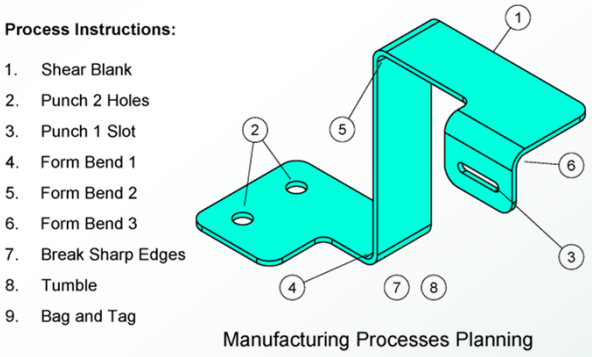
- **Can be used by automated and semi-automated processes**
- **Can be used directly in downstream processes**
- **Helps eliminate disconnected derivative datasets**
- **Improves process validation**
- **Facilitates feedback**
- **Ensures product quality**
- **Significant productivity increase with proper use**



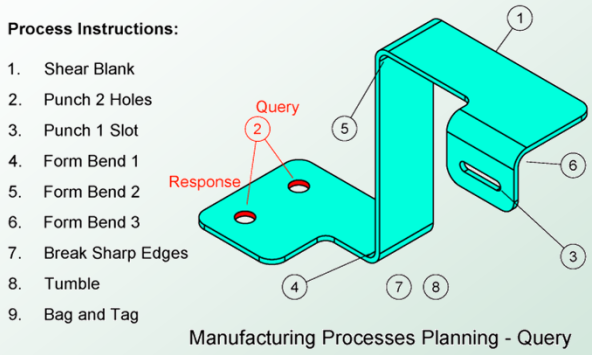
Product Definition



Process Definition



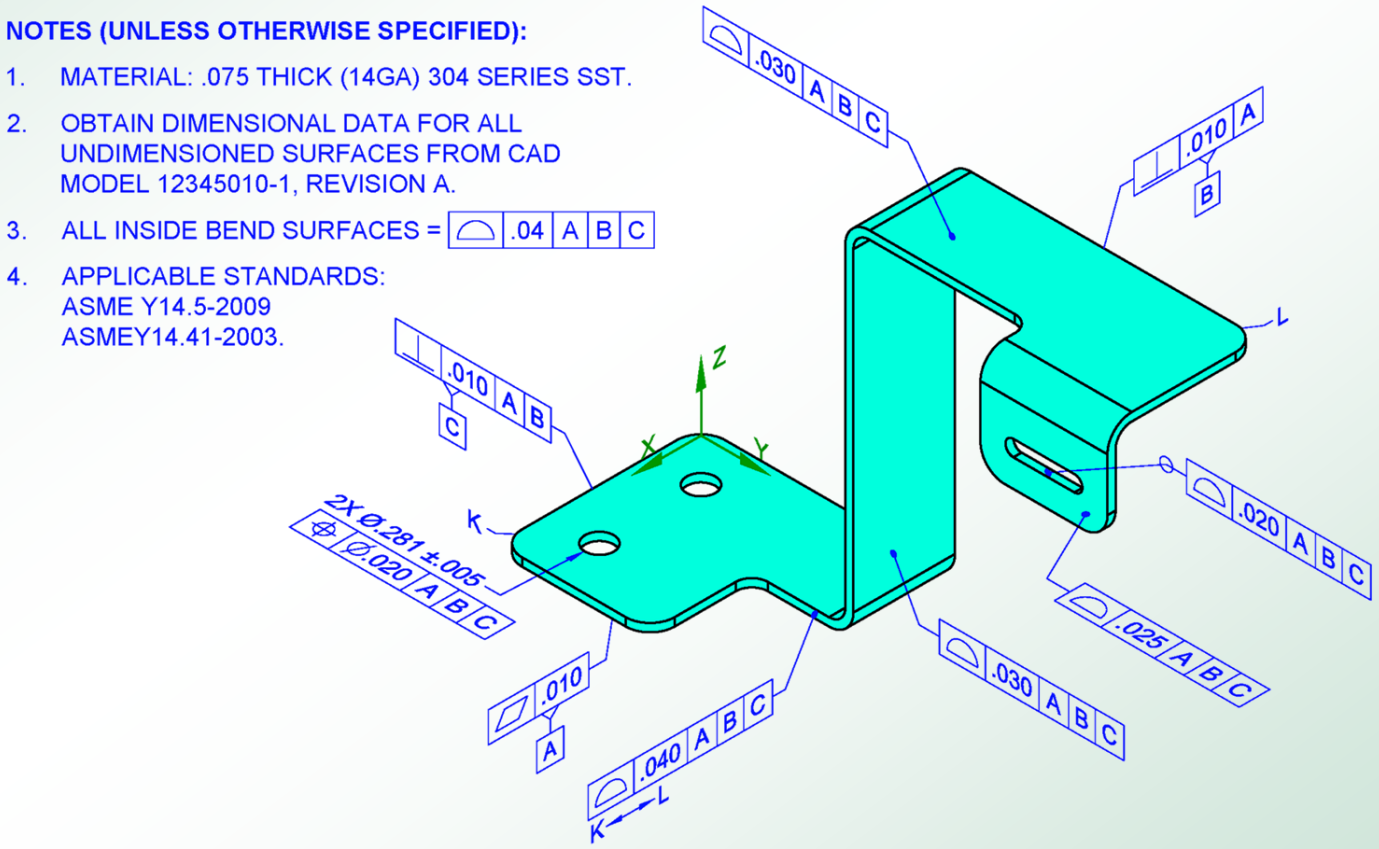
Process Definition Use Case



Visually-Displayed PMI

The only use case for visible PMI is human interpretation

All uses yield disconnected derivative data

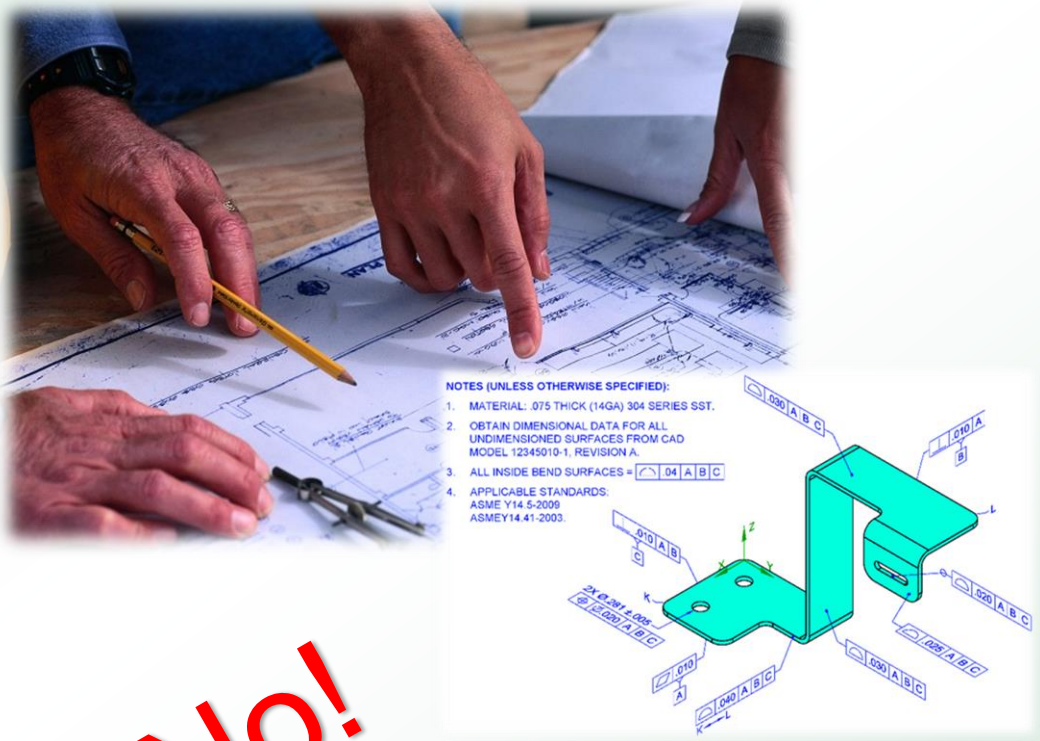


Visually-Displayed PMI

Only result of human use:

Recreate data in a process that is not linked to product definition data

We must eliminate disconnected use cases



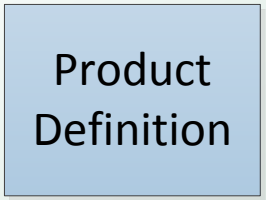
No!

Product Definition vs. Process Definition

A properly modeled Product Definition Dataset completely defines a product

Product is defined by

- **Linked / embedded requirement definitions**
- **Geometry**
- **Annotation (PMI)**
- **Attribute data**
- **Metadata**
- **Reference to standards, specifications, etc.**



Product Definition vs. Process Definition

A properly modeled Process Definition Dataset defines processes related to a product

Processes are defined by

- **Links to Product Definition**
- **PMI**
- **Attribute data, metadata**
- **Tooling and fixture models and characterization data**
- **Path, sequence, tool data, tool life, etc.**
- **Conformance to requirements, validation data**
- **Execution (who, when, where, how, duration…)**
- **Links to product definition**

Process Definition

Product Definition vs. Process Definition

Today – often no link between process and product data it is intended to satisfy

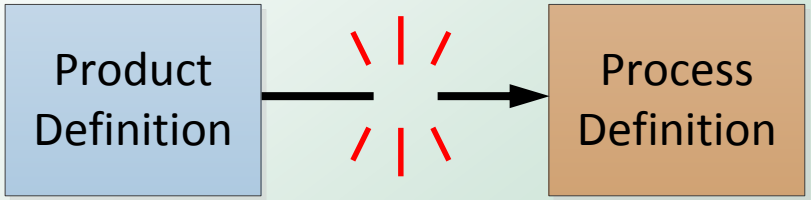
Product data presented on 2D drawings or non-semantically

Humans must process presentation data to perform tasks (time, errors, cost…)

Downstream tools cannot use presentation data

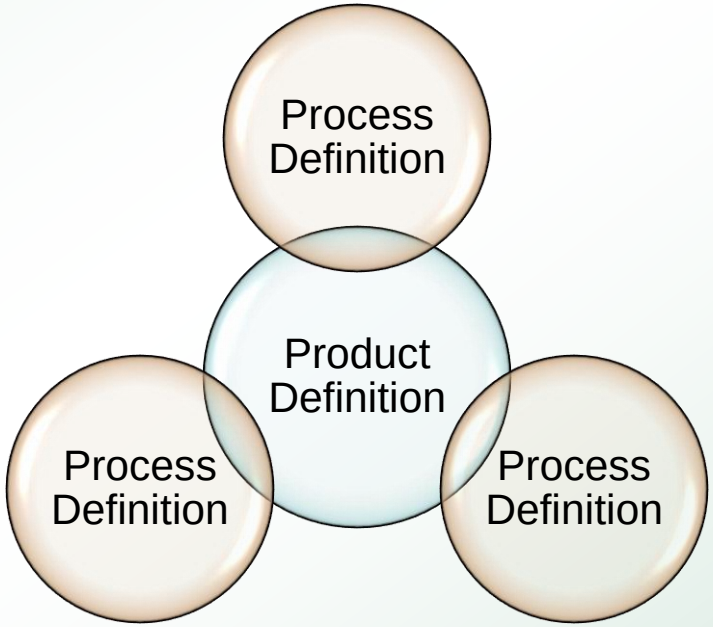
Requirements are lost between initial concept, design, and production

Disconnected Datasets



Process Definition Data *should be derived from & linked to* Product Definition Data

- **Eliminates redundant data**
- **Reduces errors**
- **Facilitates process validation**
- **Facilitates understanding and managing cost of satisfying product requirements**
- **Eliminates unnecessary process steps**
- **Improves quality and throughput**
- **Facilitates automation**
- **Facilitates feedback loops**



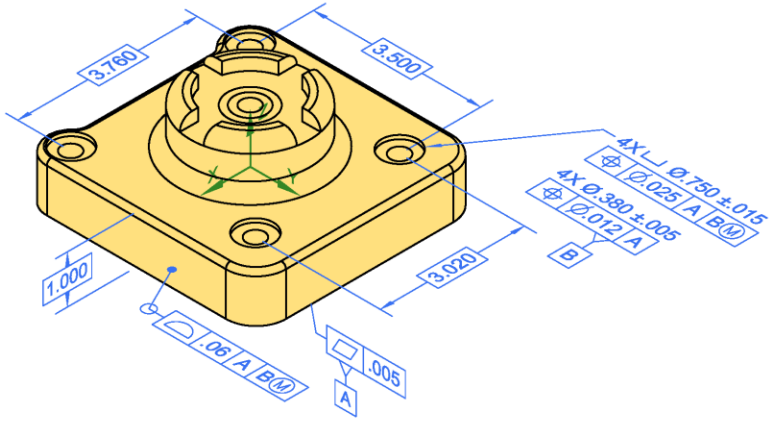
Examples

Datasets

Connected and Disconnected

NOTES (UNLESS OTHERWISE SPECIFIED):

1. MATERIAL: 304 SERIES SST.
2. OBTAIN DIMENSIONAL DATA FOR ALL UNDIMENSIONED SURFACES FROM CAD MODEL 12345010-1, REVISION A.
3. ⌓ .04 A B(M) APPLIES TO ALL UNTOLERANCED SURFACES.
4. APPLICABLE STANDARDS:
   ASME Y14.5-2009
   ASMEY14.41-2012.



3D Model-Based Product Definition
Model Contains Implicitly-Defined Geometry and Explicitly-Defined PMI
Complete Product Definition

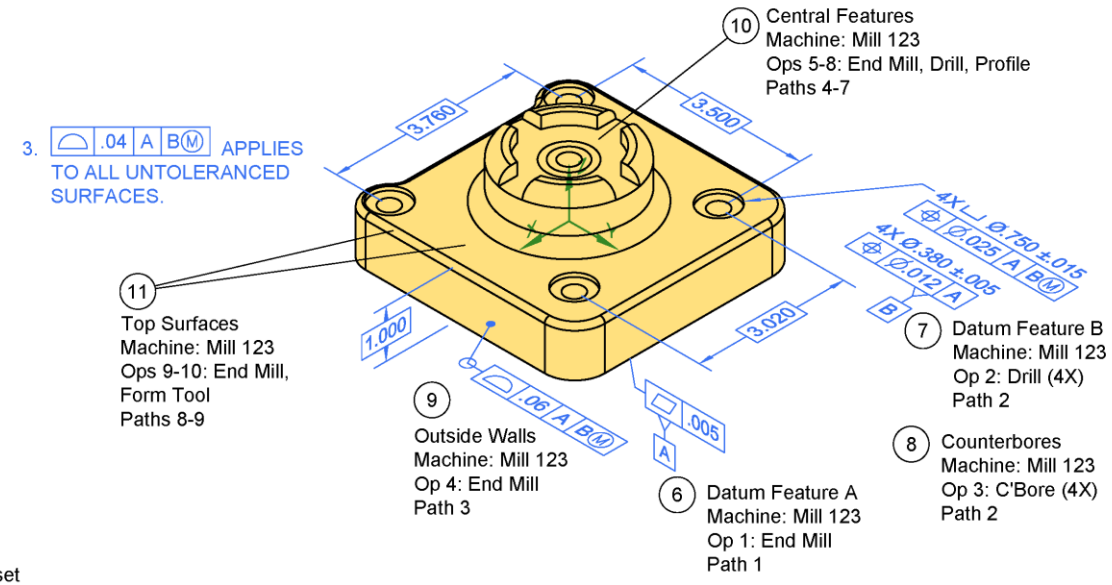
Product Definition Dataset

1. Receive notification to start new CAM file, manually enter part-level metadata
2. Manually access part file and link to part file in PDM system
3. Consume geometric data / basic dimensions directly from model. Ignore explicitly-defined dimensions.
4. Consume PMI directly from model and default profile tolerance in general notes.
5. Manually label features to correspond to process steps
6.
7.
8.
9.
10.
11.
12. etc.

Optimal:
Part-level data and metadata driven from PDM system

Optimal:
Product geometry / basic dimensions consumed directly from geometric model data

Optimal:
Geometric tolerances and related PMI consumed directly from model data



Corresponds to Dataset Classification Code 5

Process Definition Dataset - Manufacturing Plan - Option 5.1
Model Contains Implicitly-Defined Geometry and Explicitly-Defined PMI
Geometric Data and PMI Consumed from Model

Process Definition Dataset - Machining

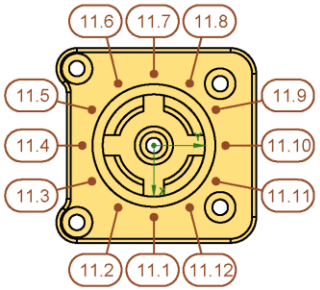
1. Receive notification to start new CAI file, manually enter part-level metadata
2. Manually access part file and link to part file in PDM system
3. Consume geometric data / basic dimensions directly from model. Ignore explicitly-defined dimensions.
4. Consume PMI directly from model and default profile tolerance in general notes.
5. Manually label features to correspond to process steps
6.
7.
8.
9.
10.
11.
12.
13. etc.

Optimal:
Part-level data and metadata driven from PDM system

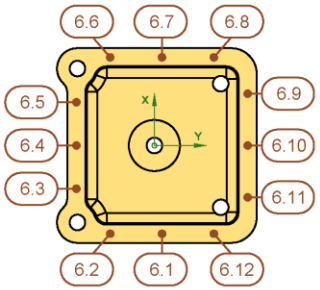
Optimal:
Product geometry / basic dimensions consumed directly from geometric model data

Optimal:
Geometric tolerances and related PMI consumed directly from model data

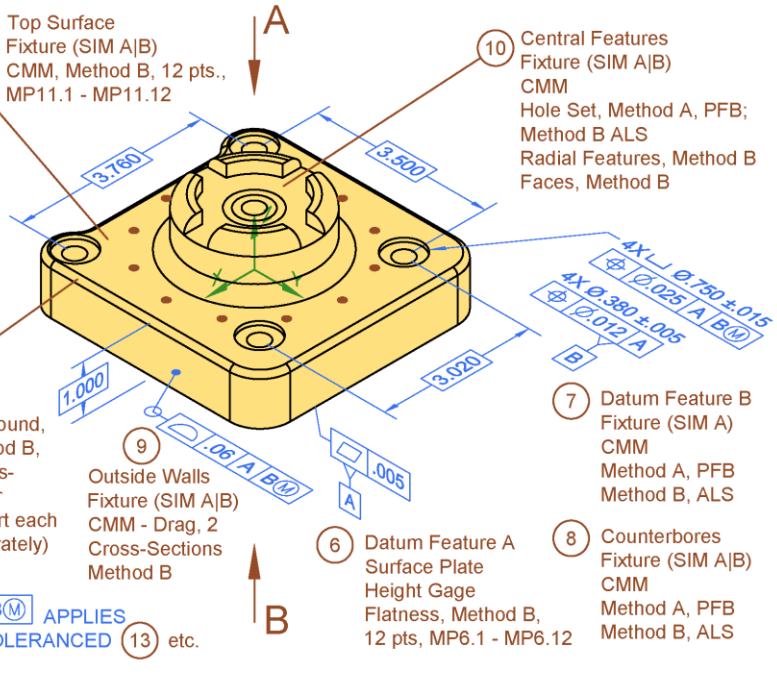
Optimal:
Measurement point locations and related data defined semantically in 3D and consumed directly from model data.



VIEW A - MEASUREMENT POINTS FOR FEATURE 11



VIEW B - MEASUREMENT POINTS FOR FEATURE 6



Corresponds to Dataset Classification Code 5

Process Definition Dataset - Inspection Plan - Option 5.1
Model Contains Implicitly-Defined Geometry and Explicitly-Defined PMI
Geometric Data and PMI Consumed from Model

Product Definition Dataset - Inspection

Contact

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MBD360 LLC

3D Model-Based Business Processes
Methods — Standards — Optimization — Software
Training, Consulting, and Implementation

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Thank You