

The Death and Rebirth of the Technical Drawing. Are Drawings Needed Anymore?

IM501262



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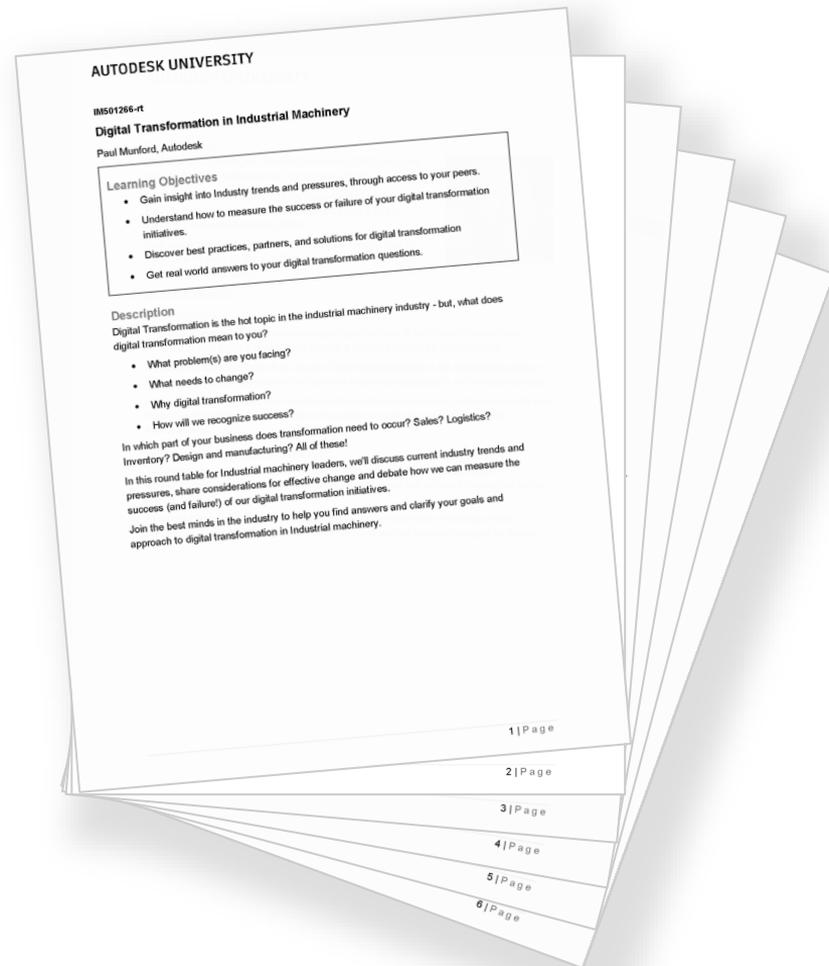
Roundtable—Mediated discussion engaging attendees.
A collaborative experience intended to help solve a challenge or answer a question shared by industry peers.

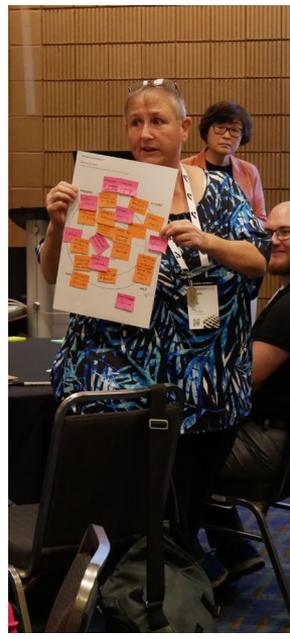
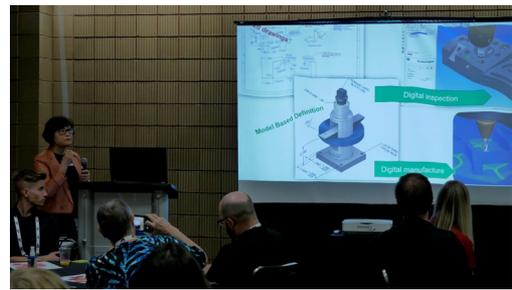


Handout:

For more photos and resources, please download the updated handout from AU online!

<https://www.autodesk.com/autodesk-university/class/death-rebirth-technical-drawing-Are-drawings-needed-anymore-2022>





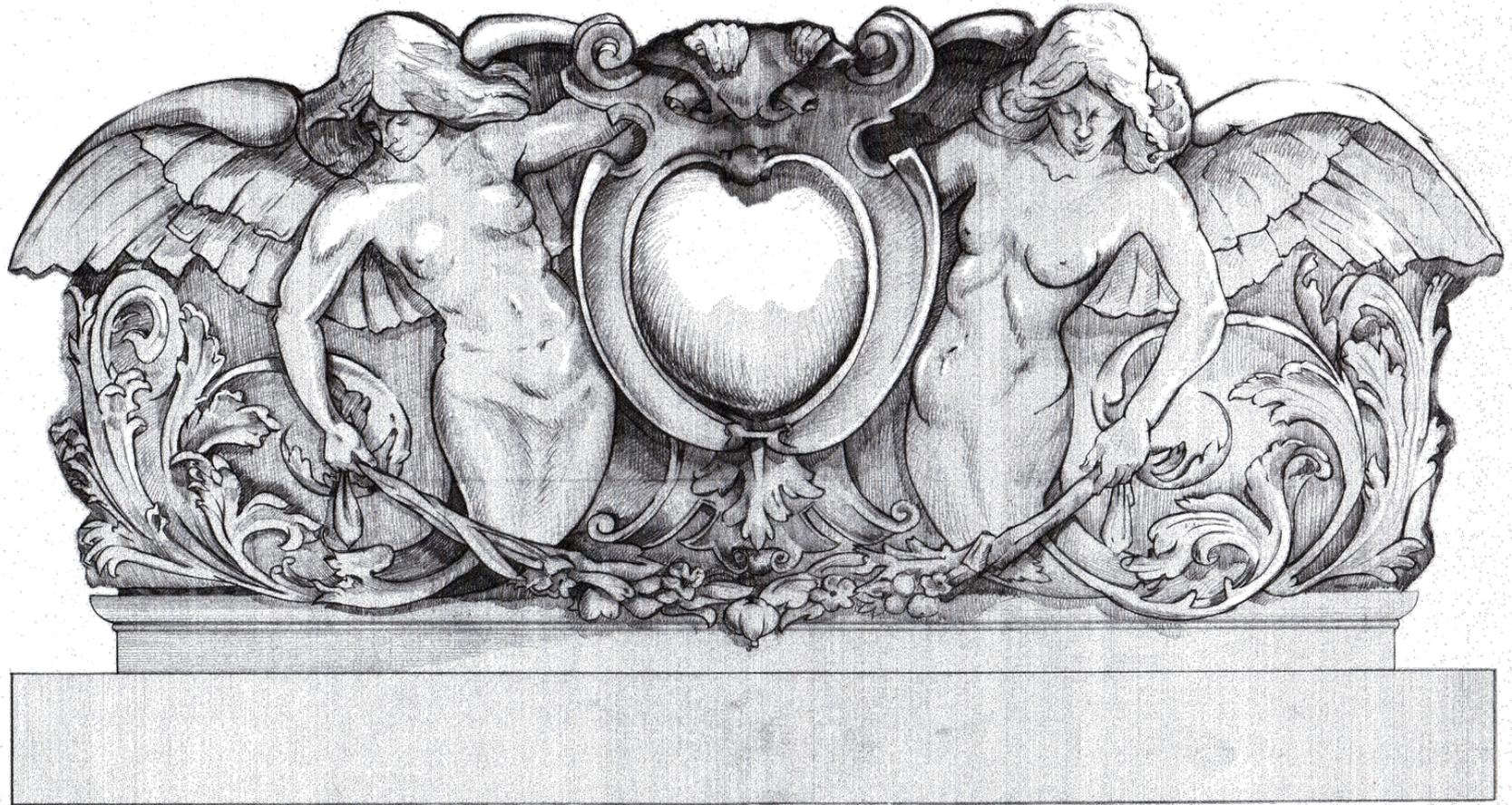
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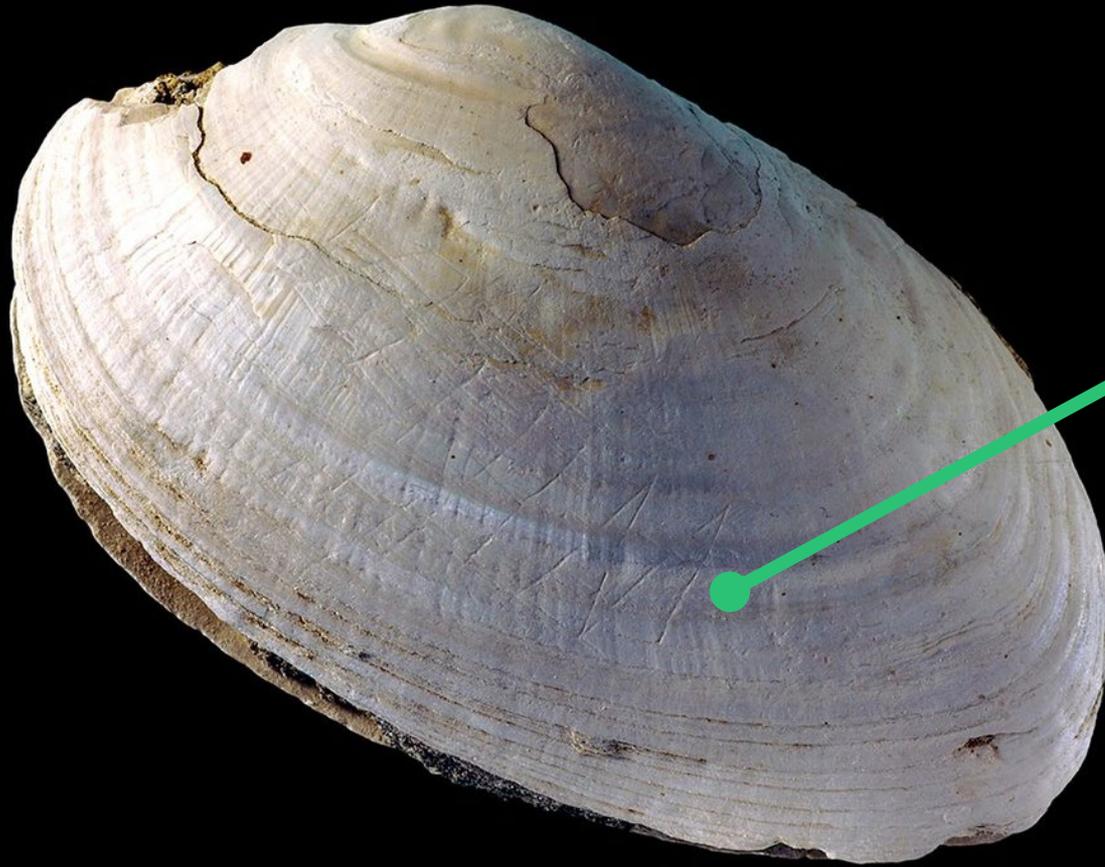


A Technical Drawing represents how an object looks, functions and can be made.



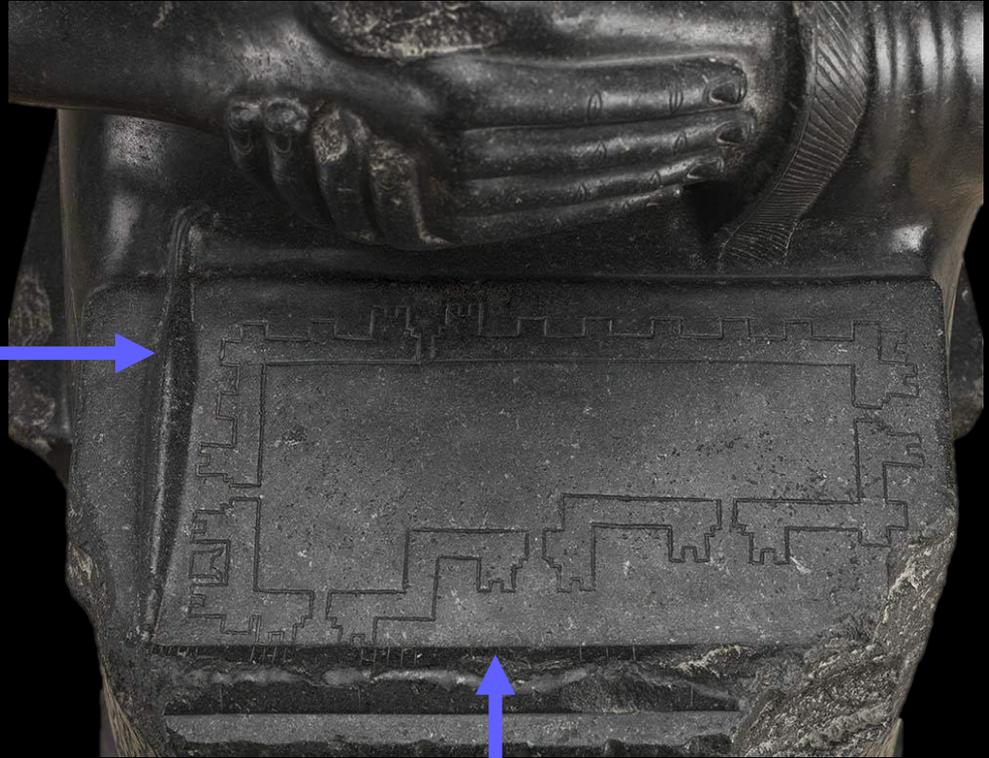
PAUL MUNFORD - SCENIC DRAUGHTSMAN

Drawing - Modelmaking - Surveying

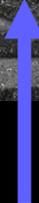








Stylus →



Scale/Rule



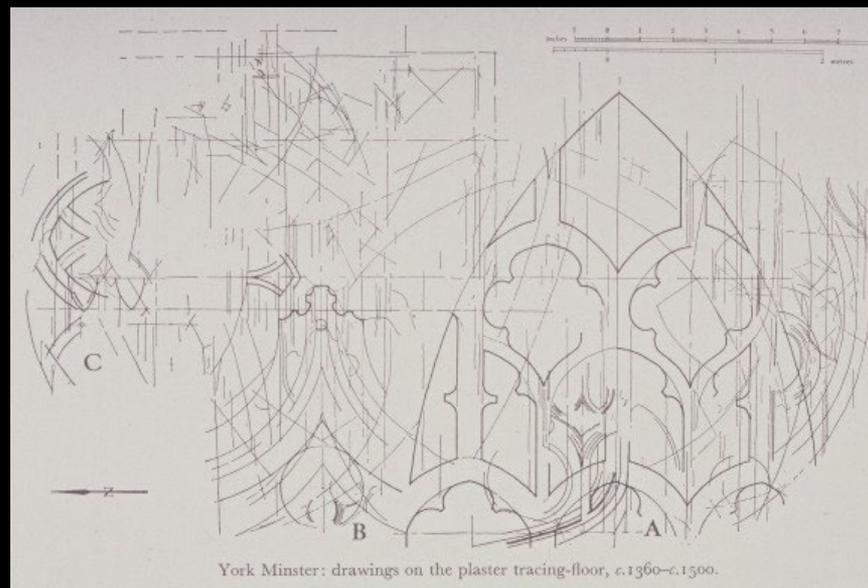
Try hard to manage with one sheet of paper for each device.

Show the whole device; don't annoy your beholder by using settings—he is as skilled as you and will recognize the purpose.

Spare your distant colleague's having to work out his own solutions for a result you have already achieved.

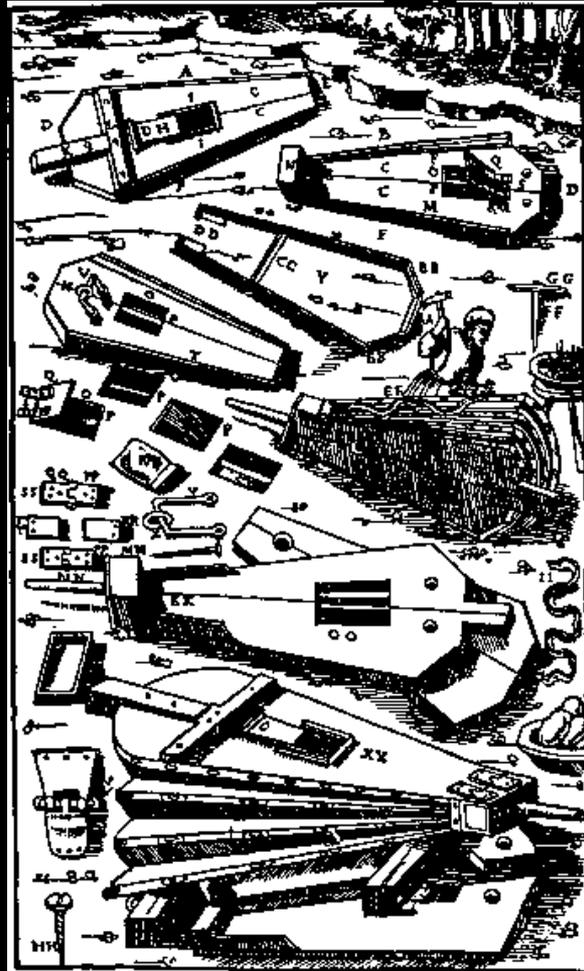
Use as many viewpoints as necessary to show all important parts and functions.

Only in case of unbearable overlapping, leave out some parts and show them separately.

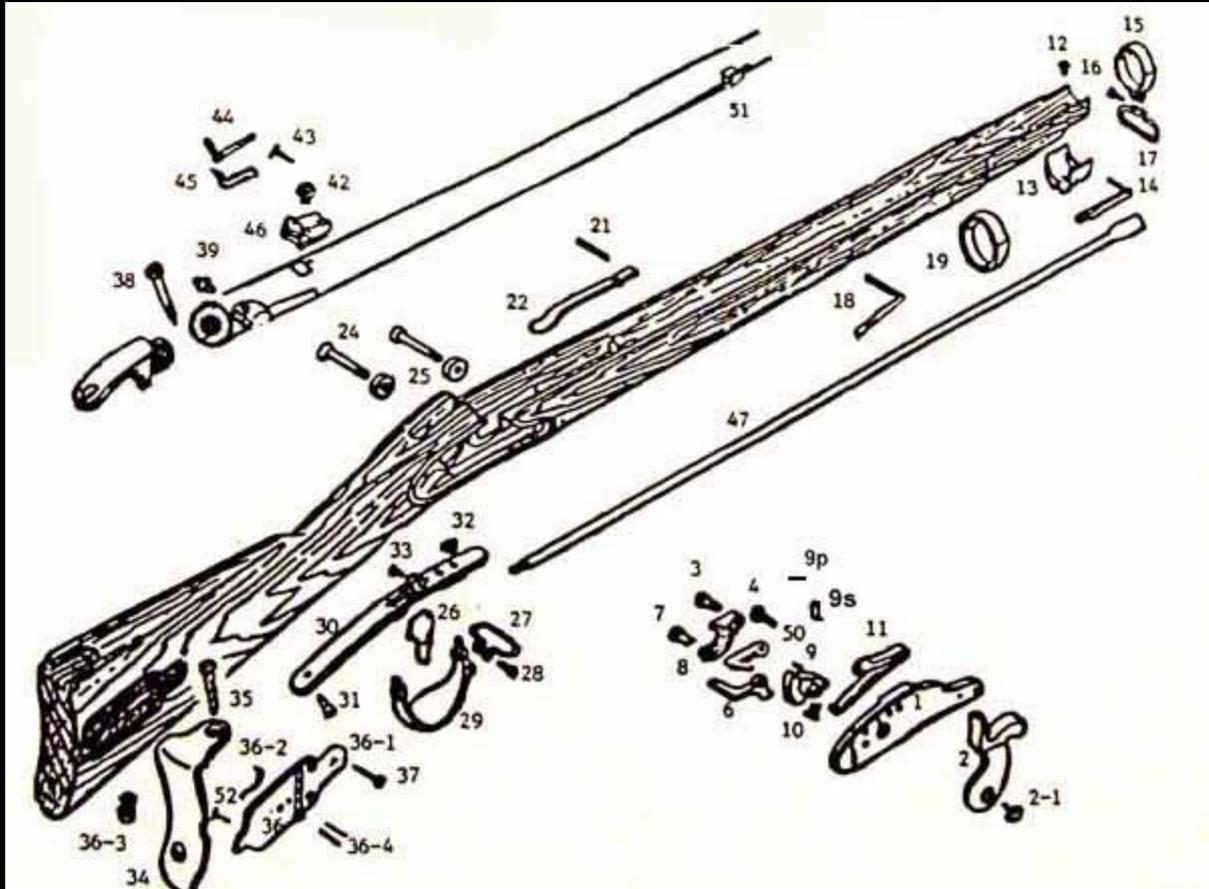


York Minster: drawings on the plaster tracing-floor, c.1360–c.1500.

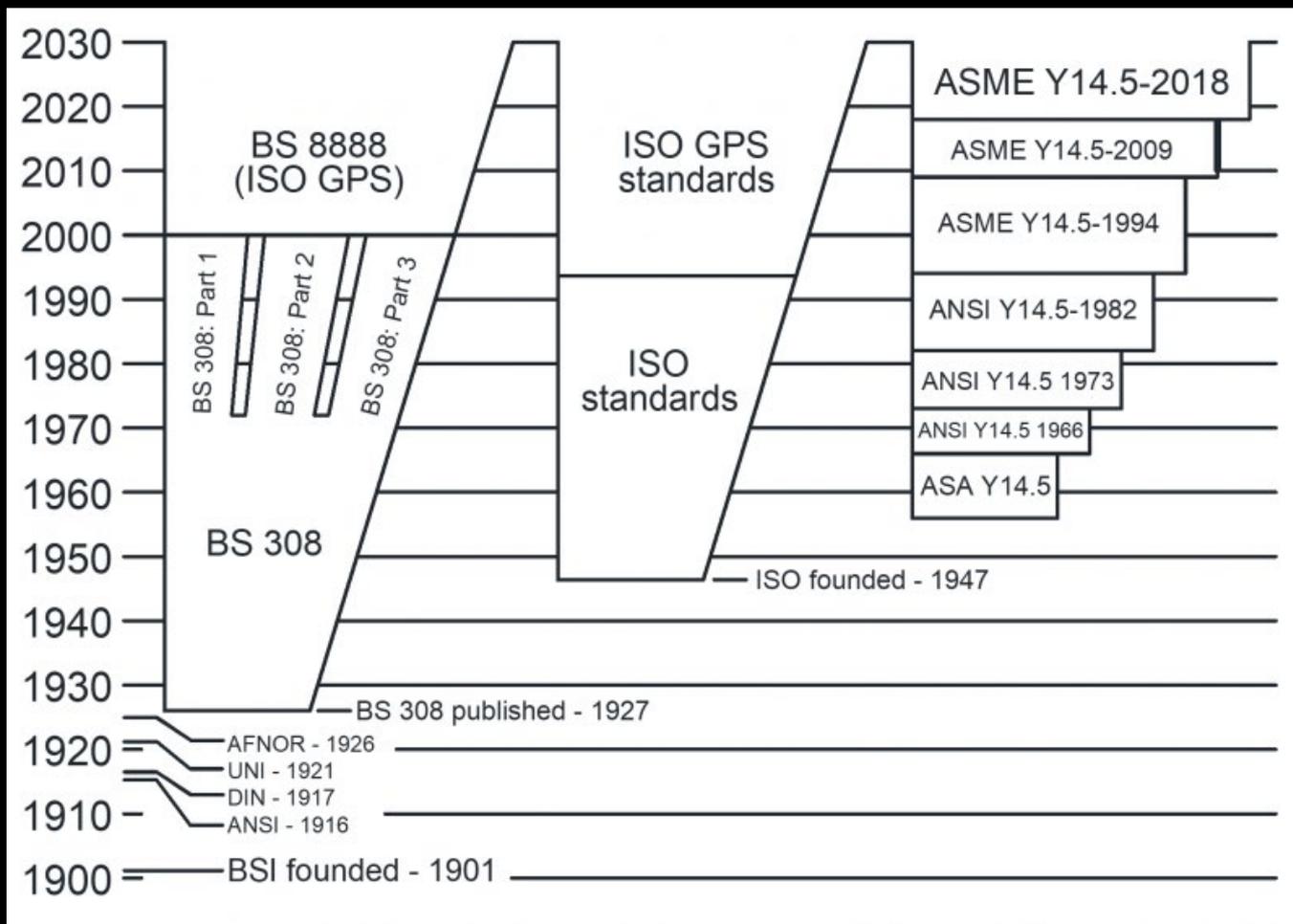




a working drawing by Agricola (1556)

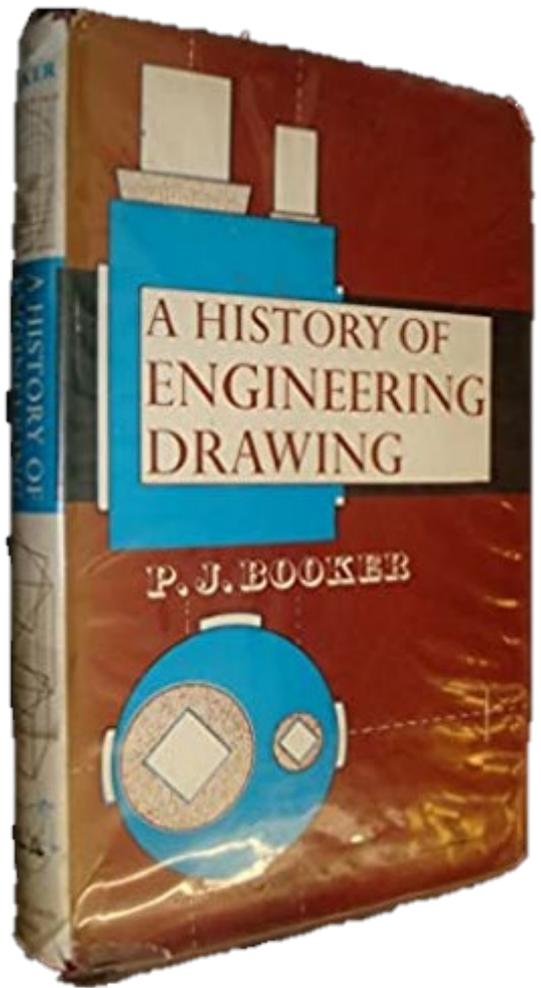


Eli Whitney's musket with interchangeable components





Ivan Sutherland – creator of 'Sketchpad' on the Lincoln TX-2 at MIT 1962





What is the **Purpose** of a
Technical Drawing?

What is **important** for that
purpose?



Icebreaker LUMA warmup



My
Idea

My
Other
Idea

This
Idea

That
Idea

The
other
Idea

Not my
Idea

Bad
Idea

Good
Idea

Another
Idea I
had

A weird
Idea

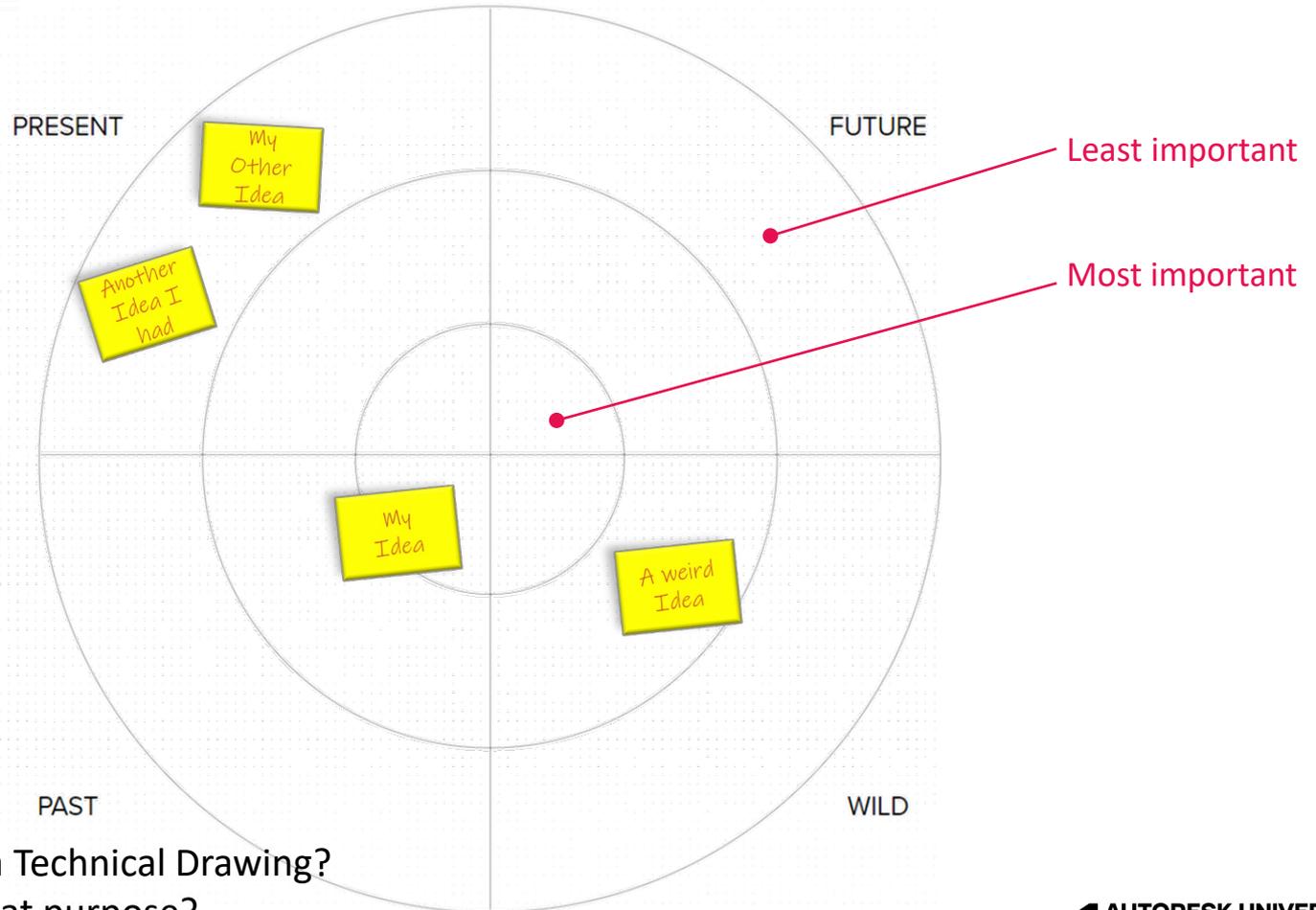
What is the **Purpose** of a Technical Drawing?

What is **important** for that purpose?



CATEGORIZE & ADD

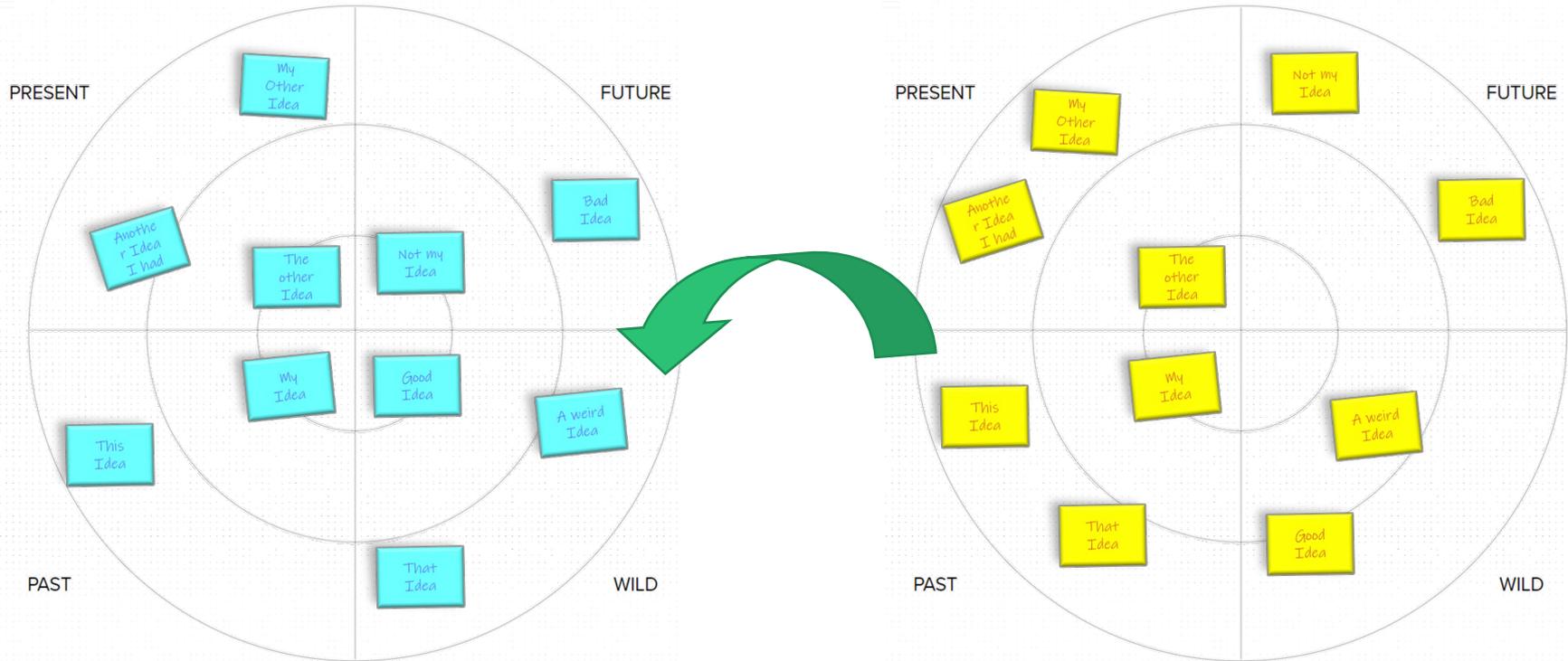
- This Idea
- That Idea
- The other Idea
- Not my Idea
- Bad Idea
- Good Idea



What is the **Purpose** of a Technical Drawing?
What is **important** for that purpose?



INTERVIEW AND SWAP



What is the **Purpose** of a Technical Drawing?
What is **important** for that purpose?



TABLE DISCUSSION



What is the **Purpose** of a Technical Drawing?
What is **important** for that purpose?



2D Drawings to Model-based Definition

September 2022

Toni Qin
SW Architect | @Interop

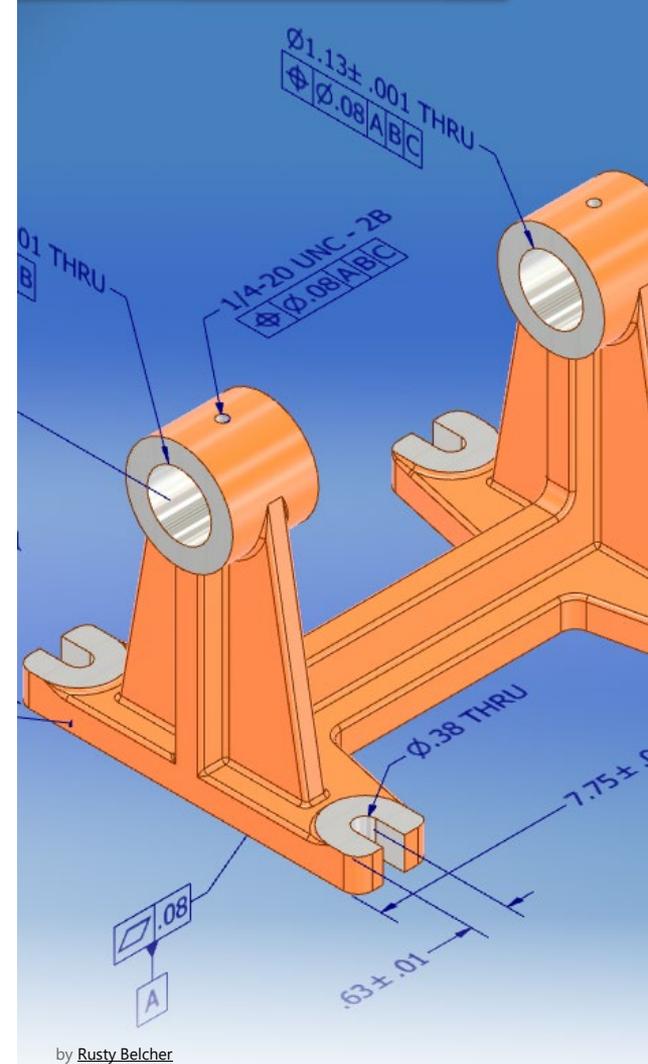


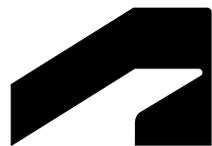
Toni Qin

- Software Architect and Tech Lead
 - @interop of Strategic Technologies of Platform Services and Emerging Technologies
- Experienced in Data Interoperability for 20+ years
 - Mechanical CAD (Inventor, AutoCAD, CATIA, NX, STEP, ...)
 - AEC (IFC, ...)
 - Visualization (JT, OBJ, USD, glTF...)
- Expertise in Model-based Definition
 - STEP, QIF, JT...

Highlight

- 1 2D Design vs 3D Design
- 2 Model-based Definition (MBD)
- 3 Industries on MBD
- 4 MBD by Inventor and Fusion

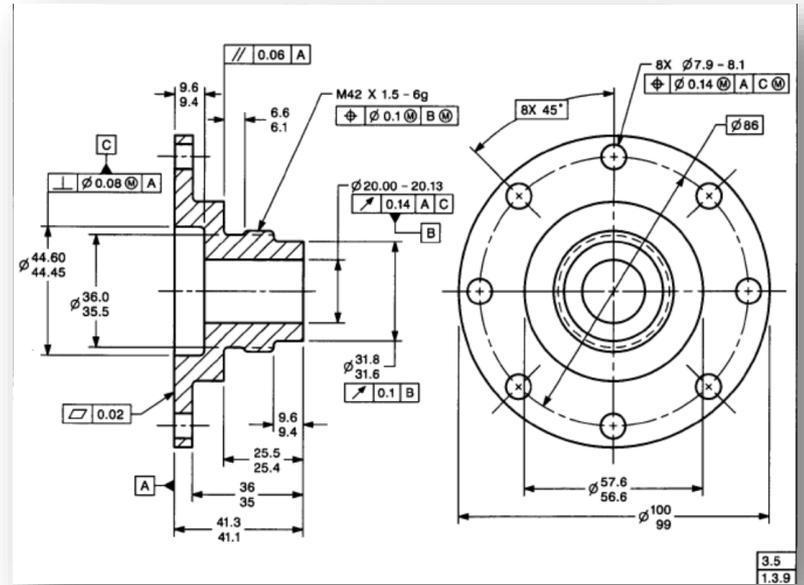
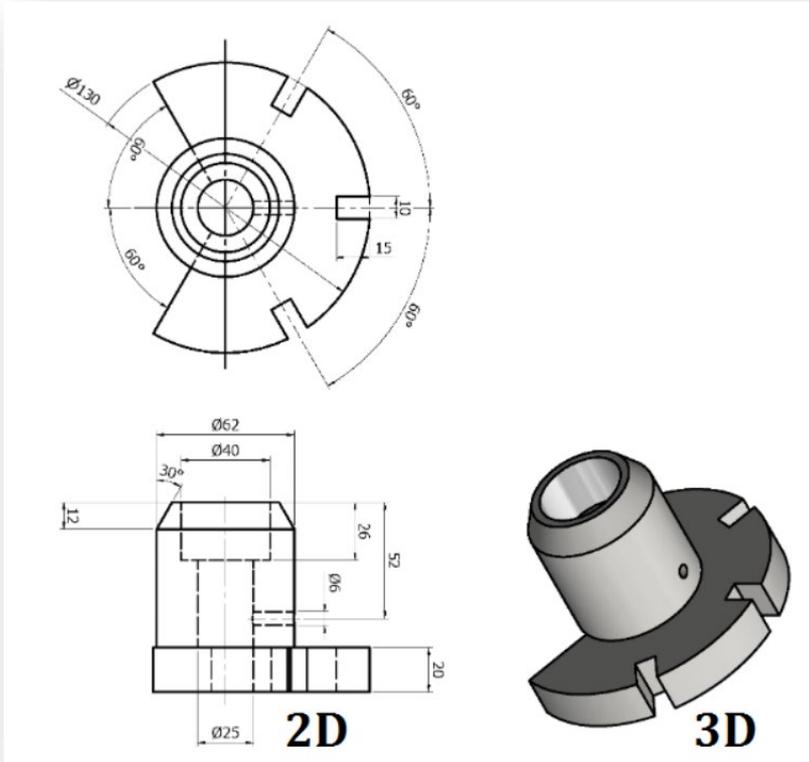




2D Design vs 3D Design



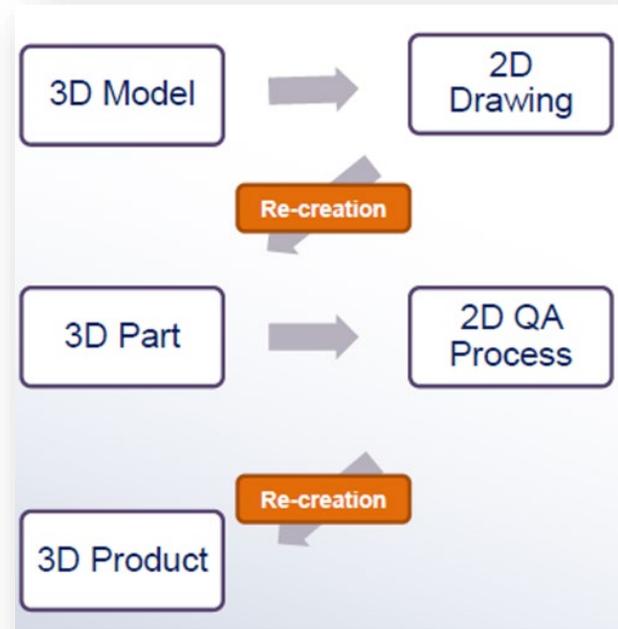
2D vs 3D



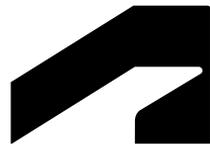
2D

Challenges with 2D Drawing

- Flat Geometry and Dimensioning Led to
 - Separated engineering groups on
 - 3D Model definition vs 2D dimensioning and tolerancing
 - Error prone on engineering intents
 - Data recreations in different product manufacturing phases
 - Irretraceable data from the original definition
- Broken interoperability
 - High cost, long lead time
 - Breakers to digital thread for automated design-manufacture cycles



http://www.loft.optics.arizona.edu/documents/presentations/2010_Chris_What_is_Geometric_Dimensioning_Tolerancing.pdf



Model-based Definition (MBD)

3D design and PMI plus high-level Interoperability

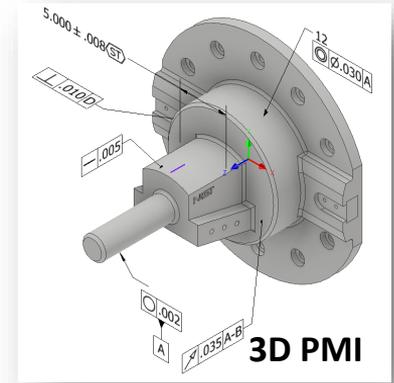
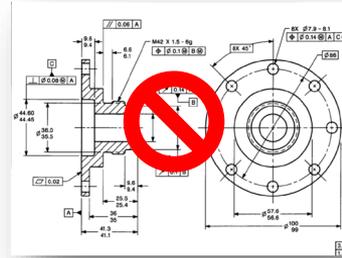


Product Manufacturing Information (PMI)

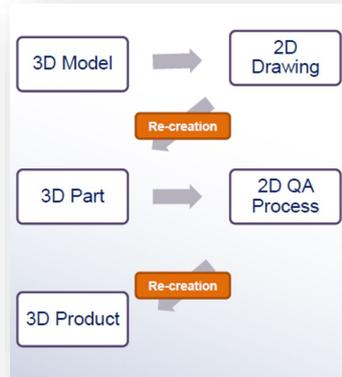
- PMI are design attributes necessary for 3D manufacturing product components and assemblies
- PMI includes
 - GD&T – geometric dimensions and tolerances,
 - 3D annotation (text)
 - Dimensions
 - Surface finish and material specifications
- PMI and 3D model within model-based definition allow for the elimination of 2D drawings

Model Based Definition (MBD)

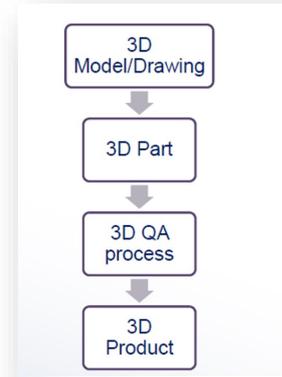
- 3D Drawings on the master 3D model:
 - PMI directly applied to 3D model - machine oriented
 - Single Source of the Truth!
- Deliver
 - Accurate interpretation on engineering intents
 - Reusable design data
 - Tracible data back to the original design
- Enable
 - High level **interoperability**
 - Digital manufacturing ecosystems



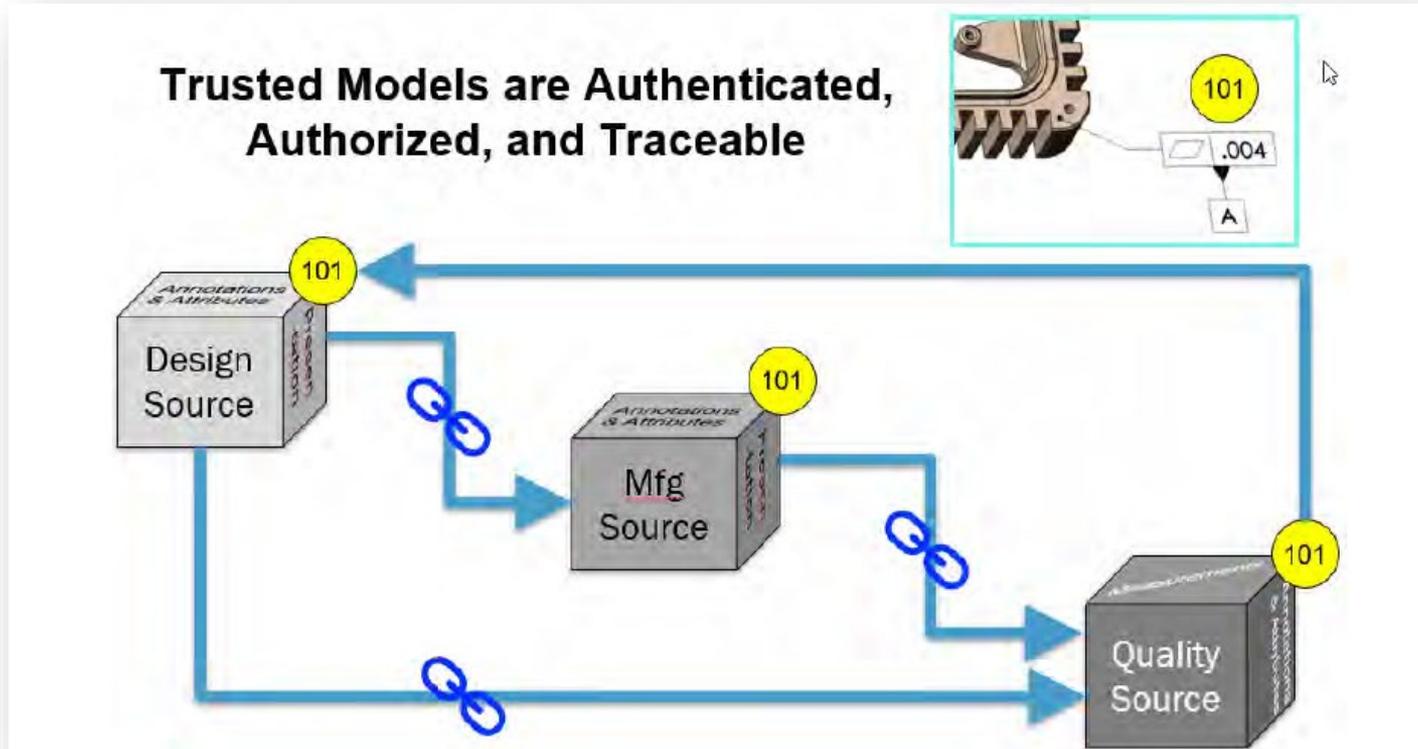
Drawing-based



Model-based

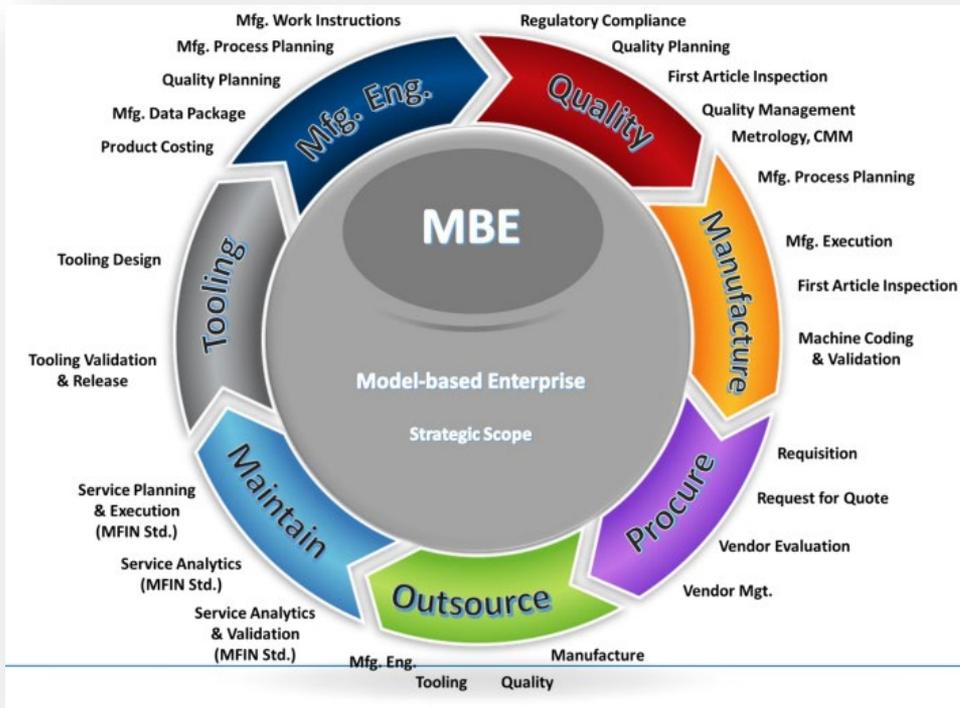


MBD: Single Source of the Truth with Interoperability

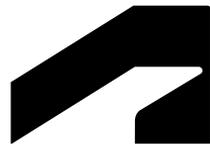


Model Based Enterprises (MBE)

Digital Transformation to Ecosystem



- MBD: the beginning of the digital thread
- Interoperability: the bridges
- A modern enterprise
 - Connected
 - Automated
 - Optimized
 - Autonomous
 - Fewer Resources
 - Lower cost
 - Reduced lead time

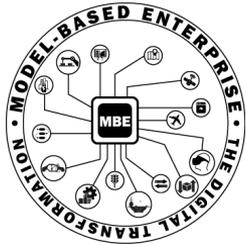


Industries on MBD

MBD Community and Requirements

- US: Led by NIST (National Institute of Standards and Technology)
- Industry and their suppliers:
 - Aerospace industry
 - Automotive industry
 - Ship building industry
- Standards communities
 - ISO standards: STEP, JT and QIF
 - DMSC: Digital Metrology Standards Consortium

MBD Community and Requirements



<https://www.nist.gov/news-events/events/2021/04/2021-model-based-enterprise-summit>

<https://www.cax-if.org/index.php>





Quality Assurance Standard for Digital Product Definition at Boeing Suppliers

DOCUMENT NUMBER: D6-51991
RELEASE/REVISION: REV N
RELEASE DATE: April 19, 2019

...

Model Based Definition – A Boeing dataset containing the exact solid, it's associated 3D geometry and 3D annotation of the product's dimensions and tolerances (and may include parts/notes list) to specify a complete product definition. This dataset does not contain a conventional 2D drawing. MBD is one possible format of DPD.

(Note: Model Based Definition is the undisputed source of definition)

...

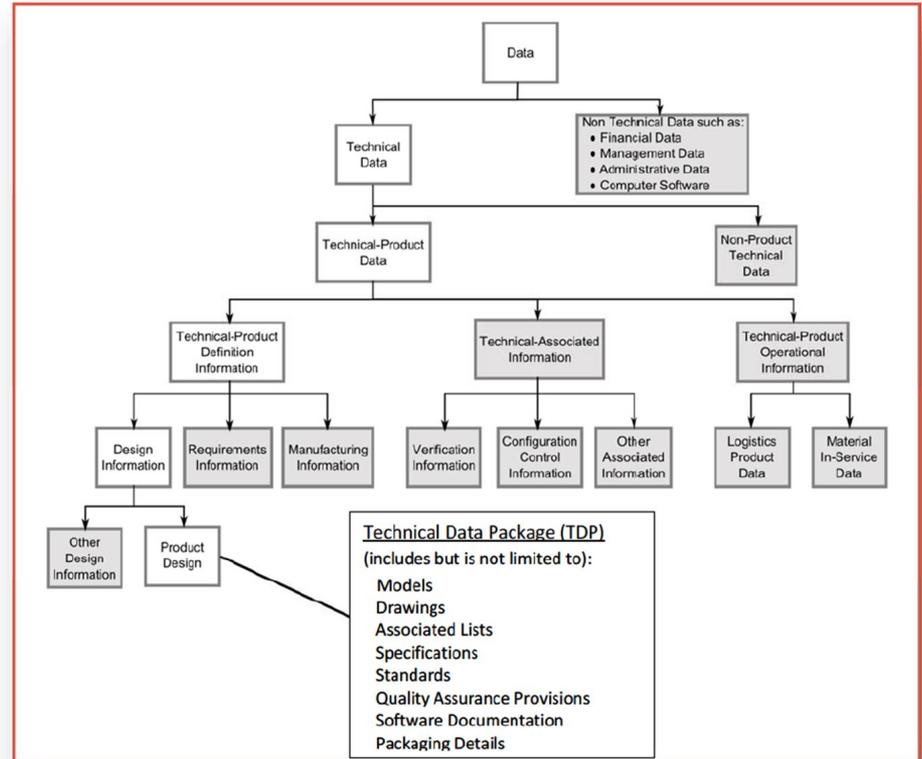
Standard Practice Technical Data Packages (TDP)

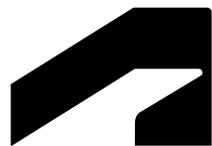
MIL-STD-31000B from Department of Defense

MIL-STD-31000B
31 October 2018
SUPERSEDING
MIL-STD-31000A
26 February 2013

DEPARTMENT OF DEFENSE
STANDARD PRACTICE
TECHNICAL DATA PACKAGES

This standard is approved for use by all Departments and Agencies of the Department of Defense.

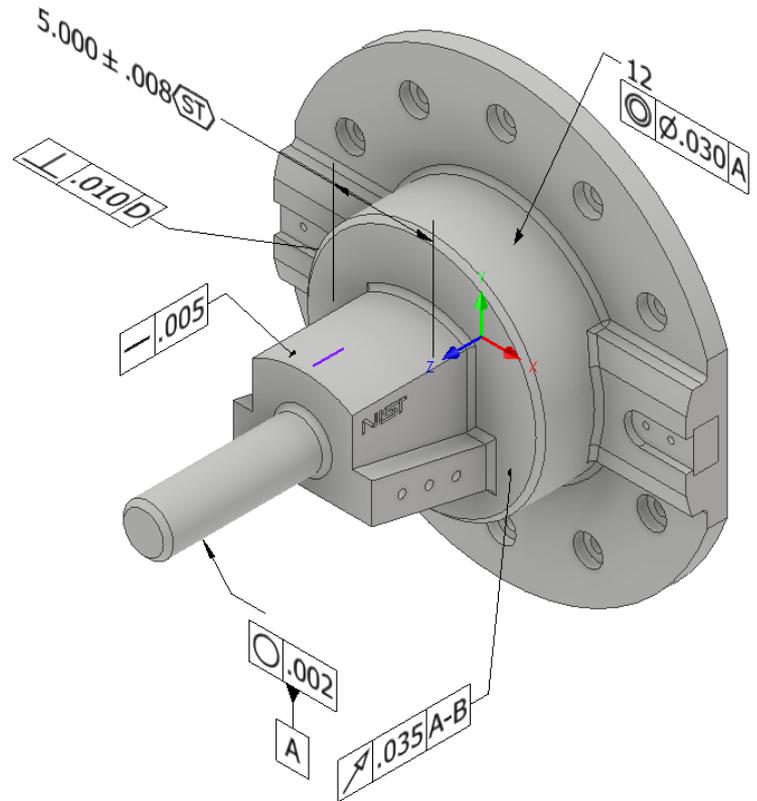




MBD by Inventor and Fusion

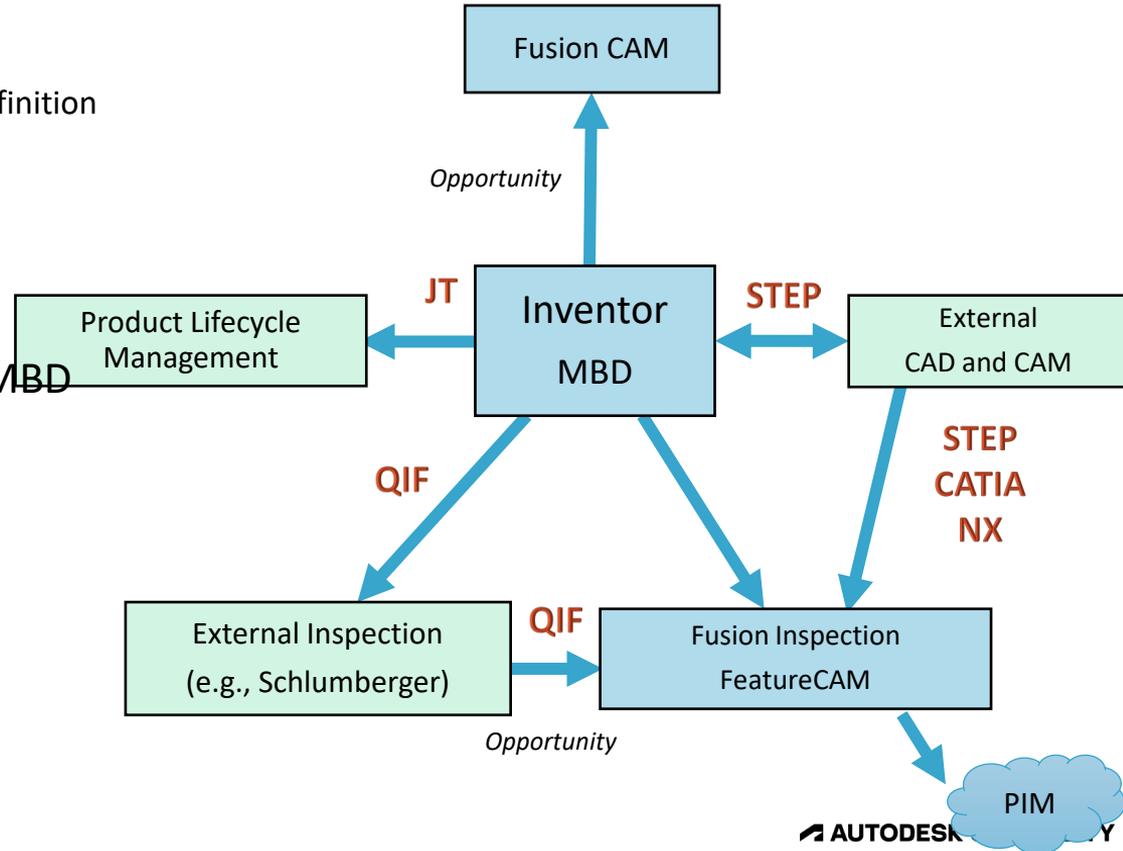
3D Annotation by Inventor

- Dimensions:
 - Location: dimensional or angular
 - for 2 geometrical pieces
 - Size: dimensional or angular
 - for 1 geometrical piece
- FCFs (Feature Control Frames):
 - Geometric tolerances
 - Perpendicular
 - Concentricity
 - Circularity
 - Straightness
 - Runout tolerance
 - ...
- Design Views for PMI



Inventor, Fusion and MBD workflows

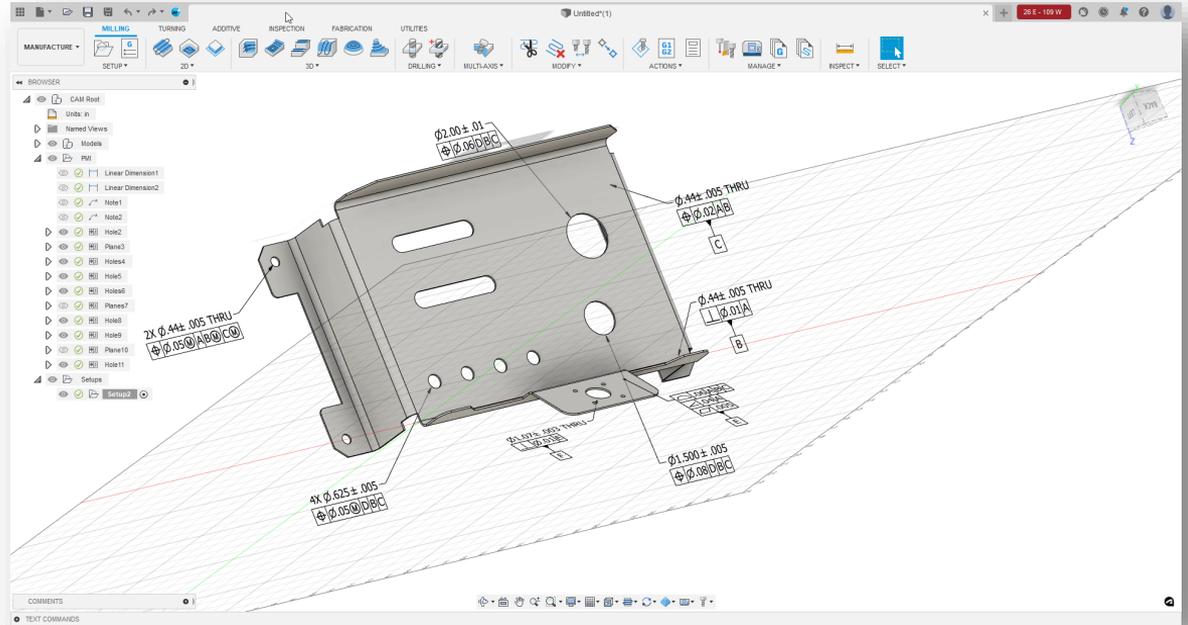
- Inventor generates MBD
 - Single source for Product Model-Based Definition
- Inventor MBD to ISO formats
 - STEP, QIF, JT
- Fusion and FeatureCAM consume MBD
 - For Quality Inspection
 - From Inventor, STEP, CATIA, NX...



Fusion Inspection: Adopting MBD Data

Connected workflow from Design to Inspection Planning

- Fusion using MBD data from
 - Inventor
 - STEP
 - CATIA
- AnyCAD: Inventor – Fusion
 - Associative MBD update
- MBD data to Cloud*
 - Common types for 3D PMI



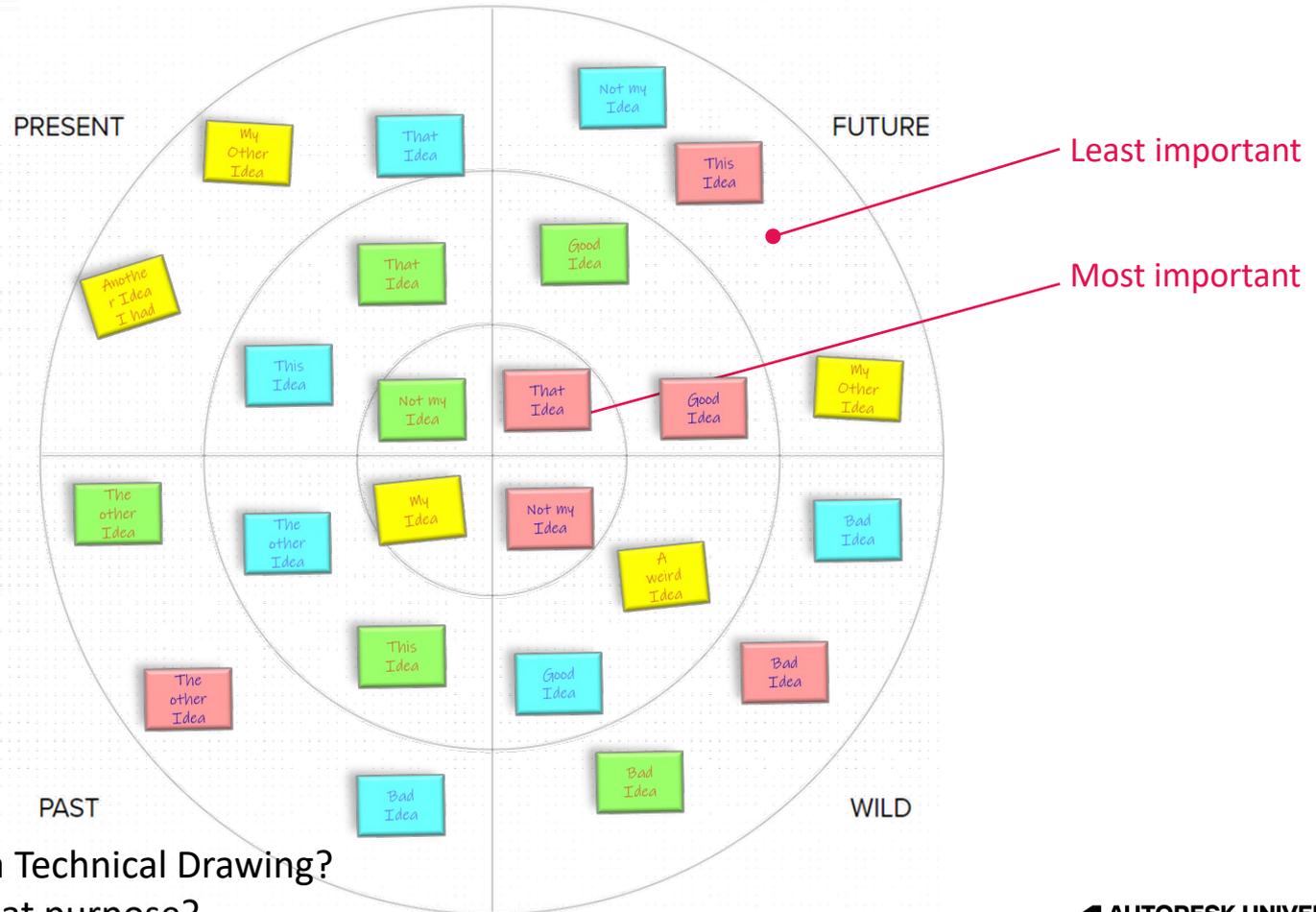


Takeaways

- Model-based definition (3D PMI) offers a way for completely dissimilar systems to ‘integrate’ and share critical manufacturing information.
- 3D PMI provides the bridge for CAD to CAM integration from design to machining, or for CAD to CAE integration from design into analysis
- It’s the time that 3D PMI becoming a widely accepted (and expected) technology in our industry of mechanical design, manufacturing and analysis.



GROUP RADAR



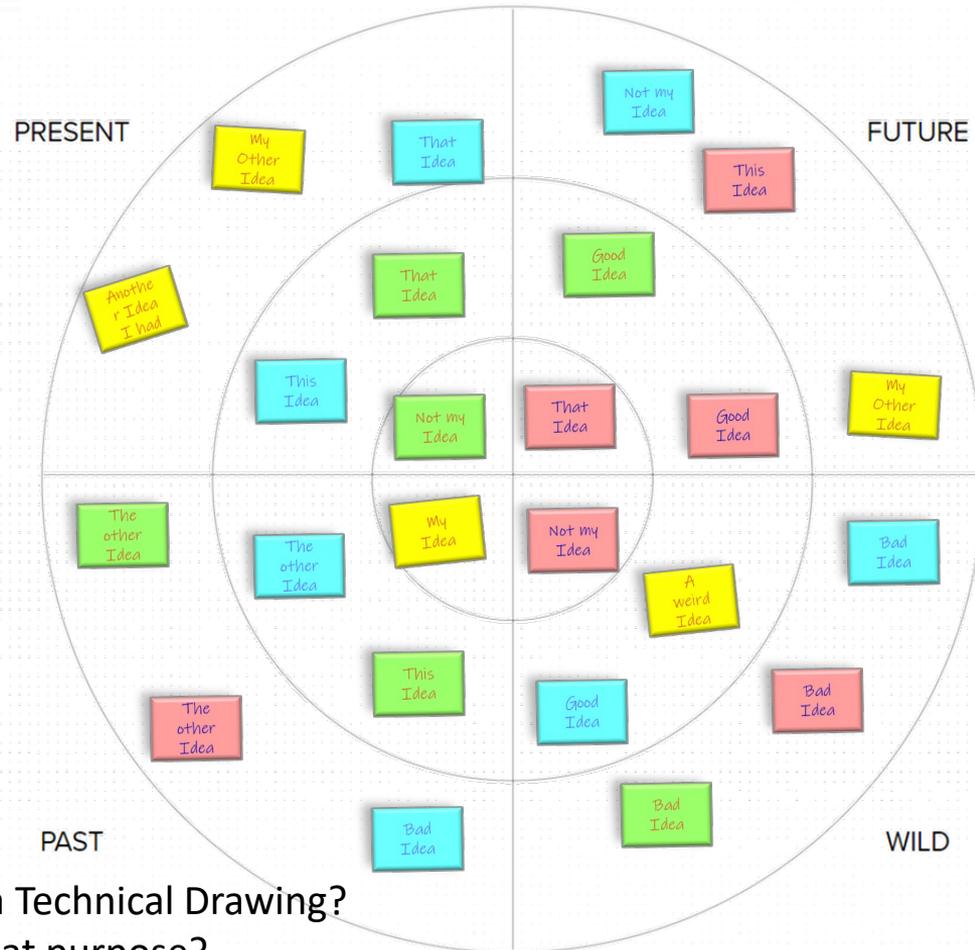
Least important

Most important

What is the **Purpose** of a Technical Drawing?
What is **important** for that purpose?



GROUP FEEDBACK



What is the **Purpose** of a Technical Drawing?
What is **important** for that purpose?



What is the **Purpose** of a
Technical Drawing?

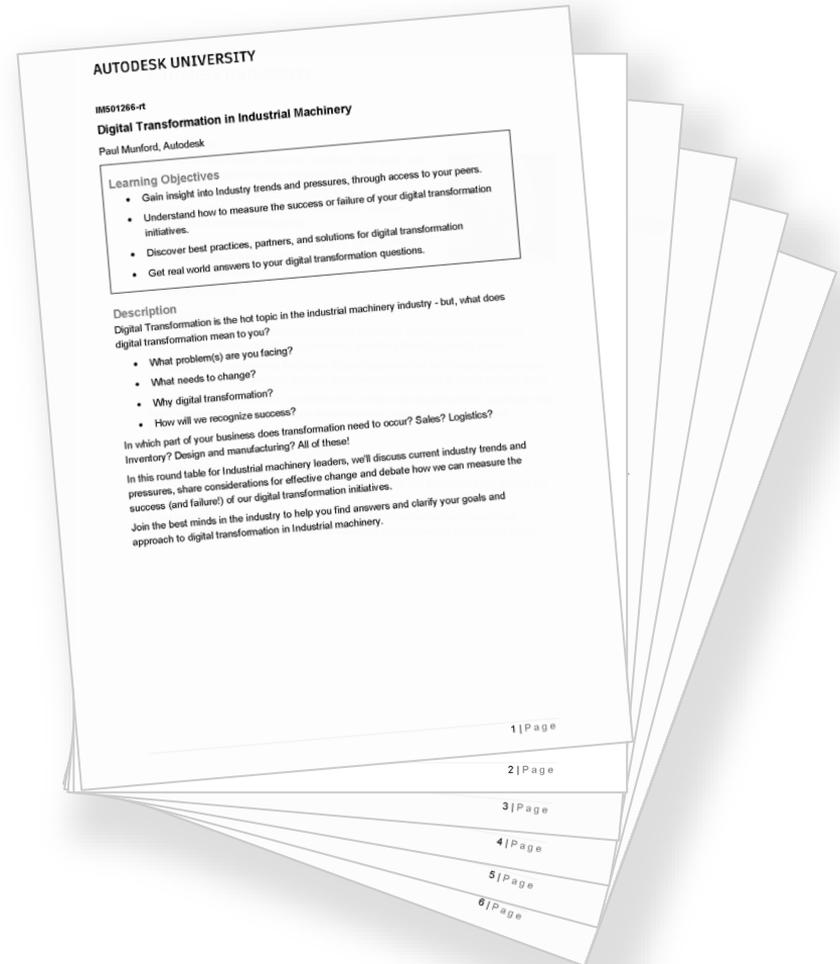
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