Model-Based Definition as a Semantic Backbone for Manufacturing Data Systems

GLOBAL PRODUCT DATA

INTEROPERABILITY

SUMMIT 2025

BOEING ELYSIUM LOCKHEED MARTIN NORTHROP GRUMMAN Parker PDES, Inc.® Connecting the Digital Enterprise

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Strategic MBE Consulting

Helping end users understand the landscape of MBD technology and unlock the roadmap to a successful MBD implementation.

CAD/MBE Software Services

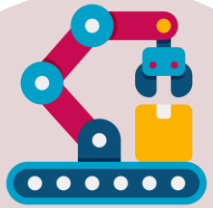
Providing expert software development services in CAD, MBD, QIF, Characteristic Management, and beyond.

Digital Gap Between Design & Ops

Product Engineering

- CAD/PLM
- Requirements
- Simulation
- Costing

Valley of Death



Manufacturing & Quality

- Manufacturing Planning
- Quality Planning
- Metrology
- CAM & Other Process

📝🔁⏳ Manual handling of characteristics at each stage is a burden

👷🎲⚖️ Inconsistent processing of characteristics by personnel

🙈🚫👁️ No visibility of characteristics across enterprise

Digital Thread, MBD, and Characteristics

What is the Digital Thread?

- We have amazing, expert point technologies in narrow domains
- The Digital Thread is connecting these technologies to allow interactions

Enabling Technology

MBD is the data language for product data

Characteristics: the atomic unit of data in an MBD

Semantic characteristics are the core building block for the digital thread

How To

- Don't think of the enabling technology in the abstract
- Identify use cases in detail – then we can understand the application of the technology

Model-Based Characteristics

DMSC 2024

How should we track characteristics?

Besides the characteristic ID, what additional metadata should we track?

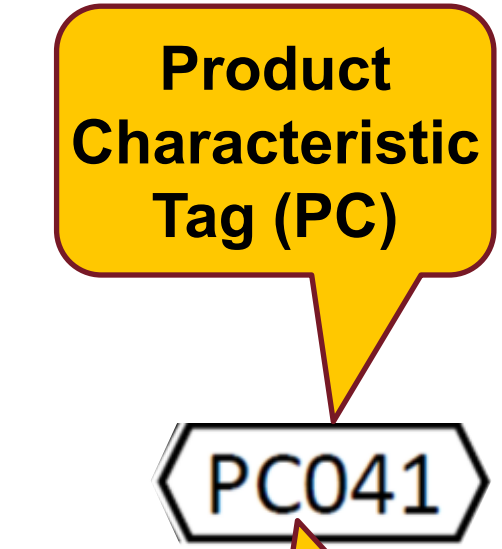
Model-Based Characteristics provides guidelines for thinking of characteristics as business objects.

Even though it addresses the model-based case directly, its principles can be applied broadly, even to drawing-based products.

MBC Standard Overview

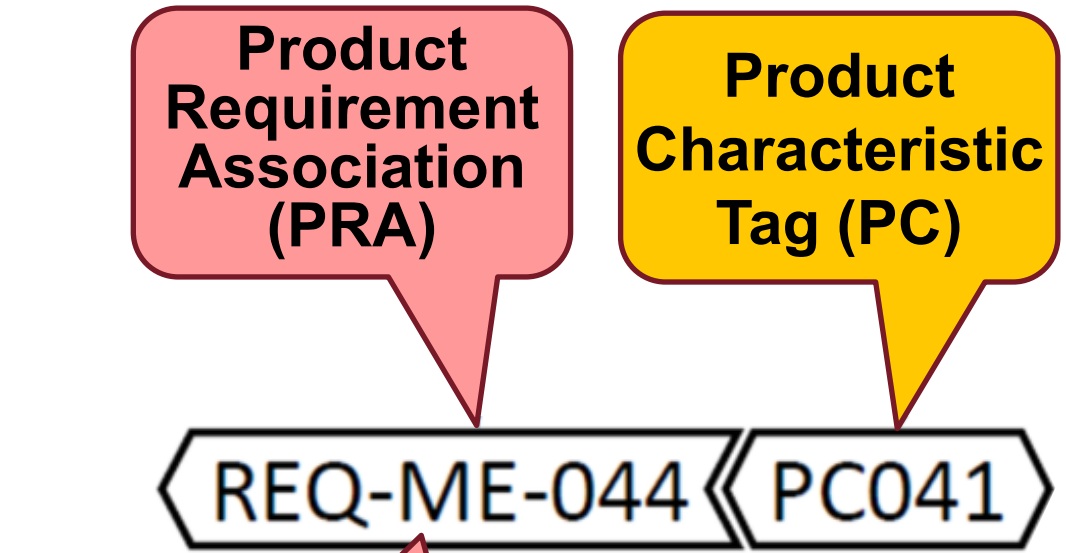
- **Characteristics IDs (Balloons)**
- Augmentations:
  - Criticality Classifications
  - Product Requirements Associations
  - Verification Plan Requirements

Model-Based Characteristics (MBC)



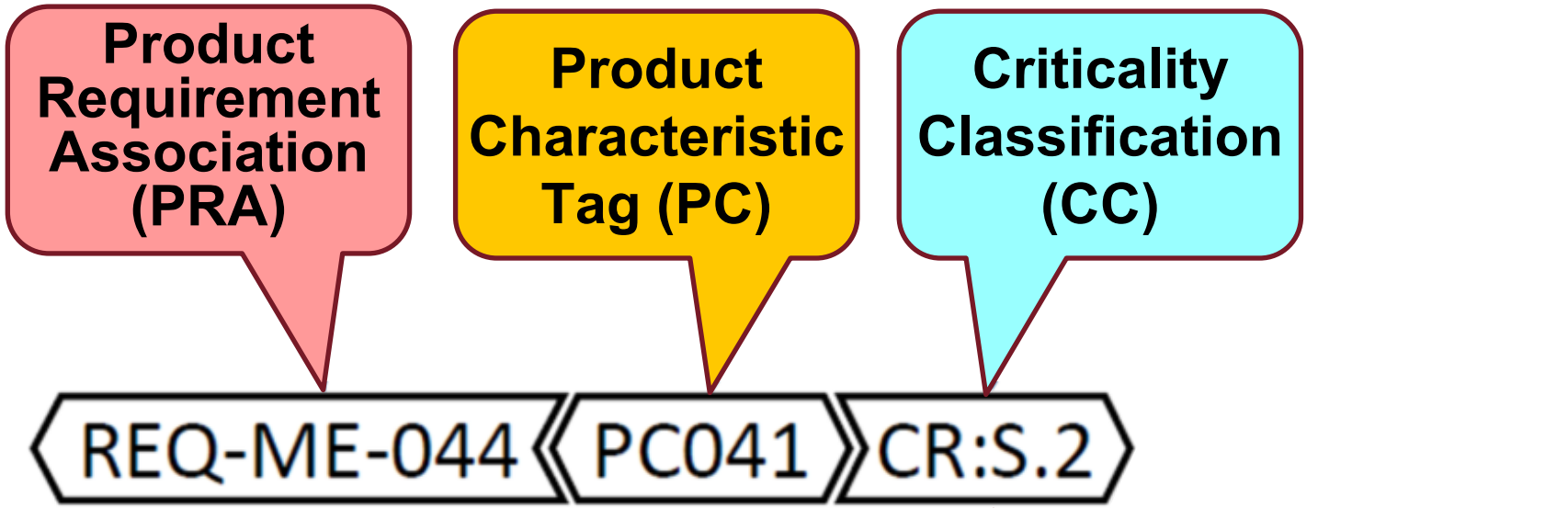
- (Balloon)
- Core ID for tracking this characteristic
- This ID should be unique in the part

Model-Based Characteristics (MBC)



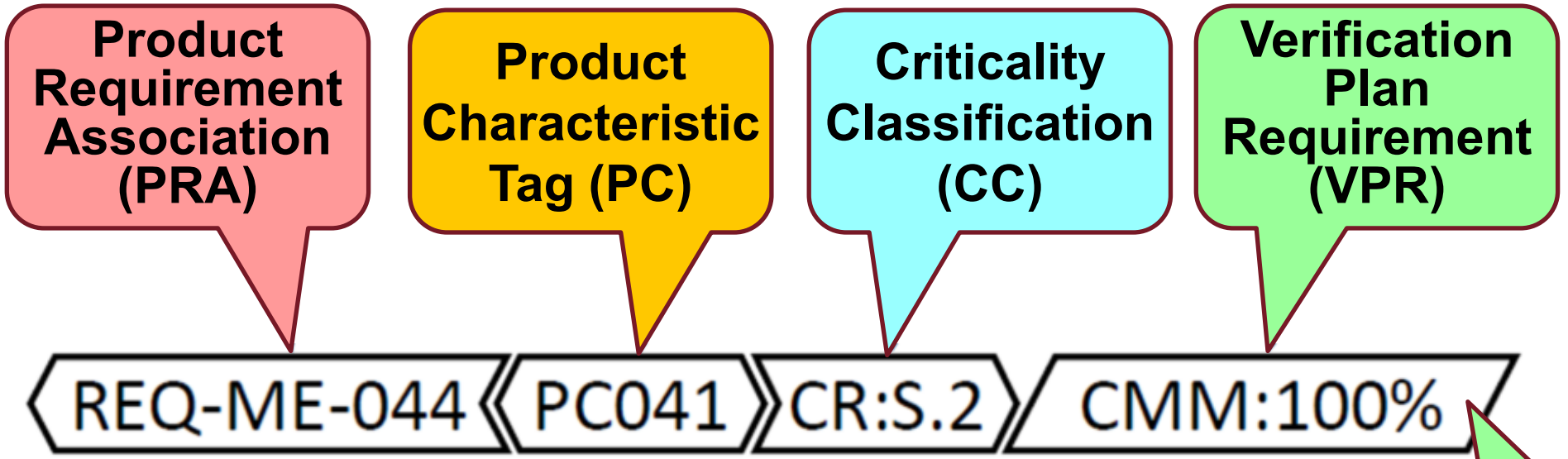
- Reference to the requirement that drove the creation of this characteristic
- Useful for systems modelling and DFMEA

Model-Based Characteristics (MBC)



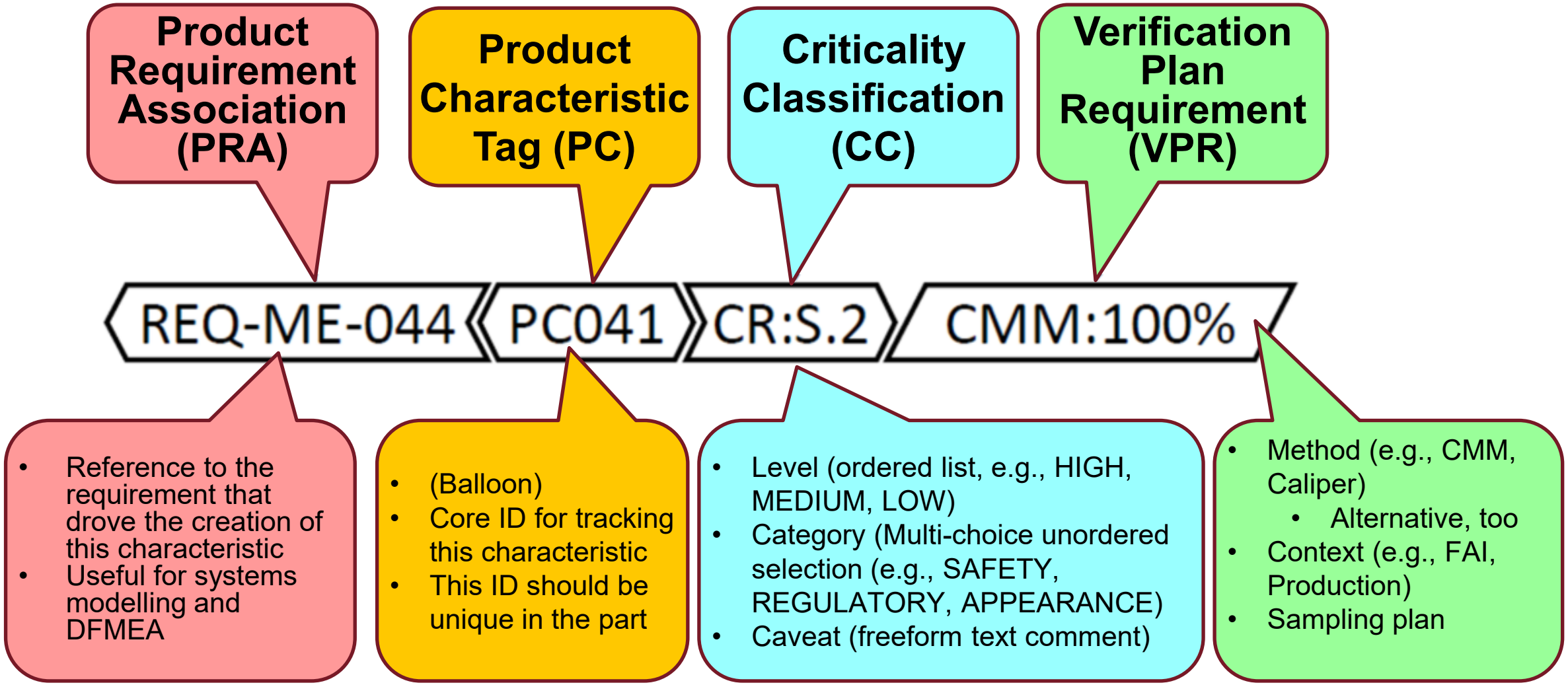
- Level (ordered list, e.g., HIGH, MEDIUM, LOW)
- Category (Multi-choice unordered selection (e.g., SAFETY, REGULATORY, APPEARANCE)
- Caveat (freeform text comment)

Model-Based Characteristics (MBC)

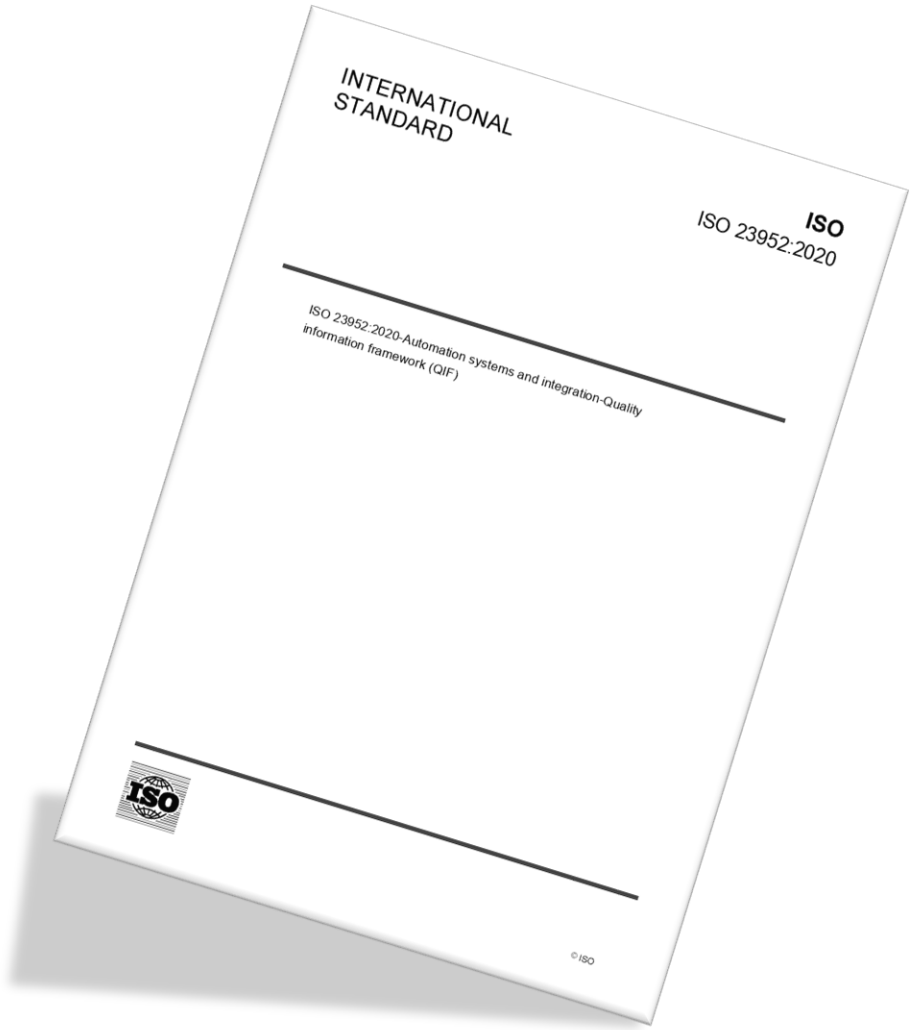


- Method (e.g., CMM, Caliper)
  - Alternative, too
- Context (e.g., FAI, Production)
- Sampling plan

Model-Based Characteristics (MBC)



ISO 23952: QIF



Features in QIF

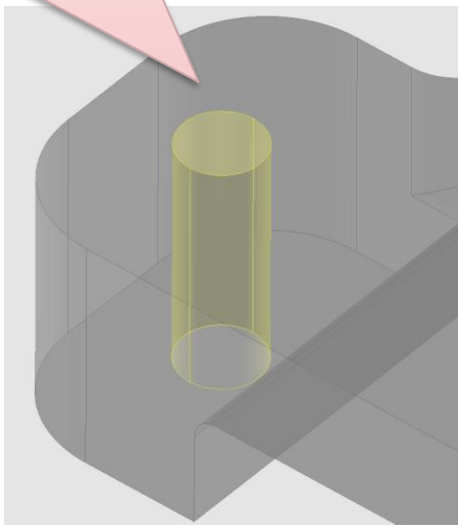
An abstraction for referencing a portion of a part.
In MBD, this means:
A container for referencing one or more geometrical entities on the model

There are lots of feature types! Some examples:

- Cylinder
- Plane
- Cone
- Opposite Parallel Planes (slot)
- Freeform (generic)
- Circles
- Lines
- Ellipse
- Compound Features
- Pattern Features
- Etc.

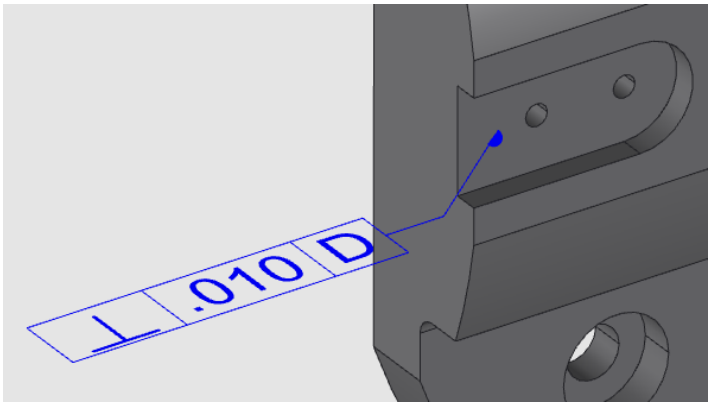
This Cylinder feature is made up of 2 CAD surfaces. (Pretty typical.)

But the CAD's mathematical representation of this geometry is irrelevant – this is a functional hole and needs to be treated as such!



A control or specification placed on a Feature.

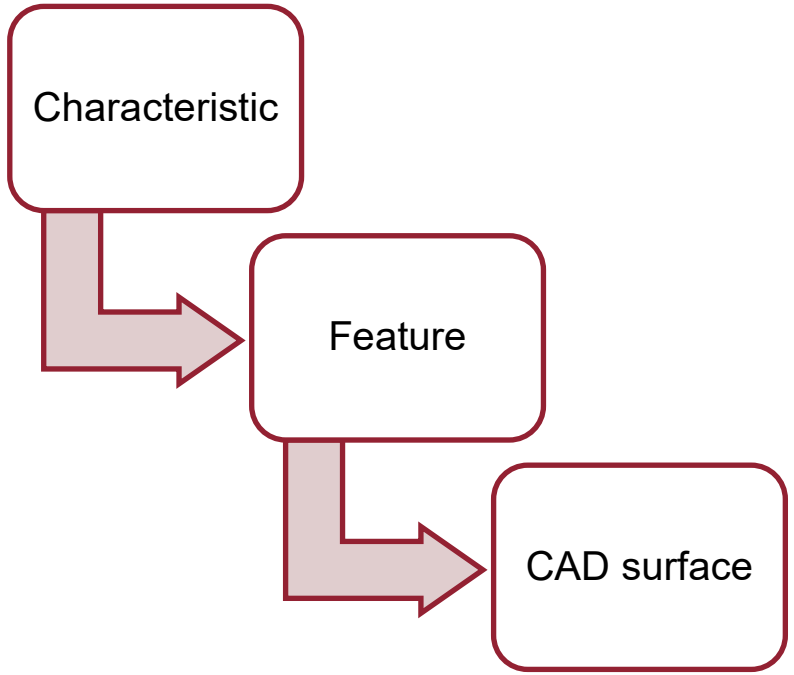
For example, a Tolerance, a Surface Finish, a Weld specification, etc.



With QIF MBD, it is also possible for a Characteristic to have a 3D presentation element (e.g., an annotation). But that's for human consumption.

How is a Characteristic connected to the MBD?

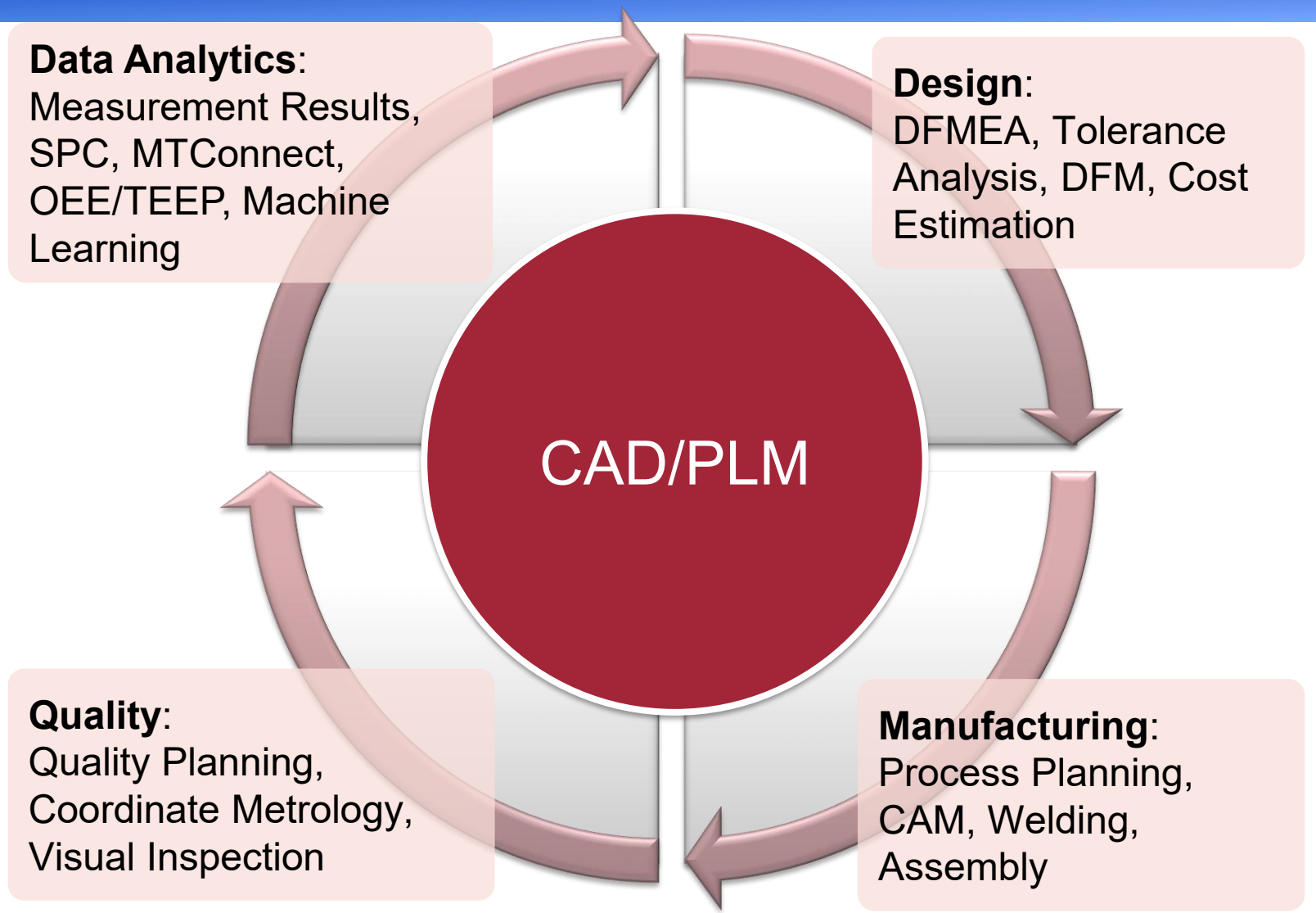
A Characteristic points to a Feature, and a Feature points to CAD geometry.



QIF Use Case Landscape

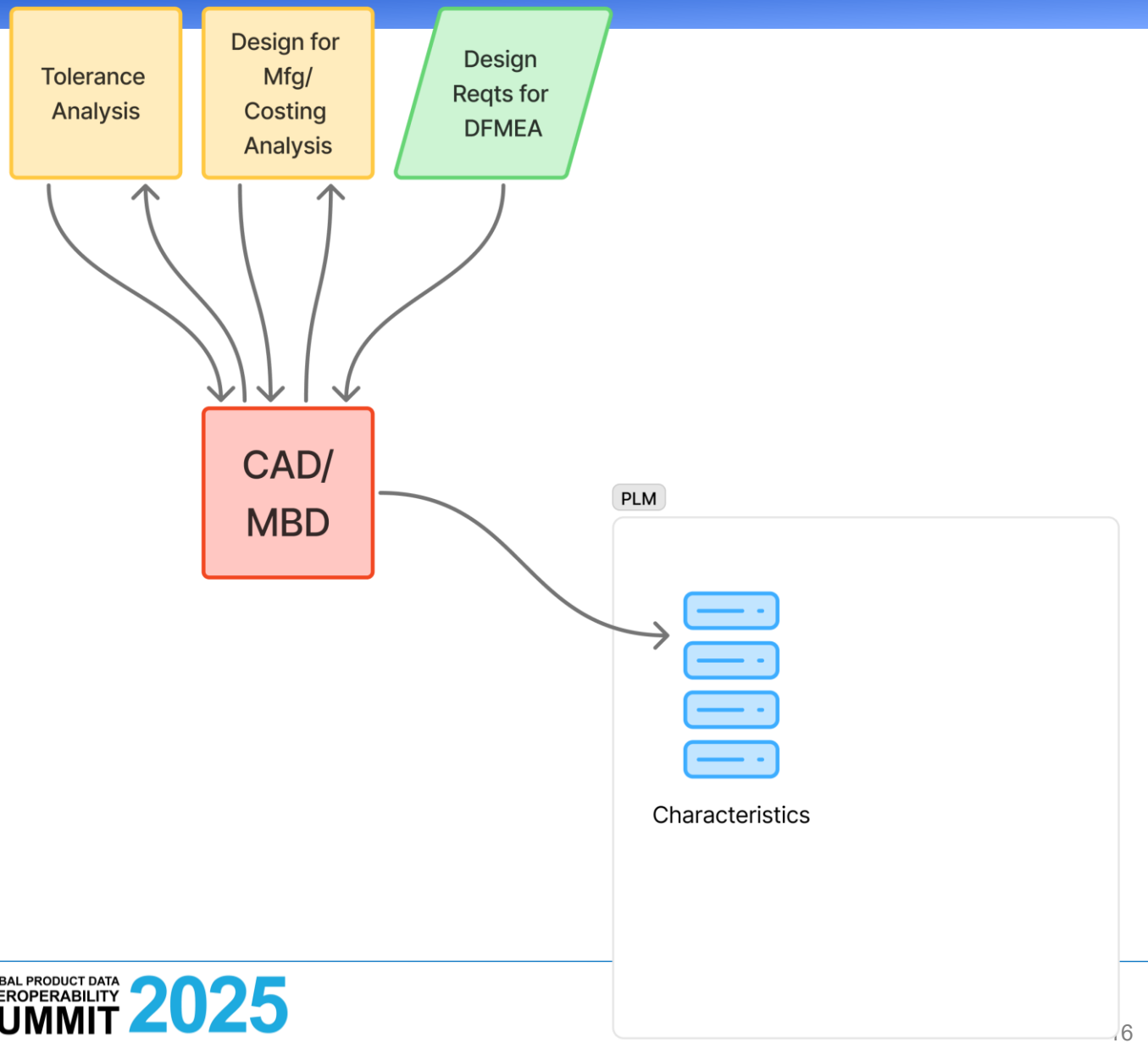
These are the initial technology areas with largescale applicability to QIF and semantic MBD

The focus is primarily on connectivity of characteristic data throughout the enterprise.



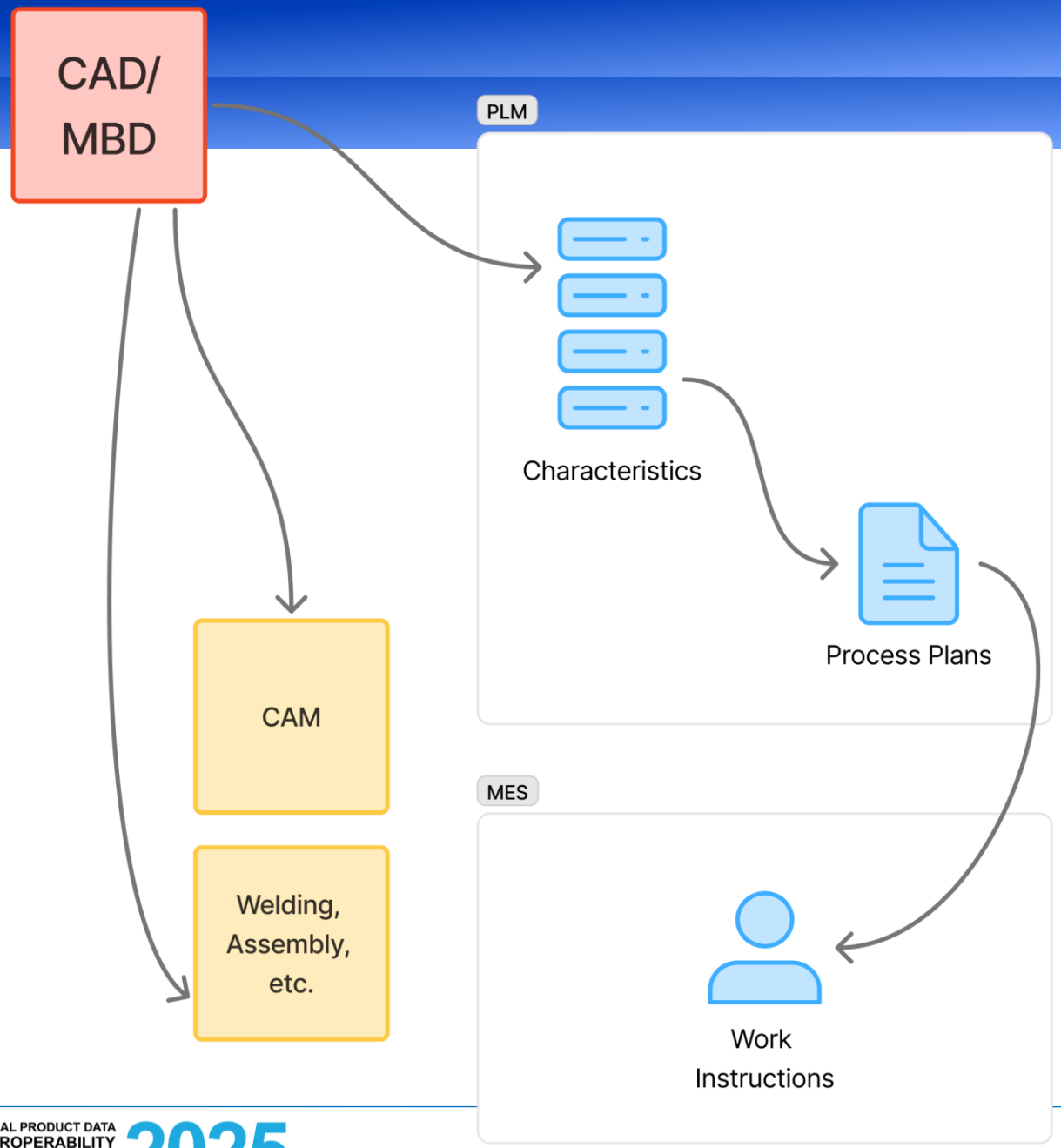
Use Cases: Design

- Tolerance Analysis
- DFM/Costing
- Requirements/DFMEA
- Characteristic Management



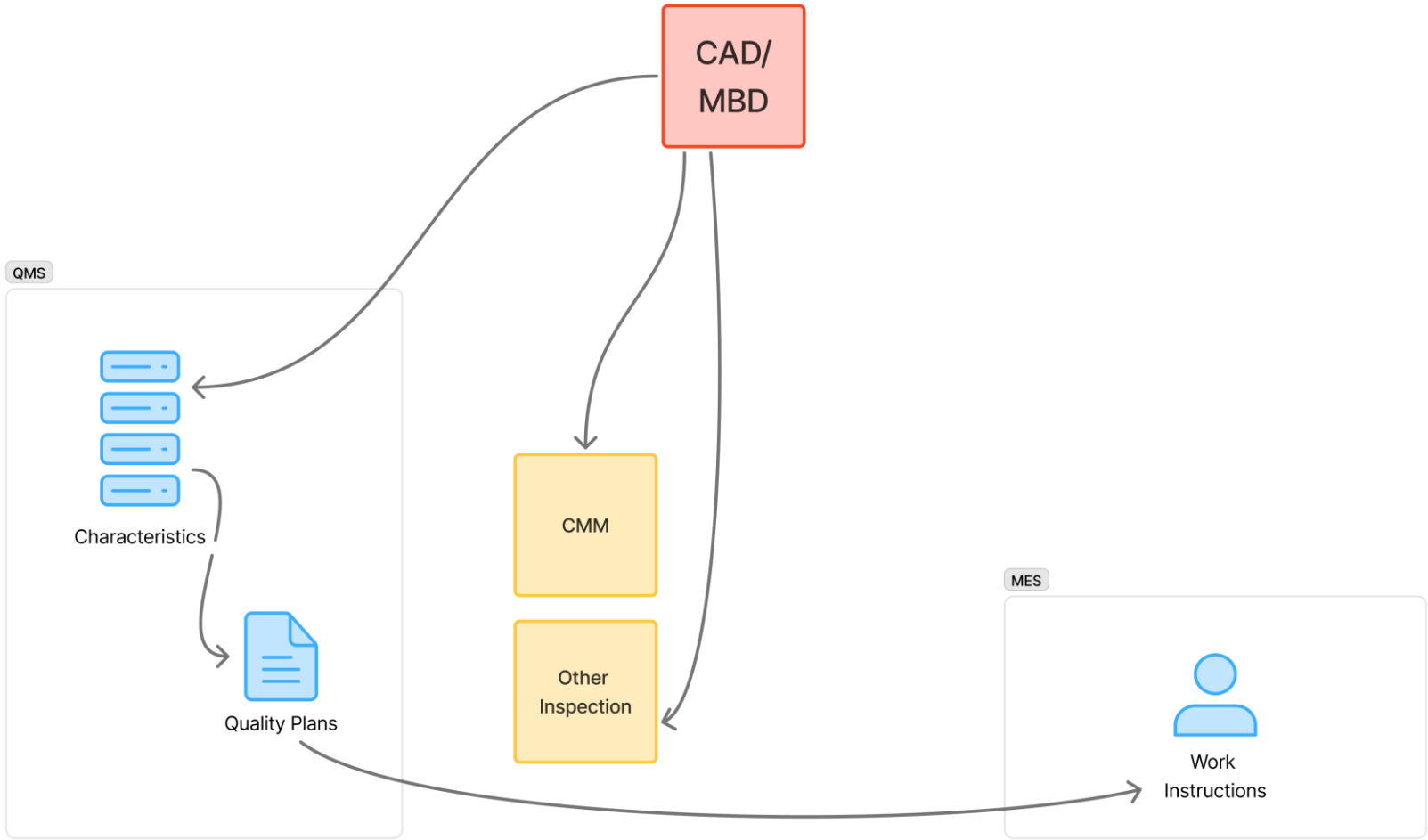
Use Case: Manufacturing

- Process planning and standard work instruction generation
- CAM
- Welding, assembly, other workflows



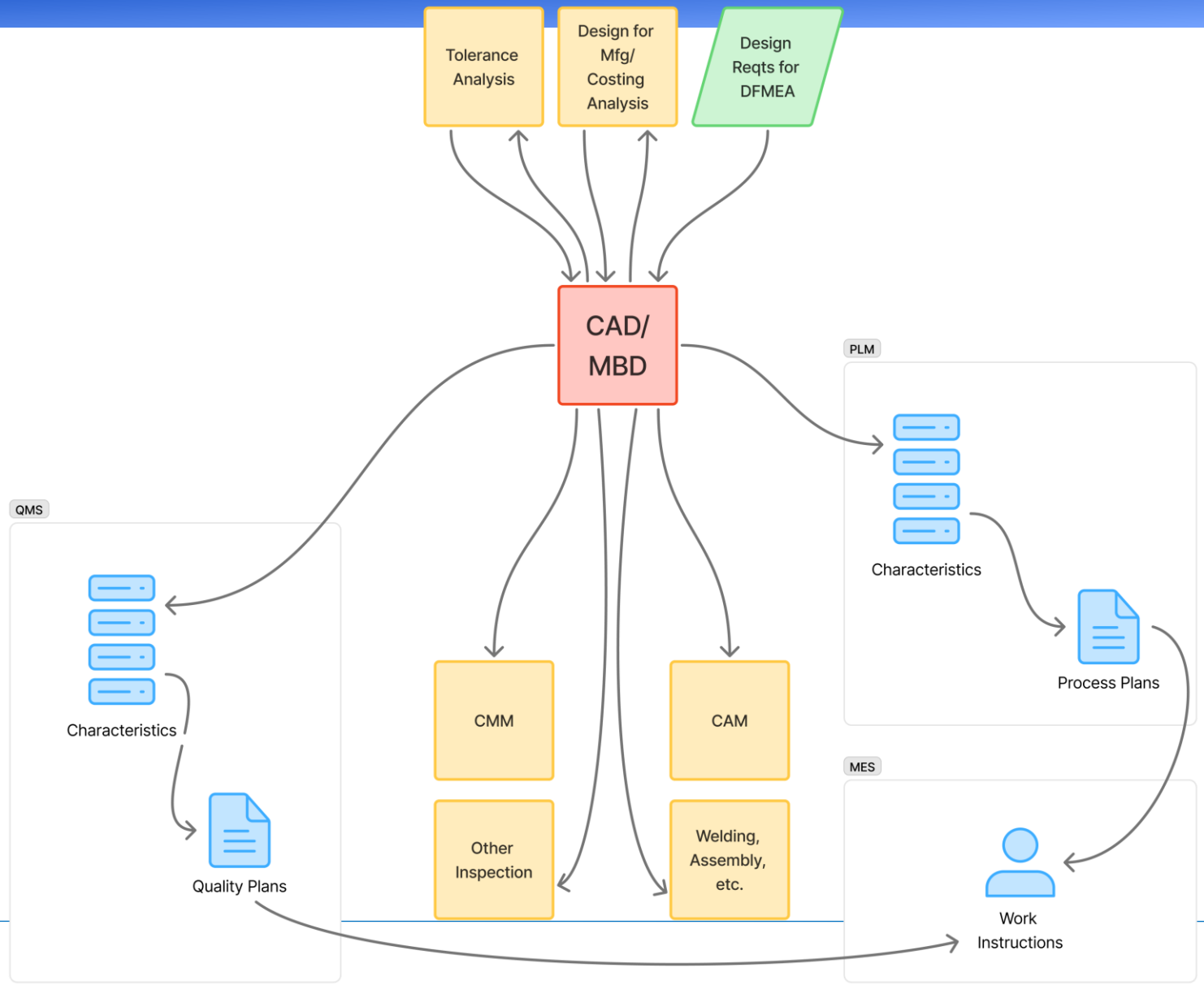
Use Case: Quality

- FAI
- Control Planning and Inspection Planning
- CMM
- Other inspection, e.g., visual



Use Case: Data Analytics

- Measurement results
- Traditional SPC
- Point clouds
- Machine telemetry, MTConnect, OEE
- Machine Learning & AI



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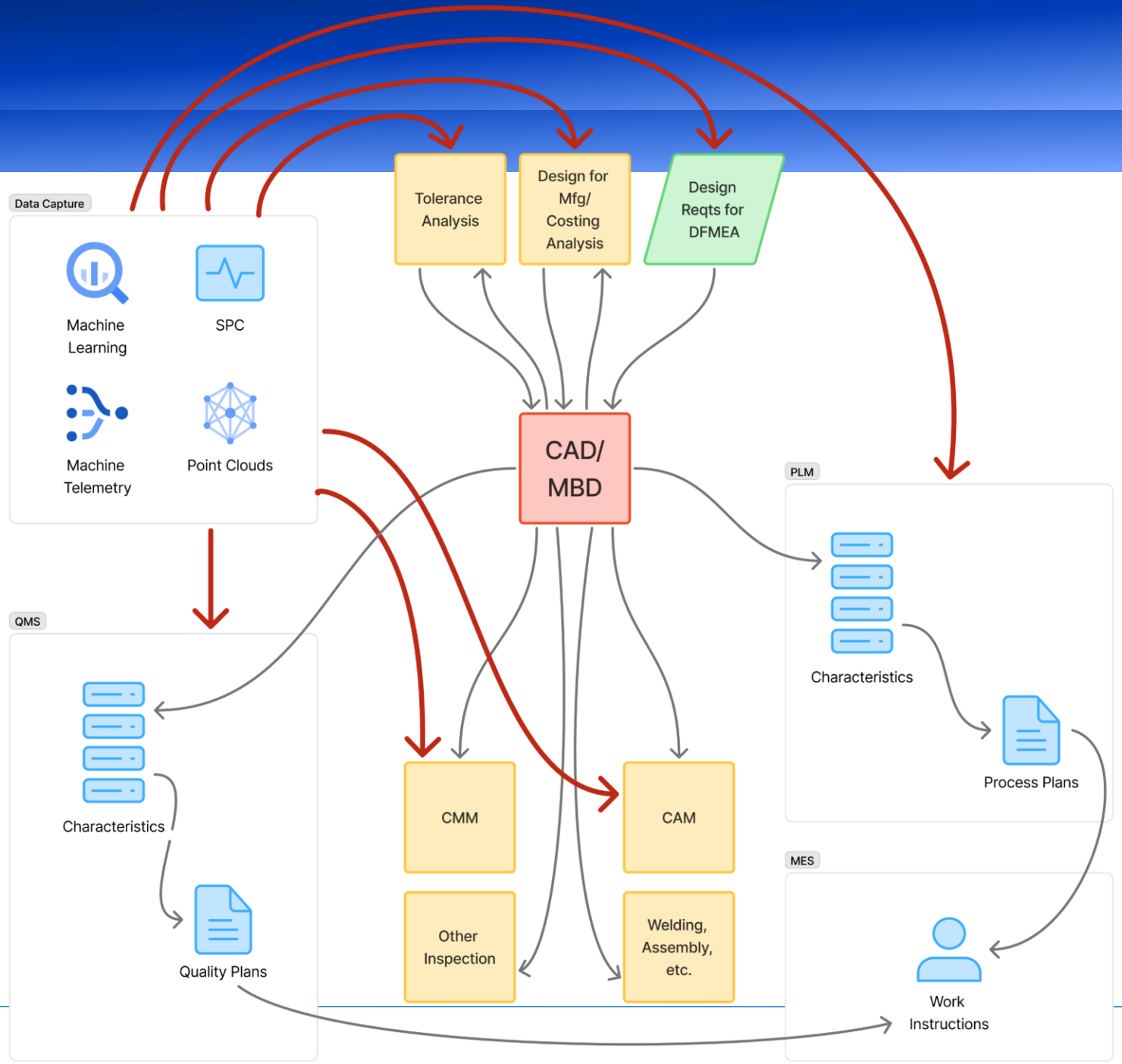

Resources & Links

Digital Metrology Standards Consortium QIF & MBC Standards

Download Quality Information Framework (QIF) by DMSC

The online hub for the QIF community | QIF Community

Download Model-Based Characteristics (MBC) by DMSC

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Thanks!