Issues on Introducing Model-Based Definition - Case of Manufacturing Ecosystem

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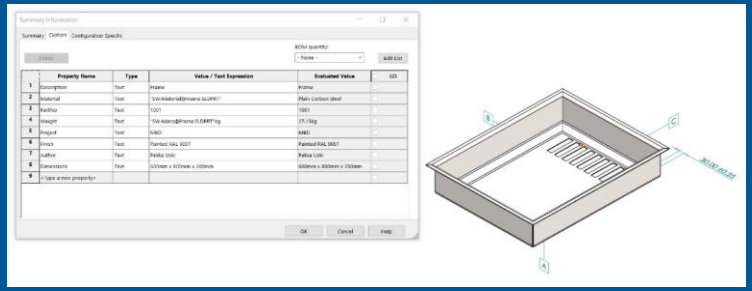
Introduction

- Research Question
  - Benefits of Model-Based Definition (MBD) vs.
  - Rare utilization of MBD in
    - the manufacturing ecosystems of
      - low volume
      - customized
      - commercial products
- Studies on
  - Literature on MBD, manufacturing ecosystems and their mutual relations
  - A case study of manufacturing ecosystem
- Conclusion

Concepts

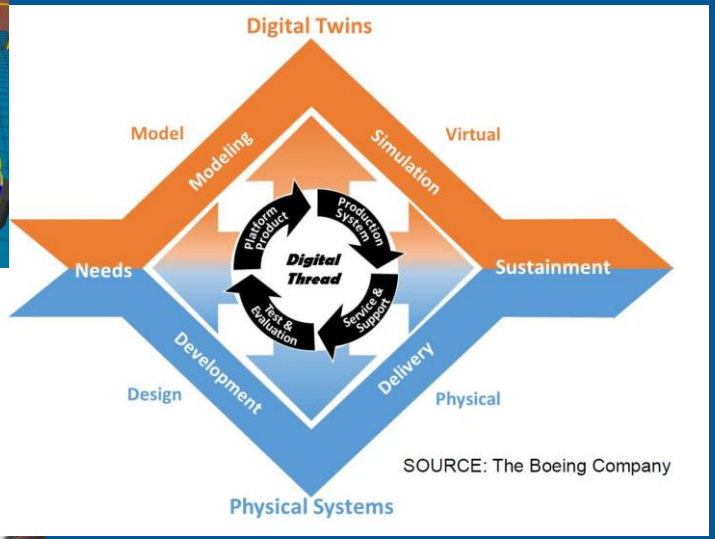
- Model Based Definition
  - Annotated 3D model and its associated data elements
  - fully define the product
  - an integrated presentation of a part
  - replace the datasets of models and drawings
  - ¨single source of truth”



- Product and Manufacturing Information (PMI)
  - non-geometric attributes in 3D CAD / Manufacturing / Inspection / Engineering (CAx) systems
    - Geometric Dimensions & Tolerances (GD&T)
    - Functional Tolerancing and Annotation (FT&A)
    - 3D annotation (text) and dimensions
    - Surface finish
    - Material specifications
  - Necessary for manufacturing product components

- Model Base Enterprise (MBE vs. cPDM & PLM)
  - a fully integrated and collaborative environment
    - founded on 3D Model-based product definition
    - constructed and shared across the enterprise
    - to enable the deployment of products from a concept through delivery

- Early adopters
  - Industries
    - Military and aviation industry
    - Automotive industry
  - Common to those
    - Very high investment on product & production engineering
    - The most complete product definition required
    - Tight co-ordination & information exchange within supply networks

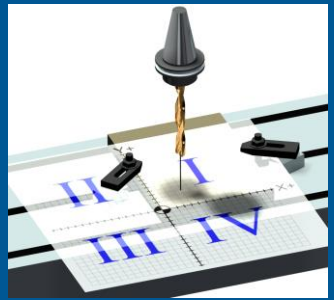


Manufacturing Industry in our case

- Markets
  - Global
  - Niche
  - Business to Business
- Products
  - Innovative
  - Customized
  - Investment / CAPEX
  - Expensive / OPEX
- Production
  - Low volumes – High mix
  - Limited automation
  - Networked production
  - Skills for critical components



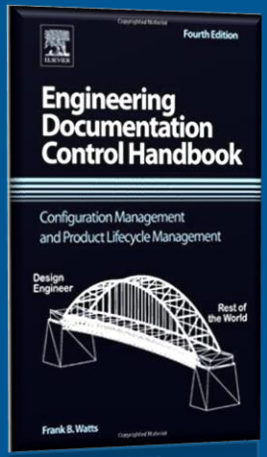

The benefits of MBD (literature)



- Generic Benefits
  - Speeds product ramp-up and lowers quality defects
  - Accelerate and to improve communication
  - The principle of single-source
    - avoiding 2D drawings
    - not anymore needed to control paper-revisions
- Distinct Benefits
  - Automatic toolpath generation
  - MBD datasets useful in quality control
    - E.g. (CMM) based on part geometry, can incorporate the use of tolerance data (MBD)
  - Enabling the intelligent manufacturing of parts

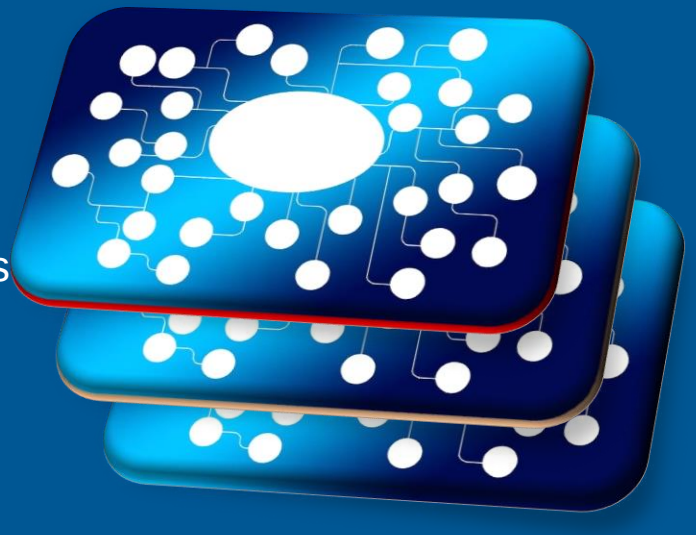
Barriers of MBD (literature)

- Generic barriers (Business issues)
  - Main issues
    - large capital investment (CAPEX Cost)
    - lack of business pull (OPEX Value)
    - legacy designs
  - Minor issues
    - lack of workforce skilled in MBD
    - the lack of training opportunities
- Distinct barriers
  - Technical issues
    - Compatibilities
    - Data exchange
  - Process issues, such as
    - Version management
    - Data retention (process gatekeeping based on documents)
  - Legal issues
    - Agreements refer to drawings



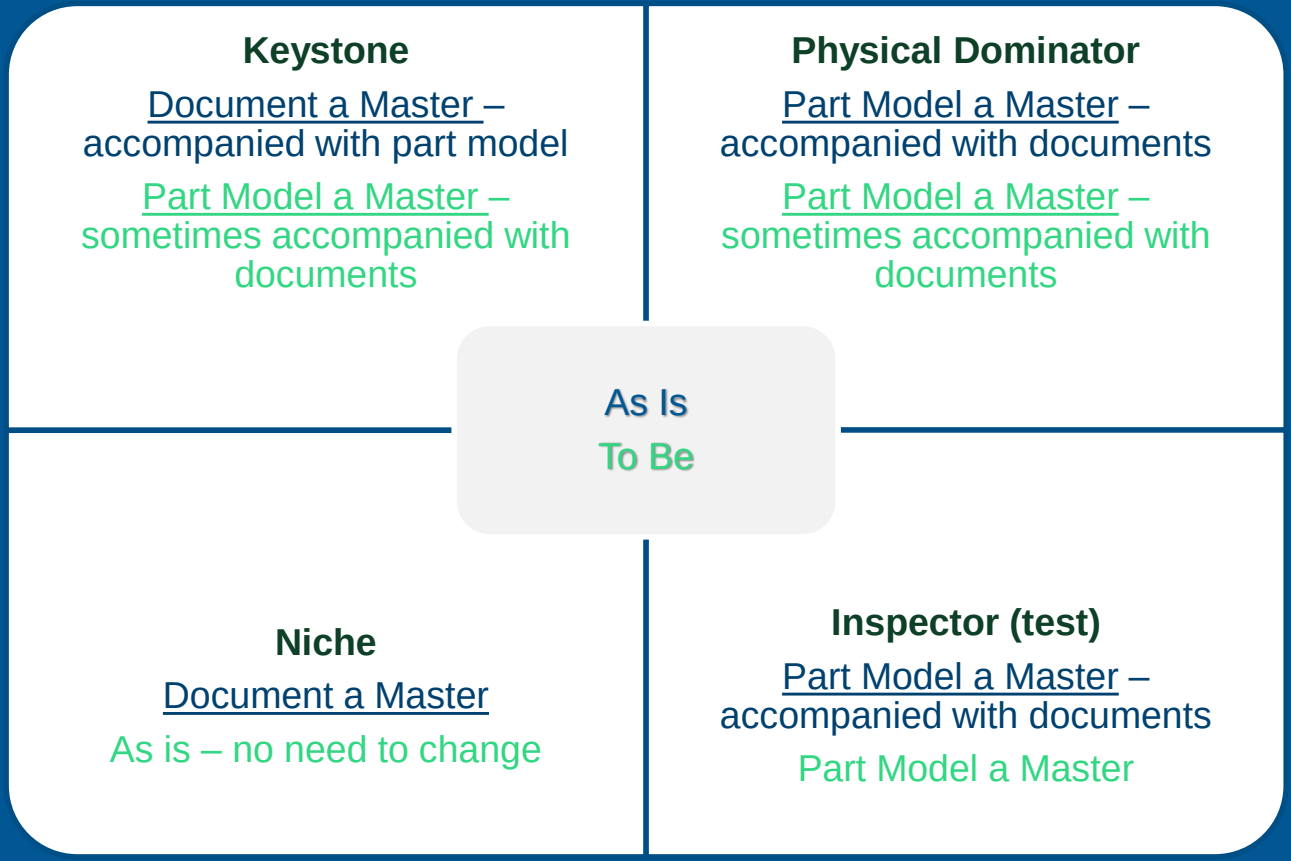
Product definition in an Ecosystem

- Ecosystems
  - System: elements, relations
  - Purpose: **business, innovation, knowledge**
  - Borders
  - Unique concept: unique set of actors + interactions
    - Business interactions: transactions & operations
    - Knowledge interactions: semantics and taxonomy
    - Innovation interactions: utilization in information exchange
  - Each actor has a certain role
  - Manufacturing ecosystem (types of roles)
    - keystone, niche, commodity, physical dominator



Case: Intelligent Manufacturing Ecosystem (IME)

Position	Turnover (M€)	Result / (M€)	Specialization	Personnel	Actor / role
Customer	1 000	155.6	Dedicated mobile machinery	2009	Keystone
Supplier A	15.7	1.8	Bearing sleeves, material expert	85	Niche
Supplier B	12.5	0	ETO Gears	62	Niche
Supplier C	9.4	0	Subcontractor machine shop	50	PD
Supplier D	7.6	0.3	Subcontractor machine shop	40	PD
Inspector / Research			Measuring		Niche


Keystone
Document a Master – accompanied with part model
Part Model a Master – sometimes accompanied with documents
Physical Dominator
Part Model a Master – accompanied with documents
Part Model a Master – sometimes accompanied with documents
As Is
To Be
Niche
Document a Master
As is – no need to change
Inspector (test)
Part Model a Master – accompanied with documents
Part Model a Master

Benefits and Barriers (emphasized by IME CASE)

- Generic benefits vs. Barriers
  - Value of MBD for keystone vs. Investment
  - Lack of workforce skilled in MBD
  - Single source not seen as a major topic (an issue not addressed to any partner) – several versions of documents & models exist within IME
- Distinct benefits vs. Barriers
  - Obvious benefits for Physical Dominators
    - the usual case of CAM & CMM toolpath generation (PD & Inspector Niche – even 4 times faster)
  - No value for niche roles (custom or simple geometries) / MBD considered as obsolete (Niche partners)
  - Processes & Legal issues – no one recognized as an issue

Conclusions

- Common problem: Value ≈ Cost vs. Benefit
- Investment by keystone – benefit by physical dominators
- Niche partners tend to neglect the topic – no distinct value
- Overall need
  - Model, study and represent the aspects of the value of MBD in manufacturing ecosystems
  - Co-innovation on MBE / Ecosystems ≈ MBEE?
    - Knowledge ecosystems – MBD as means of communication
    - Innovation ecosystems – MBD as an integrative environment
    - Business ecosystems – MBD in operation

Thanks / Questions?

beyond
the obvious

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