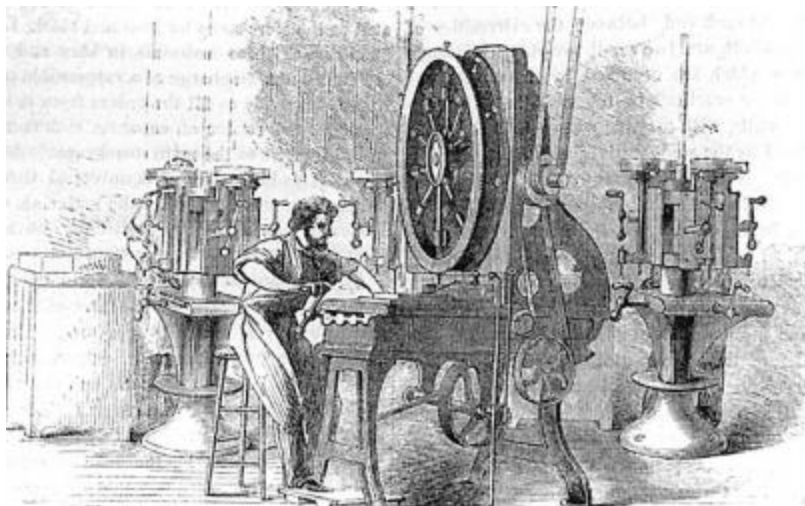


# Issues in Implementing a Model Based Enterprise

Dr. Gregory Harris, P.E.  
Associate Professor, Industrial & Systems Engineering Department  
Auburn University  
Director, Southern Alliance for Advanced Vehicle Manufacturing Center  
MBE Summit  
NIST HQ, Gaithersburg, MD  
April 2-5, 2018

# Manufacturing Data History

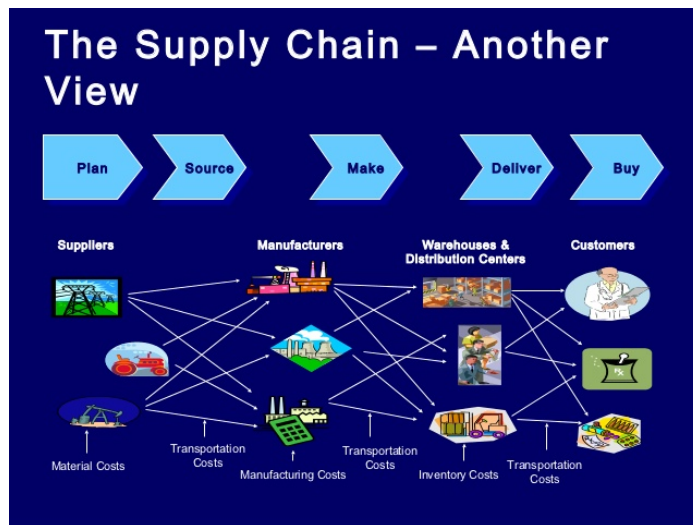


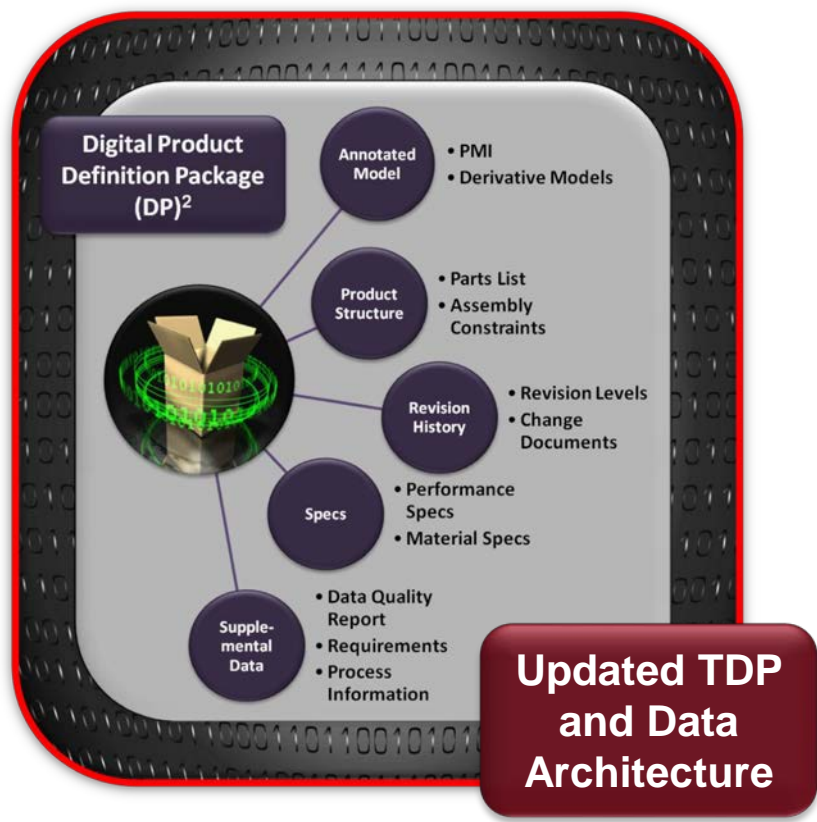
Antebellum Era of Manufacturing



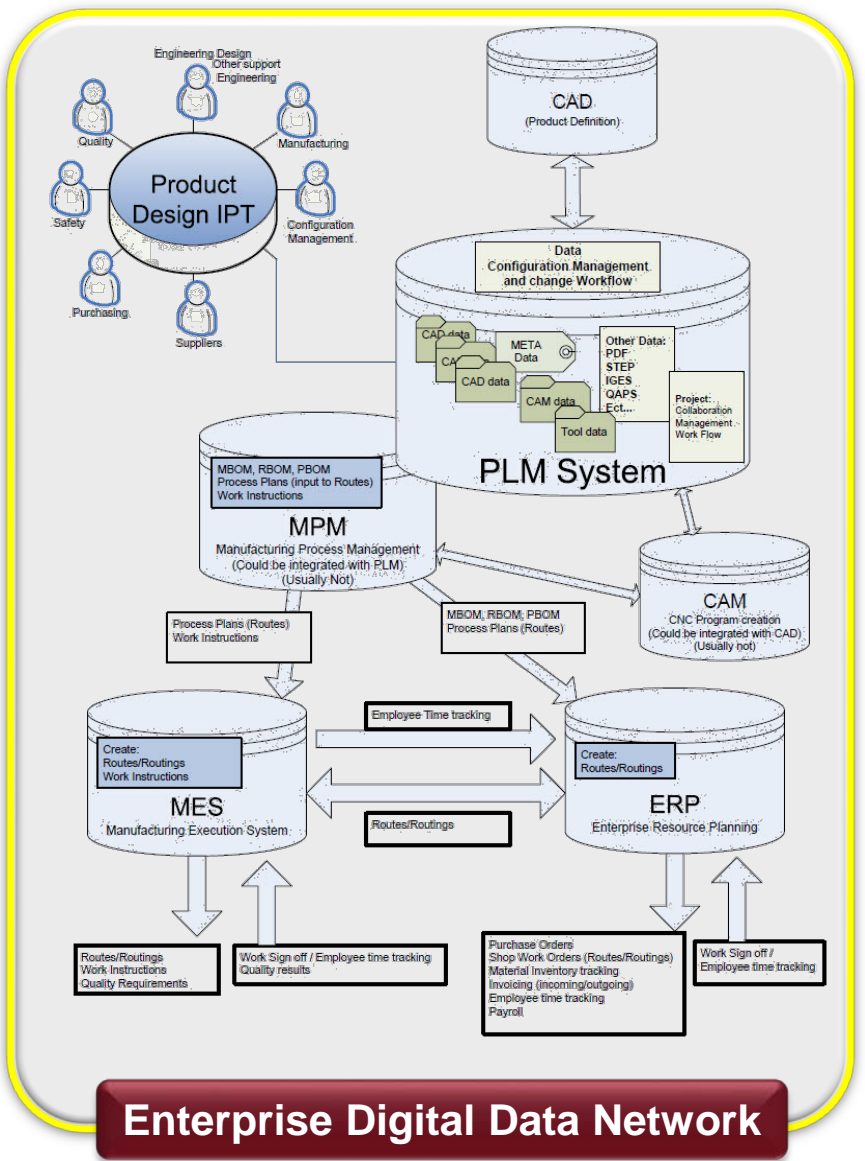
Mass Production

- Most engineering and manufacturing activities relied on 2 Dimensional (2D) drawings in hardcopy or digital form
- Today, it is possible to perform most engineering functions using data models.

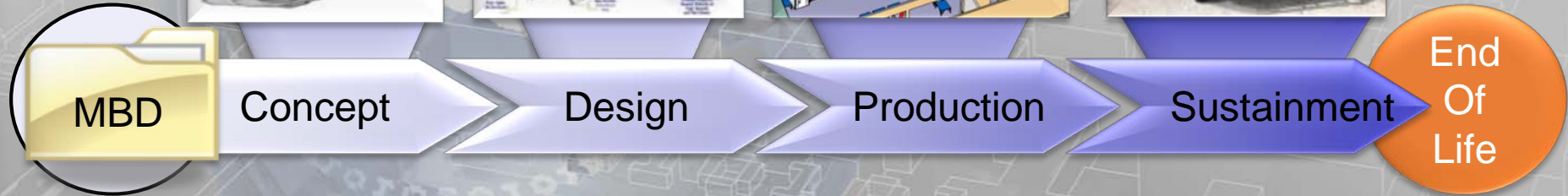
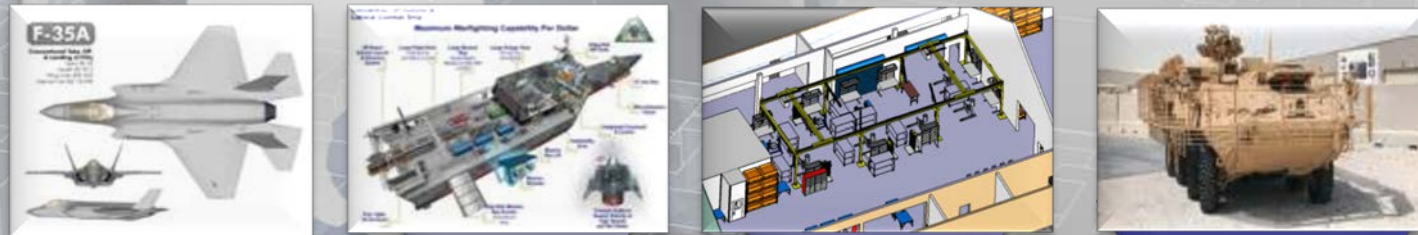




## MBE Level 4: Model Based Definition With Data Management



The Model Based Definition: created at the beginning of the lifecycle then reused and repurposed throughout the enterprise, thus creating the Model Based Enterprise (MBE)



MBE: an integrated and collaborative environment, founded on 3D product definition (i.e. MBDf) shared across the enterprise, enabling rapid, seamless, and affordable deployment of products from concept to disposal.

- A focus on geometric related information with little to no associativity.
- Multiple CAD/CAM environments in the supply chain.
- Lack of Interoperability among different systems.
- Most operations are in different degrees of 'silo' effect.
- Supply chain collaboration is typically manual.
- There is a lack of in-depth model exchange validation capability.
- Lack of a common lexicon for discussing issues.

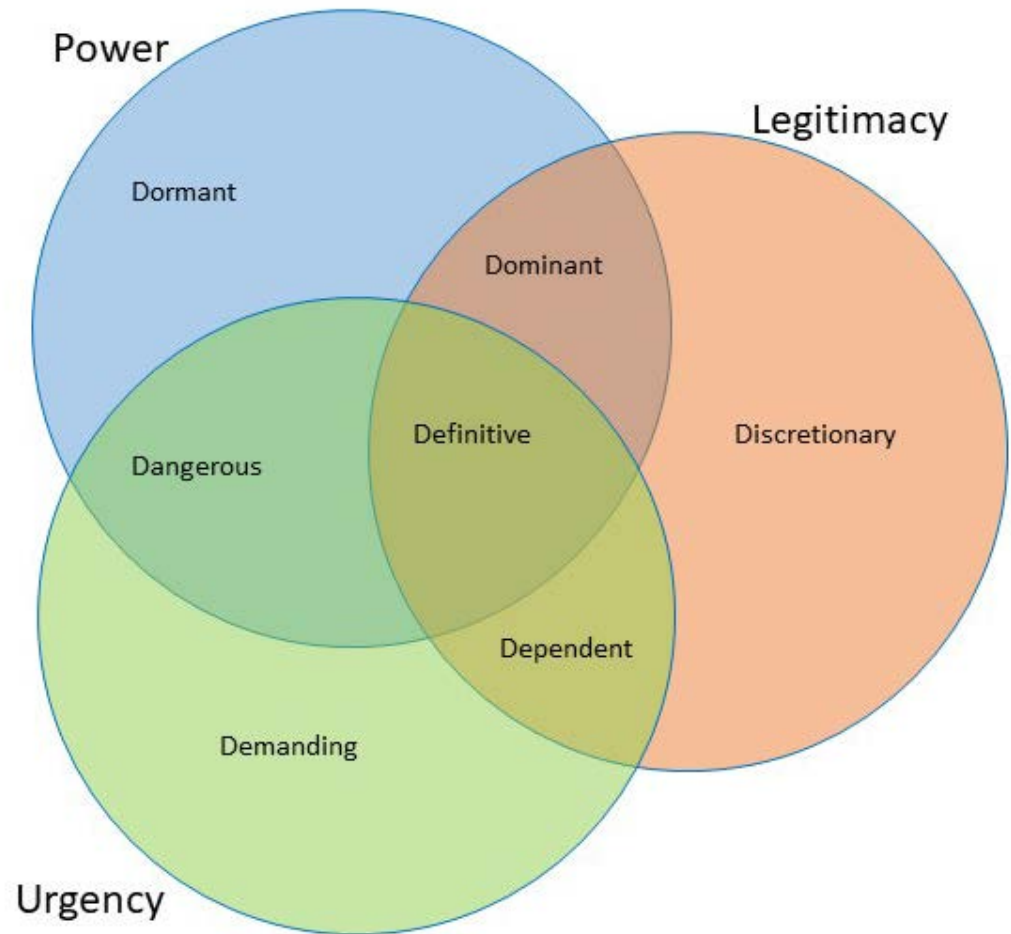
# Stakeholders Interviewed

Chief of Manufacturing
Foreman Manufacturing
Technical Lead
Mech Eng
Supervisor
Mech Eng-Lead
Production Planner
APO
Branch Chief
Process Eng
Additive
Eng Tech
Mech Eng
Process Engr

Publications
AED/Structures & Materials
AMDEC Industrial Operations (Tech Loop)
Logistics
Sustainment
AED/Modernization
AED/CH-47F Production
Provisioning (Lead)
Modernization
AED/Structures & Materials (Lead)
Contractor, AED/Structures & Materials
Sustainment (Dep. Chief)
Contractor, AED/Structures & Materials
Contractor, Configuration Management
AED/Structures & Materials
Provisioning

Chief of Manufacturing Engineering and Technology
CMM Programing
Div. Chief
Logistics - Packaging
ARDEC Process Engineering
NC Prog
Division Chief Tool Design
NC Programing Division Chief
NC Programing
Process Planning
Tool Design
Division Chief Engineering
IT
JMTC Deputy Chief

- Dormant stakeholders
- Discretionary stakeholders
- Demanding stakeholders
- Dominant stakeholders
- Dependent stakeholders
- Dangerous stakeholders
- Definitive Stakeholder
- Non-Stakeholders



- Interoperability
- Data Reuse, Communication, and Archiving
- Advanced Manufacturing Vulnerabilities
- Analysis
- Infrastructure

## Sources

- Review a library of past articles, presentations, white papers, and reports (40+)
- Interviews
- DMDII Data Call
- Net-Centric Model Based Enterprise
- Overcoming Key AME Inefficiencies Through Improved MBE Tools and Processes
- Systems Engineering Research Center
- Workshop Report on MBx: Towards Defining the Components of the Model-Based Enterprise

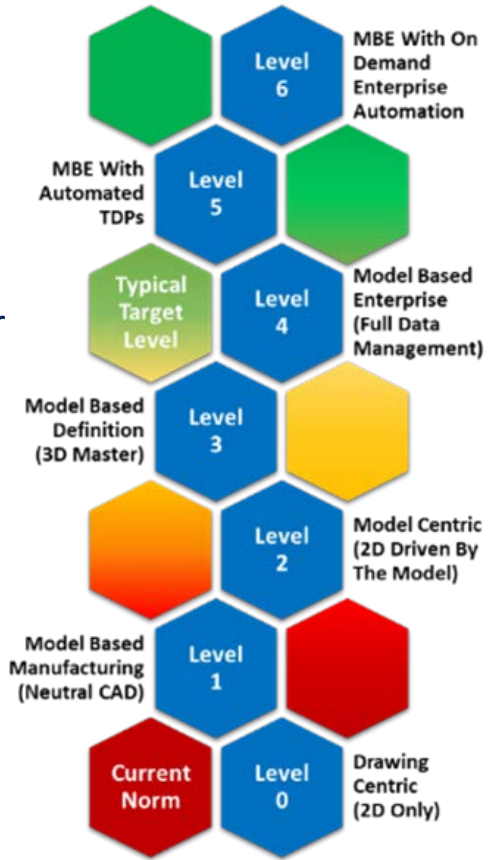


# Future State of MBE Capability (What is needed)

- More than just replacing drawing type information exchange to include design intent and context.
- Robust interoperability among disciplines and organizations.
- Responsive and adaptive to the changing market place and technology.
- Improved product life cycle time and costs.
- A building block for accelerating the maturation of the full MBD schema and communications across silos.

# Future State

- Quickly move from customer wants and desires to actionable system requirements
- An unconstrained information flow, networked, and interoperable system
- Agile and robust manufacturing strategies with integrated capabilities
- Smart design tools with designer, engineer, analyst, manufacturer, and maintainer collaboration
- Manufacturing modeling and simulation tools allow faster time to market
- Minimize multiple designs, prototypes, and test iterations typically required for product or process qualification
- Utilize high-performance computing to develop physics-based models of performance by design with manufacturing in mind
- Does not matter whether products are unique “one of a kind”, mass production or a combination such as mass customization
- The workforce is capable and confident in the use of “Apps” on the shop floor to minimize delays and improve flow
- The development and integration of smart sensors, controls, metrology, analysis, decision and communication software tools for self-aware manufacturing provides data to enhance continuous improvement and sustainability
- Plug and play functionality allows equipment to utilize manufacturing knowledge and enables better decision-making while planning and processing components
- Worker and environmentally friendly



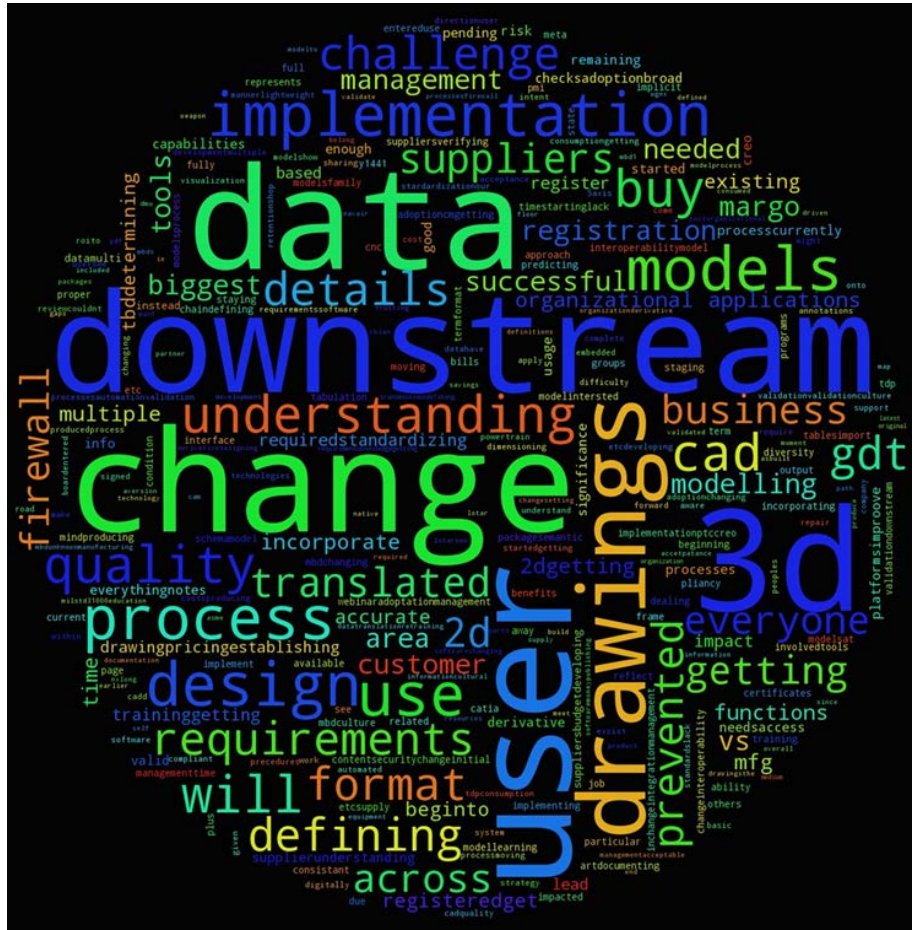
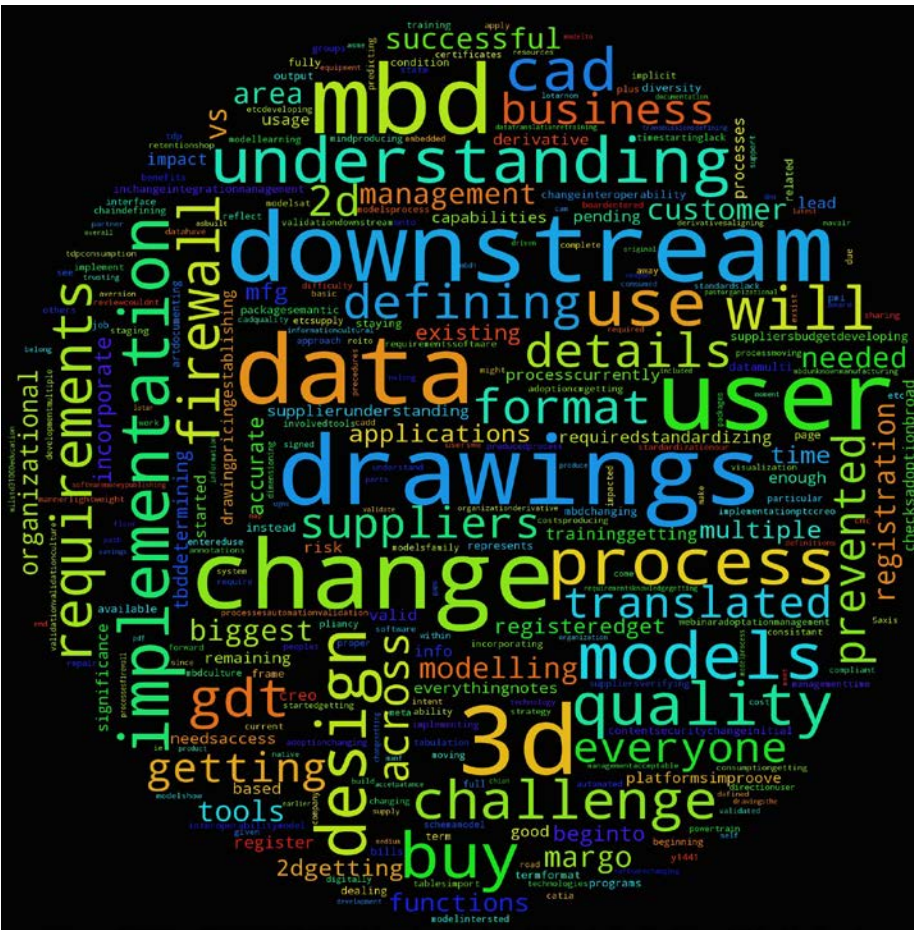
# Gap Analysis

- Gaps between the current and future state of an organization will have to be examined through the application of an assessment tool such as the MBE Capability Assessment Tool
- Organizational and implementation gaps and issues that will have to be overcome
- A functioning enterprise Product Data Management system.
- Documented business processes to guide MBE tool selection and configuration.
- Policy regarding the contracting and use of 3D MBD.
- Consistent leadership emphasis to affect cultural change, and digital product data management.
- Most solutions to data and information problems are carried out as point solutions
- An era of fewer skilled personnel coming into the workforce.
- Support to organizations is needed in the development of solutions to unique problems
- A need to interface with the advanced manufacturing institutes such as the Digital Manufacturing and Design Innovation Institute (DMDII) and other advanced manufacturing entities to stay abreast of the technology and learn about those technologies that could make an impact on the organization.

- Word Clouds: graphical representations of word frequency that give greater prominence to words that appear more frequently in a source text.
- The larger the word or shape in the visual the more common the word.
- Assist evaluators with exploratory textual analysis by identifying words that frequently appear in answers.
- What we did:
  - Extract the open question with corresponding answers from each survey and join them into one csv file.
  - Conduct text preprocessing to remove irrelevant words or make revisions on words (tokenization, remove symbols and stopwords, and stemming).
  - Perform the word Cloud



# What is your biggest MBD Implementation Challenge?



With MBD/MBE/TDP included







# What is your organization's biggest challenge as you move toward a MBE?



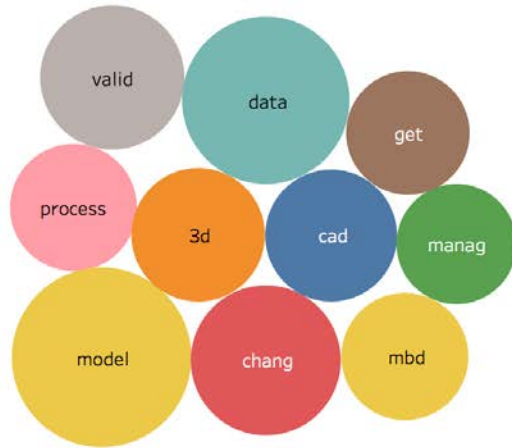
With MBD/MBE/TDP included



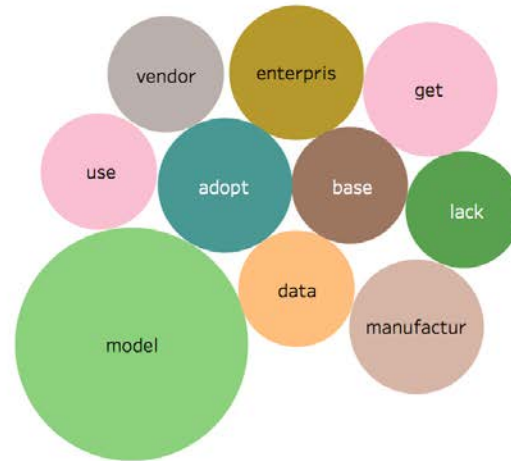


# MBE Challenges by Group

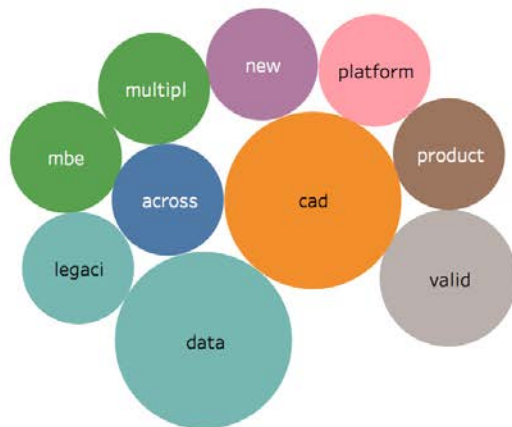
Industry



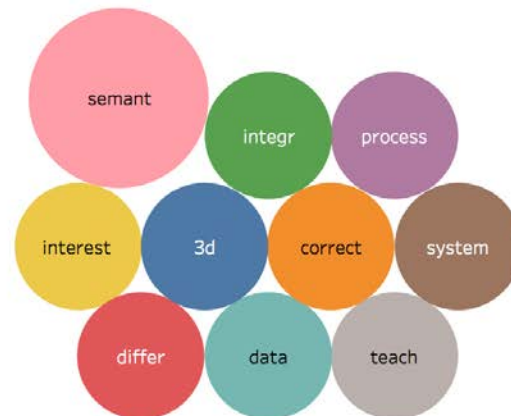
Government



Consultant

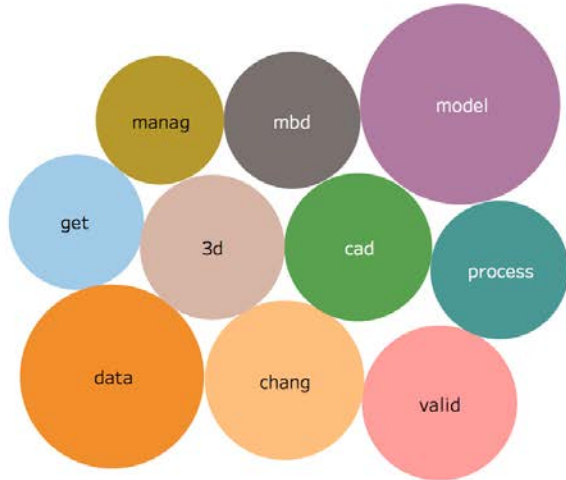


Education

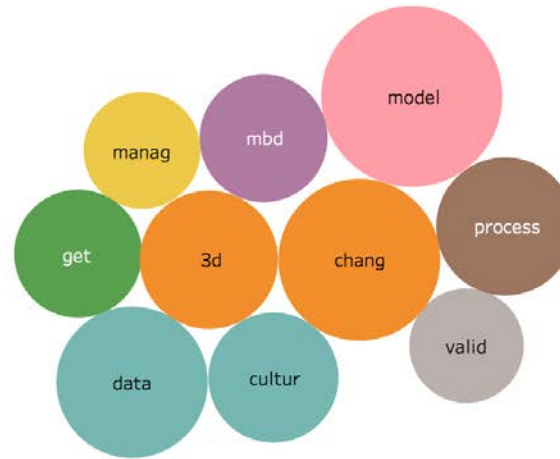


# MBE Challenges by Topic

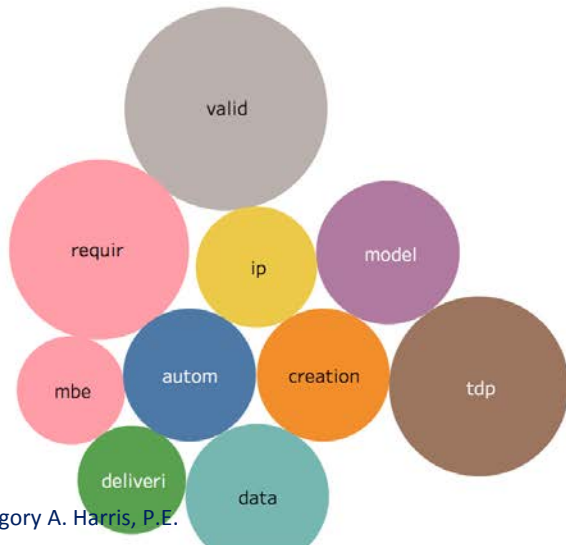
Overall



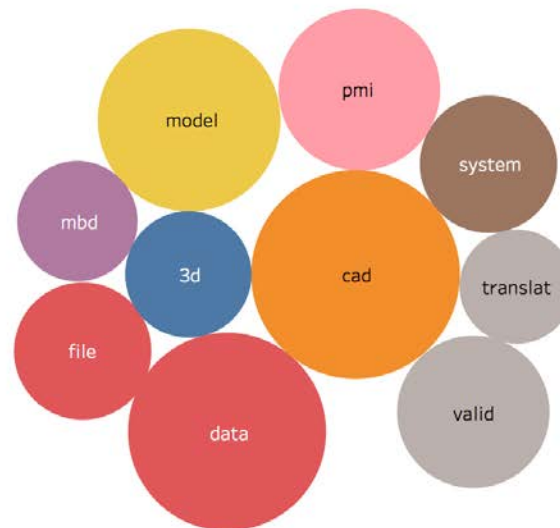
MBE



TDP



Interobility



# Questions?

Thank You!

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