

Implementing the Model-based Enterprise for a Measurable Return on Investment

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GLOBAL PRODUCT DATA
INTEROPERABILITY
S U M M I T
2019



Biography

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Kenn Hartman is the Managing Director of DSA, a PLM/MBE Consulting Practice.

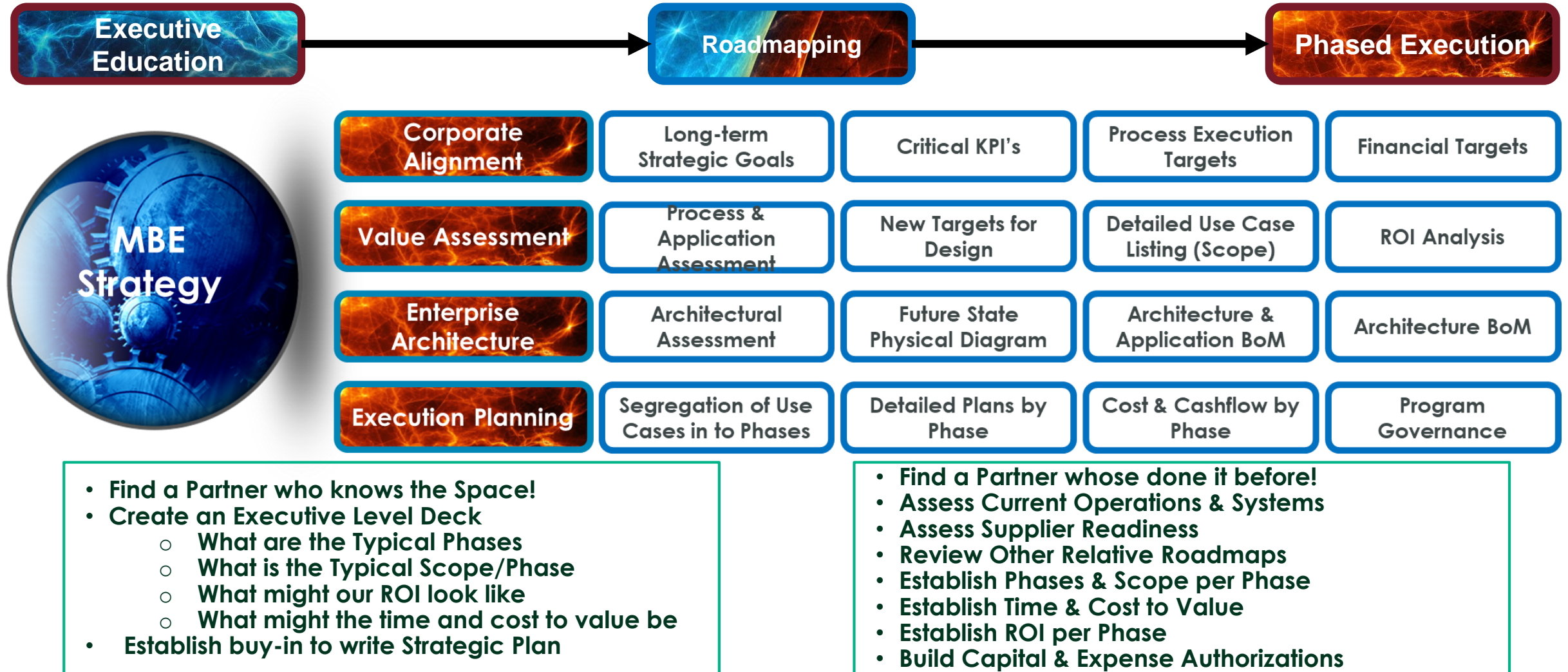
Kenn possesses more than 35 years of Experience in Engineering Systems and Processes.

Overview of Experience:

- 1. Primary consultant to seven multi-national corporations to derive Global Engineering System Strategy**
- 2. Primary consultant to two multi-national corporations to derive Global MBE Strategies**
- 3. Lead Process Analyst on 11 Global PLM Implementations (Master Black Belt)**
- 4. Global Design Lead on two Global PLM Implementations (PLM Solution Architect)**
- 5. Program Management Lead on six Global PLM Implementations (PMP, SCRUM Master)**
- 6. Expert in SDLC Methodology (Waterfall, Spiral, AGILE)**

Establishing a Project with Real Legs

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Strategic Scope & Phases – Stage One, Preparing for MBD

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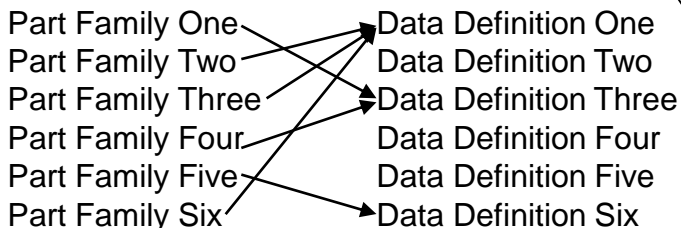
3D Modeling Standards

Update 3D Modeling Standards
Train and Institutionalize the Standards
Validate adherence to Standards

PMI Standards

- Define PMI Standards – it is in some part a regression analysis from Supply Chain backwards
- Train and Institutionalize the Standards
- Validate adherence to Standards

Data Definitions



The **Y14.5 standard** is considered the authoritative **guideline for the design language of geometric dimensioning and tolerancing (GD&T.)** It establishes uniform practices for stating and interpreting GD&T and related requirements for use on engineering drawings and in related documents.

The **Y14.41 standard** establishes requirements and reference documents applicable to the preparation and revision of digital product definition data (also known as [model-based definition](#)), which pertains to CAD software and those who use CAD software to create the product definition within the 3D model.

Y14.46 is intended to support engineers engaged in Additive Manufacturing including mechanical design, drafting, and quality assurance & control personnel especially those involved in extended, global supply chains.

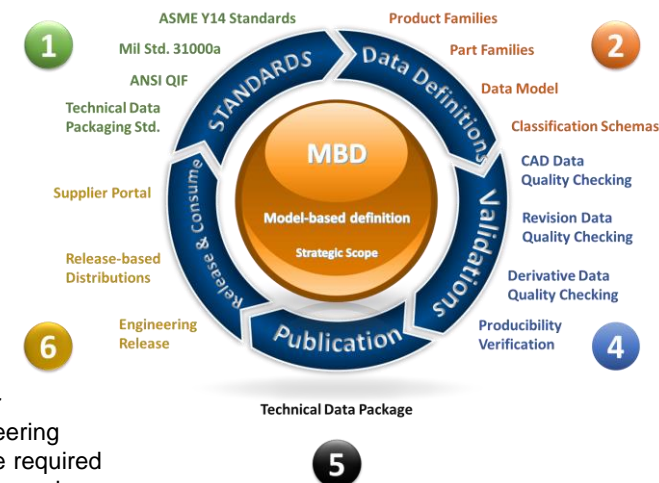
MIL-STD-31000A defines a TDP as: A technical description of an item adequate for supporting an acquisition, production, engineering, and logistics support (e.g. Engineering Data for Provisioning, Training, and Technical Manuals). The description defines the required design configuration or performance requirements, and procedures required to ensure adequacy of item performance. It consists of applicable technical data such as models, drawings, associated lists, specifications, standards, performance requirements, QAP, software documentation and packaging details

MIL-STD-31000B 31 October 2018

SUPERSEDING MIL-STD-31000A 26 February 2013

The types of information included are geometric dimensioning and tolerancing, component level materials, assembly level bills of materials, engineering configurations, design intent, etc. By contrast, other methodologies have historically required accompanying use of 2D engineering drawings to provide such details.

1. You will require multiple Data Definitions across your Part Family Tree e.g., Complex Machined Parts like Bearings and Gears vs. Sheet Metal parts like Brackets
2. Each Data Definition will require a corresponding Recipe and Template to Produce a Technical Data Package (TDP)



Strategic Scope & Phases – Stage Two, Publication and Validation

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Technical Data Packaging

Options:

1. COTS TDP Supplier
2. Configure in PLM

Trade-offs:

1. COTS – License Fees, Implementation Costs, Maintenance Fees
2. PLM – Implementation Costs

1. Define and configure the TDP Template for each Data Definition
2. Define and build the Scripts to extract the data – this will often require; rationalization of Non-PLM Data Sources into PLM or API's into other systems
3. Classification schema to identify Part Family and enable automated selection of correct Publishing Template & Recipe

Data Validation

Data Validations:

1. Model Data Quality
2. PMI
3. Revision Data Quality
4. Derivative Data Quality
5. Producibility

1. Define, Configure, and Tune Model Data Quality Checks
 - a) An individual Data Quality Check used across multiple Part families could require unique configuration e.g., tolerance based upon the Part Family you will apply the check
 - b) Criticality might also vary by Part Family
2. Classification schema to identify Part Family and enable automated selection of correct stack of Validations
3. PMI Checks are Syntactic and Semantic
4. Revision Data Quality produces a comparative view as well as executing the standard set of Model Data Quality and PMI Checks for a given Part Family
5. Producibility Checks are Part Family Specific e.g., complex machined part vs. sheet metal part
6. Plan for Tuning time!!!

PLM

1. Single Source of the Truth – Global Engineering Data Model
2. Primary Control Mechanism for all MBD Functionality
3. Controlled Dissemination & Synchronization of Technical Data to Supply Chain

1. Can require rationalization of Non-PLM Data Sources to create a Single Source of the Truth – eliminates requirements to design, build, maintain multiple API's and reduces scripting costs
2. Reconfiguration of EC Workflow to trigger validation events
3. Reconfiguration of EC Workflow to trigger packaging events
4. Lifecycle Policy to enable specific Publishing and validation events by Lifecycle state
5. Configuration of Translators to Produce Neutral Formats of CAD
6. Configuration of Dispatchers to manage Publication Jobs
7. Middleware for Temp File Management
8. Configuration of CAD Cloning Tool to create a Clone against which Model Data Quality, PMI, and Producibility checks are executed
9. Configuration of Dispatchers to manage Validation Jobs on EC Approval
10. Modifications to Access Controls and Relationship Rules to enable attachment
11. May require a Bi-directional integration to ERP if ERP Data is required for any TDP

MBD Implementation Imperatives

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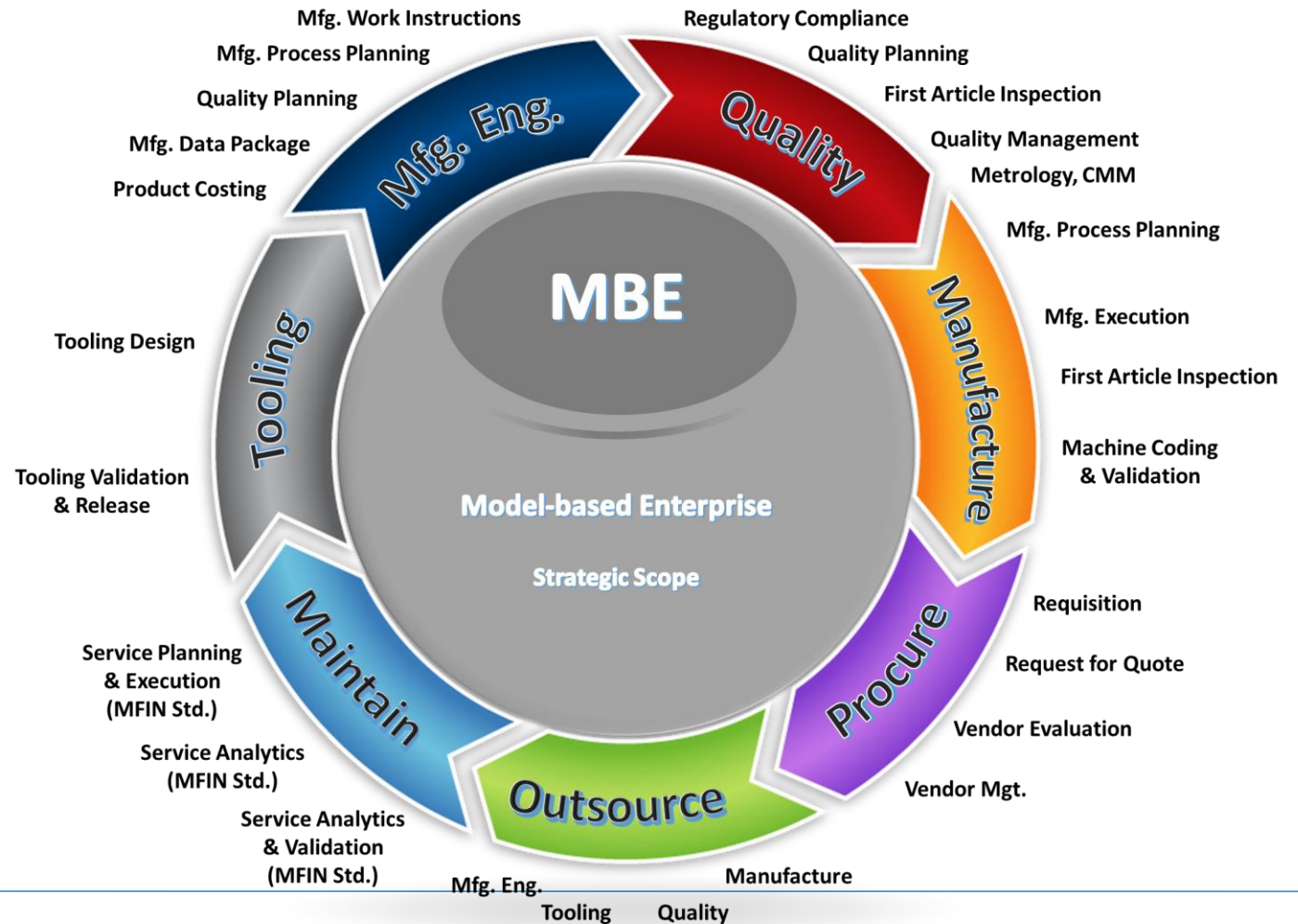
- **Creation of an MBD Strategy is critical to enable:**
 - Realistic calculations of Time & Cost to Value
 - Attainable ROI – real money in the Bank
- **Like PDM is pre-requisite to PLM so is MBD to MBE**
 - You must get MBD right!
- **Great Standards are not enough**
 - Institutionalization and real-time validation are critical
- **Prepare your Executive Team for long Development & Tuning Cycles**
 - Data Quality checks, Producibility checks
- **Extend PLM as the Single Source of the Truth**
 - You can't get just the right data into a TDP if its Text-based
 - API's to "Other Engineering Applications" are expensive
- **You must exploit some form of a Lifecycle Policy and extend the Engineering Release process to enable effective application of Data Quality Checks, Publication, and Dissemination**
- **You will require Classification Schemas to enable selection of specific Data Quality Checks and Publication events by Part Family**
- **You will require integration of Temp a Dispatcher and Translator**
- **You may require a CAD Cloning Tool that produces a clone against which you execute Data Quality Checks to ensure Master Model integrity**
- **You will likely require Middleware to house Clones and manage transactions between Clone, Translator, Dispatcher, ECO, Part Item revision**

Strategic Scope & Phases – Stages x, y, z MBE Exploitation Opportunities

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Core Tenant: The Data Definitions derived by Part Family which specify the TDP Requirements must be derived from a regression analysis of each of the downstream Supply Chain processes which will exploit the Model-based Definition – **optimally annotated models by Part Family**

The Primary Objective is to enable
A High First Pass Yield through the
Downstream Supply Chain Processes



MBE Implementation Imperatives

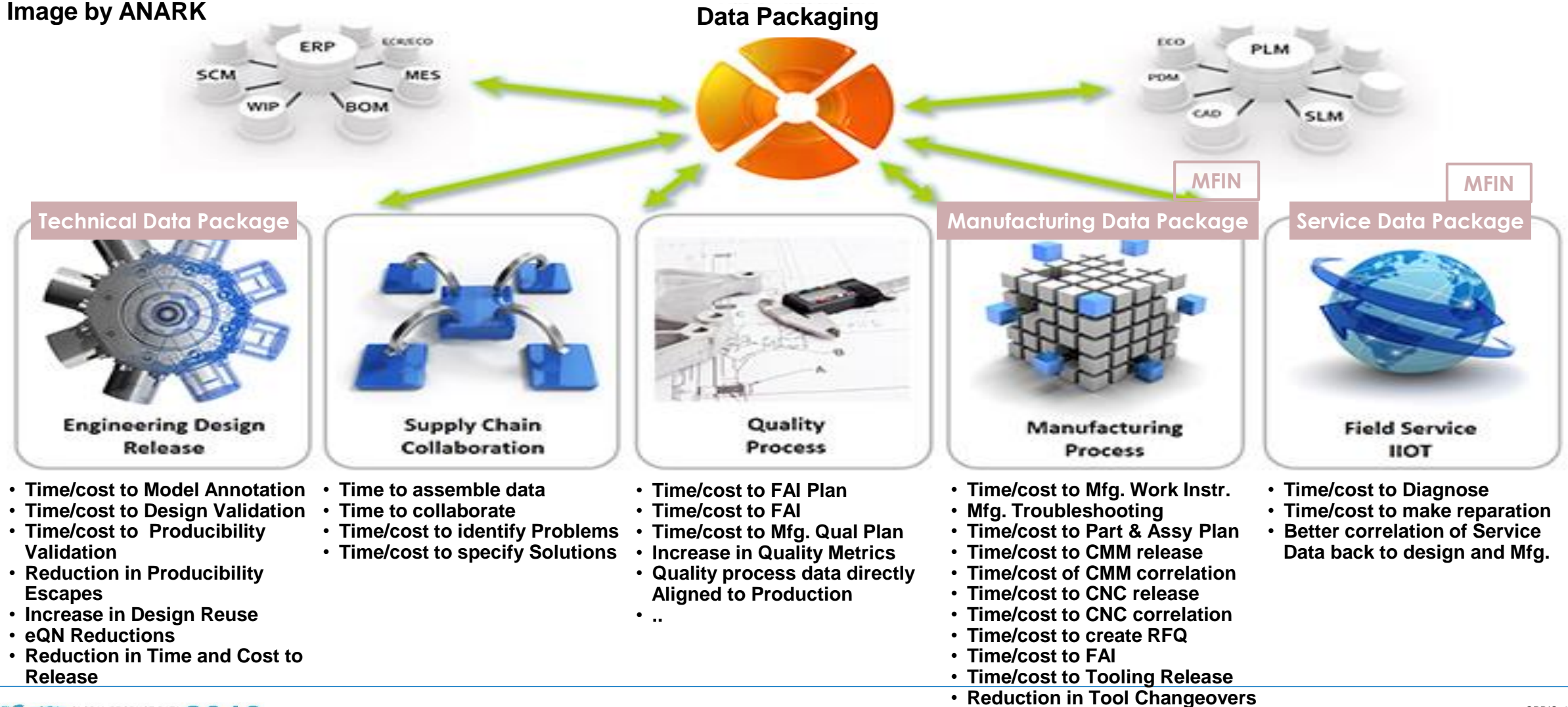
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- **Creation of an MBE Strategy is critical to enable:**
 - Realistic calculations of Time & Cost to Value and Cashflow requirements
 - Attainable ROI – real money in the Bank
 - Resource Loading & Balancing through the Program
 - Critical OCM Activities
- **Supply Chain should take ownership of the Program at this Stage**
 - Most of the work will be theirs
 - They will get the large & ROI post MBD – so, they should fund it and be accountable for its success
- **Process Integration/Reengineering is critical to success**
- **Measure and report the real ROI along the way to maintain buy-in**
- **Don't under-estimate the cost & time to retrain & institutionalize**
- **Must get Outsource Community On-board – increase Supplier Capability Maturity**
 - Must be able to get your ROI from outsource Suppliers

MBD Exploitation – where's the Money

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Image by ANARK



MBE ROI Summary – Product Design

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Value Drivers	Advanced Capabilities Required	Evidentiary Data –Surveyed Respondents Report:
Modeling & Annotation Time	<ul style="list-style-type: none"> Modeling Standards (GD&T, PMI) Single Source of the Truth 	<ul style="list-style-type: none"> >25% reduction in Model Preparation Time
eQN's to make Drawing's match Model	<ul style="list-style-type: none"> Modeling Standards (GD&T, PMI) Data Definitions which prescribe Model Content to enable a High First Pass Yield of the Downstream Dependent Supply Chain Processes Conversion away from 2D Drawings 	<ul style="list-style-type: none"> >85% reduction in eQN's
Model & Derivative Validation	<ul style="list-style-type: none"> Automated Model & Drawing Validation Automated Producibility Validation Tools Classification Schemas to enable selection of a specific set of checks by Part Family Reconfiguration of EC Release Processes to trigger specific validations by Lifecycle Release State Color-coded 3DPDF Zone Definition 	<ul style="list-style-type: none"> 14% to 26% reduction in Model Validation Time 100% reduction in Derivative Validation Time >80% reduction in Producibility Escapes originating in Product Design
Design Reuse	<ul style="list-style-type: none"> Part & Product Classification Schemas (Parametric Classification) Single Source of the Truth – PLM Data Definitions which prescribe Model Content to enable a High First Pass Yield of the Downstream Dependent Supply Chain Processes 	<ul style="list-style-type: none"> >11% increase in Design Reuse
Big Data Analytics	<ul style="list-style-type: none"> Technical Data Packaging Capability Automated compilation and correlation of Supply Chain Feeds back on to Technical Data Package 	No Evidentiary Data Available at this time
Design/ME Design Reviews and Design Review Time	<ul style="list-style-type: none"> Technical Data Packaging Capability Data Definitions which prescribe Model Content to enable a High First Pass Yield of the Downstream Dependent Supply Chain Processes 	

MBE ROI Summary – Mfg. Engineering

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Value Drivers	Advanced Capabilities Required	Evidentiary Data –Surveyed Respondents Report:
Producibility Analysis & Release	<ul style="list-style-type: none">Automated Producibility ValidationExtended EC Release process to trigger Producibility Analysis at specific Lifecycle States	Contact Kenn Hartman for ROI Data & Calculation methods/formulas khartman@dsasite.com (216) 533-6302
Producibility Non-conformance Remediation	<ul style="list-style-type: none">Automated Producibility ValidationExtended EC Release process to trigger Producibility Analysis at specific Lifecycle States	
Work Instruction Creation and Validation Time	<ul style="list-style-type: none">Data Definitions which prescribe Model Content to enable a High First Pass Yield of the Downstream Dependent Supply Chain ProcessesTechnical Data Packaging CapabilitySingle Source of the Truth - PLM	
Work Instruction First Pass Yield	<ul style="list-style-type: none">Data Definitions which prescribe Model Content to enable a High First Pass Yield of the Downstream Dependent Supply Chain ProcessesTechnical Data Packaging CapabilitySingle Source of the Truth - PLM	
Reduction in Lead time to initiate Tooling, CMM, CNC, Quality Planning	<ul style="list-style-type: none">Integrated Part & Assembly Planning Process	

MBE ROI Summary – Manufacturing

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Value Drivers	Advanced Capabilities Required	Evidentiary Data –Surveyed Respondents Report:
Scrap & Rework from Producibility Escapes	<ul style="list-style-type: none">Automated Producibility Validation ToolsClassification Schemas to enable selection of a specific set of checks by Part FamilyReconfiguration of EC Release Processes to trigger specific validations by Lifecycle Release StateColor-coded 3DPDF Zone Definition	Contact Kenn Hartman for ROI Data & Calculation methods/formulas khartman@dsasite.com (216) 533-6302
Scrap & Rework from Drawing to Model Mismatches	<ul style="list-style-type: none">Data Definitions which prescribe Model Content to enable a High First Pass Yield of the Downstream Dependent Supply Chain ProcessesConversion away from 2D DrawingsTechnical Data Packaging	
Scrap & Rework from Model Interpretation Errors	<ul style="list-style-type: none">Data Definitions which prescribe Model Content to enable a High First Pass Yield of the Downstream Dependent Supply Chain ProcessesConversion away from 2D DrawingsTechnical Data Packaging	
Manufacturing Troubleshooting	<ul style="list-style-type: none">Data Definitions which prescribe Model Content to enable a High First Pass Yield of the Downstream Dependent Supply Chain ProcessesConversion away from 2D DrawingsTechnical Data Packaging	
Part Fabrication Time & Cost	<ul style="list-style-type: none">All AboveAdvanced Tooling Lifecycle Management ProcessAutomated compilation and correlation of Tooling Lifecycle Data to CMM and Inspection Data	

MBE ROI Summary – Tooling

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Value Drivers	Advanced Capabilities Required	Evidentiary Data –Surveyed Respondents Report:
Tooling Design Time	<ul style="list-style-type: none">• Increased Design Fidelity from Standards and Validation Technologies• Optimally Annotated Models• Increase in Mfg. Work Instruction First Pass Yield	Contact Kenn Hartman for ROI Data & Calculation methods/formulas khartman@dsasite.com (216) 533-6302
Tooling Conditioning & Validation Time	<ul style="list-style-type: none">• Increased Design Fidelity from Standards and Validation Technologies• Optimally Annotated Models• Increase in Mfg. Work Instruction First Pass Yield• High First Pass Yield/Automated Creation of CNC from Optimally Annotated Model• High First Pass Yield/Automated Creation of CMM from Optimally Annotated Model	
Tooling Reconditioning & Changeover	<ul style="list-style-type: none">• All Above• Advanced Tooling Lifecycle Management Process• Automated compilation and correlation of Tooling Lifecycle Data to CNC and Inspection Data• Automated compilation and correlation of Tooling Lifecycle Data to CMM and Inspection Data	

MBE ROI Summary – Quality

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Value Drivers	Advanced Capabilities Required	Evidentiary Data –Surveyed Respondents Report:
First Article Inspection Defects	<ul style="list-style-type: none">• High Fidelity Design Package – advanced ballooning for Feature and Characteristic Identification	Contact Kenn Hartman for ROI Data & Calculation methods/formulas khartman@dsasite.com (216) 533-6302
First Article Inspection Time & Cost		
CMM Lead Time and Validation	<ul style="list-style-type: none">• Automated Derivation of CMM Code	
Equipment Calibration Issues	<ul style="list-style-type: none">• Advanced Trend Analysis from CMM (Persistent Ballooning ID's and Intelligent FAI Forms)	
Reduce Correlation Time	<ul style="list-style-type: none">• High Fidelity Design Package – advanced ballooning for Feature and Characteristic Identification• Advanced Trend Analysis from CMM (Persistent Ballooning ID's and Intelligent FAI Forms)	

MBE ROI Summary – Procurement

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Value Drivers	Advanced Capabilities Required	Evidentiary Data –Surveyed Respondents Report:
Lead Time to Assemble RFQ	<ul style="list-style-type: none">• Data Definitions which enable a High First Pass Yield of the Downstream Manufacturing, Quality, and Tooling Analysis, Planning & Costing Processes• Automated Model Validation• Single Technical Data Package to enable a High First Pass Yield• Automated Validation of Technical Data Package• Vendor Portal• Enhanced EC Process to enable release of New & Revised TDP's to Outsource Portal	Contact Kenn Hartman for ROI Data & Calculation methods/formulas khartman@dsasite.com (216) 533-6302
Lead Time to Quote	<ul style="list-style-type: none">• High Fidelity Technical Data Packages	
Contingency Pricing	<ul style="list-style-type: none">• All Above	

MBE ROI Summary – Outsource Suppliers

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Value Drivers	Advanced Capabilities Required	Evidentiary Data –Surveyed Respondents Report:
All Value Drivers from Mfg. Engineering, Quality, Tooling Slides Above	<ul style="list-style-type: none">• All Advanced Capabilities from Mfg. Engineering, Quality, Tooling Slides Above	Contact Kenn Hartman for ROI Data & Calculation methods/formulas khartman@dsasite.com (216) 533-6302
Lead Time to Ship	<ul style="list-style-type: none">• All Advanced Capabilities from Mfg. Engineering, Quality, Tooling Slides Above	
NOTE: Securing the ROI from your Outsource Community	<ul style="list-style-type: none">• Understand through Survey and TDP Walkthroughs what the real MBE Capability Maturity is across your Critical outsource Suppliers• Establish a Capability Maturity Process for your Critical outsource Suppliers• Measure and Understand your Own Internal ROI to enable Comparative Analysis Time and Cost Data from your Critical outsource Suppliers• Establish Vendor RFP Evaluation & Contract Process that Captures the ROI you enable from your MBD/MBE Investments	

Key Takeaways

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- **Like PDM is pre-requisite to PLM so is MBD to MBE**
 - **You must get MBD right!**
- **You must have Executive Buy-in**
- **You must have a Strategic Execution Plan**
- **You must know what you're in store for – it won't be easy!**
- **You must plan effectively**
- **You must execute methodically**
- **You must measure success along the way**