



# EXCELERATE '22

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NO LIMITS

WEBINAR

# The PLM-MES Gap & Why Bridging it is Urgent Now

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Jonathan Scott, Chief Architect, Razorleaf Corporation

# Speakers



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Razorleaf Corporation



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Chief Architect  
Razorleaf Corporation



**Attila Labas**

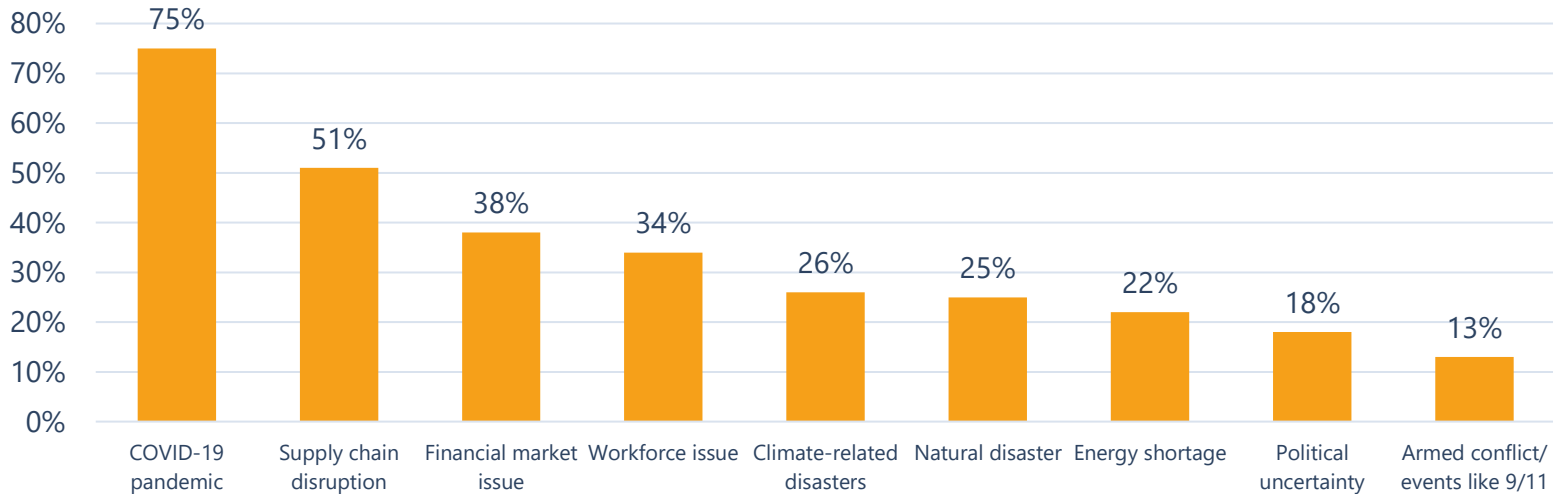
Sr. Director Product  
Management iBASEt

## Agenda

- Manufacturing Challenges
- View from the Smart Factory
- Evidence of the PLM-MES Gap
- Best Practices
- MES Requirements
- Closing the Gap
- Q&A

# Manufacturing Companies Under Pressure

## Significant Negative Impact on Business Over The Prior Year

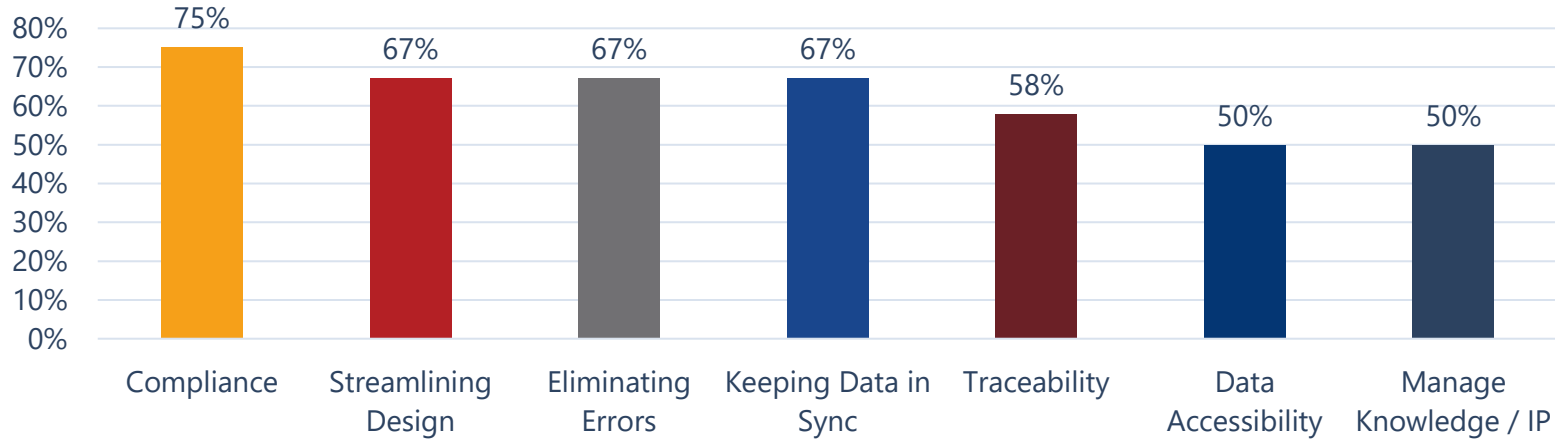


Source: Executive Strategies for Long-Term Business Sustainability 2022

# Everyone Wants Digital Continuity

Over Three-Quarters Believe Digital Thread is Important or Critical to achieving their business strategy

## A&D Digital Thread Initiative Goals



Source: Choosing the Right PLM to Support the A&D Digital Thread, © Tech-Clarity Inc. 2021

# Yet the Gap Exists

## Manufacturing focus

- Efficient processes
- On-time shipment
- Consistent results

## Manufacturing frustrations

- New products are difficult to make
- Tolerances are impossibly tight
- Quality is not consistent using specs

## Design focus

- Product innovation
- Measured on speed
- Product cost, meeting specs

## Design frustrations

- Wasting time in engineering
- Slow handoff to production
- Finished products don't meet design intent or specs



# Initiatives' Success Rests on Connection

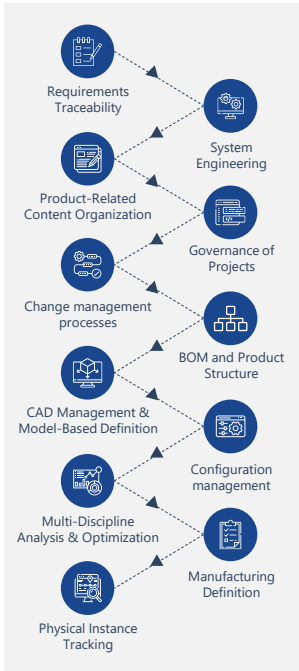
## Digital Twin

1 Data Acquisition & Ingestion	9 Synthetic Data Generation	17 Enterprise-System Integration	23 Edge AI & Intelligence	29 Prediction	39 Basic Visualization	45 Dashboards
2 Data Streaming	10 Ontology Management	18 Eng-System Integration	24 Command & Control	30 Machine Learning ML	40 Advanced Visualization	46 Continuous Intelligence
3 Data Transformation	11 Digital Twin (DT) Model Repository	19 P/AsT System Integration	25 Orchestration	31 Artificial Intelligence AI	35 Prescriptive Recommendations	41 Real-time Monitoring
4 Data Contextualization	12 DT Instance Repository	20 Digital Twin Integration	26 Alerts & Notification	32 Federated Learning	36 Business Rules	42 Entity Relationship Visualization
5 Batch Processing	13 Temporal Data Store	21 Collab Platform Integration	27 Reporting	33 Simulation	37 Distributed Ledger & Smart Contracts	43 Augmented Reality AR
6 Real-time Processing	14 Data Storage & Active Services	22 API Services	28 Data Analysis & Analytics	34 Mathematical Analytics	38 Composition	44 Virtual Reality VR
7 Data Pub/Sub Push	15 Simulation Model Repository	22 Device Management	54 Event Logging	56 Data Encryption	58 Security	60 Safety
8 Data Aggregation	16 AI Model Repository	53 System Monitoring	54 Data Governance	57 Device Security	59 Privacy	61 Reliability

## Model-based Enterprise

Level name	Drawing-Centric	Drawing Model-Centric	Validated Model-Centric	Formalized Model-Based Definition	Trusted Model-Based Definition	Integrated Model-Based Enterprise	Extended Model-Based Enterprise
Level Identifier	L0	L1	L2	L3	L4	L5	L6
Level Theme	2D drawings only Disconnected	2D drawings derived from 3D models; Drawings disconnected from models	2D drawings & derivatives derived from 3D models	3d Models with semantic PDM added; Practising 3D interactive viewable	Digital Model-based definition (MBD); certified and authorized	MBD dataset made usable for all lifecycle activities within enterprise	Enterprise extended with optimized capabilities and extended partners
Authorized Definition	2D drawings	3D drawings	3D drawings w/ support models	Drawings w/ support MBD	3D MBD w/ support drawing	3D MBD dataset	3D MBD Dataset
Artifact management	File sharing	Document-centric PDM	Document-centric PDM	Part-centric PDM	Part-centric lifecycle PDM	Enterprise part-centric PDM	Extended part-centric PDM

## Digital Thread

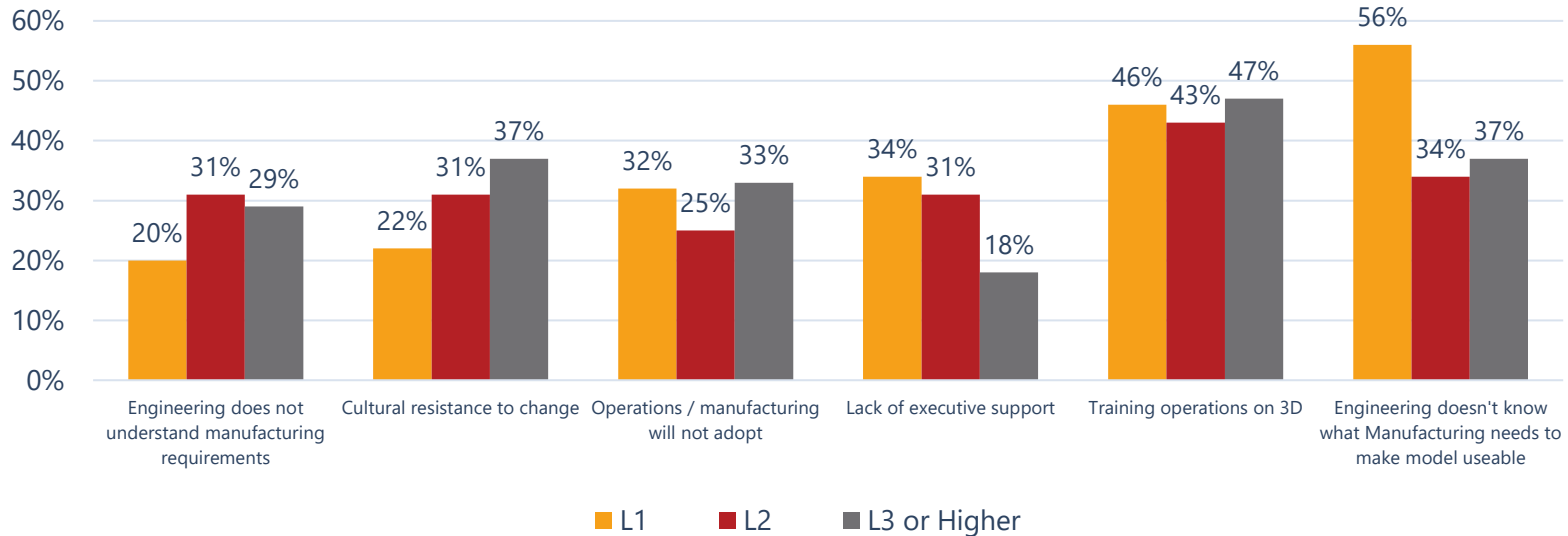


- ✓ Digital Transformation
- ✓ Industry 4.0
- ✓ Smart Manufacturing
- ✓ Digital Fabric
- ✓ Sustainability
- ✓ Metaverse



# Gap Creates Issues for Initiatives

## Biggest MBE People-related Challenges



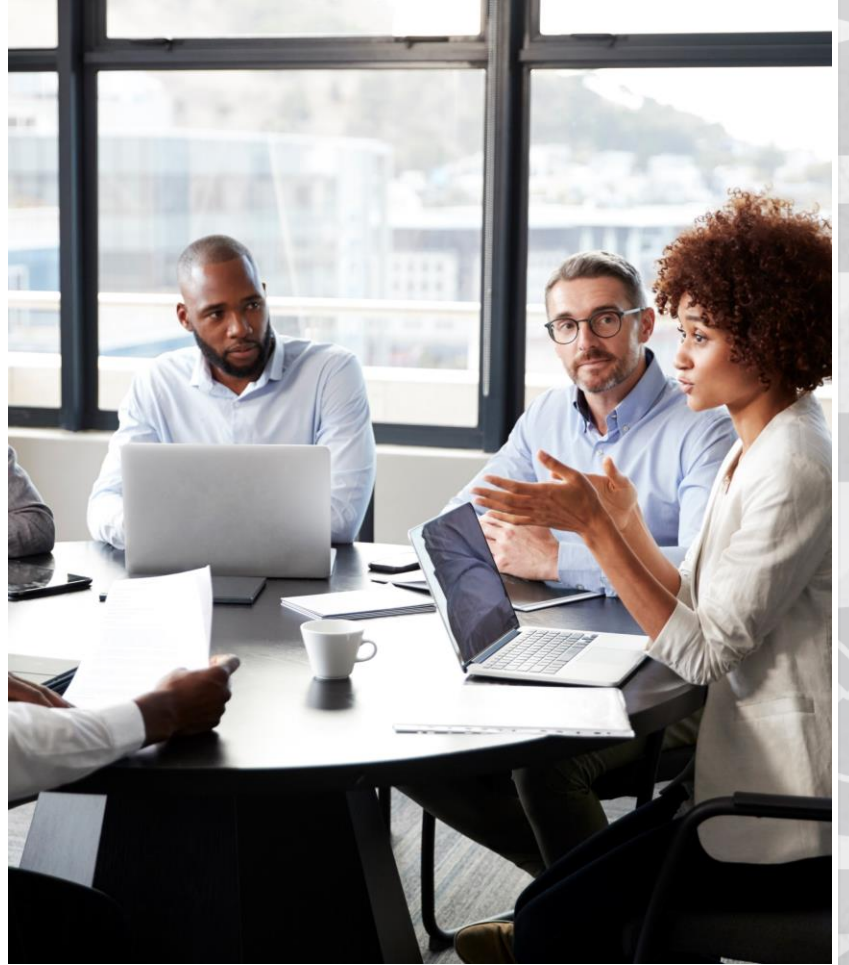
Source: Adopting a Model-Based Enterprise Strategy? What you Should Know © Tech-Clarity Inc, 2022

# View of Smart Factory Attila Labas

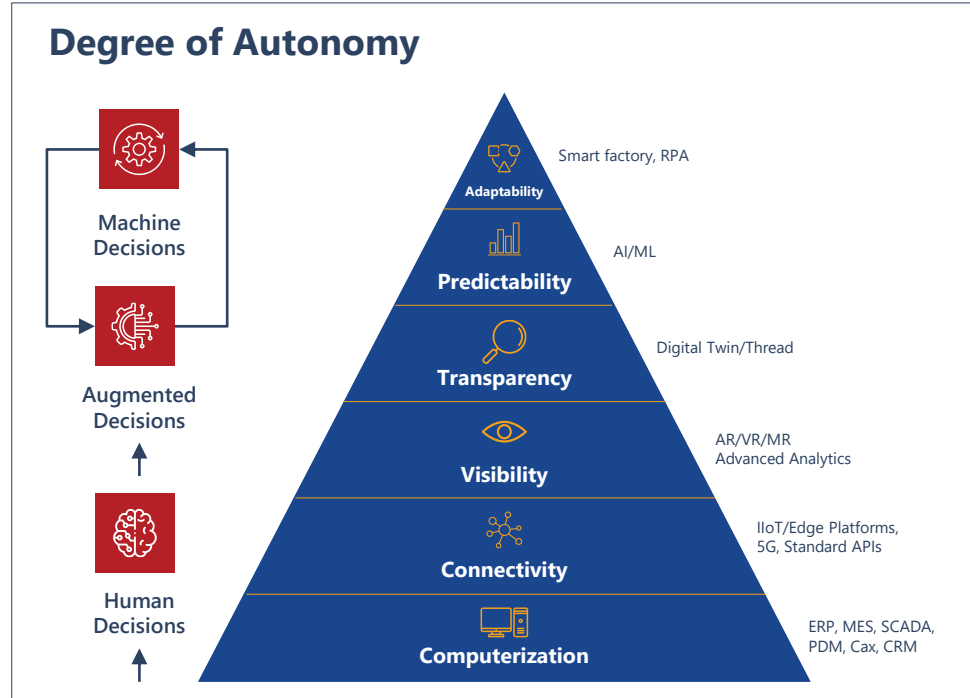
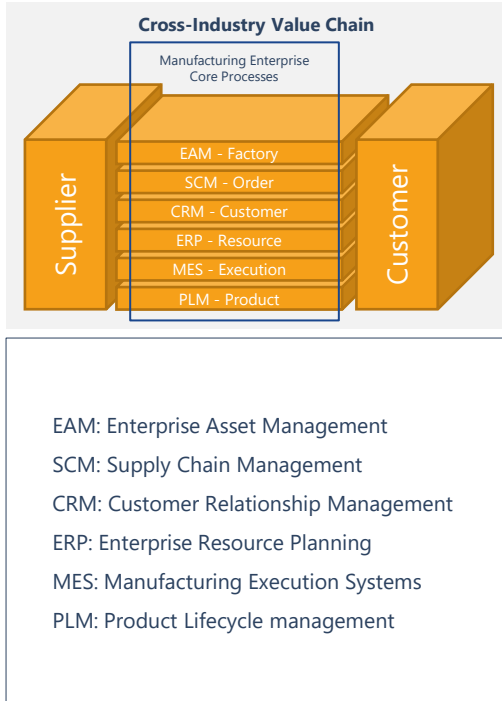
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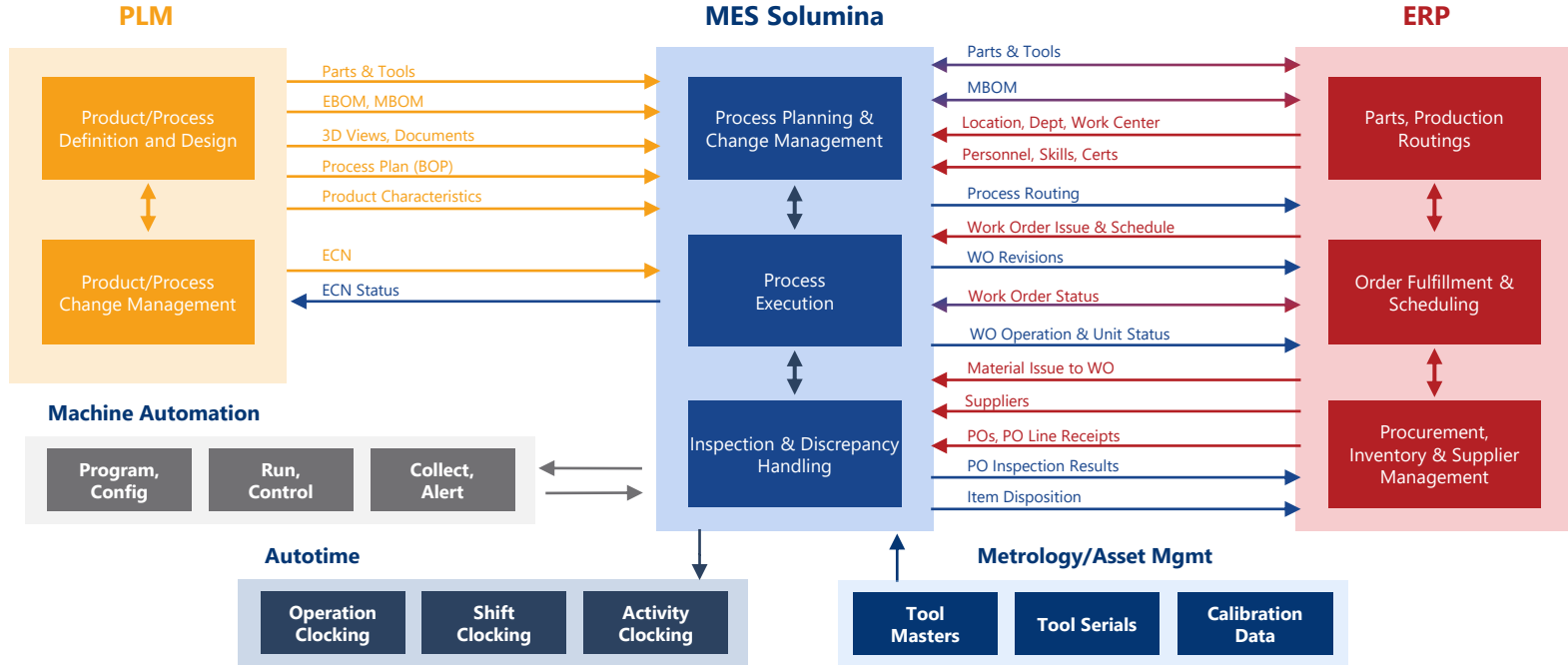
- As an MES provider, how do you view this Issue?
- Why is it so fundamental to connect PLM and MES?
- And what is involved; is it difficult?



# Implementation of Smart Factory



# Typical Connections



# Recap of Connectivity for Smart Factory



## Connectivity is Basic

- PLM and MES are just two of the applications must connect
- Computerization and Connectivity are the base layers for
  - Advanced analytics
  - Digital thread and digital twin
  - Predictive analytics
  - Smart Factory



## And Complex

- Many streams of data must flow
- Within the MES:
  - Planning, Execution, Quality
- Between MES and ERP, equipment, timekeeping, and metrology, maintenance
- From the PLM to MES
- From the MES back to PLM

# PLM – MES Gaps and Overlaps



## Gaps

- No feedback from MES to PLM
- Improvements not able to synchronize
- Manual change requests
- Plant floor uses 2D drawings, not 3D models
- Detailed PMI missing from models



## Overlaps

- MBOM
- Routings
- Process Plans
- Work Instructions
- ECOs and Change

**Needs Context-rich Integration**

# PMI: Part of the Bridge Structure



## PMI (Product and Manufacturing Information):

The annotations in a 3D model that support various lifecycle activities such as material specifications, tolerances, and inspection requirements.



If you give me semantic PMI, wow, that's truly transformational. I can automate so many things, and I can eliminate a lot of the need for shop floor operators to access engineering and provide them with richer instructions. It's just mindboggling how fertile that is."

### Jeff Gleeson

Senior Manager of Manufacturing Systems  
LOCKHEED MARTIN AERONAUTICS COMPANY

# Evidence of the Gap

## Example 1

# 1

Design shows four identical screws for an assembly, but without indication of which goes where or which to insert first



### **Solution: Next-level Detail in Model Used in MES**

Complete GUID per component linked to detailed work instructions



# Evidence of the Gap

## Example 2

# 2

A design engineer lost productive time by needing to interpret / augment a 2D drawing for a planner or quality engineer



### **Solution: Complete Model with Semantic PMI**

The engineering group uses annotated 3D models for downstream consumers to query directly

# Evidence of the Gap

## Example 3

# 3

The engineering team wasted time finding ways to meet a tolerance requirement that the shop floor previously could not, but can now meet



### **Solution: Feedback Loop**

Manufacturing capabilities are updated regularly in PLM

# Recap of Best Practices to Bridge the Gap



## Enterprise Issues

- Connecting change processes in a closed loop
- BOM-Centric viewing connecting 3D to all BOMs
- All disciplines use model-based links: quality, design, etc.

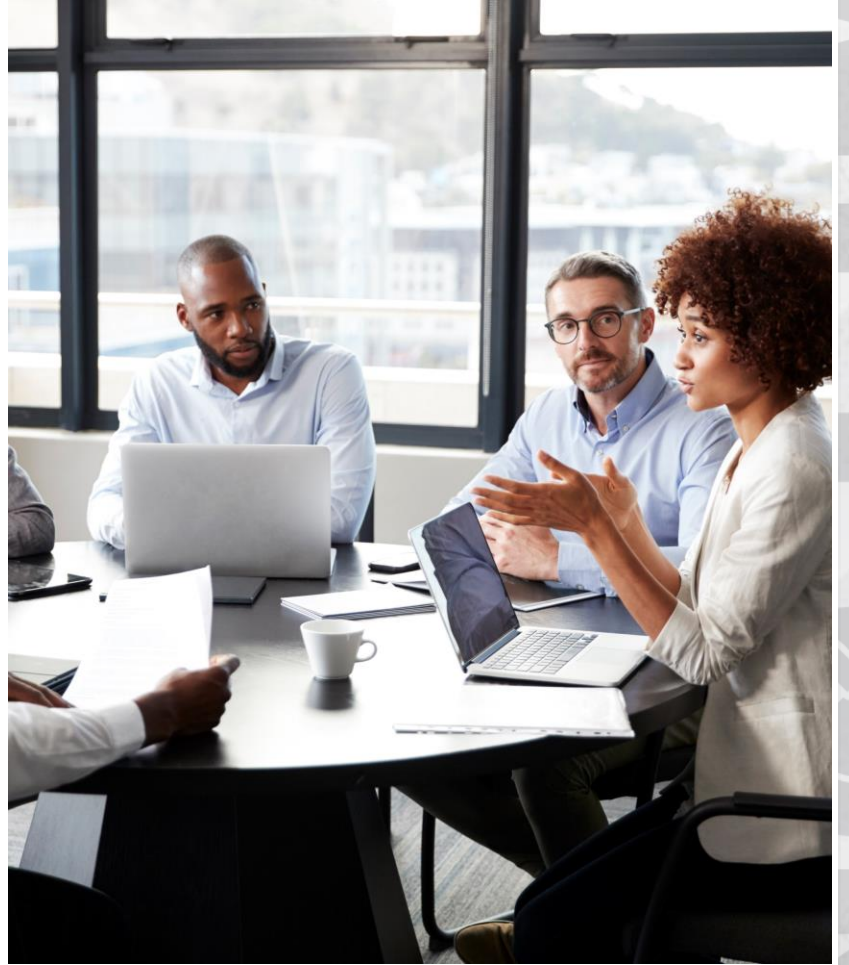
# What is the path forward?

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Jonathan Scott



In your experience, how have the most successful organizations addressed these gaps and overlaps differently than others?



## Leading Practices

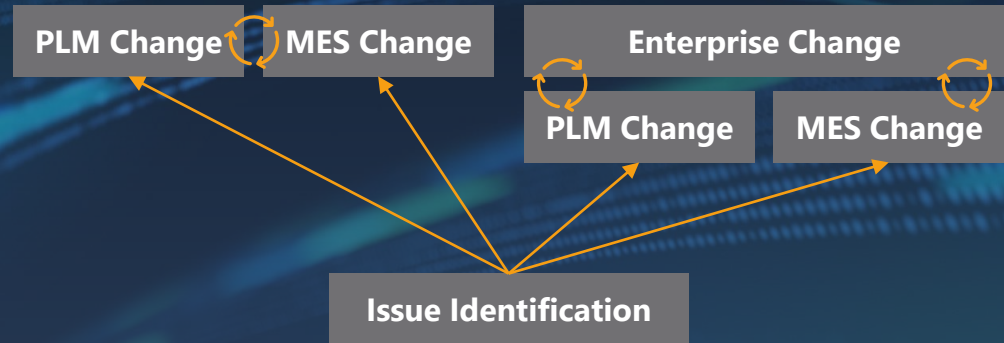
## Connected Change

### Mode 1:

- PLM change connects to MES change
- MES closes loop back to PLM change

### Mode 2:

- Enterprise process manages PLM change and MES change



**Bonus Points:** anyone can raise an issue  
(that is triaged into NCR, Deviation, ECR, etc.)

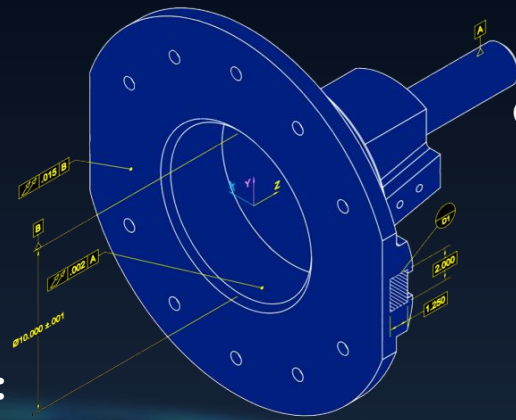
## Leading Practices

## BOM-Centric Viewing

- Visualization of MBOM, EBOM, xBOM by connecting 3D components with various product structures
- **Bonus Points:**
  - Access to PMI on models (MBD)
  - Markup to enable 2-way communication
  - Using markup with prior “Connected Change” topic

## Leading Practices

# Cross-Domain Model Linking



### Example 1:

- Model Based Manufacturing derived from Model Based Definition
- Speeds and feeds for CNC determined by required precision to meet MBD tolerances

### Example 2:

- Model Based Inspection derived from Model Based Definition
- Sampling rate, inspection protocol, etc. determined by allowable tolerance and criticality

### Bonus Points:

- Internal system linkage or cross-system integration linkage to expose internal model linkages for impact awareness

# MES Customers' Top Three Use Cases

1

## “Execution of 3D Model View”

- Data collection from a model
- Buyoff of a model process
- Adding a note to a model
- Viewing as-built model

2

## “Send Enhanced CAD Data back From MES to External System For better Design”

- Send inspection results back from MES to external system

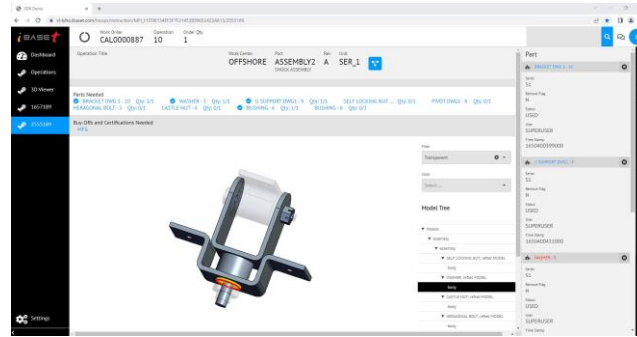
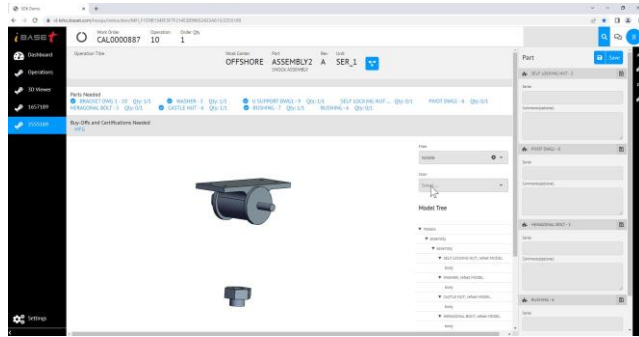
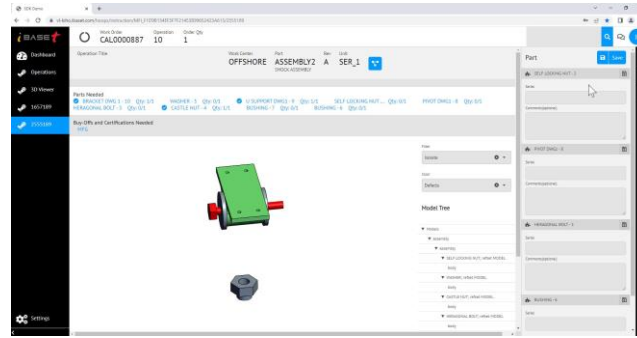
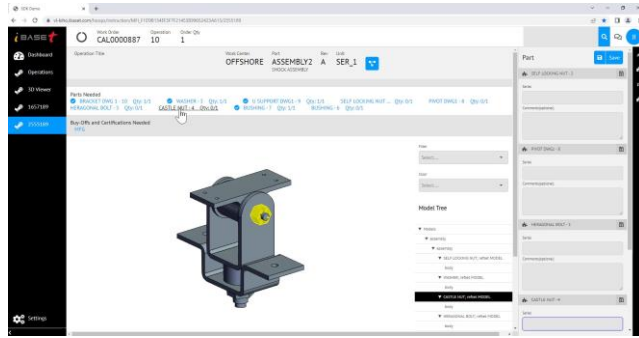
3

## “Report Data as Model Layers”

- Show material delays
- Show cycle time variance
- Show testing rates
- Show defect rates
- Show escapes
- Show corrective action requests
- Show efficiency data



# Collaboration: Proof of Concept



# Recap MES Requirements



## Customer Needs

- Use the 3D product model in execution and update for as-built
- Send data back from MES testing for design enhancement
- Show actuals and production issues as layers in the model



## In Development

- 3D model viewing
- Ability to see only needed components
- Highlight areas by clicking PMI
- Rotate
- Interactively feedback to Design

# Six Reasons to Bridge the Gap Now

Quality



Time to  
Market

Cost



Workforce  
Efficiency

Improved  
Decision Making



Customer  
Responsiveness





# THANK YOU

QUESTIONS?

Contact Us

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