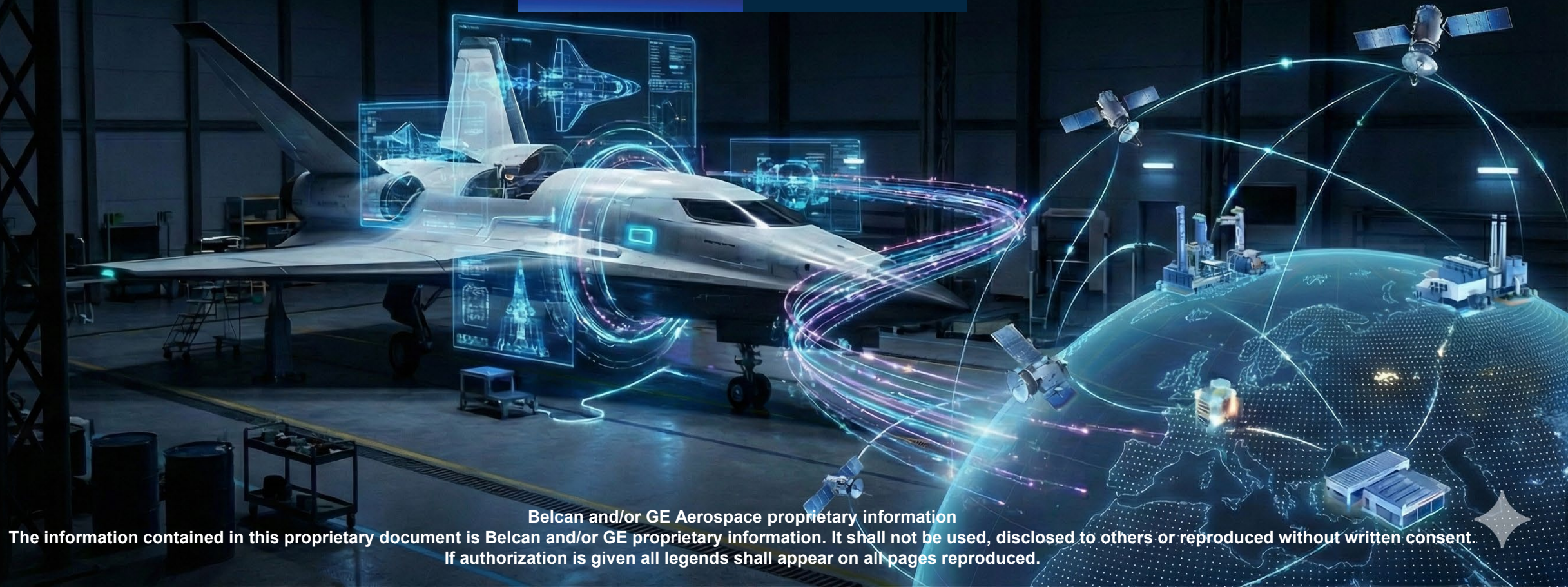


Requirements To Reality: Building A Digitally Connected Supply Chain



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Who Are We?



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What Does MBM and MBI Mean in the Supply Chain?

Digitally traceable data populated automatically during relevant operations and linked from the ASOT product definition to fixtures, tooling, in-process models, and inspection results

Model-based definition TDPs and procurement packages that are digitally approved for use and directly accessed from the source of record (the “ASOT”)



Digital work instructions which are supplemented with 3D interactive models and animations that are available to the technicians and operators at the point of consumption

MBD-driven manufacturing and inspection planning, in-process definition, NC code generation, and tooling/fixture selection (or definition) that links to and re-uses data everywhere possible



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Model-Based Definition (MBD)



Industry standards for authoring in Native CAD, packaging TDPs, and translating to derivatives



Significant attention from companies and users in many industries and from software vendors



Expected ROI and cost/time impacts from implementation studies and test cases



Aerospace customers have been looking for MBD solutions and opportunities for years



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Model-Based Manufacturing (MBM) and Inspection (MBI)



Lots of ideas and potential implementations, but many not yet ready for “prime time”



Uncertainty in standardization of file types and contents, user roles, validation, and software consumption



ROI is still in question due to inconsistencies in consumption and machine capabilities



Government customers starting to push harder for MBM and MBI capabilities throughout the supply chain

What is Success?

Digital Maturity Levels

Drawing-Centric	Drawing Model-Centric	Validated Model-Centric	Formalized Model-Based Definition	Trusted Model-Based Definition	Integrated Model-Based Enterprise	Extended Model-Based Enterprise
L0	L1	L2	L3	L4	L5	L6
2D Drawings used for all activities	2D Drawings derived from models	2D Drawings and other derivatives from validated 3D model	Semantic PMI included within 3D model	Certified, Authorized MBD	MBD dataset made useable for all lifecycle activities within enterprise	Product definition system model made useable for all lifecycle activities



Most Impactful Supply Chain Digital Maturity Categories



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Challenges: Internal and External

OEM/Company

Internal focus: Years or decades of focusing on strategic, competition-sensitive internal development efforts.

Corporate acquisitions: Drive disparate tools, processes, and cultures that can be deeply ingrained or extremely different from each other.

Lack of transparency: Limited understanding of the inner workings, processes, and capabilities of external suppliers.

Shared

Relationships: Purchaser/vendor rather than partnerships.

Organizational Change Management: Is hard and hard to justify...especially when you have profitable work in progress.

Legacy processes: Often exist for a reason and can be difficult to change without taking on risk.

Interoperability and Tools: Some “required” capabilities don’t exist or aren’t interoperable with others!

Supply Chain

Uncharted territory: Suppliers have not typically needed to expose the details of their data usage or processes. Digital data handoffs add new risk of unintended IP exposure.

Large suppliers: Cautious to change a working formula.
Small suppliers: Limited resources to invest and mature.

Varying Requirements: OEMs have differing expectations for data usage capabilities and reporting, driving uncertainty in supplier development.



Roadmap Execution

Go out and do! Complete the mapped tasks and document issues encountered along the way.

Site- and Process-Based Roadmap Development

Agree on areas and methods for improving digital maturity. Remember that advancement at the company OR the supplier can drive significant benefits for both!

Site- and Process-Based Capability Assessment

Utilize standardized surveys and process mapping to identify current state and potential areas for improvement while also educating everyone involved on the metrics and affected processes.



Company and Customer Alignment

Ensure that the customer's needs are well understood and timelines enable program execution alongside development of digital supply chain maturity. Development efforts take time!

Executive Buy-In

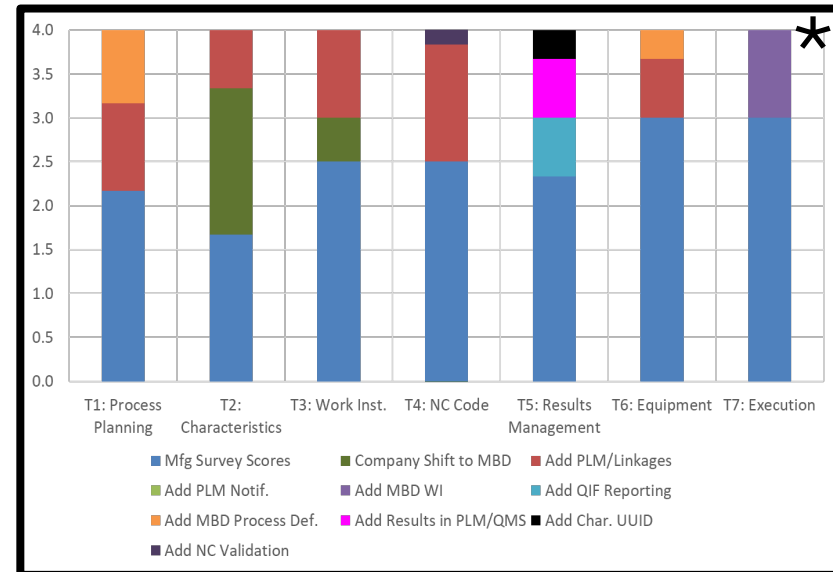
Without executive buy-in at your company now and, later, at your suppliers, maturation efforts are likely to fail.

Capability Assessment Process

1. Create “simplified language” MBE survey
2. Suppliers complete survey
3. Post-process data (~500 data elements/supplier)
4. Create supplier-facing documentation
5. Discuss roadmap development areas

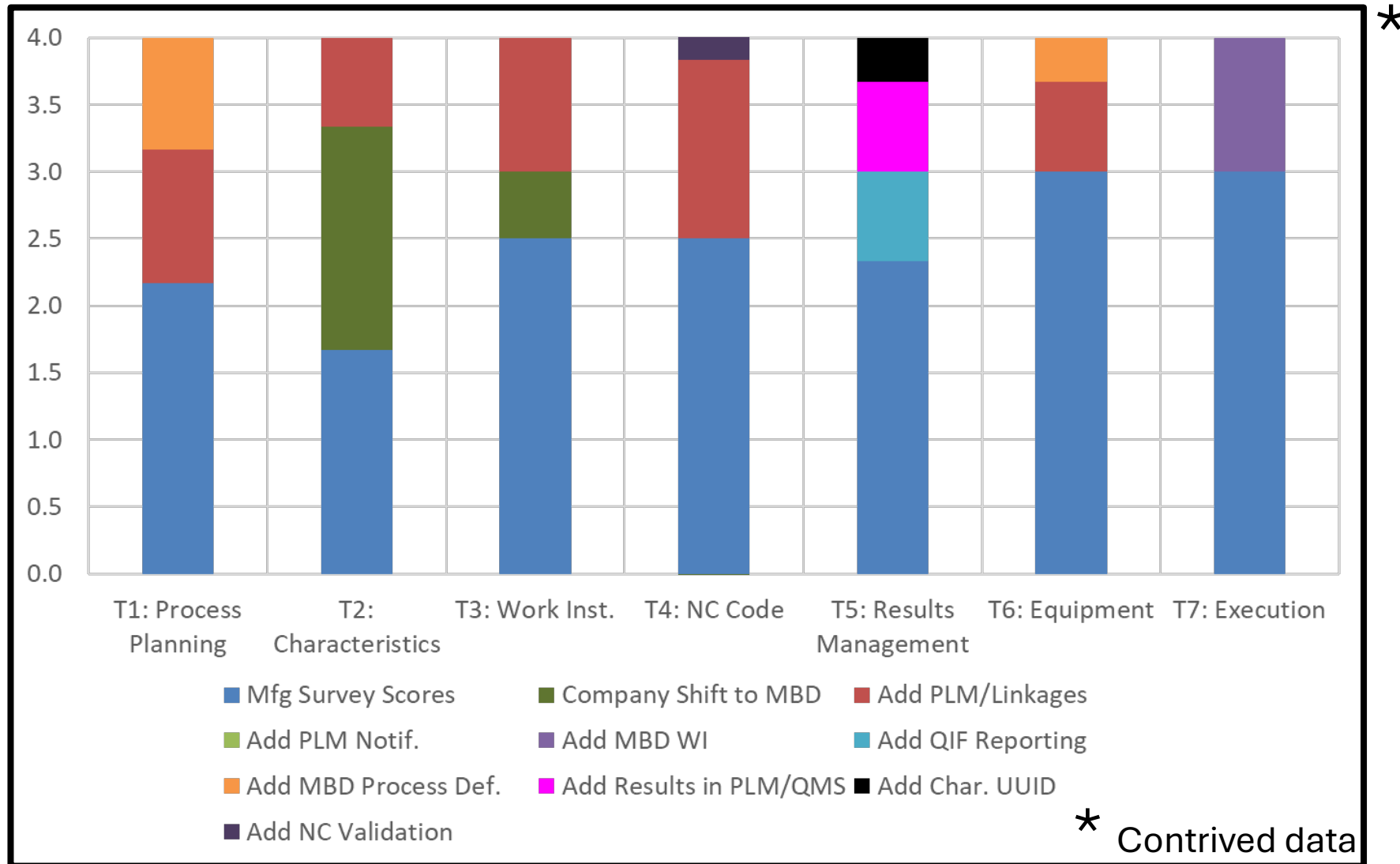
* 20. For technician and operator manufacturing work instructions, please select the data that is available to be included in the work instructions in your system.

	Textual instructions	Model images or photographs of hardware	Animations or videos	Linkage or access to 3D CAD models
→ Traditional NC-machining (CNC milling, CNC turning, etc.)	☐	☐	☐	☐
→ Traditional non-NC-Machining (Manual milling, manual turning, etc.)	☐	☐	☐	☐



* Contrived data

Capability Assessment Results and Roadmap



Customer Impact Testimonials

PLM Model Management and Digital Connections

- “[We saw a] 90% reduction in time spent to implement design changes into in-process models and work instructions.”
 - From ~3 days to ~2 hours
- “[We have improved] access to revision-controlled design data, eliminating the risk of unintentional design changes by unauthorized users.”

Direct Consumption of MBD into CAI Software (using QIF)

- “[QIF allowed us to automate] initial generation of CMM inspection code for 85% of inspected features.”
- “[Reduction in CMM programming time] by several hours.”
- Expected to see a “significant reduction” in human-introduced errors from typos, interpretation issues, and missed data.

Reference of MBD by Technicians/Operators During Execution

- “[Model interrogation by technicians and operators] has reduced engineering time spent on the manufacturing floor answering questions”
- “...[and has] prevented delays while operators wait for answers.”



Lessons Learned

	Long-Term Commitment	Development of MBDMI capability in the supply chain is an ongoing process with many moving parts and constant change.
	Standardization Drives Advancement	A standardized approach to baselining capability and road-mapping to allows vendor advancement despite unique processes.
	Incentivization Drives Acceptance	Resources at suppliers for MBMI advancement are limited & they often must be incentivized to make progress toward non-hardware goals.
	Customized Standard Solutions	Every supplier is unique and will require a custom solution to fit into their existing systems without significant disruption.
	People Fear What They Don't Understand	Education is a critical piece of vendor advancement. Clear communication of the impacts of model-based processes through example processes and testimonials creates pull from the supply chain.



Closing Thoughts and Q&A



Model-Based Advancement is a Journey

MBMI maturity gains (both at a company and at suppliers) must be leveraged by future projects to maintain and enable progress! Target sustainable changes to drive impacts across the whole business.



We Must Work Together to Drive Change

Engagement with peers within the engineering and manufacturing sides of the industry are critical to the development of standards that benefit company product definition and supplier implementation and usage to drive more widespread adoption of MBMI practices.

