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AEROSPACE & DEFENSE EXPERTS

Authoring Process Definitions in a Model-based Environment

Leverage all of the PLM capabilities while utilizing MES at its full potential (without customizations).

White Paper

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Introduction

This document summarizes the systems involved in key process authoring activities for Aerospace and Defense programs, aligned with their level of maturity in adopting a Model-based Enterprise (MBE) approach. Despite MBE's promise of faster, more accurate, and more cost-effective design-to-sustainment workflows, adoption remains low. Fewer than 5% of programs are expected to be fully model-based over the next five years. The shift will come, but gradually—with a sharp increase in adoption expected in years 10–15, as digital-first programs replace aging platforms.

In the interim, contractors must support a diverse mix of program types:

- Legacy programs like the C-130 depend on drawing-based protocols. [Still active after 70+ years]
- Hybrid MBE programs like the F-35 operate with digital models but lack embedded PMI.
- Next-gen MBE programs like Sentinel, Hypersonic Cruise Missiles, and Unmanned Systems will eventually be built on semantically defined characteristic data and require a fully integrated Federated Data Architecture (FDA) to achieve a true closed-loop data flow.

This evolving landscape demands flexibility—not only in design systems, but more critically, in the operations platforms used for process execution.

While PLM tools are essential for modeling and design, they aren't built to manage the real-world complexity of turning engineering intent into repeatable, executable, and traceable shop floor processes.

That responsibility belongs to industry-adapted Manufacturing Execution Systems (MES)—especially those designed to ingest models of any maturity and support seamless transitions from plan to product.

Given that 80–90% of an A&D Tier-1 contractor's profit will come from sustainment activities, the importance of managing life-cycle execution across legacy, hybrid, and model-based programs cannot be overstated.

This guide categorizes process responsibilities and process-phase mapping across the three primary program types, and aims to be descriptive enough so that an enterprise can clearly understand:

- What roles CAD/PLM plays in the value stream
- Where an out-of-the-box (OOTB) Operations Platform fits into the Federated Data Architecture
- What role an OOTB ERP system plays in value streams
- What potential policy constraints can interfere with implementing these flows

Program Flow 1: Legacy Programs (Pre-MBE)

Legacy programs often include platforms like the C-130 or F-16, which have decades of operational history. These systems rely primarily on drawings with 2D/3D CAD as originating sources, but do not support modern MBE processes. PLM drives configuration control, while MES takes over all downstream process planning and execution responsibilities.

Key Characteristics:

- Drawing-based protocols (TIFF/PDF)
- Minimal Product Manufacturing Information (PMI)
- Asynchronous XML messages between systems
- Operations Platform owns MBOM, work instructions, sustainment, and quality management
- ERP is responsible for material and cost accounting functions

Program Flow #1 Ownership

CAD/PLM	Process Planning/MES	ERP Role (non-General-Ledger roles)
• Initiate Engineering Change Packages • Update CAD/Drawings • Update Item Master Elements (may be flowed through ERP) • Update Engineering Bills of Materials	• Ingest all of the messages from the PLM (typically asynchronous XML) • Update Manufacturing Bills of Materials • Update Quality Definitions • Update Work Instructions • Update in-Process Work Orders or Vendor Inspection Orders • Update Sustainment Master Repair Plans • Execute offline Mods in the Field for Any Units/ECOs that Require Retrofitting to the Asset	• Item Master Synchronization • EBOM and MBOM Synchronization • Demand Forecasting and Sales Order Management • Long Lead Item Purchasing • Material Requirements Planning • Inventory Control • Goods Issue to Work Orders • Work Order MASTER role • Work Order Costing • Scrap Transactions • End-Item Shipments • MRO Inductions and Shipments • Asset Management and Depreciation (tools, jigs, fixtures, machines, etc.)

Program Flow 2: MBE Programs without Semantic PMI

This transitional phase is typical of digital designs that still rely on signed 2D drawings and some model-based definitions for production. It is a common approach for programs that are either lower in priority or nearing end-of-life. In this environment, PLM plays a MUCH Larger role in process simulation, and validation. Design changes not involving characteristics or process specifications are auto-propagated to the shops and vendors for rapid review and approvals. This phase is a steppingstone that returns millions in both NPI velocity and accuracy. For some programs, this will be the most companies are willing to invest in existing designs. In other cases, it will quickly cede the way for Stage 2 Definitions.

Example programs may include:

- Modernized legacy aircraft
- Some early unmanned systems

Key Characteristics:

- Drawings still used for GD&T and QA requirements
- PLM begins preliminary process definitions for simulations or validation (Stage 1)
- Operations platform enhances process definitions with logic, certifications, data collections, and compliance steps
- Hybrid responsibilities across PLM and Operations Process Management suite
- Greater automation and review cycles for design updates

Program Flow #2 Ownership

CAD/PLM	Process Planning/MES	ERP Role (non-General-Ledger roles)
• Initiate Engineering Change Packages. • Update CAD Models with CAD ID/Drawings with GD&T and QA Notes • Update Item Master elements (may be flowed through ERP) • Update Engineering Bills of Materials. • Update Manufacturing Bills of Materials • Update Stage 1 Bill of Process 1. Operations/Steps with Work Centers (execution order optional) 2. Part Actions (install/remove/reference) with CAD ID 3. Tool Usage with or without Validation and Calibration Rules 4. ROM Time Standards 5. Skills (optional)	• Ingest all of the messages above (typically asynchronous XML) • Enhance PLM Stage 1 Bill of Process with: 1. Operation Flow Diagram with Decisions and Return Nodes 2. Add Data Collections and Calculations 3. Add Operator Signatures and Witness Rules 4. Add QA and Customer Signoffs 5. Create Multi-Language Text Nlocks for Each Sub-step 6. Add Certification Requirements 7. Create Inter Process Precedence Links 8. Set First Article and PPAP Events 9. Activate SPC Rules and Western Electric Rules 10. Add Machine Inputs for In-Process Probes and Environmental Sensors 11. Add Composite Layup and Cure Processes and Rules 12. Etc.	• Item Master Synchronization • EBOM and MBOM Synchronization • Demand Forecasting and Sales Order Management • Long Lead Item Purchasing • Material Requirements Planning • Inventory Control • Goods Issue to Work Orders • Work Order MASTER role • Work Order Costing • Scrap Transactions • End-Item Shipments • MRO Inductions and Shipments • Asset Management and Depreciation (tools, jigs, fixtures, machines, etc.)

Program Flow 3: MBE Programs with Semantic PMI

These are advanced, model-native programs such as the Sentinel or Hypersonic Cruise Missile programs. There are no drawings—the entire lifecycle is digitally authored and maintained. These programs benefit from real-time traceability, reduced cost, and increased responsiveness.

Key Characteristics:

- Fully digital product definition with federated data architecture (FDA)
- PLM defines complete process structures with characteristics and QPIDs
- MES enhances and executes these processes, including quality planning, data collection, and analytics
- ERP handles all transactional back-office functions
- The Federated Data Architecture supports the creation and management of digital twins and cyber assets from prototypes through to high-rate production, sustainment and unit retirement

Program Flow #2 Ownership

CAD/PLM	Process Planning/MES	ERP Role (non-General-Ledger roles)
• Initiate Engineering Change Packages • Update CAD Models with CAD ID and Characteristics (with QPIDs) for Both Dimensional and Non-dimensional Attributes. • Update Item Master Elements (May be Flowed Through ERP). • Update Engineering Bills of Materials • Update Manufacturing Bills of Materials • Update Stage 2 Bill of Process 1. Operations/Steps with Work Centers (execution order optional) 2. Part Actions (install/remove/reference) with CAD ID 3. Data Collections with QPIDS 4. Tool Usage with or without validation and Calibration Rules 5. ROM Time Standards 6. Skills (optional)	• Ingest All of the Messages from the PLM (typically asynchronous XML). • Enhance PLM Stage 2 Bill of Process with: 1. Operation Flow Diagram with Decisions and Return Nodes 2. Add Calculations 3. Add Operator Signatures and Witness Rules 4. Add QA and Customer Signoffs 5. Create Multi-Language Text blocks for Each Sub-step 6. Add Certification Requirements 7. Create Inter Process Precedence Links 8. Set First Article and PPAP events 9. Activate SPC Rules and Western Electric Rules 10. Add Machine Inputs for In-Process Probes and Environmental Sensors 11. Add Composite Layup and Cure Processes and Rules 12. Etc. • Receive Quality Definitions for Both Manufacturing and Purchased Parts. • Update In-process Work Orders or Vendor Inspection Orders • Update Sustainment Master Repair Plans • Execute Offline Mods in the Field for Any Units/ECOs that Require Retrofitting to the Asset	• Item Master Synchronization • EBOM and MBOM Synchronization • Demand Forecasting and Sales Order Management • Long Lead Item Purchasing • Material Requirements Planning • Inventory Control • Goods Issue to Work Orders • Work Order MASTER role • Work Order Costing • Scrap Transactions • End-Item Shipments • MRO Inductions and Shipments • Asset Management and depreciation (tools, jigs, fixtures, machines, etc.)

About iBase-t

iBase-t is the global leader in cloud software for the aerospace and defense industry. Committed to innovation, customer success, and product excellence, iBase-t ensures digital continuity across manufacturing, quality, and maintenance, repair, and overhaul (MRO) operations on a global scale. iBase-t's Solumina Manufacturing Operations Platform is a cloud-native solution that establishes a digital ecosystem to drive innovation and improve operational performance for the most critically complex manufacturers. iBase-t customers include Lockheed Martin, Northrop Grumman, GE Aerospace, Rolls Royce, Pratt & Whitney, and Textron.

The Solumina Manufacturing Operations Platform by iBase-t consists of an integrated suite of MES, SQM, and MRO solutions. Designed for complex, highly regulated discrete manufacturers who seek to digitally transform their operations, Solumina connects manufacturing operations, quality, and sustainment management in a seamless flow of data across the value chain and product lifecycle.

The Solumina Manufacturing Operations Platform creates the technology infrastructure manufacturers need to harness advances in model-based functionality like PMI continuity, Assisted Engineering Changes and augmented reality guidance for the workforce, IIoT connectivity for equipment, new levels of intelligence for decision making, and higher levels of customer and supply chain collaboration.

Learn more at ibaset.com.

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