Terminology: Ford Definition of "MBD"

- MBD (Model Based Design) is a Common set of Processes, Tools and Methods for developing control/requirement models for simulation and/or code generation.

- MBD is designed to integrate with and enhance the current strategy/software development process used for production and research code development.

- MBD is a methodology used to design embedded software based on graphical models typically applied to control systems.
MBD Core Team is a centralized team that develops and deploys MBD Processes, Methods, and Tools for Ford globally.
Evolution of MBD at Ford

Teams applying MBD for Requirements Capture

- **Hand-code**

1990's

**Early MBD Adopters**
- Teams piloting MBD for Embedded Code Generation

2005-2008

**MBD Core Team Established**
- Ad-hoc MBD practiced across company

2012

**Production Ready MBD Process / Tools**
- MBD Roll-out for Key Production Stakeholders

2015

**Common MBD Deployment**
- Proven MBD Process; Drive for Commonality

2017

**MBSE Core Team Established**
- New MBD Stakeholders

2018

Recognition of Growth & Benefits using MBD, as well as diverging MBD practices, created value proposition for establishing MBD Core Team.
TO DELIVER BEST IN INDUSTRY STANDARD MODEL BASED DESIGN PROCESS, TOOLS, METHODS, TRAINING AND USER SUPPORT AND TO BE THE VOICE OF THE CUSTOMER WITH PRODUCT VENDORS

To that end, the MBD team is leveraging agile methodology and continuous integration platform.
Key Roles of Ford MBD Core Team

- **Core MBD Team**
  - **Defines** MBD Requirements

- **Team of Experts**
  - **Design** MBD Software Process and Tools

- **Core MBD Team**
  - **Supports** User Base via Guidance & Training

- **Core MBD Team**
  - **Deploys** MBD Process/Tools to MBD User Base

Define

Design

Support

Deploy
Continuous Integration & Agile MBD Workflow

Increased Efficiency, Higher Quality MBD Tools

- Continuous Integration Process & Tools
  - Issue Management
  - Develop Fix
  - Write MATLAB Unit Test Case
  - Execute Test Suite
  - Release MBD Tools

JIRA

Jenkins
What are Ford MBD Process/Tools?

Global MBD Processes/Methods/Tools that allow engineer to follow Ford Recommended MBD Workflow

Each step of Ford MBD Process applies MathWorks Tools at the foundation.

- Model Templates
- Model Configuration
- Modeling Style Guidelines
- Blocksets (FSAB, PCCN, ...)
- Example Models
- Requirement Traceability
- Parameter Management

Customizations are applied to base tools, however, to support Ford MBD Workflow.

- Model Utility Tools
- Model Checking Tools
- Code Generation Tools
- Documentation Tools
- Static Analysis Tools
- Design Verification
Ford MBD Tools Release Process

Step 1: Ford MBD Users Submit Issue/Enhancement Request

Step 2: Requests Reviewed Weekly in Global MBD Issues & Enhancement Meeting

Step 3: Request Prioritized, Scheduled & Assigned to Appropriate MBD Expert/s for Resolution

Step 4: MathWorks Engaged, if Required

MathWorks

Step 5: Expert/s Develop Requirements, Implements & Validates Changes

Step 6: Reviewer Assesses Changes

Step 7: Update Released to MBD Tools!

MBD Core Team delivers enhancements and fixes to existing MBD Tools on a Quarterly basis, supporting Production Users.
Prioritize Ford Requests

“Top 10”

Provide Clarification on Requests

Track Progress
MBD Tools Support for All Ford MBD Users

**Single MBD Tools Release Package Supports:**

- Latest 3 MATLAB “b” versions
  - Users encouraged to migrate every 3 years, at minimum

- Multiple Model Architectures
  - AUTOSAR, Export-function, Rate-Based

- Compliance to Model Industry Standards
  - MAAB Guidelines
  - Functional Safety
  - MISRA
  - AUTOSAR Style Guidelines

Some degree of flexibility required in MBD Tools to support multiple architectures, production timing, and model requirements.
Easing the Migration/Upgrade Pain

• MathWorks Industry Model Testing (IMT) Process
• Early Product Testing (Pre-Releases)
• Evaluate new tools for alignment with Ford MBD workflow
• Identify & Fix issues prior to reaching Ford MBD end-users

MBD Core Team is responsible for testing new MATLAB releases and ensuring compatibility with Internal Ford MBD Tools.
Management of MBD Portfolio (MBD Vendor Tools)

➢ Manage Deployment of MBD Portfolio Tools, including MATLAB, for all Ford users
➢ Manage MBD Vendor Toolbox Usage
➢ Manage Enterprise Licensing Needs

Management of MBD Portfolio allows us to better take advantage of latest tools to support desired MBD workflow.
Ford / MathWorks Collaboration

CREATING TOMORROW TOGETHER .....

Strong Working Relationship

Early Product Evaluation & Feedback

Collaboration with a Purpose

Setting Direction Together

Win-Win Solutions

Workflow Development
Requirements for Common MBD Enterprise-Wide Alignment to MBD Strategy

**Challenges Along Way:**

- MBD Process/Tools Maturity
- Gaining Commonality
  - Migrating Pre-established Processes
- Culture
  - Shift in Mindset
- Overcoming Silos

**Strong Relationship with vendors**

**Engagement with Functional Teams**

**Centralized MBD team driving & advancing MBD**

**Functional Team Alignment**

**Enterprise-Wide Alignment to MBD Strategy**
<table>
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<td><strong>MBD Process / Tools Maturity</strong></td>
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<td>Agile Methodology that allows support for Latest Emerging Technology</td>
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<td><strong>Gaining Commonality</strong></td>
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<td>Dedicating time for hands-on user support &amp; engagement</td>
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Proven MBD process allows Quicker Onboarding of new engineers.

Model Design Process allows for Earlier Simulation and Defect Detection.

Common MBD Processes & Tools Not Only Benefit the Engineer, but the Entire Enterprise.

Common MBD Processes allow for Easier Integration of Component Models at System Level.

Common MBD Processes enable validation at all System-V layers, enabling early Validation of Requirements, System Design, Architecture, Component and Implementation.
Thank You!