

Pragmatic Strategies for Adopting Model-Based Design for Embedded Applications

Vinod Reddy Manager, Consulting Services The MathWorks, Inc.

MathWorks Symposium

Adopting Model-Based Design within Aerospace and Defense

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Model-Based Design (MBD)

- What's MBD?
- Why do it?

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- Eliminate HW prototypes?
 - Minimize HW prototypes!
- Build it right the first time?
 - Build it wrong a thousand times!
- Benefits:
 - Innovate
 - Reduce time to market
 - Reduce cost
 - Improve quality
- How do you start?



Best Practices for Establishing a Model-Based Design Culture (SAE Paper 2007-01-0777, Smith, Prabhu, Friedman)

- 1. Identify the problem you are trying to solve
- 2. Use models for at least two things "Rule of Two"
- 3. Use models for production code generation
- 4. Treat models as the sole source of truth
- 5. Use migration as a learning opportunity
- 6. Focus on design, not on coding
- 7. Integrate the development process
- 8. Designate champions with influence, expertise, and budgetary control
- 9. Have a long-term vision

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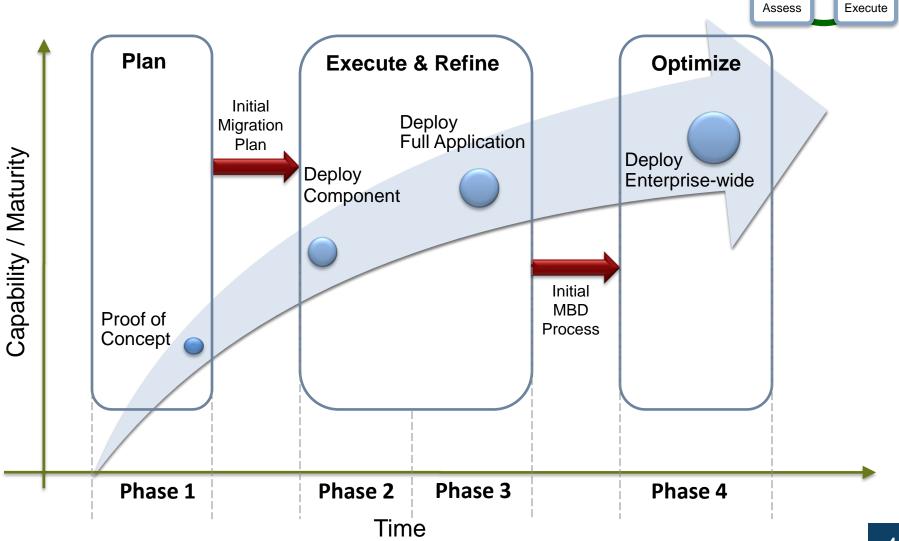
10. Partner with your tool suppliers





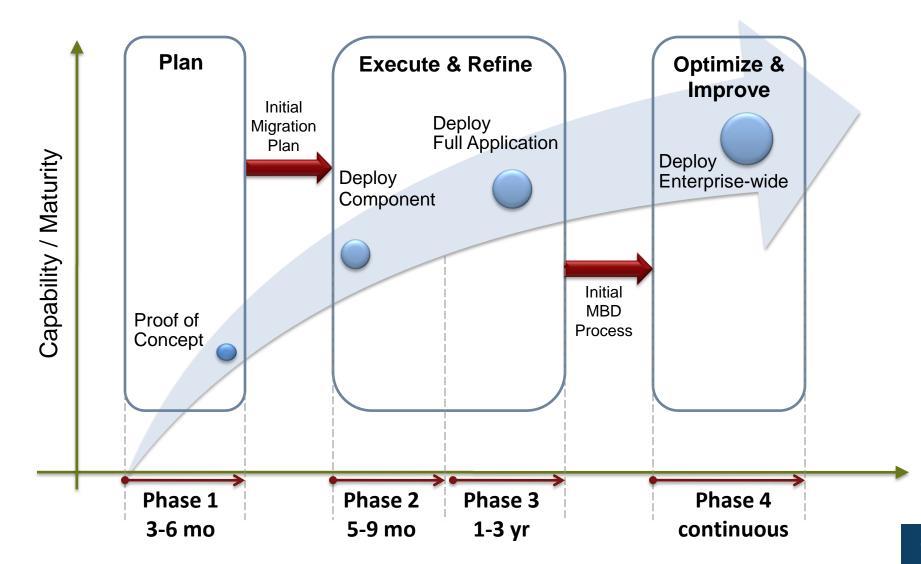
Plan







Timing the Phased Approach





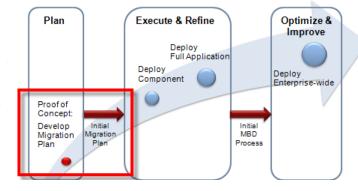
Phase 1: Proof of Concept

Theme: Discovery

Activities:

- Identify Objectives
- Form a dedicated team and provide training
- Select an algorithm
- Build models and execute on target

- Focus on technology prove the tools can do the job
- Learn and build support for future changes
- <u>KEY OUTPUT</u>: Initial Migration Plan



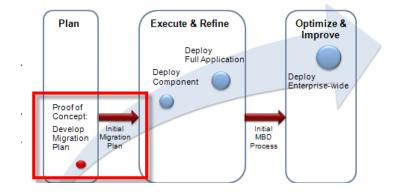


Phase 1: Proof of Concept

Success Factors:

- Keep it simple
- Firm deadline
- Dedicated cross-functional team

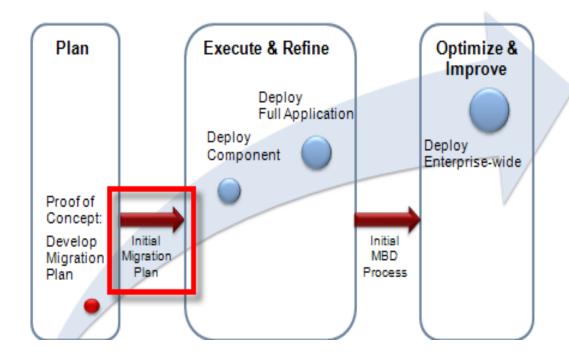
- Deliverable on the production path
- Expecting ROI
- Aggressive timing without help





The Migration Plan

- Objectives
- Metrics
- Organization
- Training
- Process Changes
- Constraints
- Standards
- Automation



This plan will change – it is not static!

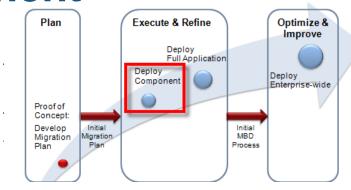
Phase 2: Deploy a Component

Theme: Execute & Refine

New Activities:

- Selection of component to deploy
- Introduce Model-Based V&V: Simulation-Based Testing
- Integration with production build, configuration management

- Larger number of people engaged in Model-Based Design
- Bigger model representing more functionality; ROI is emerging
- Some automation, metrics and process definition <u>KEY OUTPUTS</u>:
- Production "component" delivered
- V1.0 Model-Based Process Definition







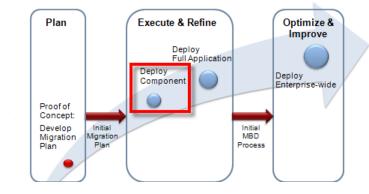
Phase 2: Deploy a Component

Success Factors:

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- Focus on the initial architecture
- Adopting Modeling Standards
- Common working environment

- Complexity, Size, and Representation (common patterns)
- Outsourcing migration
- Graphical coding





Phase 3: Deploy an Application

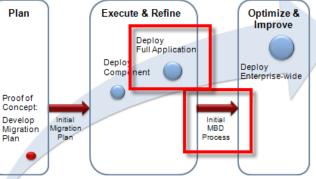
Theme: Scale Up

New Activities:

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- Requirements linking
- Full Model-Based V&V Coverage, SIL, PIL, etc
- Automation Standards checking, testing

- Production application delivered
- Significant return on investment
- V2.0 MBD process: Base set of capabilities



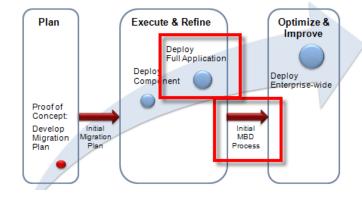


Phase 3: Deploy an Application

Success Factors:

- Multiple organizations involved
- Standardized MBD environment

- Architecture scalability
- Touching the code
- Lack of modeling standards



Phase 4: Optimize & Improve

Theme: Continuous Improvement

Adapt and deploy

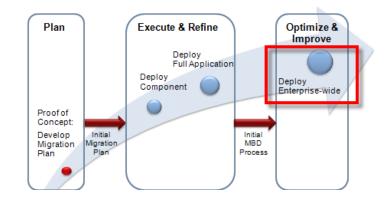
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Fully leverage success: Optimization

New Activities:

- Assess other site requirements
- Refine objectives & capabilities

- Replicated success at multiple sites
- Dramatic productivity improvement
- Increased capacity for complexity



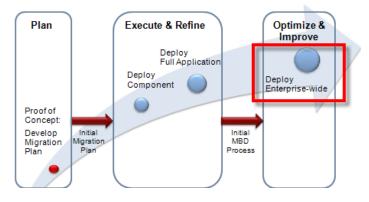


Phase 4: Optimize & Improve

Success Factors:

- Continuous Improvement:
 - Tools & products are constantly evolving

- No dedicated central tool group
- Rollout without adequate representation



Pragmatic Strategies for Adopting Model-Based

Design (SAE Paper 2010-01-0935, Dillaber, Kendrick, Jin, Reddy)

Strategies to consider in planning your phased approach:

- Assess organizational challenges and impact
- Plan for change

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- 1. Identify the problem you are trying to solve
- 2. Choose a project with proper complexity and technology
- 3. Mitigate risk with a phased approach
- 4. Choose the appropriate legacy components for migration

Pragmatic Strategies for Adopting Model-Based Design for Embedded Applications

2010-01-0935

Eric Dillaber, Larry Kendrick, Wensi Jin, and Vinod Reddy The MathWork

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ABSTRACT

When transitioning p Model-Based-Darig for sub-stellad system development 1 is search to result in the beginning event 1 juin game, paper, development processes, and shot. It comme states approach these beginning and process improvement activity is to fart identify the problem to be solved on them develop a pint on implement the solution. When transitioning on Model-Based-Development process when the model is the design region of the solution in an intertion process when the model is the design, vertication is one through the development process using immittee, and the implementation of the active splicitons onto target hardware is highly answards. For eld that we will normalize down the highway. Choosing the right threat up on the web development process implements are obtained by the development of the active splicitons of the target hardware is highly answards. For eld that we will normalize down the highway. Choosing the right threat up are key to as uscered in transition proper presents as or dispected resulting to fast range when deploying Model-Based Design and code generation in production development processes.

INTRODUCTION

A proving number of embedded systems development ergenizations are seeking to sdopt Model-Based Design to the advantage of benefix, including databased ballty to deal with complexity, reflected for early trade design advantage of the start of the start of the start of the start of the second start of the trade design advantage of the start start of the signal start of the start o

This paper presents as set of considerations and strategies for adopting Model-Based Design for numbedded software development. A key component of the resulting is outlined here is a phased rollout, which spars from the fur production deployment to a highly optimized integration of speople, processes, and both that delivers on the promise of Model-Based Design. We present the common challenges associated with such a rollout and the current industry between them.

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Strategies to help you choose what areas and capabilities to target first

(Selected key items)

- 1. Use executable spec development as an opportunity to solidify requirements
- 2. Make the model a source for documentation
- 3. Choose architecture and component technology early
- 4. Establish and enforce design standards
- 5. Develop a plant model with "trend-correct" behavior
- 6. Verify what you need, not what you want
- 7. Migrate key supporting processes such as CM

Strategy Organization Process Tools Culture



User Stories

Company	Application	Strategy	Result
Astrium		 Modeling, Early Verification, Code Generation, HIL/RPC 	 Design iterations reduced from days to hours Overall development time reduced by six months
BAE Systems BAE SYSTEMS	First of its Kind Laser Link	 Modeling, Early Verification, VHDL Traditional Effort Comparison 	 Project development time reduced by 80%: SDR SP Devel 10:1 Overall time 4:1
Honeywell Honeywell	SDR	 Modeling, Early verification, code generation Legacy Reuse 	 5:1 improvement in productivity Highly accurate, reusable code A superior product
Lockheed Martin	Flight Control System	 Modeling Early verification, code generation Large-Scale & Collaborative Devel 	Reduced Software Defects Overall Reduction in Manhours/SLOC of ~40%



Next Steps

Read the paper:

Pragmatic Strategies for Adopting Model-Based Design for Embedded Applications http://www.mathworks.com/automotive/technicalliterature.html

- Review the MBD literature
- Connect with others who have gone through the process before

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