Best Practices for Establishing a Culture of Model-Based Design

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The MathWorks
Review: Benefits of Model-Based Design

- Simulation enables validation and documentation of requirements
- Requirements models are reused to generate code and documentation
- Test cases are reused to verify deployed application
- Results:
  - Improved quality
  - Reduced time to market
  - Capability to develop more complex systems
Adoption of Model-Based Design

What happens in the “real world”? Why do organizations adopt Model-Based Design?

- Corporate mandate
- 6 Sigma / quality initiatives
- Young engineers used it in college
- It’s more fun than writing C
Transformational Levels for the Adoption of Model-Based Design

From Phil Martens, Ford Motor Co., 2003 DARATECH Conference
Best Practice # 1: *Identify the problem you are trying to solve*

- Have metrics that identify the weak points in your current process
- Attack your greatest weaknesses first
- Monitor your Return on Investment (ROI)

**Example 1:** Can’t hit release dates  
**Example 2:** Excessive software defects  
**Example 3:** Availability of prototype hardware
Best Practice # 2:  
*Use models for at least two things – “Rule of Two”*

- Overcome startup costs and resistance to change
- ROI increases with multi-use models

**Example 1:** Validate requirements through simulation and add new functionality through rapid prototyping

**Example 2:** System specification and automatic code generation
Best Practice # 3: **Use models for production code generation**

- To ensure success you must connect models to real system
- Enable a culture of modeling by removing temptation and option to write code
- Executable code is what makes machines move and generates profits
Best Practice # 4:  
*Treat models as the sole source of truth*

- Remove the temptation to hack code by hand late in a program when under time pressure
- Prevent divergence of code and model
Best Practice # 5:
*Use migration as a learning opportunity*

- Learn what really happens in the current system
- Solicit help on process and tools, not on translation
- Focus on value-added features first
- Conversion is a tremendous learning and quality improvement opportunity
  - True even in small code footprints and efficient organizations
Best Practice # 6: Focus on design, not on coding

- Software design is still taking place

- Software engineers establish and manage the code generation infrastructure

- Model refinement continues after the controls engineers finish their work and before the model is ready to generate code, especially in a fixed-point implementation

- Legacy code must be integrated and maintained
Best Practice # 7: Integrate the development process

- Develop a comprehensive plan:
  - Training
  - Modeling Style
  - Enforcement.
  - Supporting Tools
  - Configuration Management
  - Requirements Management
  - Process

- Develop new metrics

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Measuring Productivity and Quality in Model-Based Design

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ABSTRACT

Accurate measurements of productivity and quality are essential for business success. Using Model-Based Design, MathWorks provides toolset products that support all the disciplines of Model-Based Design. This paper provides a brief overview of Model-Based Design and introduces a practical approach to measuring productivity and quality.

INTRODUCTION

Model-Based Design is a method for developing complex systems using software models. It allows developers to create, simulate, and verify models before committing to hardware and software development.

MODEL-BASED DESIGN

Model-Based Design allows developers to:
- Reduce development time and costs
- Improve system quality and reliability
- Enhance collaboration and communication

OVERVIEW OF MODEL-BASED DESIGN

Model-Based Design uses the Model Inversion method to convert models into executable code. This method allows developers to:
- Generate code directly from models
- Use simulation to verify and validate models
- Reduce the risk of errors and improve system quality

The benefits of Model-Based Design include:
- Improved productivity and quality
- Reduced development time and costs
- Enhanced collaboration and communication

MODEL-BASED DESIGN: A practical approach to measuring productivity and quality

MathWorks offers a comprehensive suite of products that support Model-Based Design, including: MATLAB, Simulink, and Stateflow.

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MathWorks
Aerospace and Defense Conference ’07
Best Practice # 8: Designate champions with influence, expertise, and budgetary control

Business champion:
- Assigns overall priorities
- Assigns people
- Acquires tools, equipment, and services
- Sometimes act as a consensus builder
- Sometimes act as a benevolent dictator
- Handles issue escalation

Technical champion:
- Assigns technical priorities
- Is point of contact for Model-Based Design issues
- Attends MathWorks Advisory Boards
- May also be business champion in some organizations
Best Practice # 9: 
Have a long-term vision

- Good things come to those who have a vision and work hard to achieve it
- The full transition from hand-coded, textual languages takes 2-3 years to fully implement in a production organization
- Research organizations often have fewer constraints and less legacy code, and can move faster
- Be flexible
  - Don’t get bogged down with needs derived from traditional approaches (paving the cow paths)
  - Be receptive to workarounds
  - Plan for migration
Best Practice # 10:

*Partner with your tool suppliers*

Suppliers bring the experience of working with entire industries and can help you avoid common pitfalls, accelerate your ROI breakeven point, and quickly achieve productivity and quality goals.