Model-Based Design for High Integrity Software Development

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Model-Based Design for High Integrity Software Development Agenda

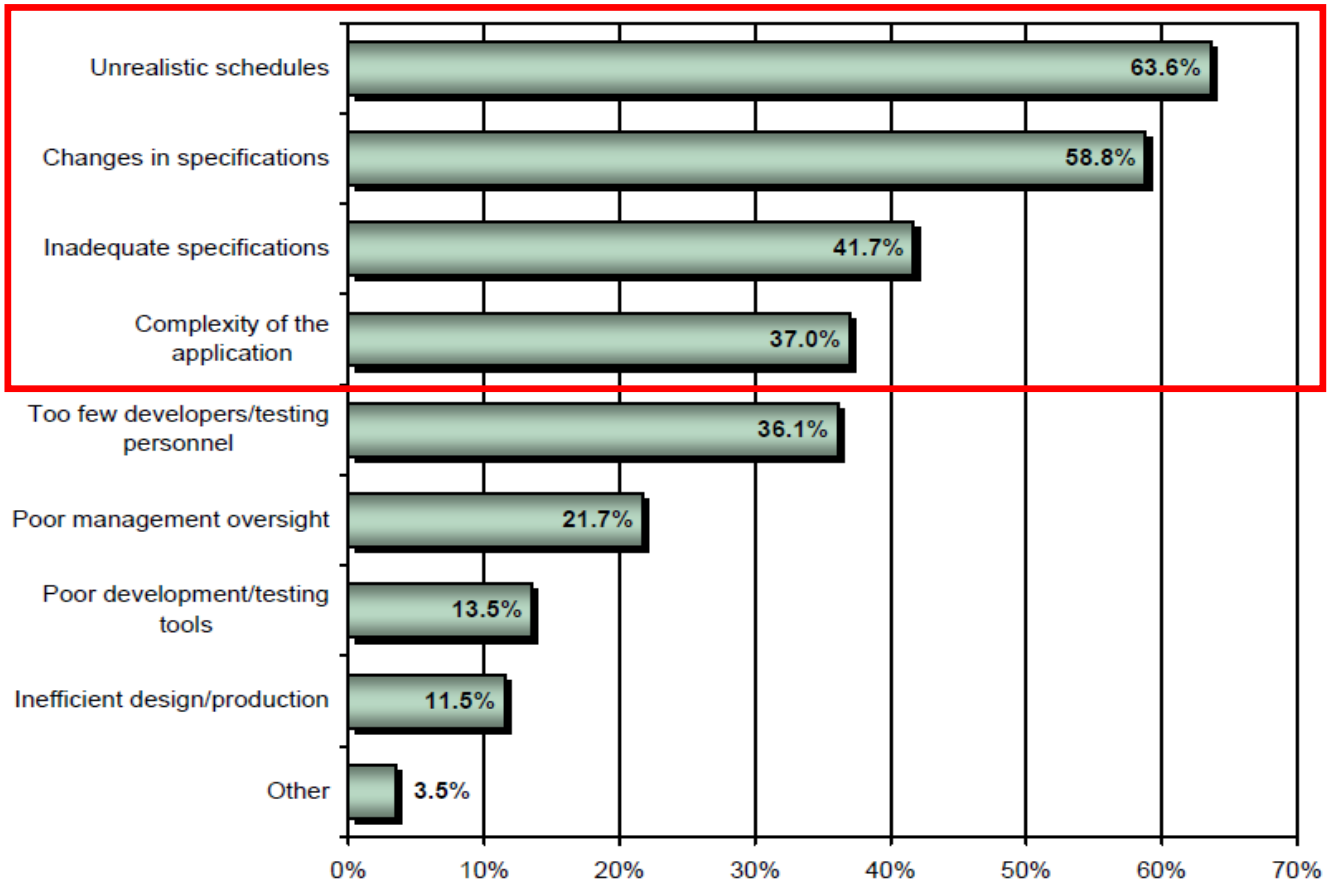
Development and V&V of the Model

- Building a Model from Requirements
  - Introduction to Simulink
- Traceability of a Model to Requirements
  - Using the Requirements Management Interface
  - The Requirements Report
- Conformance to Modeling Standards
  - Using the Model Advisor
  - Customizing the Model Advisor
  - Model Advisor Report
- Verification of the Model against Requirements
  - Requirements-Based Testing & Report Generation
  - Formal Methods Verification

Development and V&V of the Code

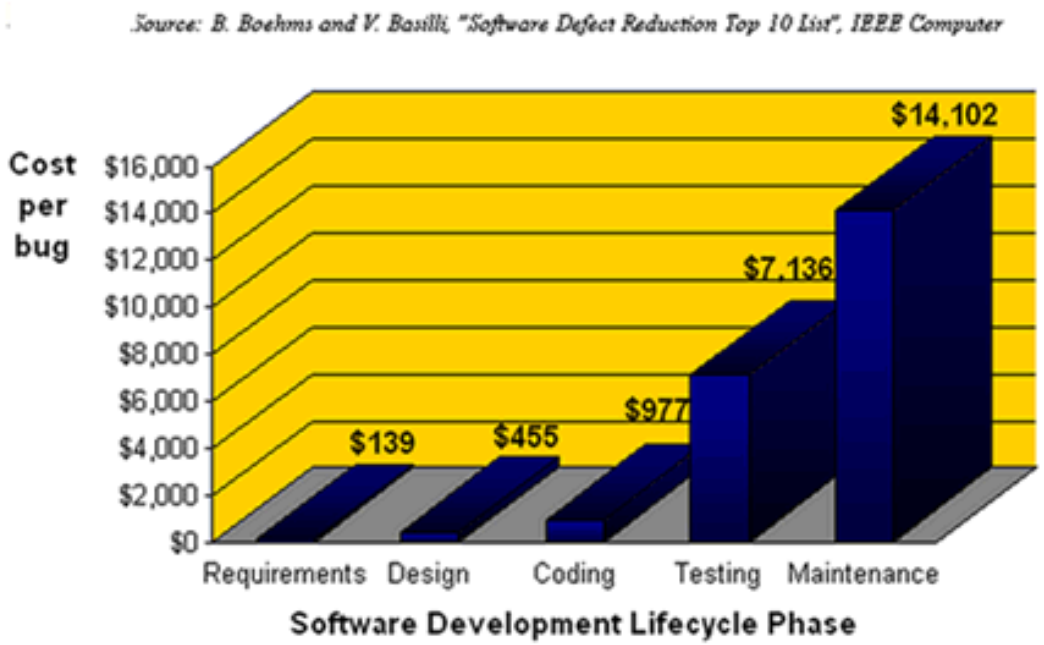
- Production Code Generation
  - Creating Data Objects
  - Function Prototype Control
- Traceability of the Generated Code to the Model
  - Code-to-Model Linking
  - Model-to-Code Linking
  - Traceability Report & Traceability Matrix
- Conformance to Coding Standards & Code Verification
  - PolySpace
    - MISRA-C Compliance
    - Proving the Absence of Runtime Errors
- Verification of the Source Code
  - Automating Code Reviews with Simulink Code Inspector
- Verification of the Object Code
  - Test Case reuse
  - SIL/PIL Testing
  - Code Coverage

Why did we miss our deadline?



Reasons for late projects, as reported by Venture Development Corporation.
Source: Embedded Software Strategic Market Intelligence report, Volume 4, December 2007, VDC.
Note: Percentages sum to over 100% due to multiple responses.

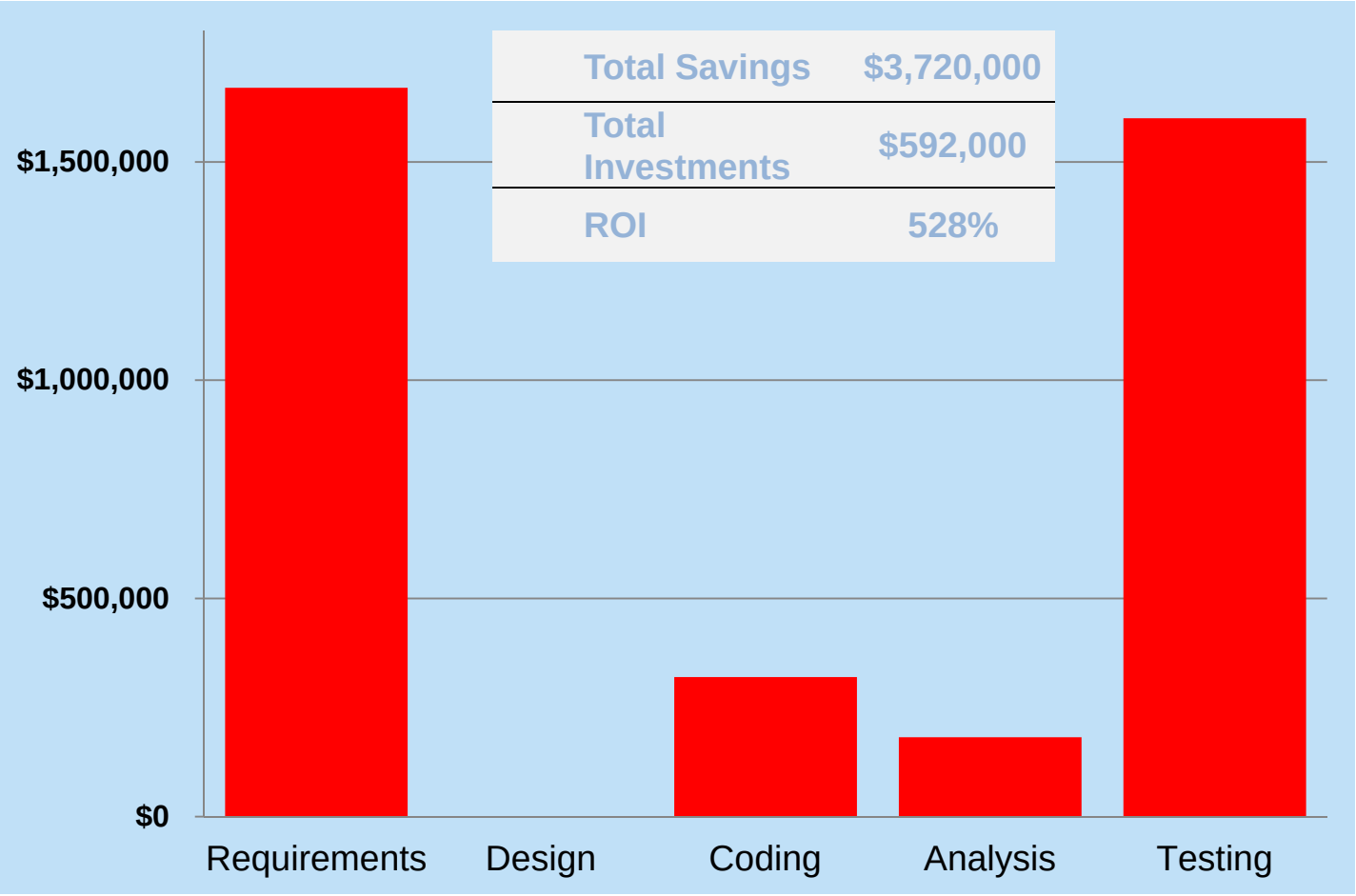
Minimize Costs by Detecting Errors Earlier



"…each delay in the detection and correction of a design problem makes it an order of magnitude more expensive to fix…"

Clive Maxfield and Kuhoo Goyal
"EDA: Where Electronics Begins"
TechBites Interactive, October 1, 2001
ISBN: 0971406308]

62% Cost Savings

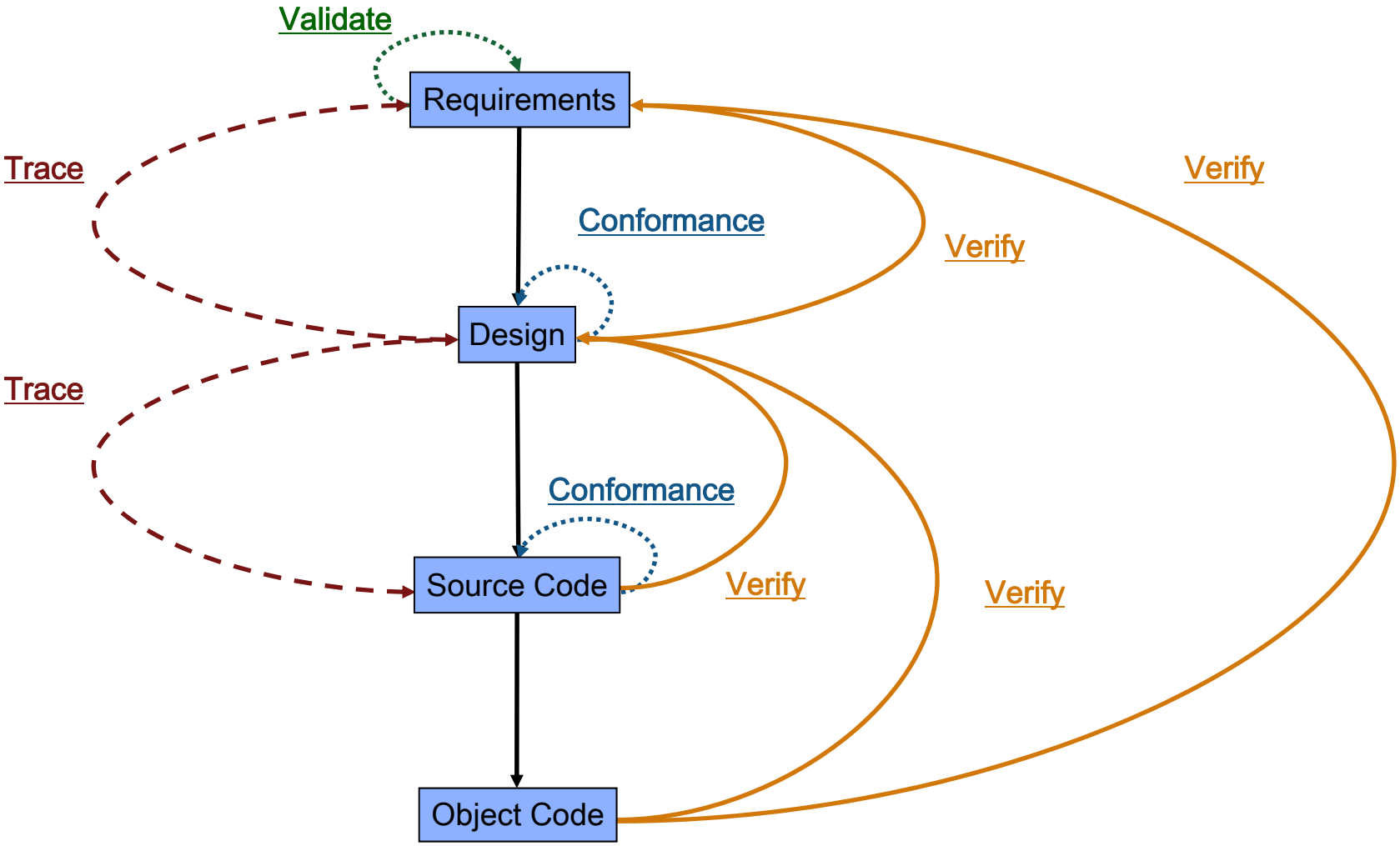


Methods for Verification and Validation

Verification: Did I do the design right?
Validation: Did I do the right design?

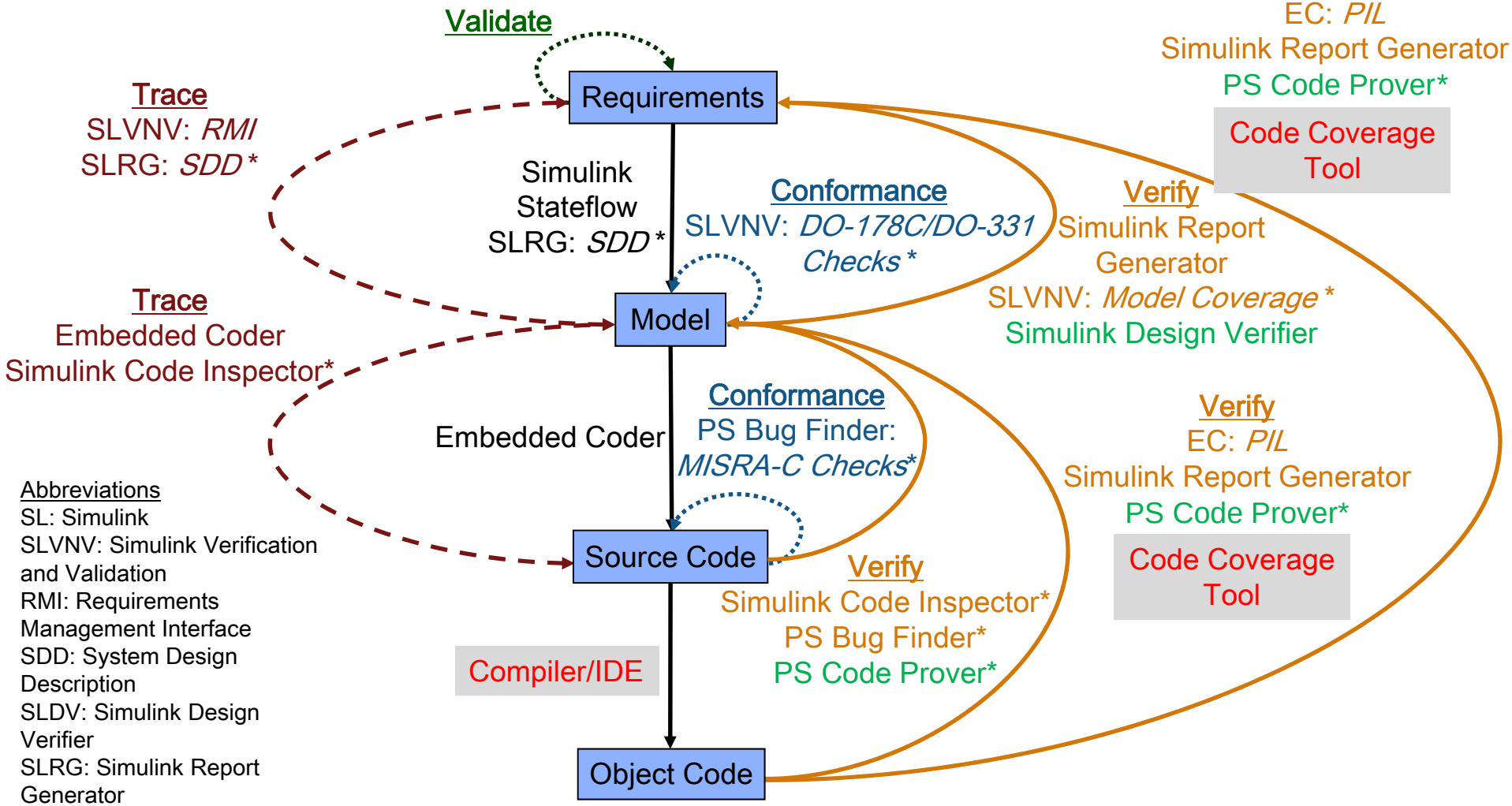
- Traceability
  - Requirements to model and code
  - Model to code
- Modeling and Coding Standards
  - Modeling standards checking
  - Coding standards checking
- Testing
  - Model testing in simulation
  - Processor In the loop
- Proving
  - Proving design properties
  - Proving code correctness

Workflow Example



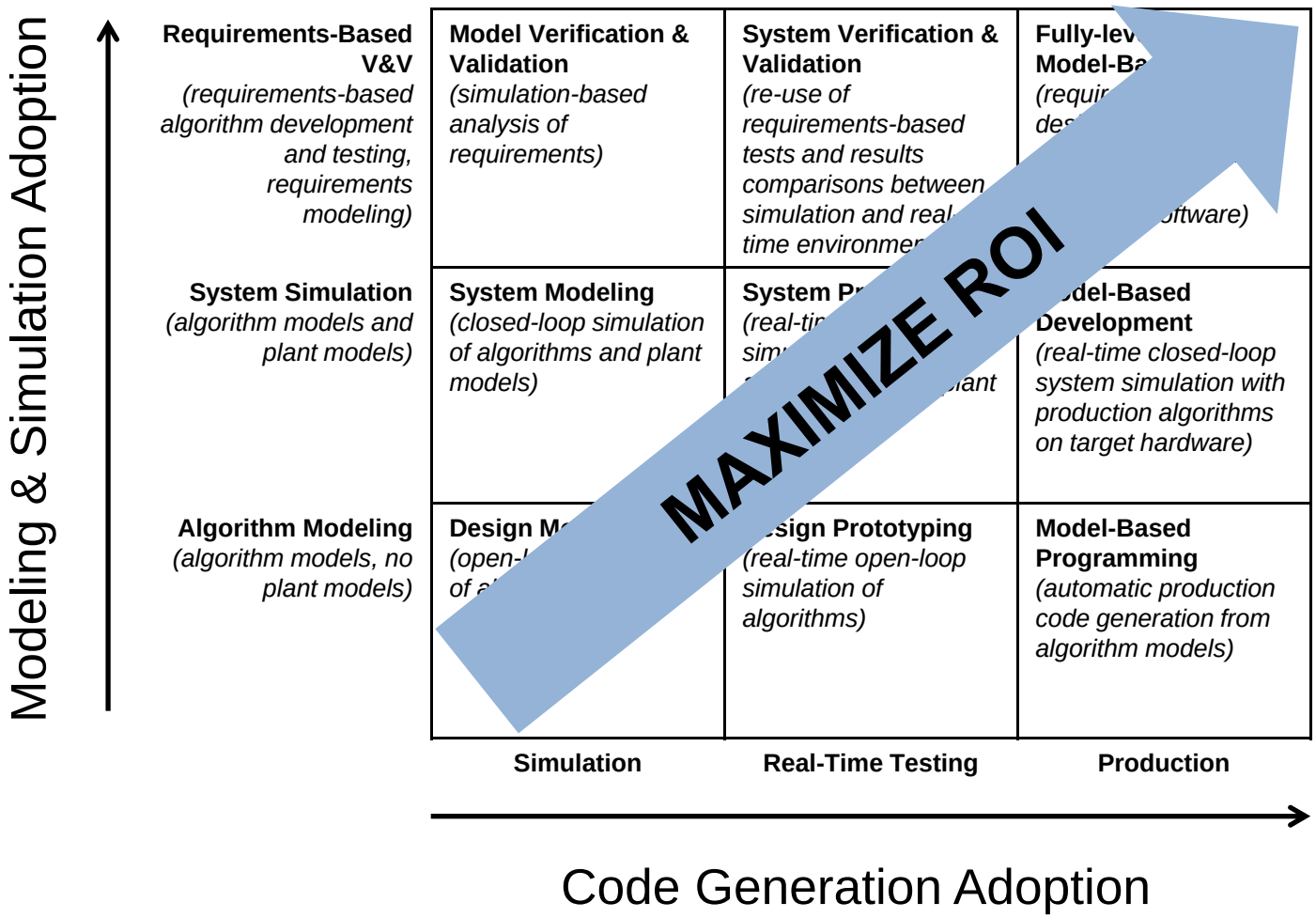
Workflow Example

* DO-178C Qualifiable Tool

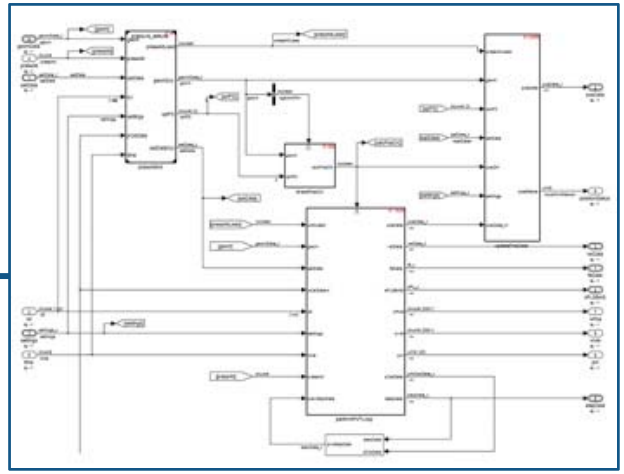


Abbreviations
SL: Simulink
SLVNV: Simulink Verification and Validation
RMI: Requirements Management Interface
SDD: System Design Description
SLDV: Simulink Design Verifier
SLRG: Simulink Report Generator
PS: Polyspace
RTE: Run-Time Error
EC: Embedded Coder
PIL: Processor-in-the-Loop

Model-Based Design Maturity



Septentrio Streamlines DO-178B Certification with MATLAB and Simulink



Simulink model of part of the AiRx2 system.

Challenge

Obtain DO-178B certification for a GNSS-based landing system for precision aviation applications

Solution

Use Model-Based Design with MATLAB and Simulink to trace requirements, architect system components, simulate the design, and generate and verify source code

Results

- Design test cases reused on generated C source code
- Models verified via simulation, ensuring virtually bug-free code
- Key SOI-1 certification milestone achieved

"Model-Based Design enabled us to streamline the certification process by tracking requirements, verifying the design using simulation, and maintaining the system model as the single source of truth throughout development."

Jan D'Espallier
Septentrio

Link to article

Eurocopter Accelerates Development of DO-178B Certified Software with Model-Based Design

The Eurocopter EC130 helicopter.

Challenge

Speed the development, validation, and verification of DO-178B certified helicopter flight software

Solution

Use Model-Based Design to model the system design and software design, and to generate flight code

Results

- Software testing time cut by two-thirds
- Requirements stabilized earlier
- Certified flight software automatically generated

"We use our system design model in Simulink for ARP4754 to establish stable, objective requirements. We save time by using the model as the basis for our software design model for DO-178—from which we generate flight code—and reusing validation tests for software verification."

Ronald Blanrue
Eurocopter

Link to user story

Airbus Develops Fuel Management System for the A380 Using Model-Based Design

Airbus A380, the world's largest commercial aircraft.

Challenge

Develop a controller for the Airbus A380 fuel management system

Solution

Use MATLAB, Simulink, and Stateflow for Model-Based Design to model and simulate the control logic, communicate the functional specification, and accelerate the development of simulators

Results

- Months of development time eliminated
- Models reused throughout development
- Additional complexity handled without staff increases

"Model-Based Design gave us advanced visibility into the functional design of the system. We also completed requirements validation earlier than was previously possible and simulated multiple simultaneous component failures, so we know what will happen and have confidence that the control logic will manage it."

Christopher Slack
Airbus

Link to user story

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- 662,000 visits per month
- File Exchange
  - Upload/download free files including MATLAB code, Simulink models, and documents
  - Rate files, comment, and ask questions
  - More than 9,000 contributed files, 400 submissions per month, 25,500 downloads per day
- Newsgroup
  - Web forum and newsgroup for technical discussions about MATLAB and Simulink
  - 200 posts per day
- Blogs
  - Read posts from key MathWorks developers who design and build the products
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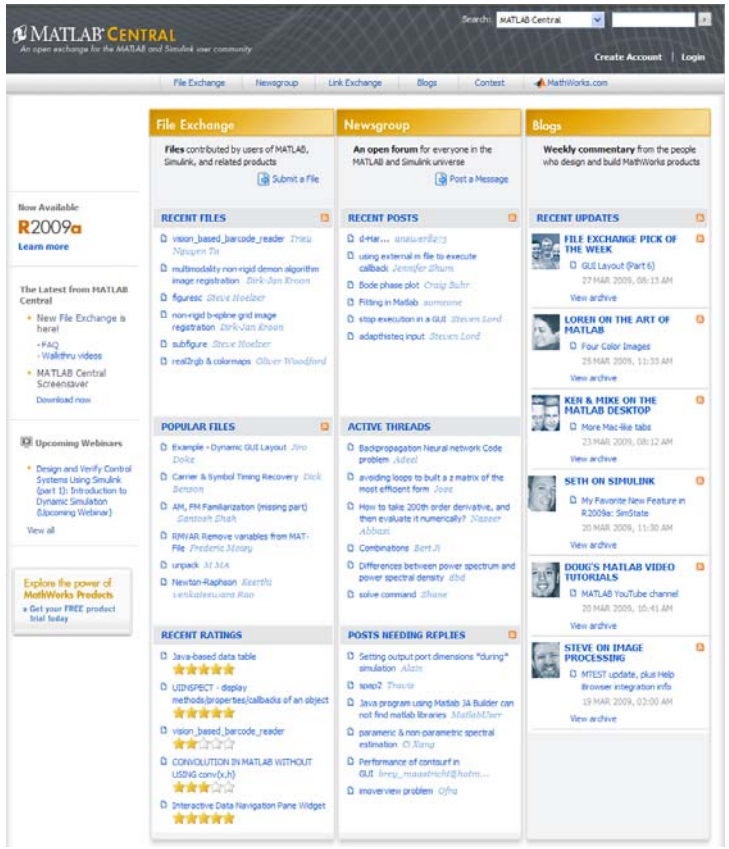

Based on February 2009 data

www.mathworks.com/matlabcentral

Technical Support

Resources

- Over 100 support engineers
  - All with MS degrees (EE, ME, CS)
  - Local support in North America, Europe, and Asia
- Comprehensive, product-specific Web support resources

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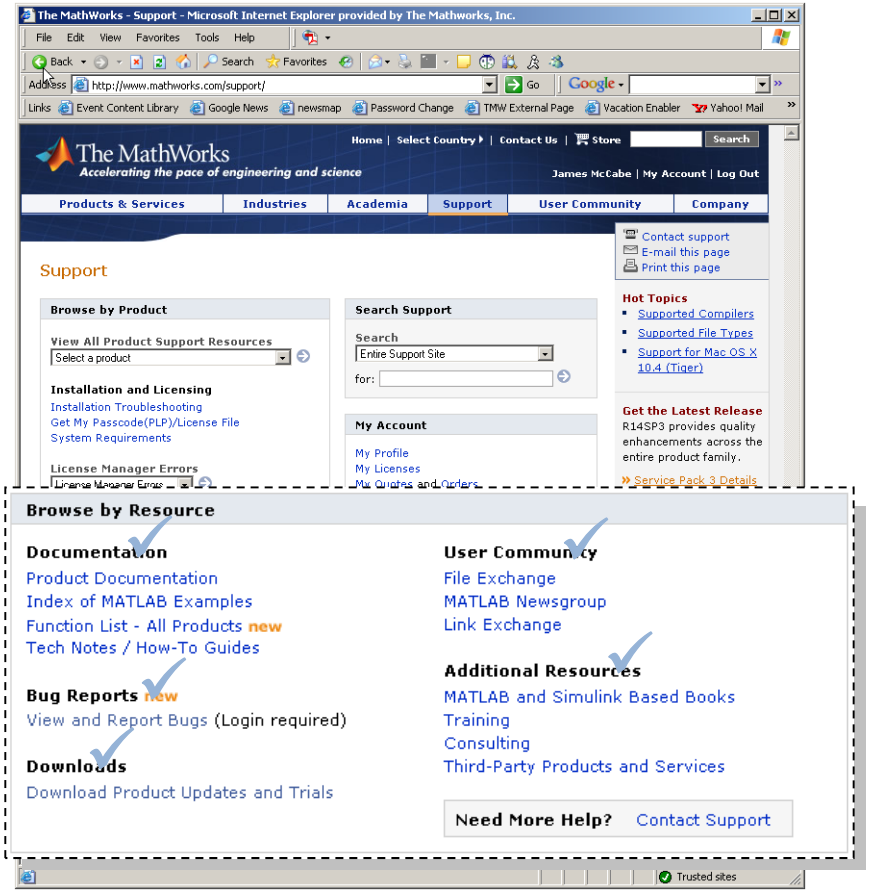
- 95% of calls answered within three minutes
- 70% of issues resolved within 24 hours
- 80% of customers surveyed rate satisfaction at 80-100%



Training

- Three ways to get training
  - Public training
    - Offered throughout the world
    - Schedule and course information at www.mathworks.com/training
  - Onsite training
    - Bring training to your site, with course customization available
  - Web-based training
    - Instructor-led e-learning
    - Train at work or at home, with flexible dates and times
- Example course topics
  - Introductory and intermediate training on MATLAB, Simulink, Stateflow, and Real-Time Workshop
  - Specialized courses in control design, signal processing, parallel computing, code generation, communications, financial analysis, and other areas

Consulting

- Engineering expertise and deep product knowledge, specializing in:
  - Application development using MATLAB
  - Model-Based Design using Simulink and Stateflow
  - Embedded systems development
  - Enterprise-wide integration of MathWorks products into engineering process and systems
  - Jumpstart services for a fast, smooth transition to MathWorks products
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