WHITE PAPER

Why Adopt Model-Based Design?

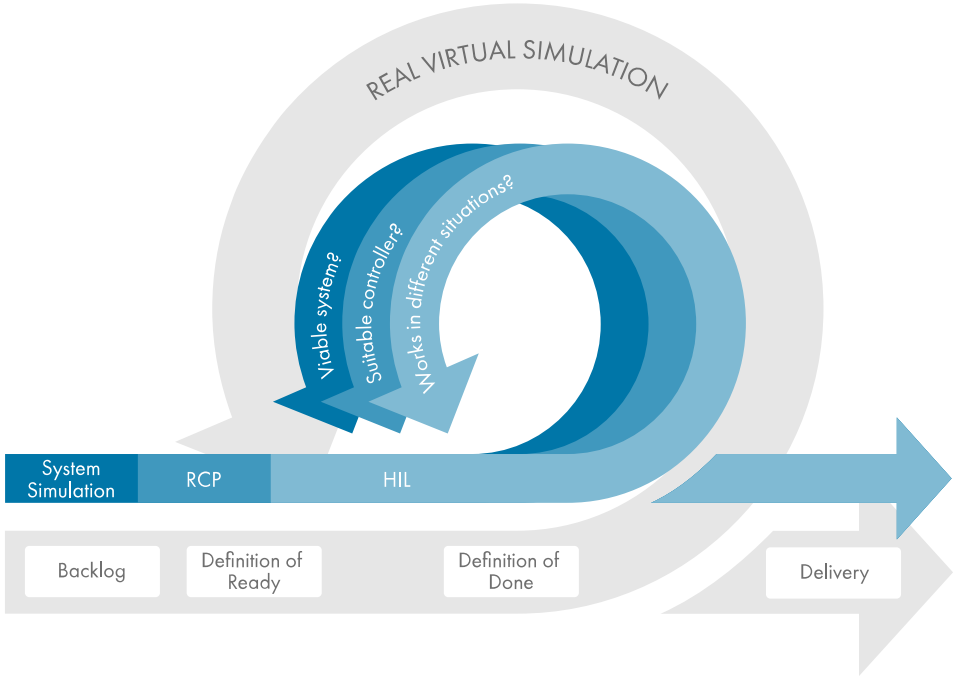
As requirements for increased product performance drive up design complexity, software is increasingly becoming the differentiating factor in a product's success in the marketplace. Faced with the need to create more complex software with better quality in less time, engineering has turning to Model-Based Design.

MathWorks®

What Is Model-Based Design?

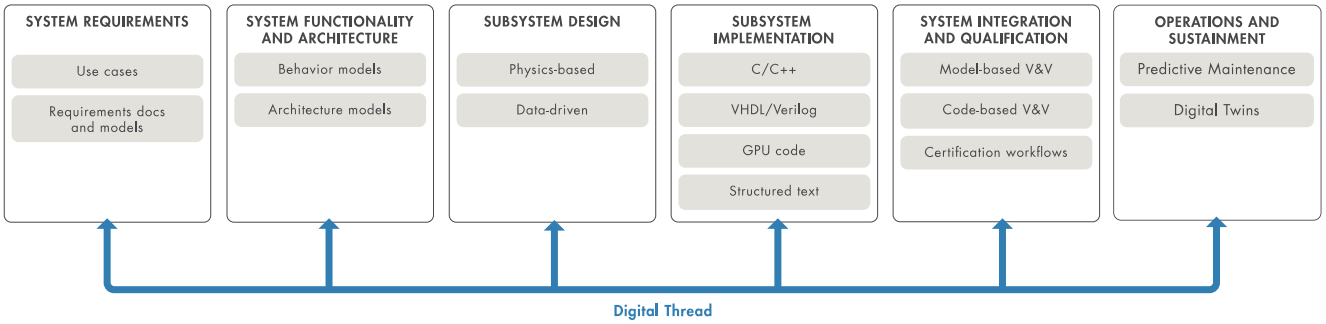
Model-Based Design provides a mathematical and visual approach to develop complex systems. It supports and encourages collaboration by providing a common language for cross-functional teams that work in multiple domains. Model-Based Design is used across a wide-variety of industries and applications, including motion control, signal processing, industrial equipment, aerospace, and automotive applications. It centers on the systematic use of models throughout the development process for requirements specification, system architecture modeling, design implementation, simulation, automatic code generation, and verification and validation.

Model-Based Design complements and enables Agile development practices. Like Agile, Model-Based Design enables developers to discover defects and design problems in the early stages of a project, accommodate changes in requirements, and deliver a system that meets customer needs. For example, users can perform fast iterations by connecting with continuous integration (CI) systems to automatically test and verify models and code throughout the development lifecycle.



Agile system development with Model-Based Design centers around simulation and code generation to incrementally deliver design and test artifacts, studies, and evaluations.

Model-Based Design supports digital transformation of your products and services. Users can further extend the use of previously developed models to the systems in operation, creating digital twins to optimize system operation, monitor system status, and provide a feedback mechanism to the development team to make continuous improvements. This approach enables applications such as predictive maintenance and real-time fault detection.



Model-Based Design: Systematic use of models throughout the development process.

Achieve Your Business Objectives

Market leaders use Model-Based Design to:

Bid on—and win—more projects.

> "Recently we won a project that several of our competitors declined to bid on because of its tight time constraints. Using Model-Based Design, we met the original delivery date with no problem."
>
> — *Lear Corporation*

Create products that could not have been developed otherwise.

> "In the past, it was prohibitively expensive to build the necessary controller hardware for specialized products. With Simulink, we can easily implement our controller designs on our existing PLC hardware. [We can now] pursue new business opportunities for engineering low-volume controller products."
>
> — *Festo*

Generate sales and revenue earlier.

> "Our three-person team completed a fully functional prototype in just six months with MathWorks tools. Without these tools, we would have had to extend the project at least by another six months."
>
> — *Océ Technologies*

Offer features and performance that the competition cannot match.

> "The hybrid hydrostatic drivetrain we designed and optimized with Model-Based Design was about 25% more fuel-efficient than a standard hydrostatic drivetrain, with a 15–20% lower total cost of ownership."
>
> — *FMTC*

Achieve product quality that the competition cannot match.

> "Simulations and real-time testing with Simulink helped us deliver an exceptionally reliable control system. Our controller has proven more reliable than traditional systems, and has caused no down time in production, which is important because outages can cost €5,000 or more per hour."
>
> — *Metso*

Reduce Expenses and Waste

Engineering teams achieve success in their development and operations with Model-Based Design through:

- Modeling, simulation, and code generation
- Reuse of models for certification, documentation, and artifact generation
- Adoption of Agile, continuous integration, and digital transformation

Modeling, Simulation, and Code Generation

Use fewer and less expensive components.

> "Initial estimates for the Lanai system included a 700 kilowatt-hour battery. The Simulink simula¬tions demonstrated that a battery about half that size would be sufficient and that a flexible AC trans¬mission device was not needed. Together, that amounted to more than $200,000 in cost savings."
>
> — *Sandia National Lab*

Minimize the number of physical prototypes.

> "For this project, the performance of the actual hardware matched the simulation results from our Simulink model of the maglev system, so we did not need to modify our test system. Eliminating multiple prototypes saves time and—when the prototype costs $20,000 to $30,000, as it did for this project—reduces costs significantly."
>
> — *Korea Institute of Machinery and Materials*

Reuse models and adapt designs.

> "On past programs, when we made a small design change we sometimes had to wait weeks for the software team to code it. With Simulink and Embedded Coder we simply made the change and regenerated the code. We had a new test build within an hour."
>
> — *Bell Helicopter*

Eliminate penalties for missed deadlines.

> "If we had to wait until the rest of the vehicle was complete before testing our suspension design, it would not have been possible to meet our aggressive delivery date."
>
> — *Rod Millen Special Vehicles*

Reuse of Models for Certification, Documentation, and Artifact Generation

Lower documentation costs.

> "We used our Simulink and Stateflow models as an executable specification, which streamlined the design review process significantly. We completed a thorough review in 10% of the time we've required in the past while eliminating 90% of the paper documentation used at every review stage."
>
> — *Mitsuba*

Reduce certification cost and time.

> "Modeling, simulating, and implementing the ventilator's embedded software with Simulink greatly simplified compliance certification. The model provided thorough documentation and a visual representation of the system for the certification review."
>
> — *Weinmann*

Adoption of Agile, Continuous Integration, and Digital Transformation

Use smaller teams.

> "Model-Based Design—with its graphical design and automatic code generation—reduces software bugs, improves software maintainability and reuse, and reduces the difficulty of software develop¬ment. This enabled us to build a development team consisting of engine and control specialists within the shortest possible time."
>
> — *Weichai Power*

Reduce time required to adapt to change using Agile.

> "At a late stage in the project, we received a new requirement for the controller to provide feedback on its own status. That kind of change would take at least a week to make with hand coding, but with Model-Based Design, we simply made a minor change to the model and fulfilled the requirement in one day. The ability to implement this kind of change without incurring time and cost overruns was a significant advantage for us."
>
> — *DEMCON*

Reduce testing duration, while improving code quality using continuous integration.

> "We have dozens of engineers worldwide working in parallel on the same model with lots of merges. Using Model-Based Design and CI together, we've shortened iterations and automated testing processes."
>
> — *Vestas*

Lower cost of supporting assets in operation.

> "With MathWorks tools we can collect data from the production press and simulate the error condition in-house. This considerably reduces time to resolution for our customer, as well as our own support and travel expenses, because our printing presses are sold all over the world."
>
> — *manroland*

Reduce warranty costs.

> "Industry-wide, the number of warranty issues has grown with software complexity. For the most recent products that we have completed using Model-Based Design, we've had no warranty issues related to application software after 12 months of production. That is a record that our current and future customers are happy to hear."
>
> — *Lear Corporation*

Adoption of Model-Based Design for Small Teams

Even with the potential benefits of using Model-Based Design, engineering managers often consider the risks of changing their development processes. This is especially true for smaller groups that do not have dedicated staff to pilot a new process and learn new tools. However, once companies ramp up on Model-Based Design, they often report that it would have been riskier not to do so.

To understand the experiences and approaches to adoption for small teams, see the white paper *"How Engineering Teams Adopt Model-Based Design."*

Summary

Adopting Model-Based Design is a game changer for systems development. For companies whose products cost thousands or millions of dollars, reducing the number of prototypes by just one unit is enough to prove out the ROI. Companies with low-cost products that can have a high market share, if they're first to market, also see a large ROI. For them, the value driver of Model-Based Design is the accelerated development. In all scenarios, companies achieve dramatic, ongoing benefits by using Model-Based Design for their system development.

To learn more about calculating ROI for Model-Based Design, see the white paper *"Measuring the Return on Investment of Model-Based Design."*

Learn More

- *Model-Based Design*
- *Simulink*