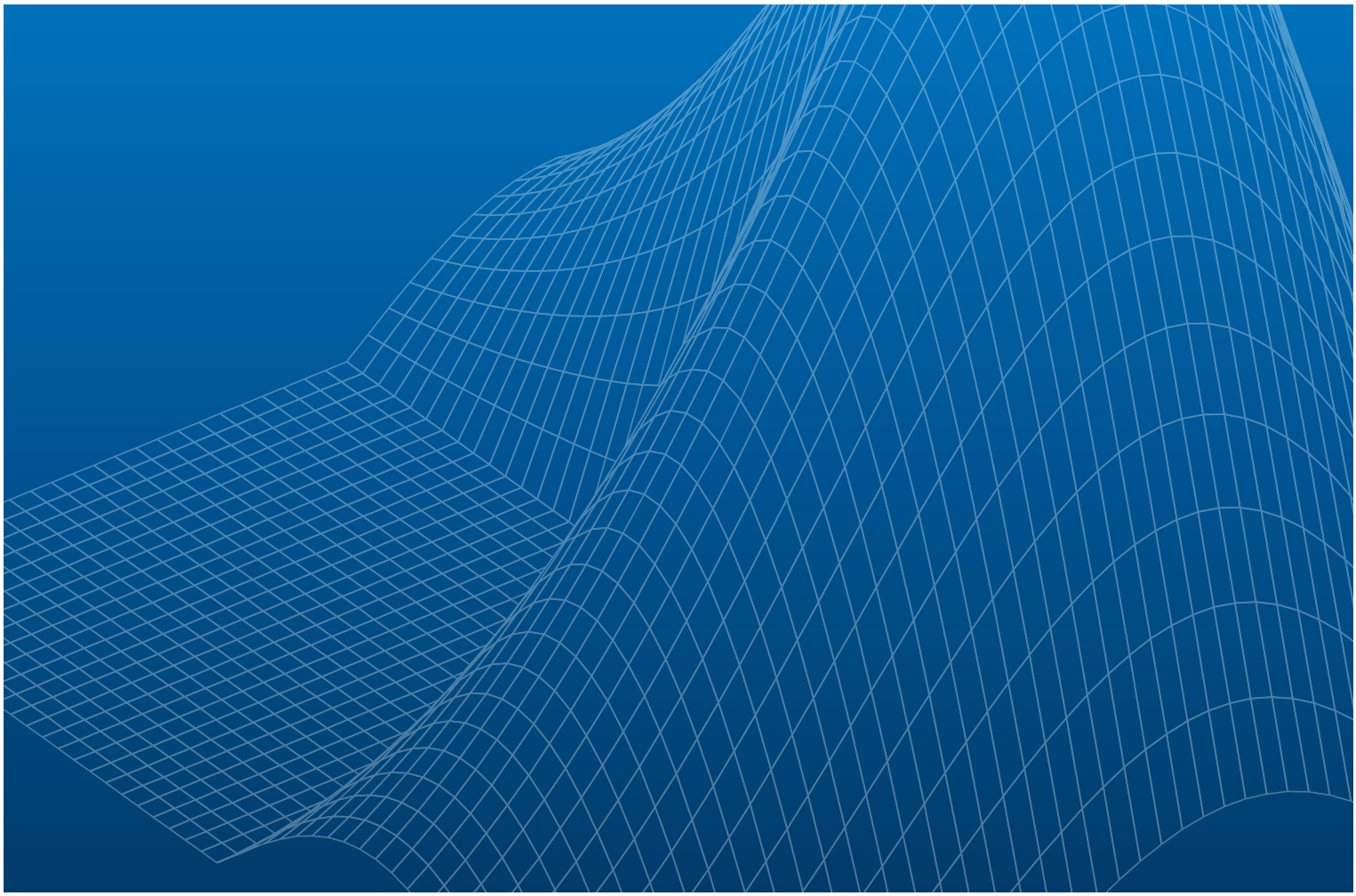

Why Adopt Model-Based Design for Embedded Control Software Development?

As requirements for increased product performance are driving up design complexity, embedded 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, engineers are turning to Model-Based Design.

WHITE PAPER

MathWorks®

What Is Model-Based Design?

Model-Based Design is a mathematical and visual approach for the development of complex control systems. It is systematic use of models throughout the development process for design, analysis, simulation, automatic code generation and verification. It is broadly used in motion control, industrial equipment, aerospace, and automotive applications.

Model-Based Design is analogous to CAD software, which allows mechanical designers to create virtual assemblies to understand whether product parts will work together before even being manufactured. Likewise, Model-Based Design lets embedded software developers create simulation models to understand whether algorithms will work before the embedded code is written.

It also helps optimize overall system design. Through virtual prototyping, system engineers can easily see whether the whole system (mechanical, electrical, hydraulic, and pneumatic, plus embedded software) will work as intended, even before the hardware is manufactured and available for testing.

Embedded software developers can automatically generate embedded code from simulation models, similarly to how a CAD drawing is automatically translated to numeric control (NC) instructions.

Impact to the Top Line

Companies that use Model-Based Design can:

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."
– *Oce 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*

Impact on Expense Reduction

Engineering teams reduce materials and development costs because they can:

Use fewer and less expensive components.

"Initial estimates for the Lanai system included a 700 kilowatt-hour battery. The Simulink simulations demonstrated that a battery about half that size would be sufficient and that a flexible AC transmission 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.

"After implementing the PLC version with Simulink PLC Coder, with a few modifications we generated the microprocessor code using Embedded Coder. We switched from a structured text implementation to C, just by changing the code generation product."
– *Iveco*

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 development. This enabled us to build a development team consisting of engine and control specialists within the shortest possible time."
– *Weichai Power*

"Even if we had added engineers, we could not have completed the projects on time because a larger team would add to the communication challenges."
– *Siglead*

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*

Lower support costs.

"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 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*

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*

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."
– R*od Millen Special Vehicles*

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 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 whitepaper: "How Smaller Engineering Teams Adopt Model-Based Design"

Summary

Adopting Model-Based Design is a game changer for embedded 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. Equally rewarded are companies with low cost products and the potential for high market share if first to market. 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 embedded software development.