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Why Can't We All Get Along? Rules for Cooperative Electrical and Mechanical Product Design

SOLIDWORKS

This research has been sponsored by Solidworks

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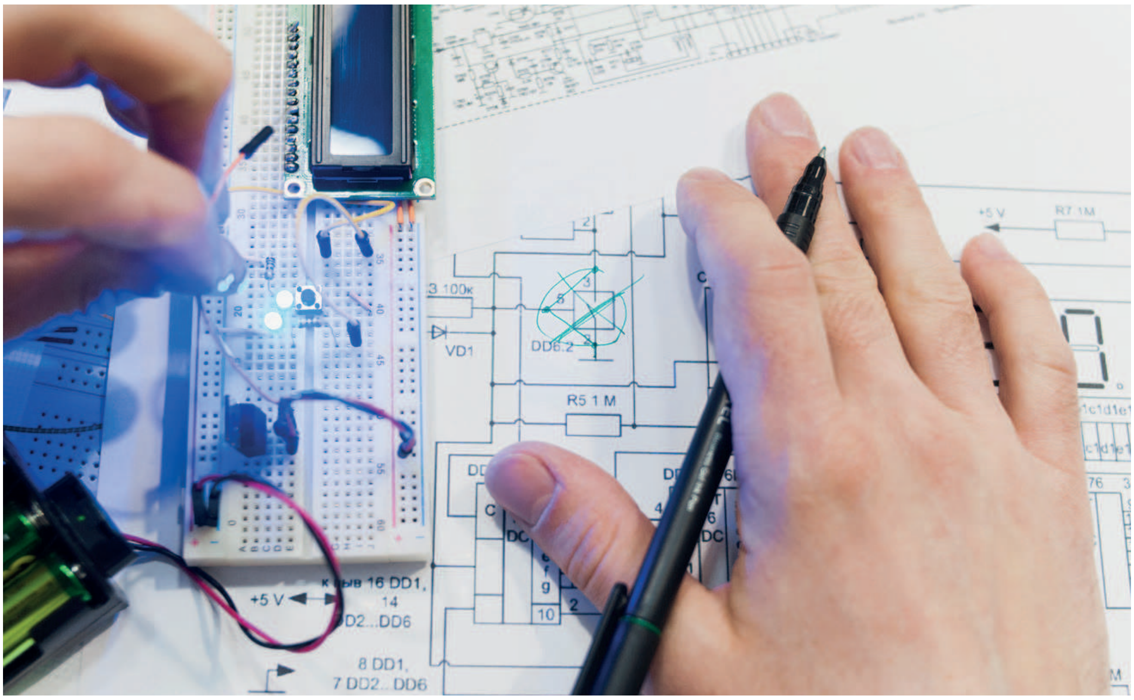
INTRODUCTION

Cooperation and collaboration between mechanical and electrical designers are absolute necessities for developing innovative electromechanical products. But why and how do some teams succeed at achieving this while others fail? Why do some multi-discipline teams get along and prosper while others struggle just to get the job done? Successful integrated multi-discipline teams have the right electromechanical product development mindset and follow some common basic rules that help ensure their success.



Engineering.com has surveyed 265 design team members to determine how they integrated electrical CAD (ECAD) and mechanical CAD (MCAD) design in a cooperative effort for developing successful electromechanical products by adhering to some basic rules. This background information will inform some of the material laid out in this eBook.

There are obvious and not-so-obvious similarities and differences between ECAD and MCAD. Successful product development teams embrace the similarities and overcome the differences through a cohesive effort.

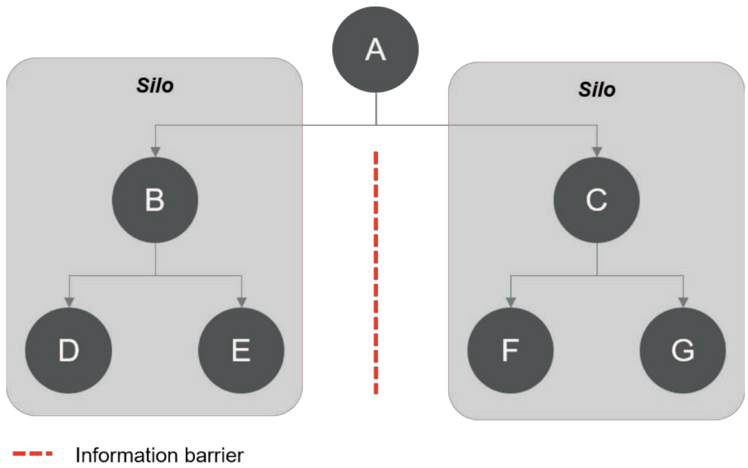
Electrical and mechanical design engineers need the right mindset to work more closely together to ensure a successful outcome, but they also need integrated ECAD and MCAD tools and support systems.

This eBook presents the importance of a product mindset that promotes informed decisions across a company by eliminating boundaries and bringing coherence to the electromechanical product development process by following some simple rules that have been proven to work.

RULE NO. 1: ENSURE DESIGN TEAMS CAN COMMUNICATE WITH UNIVERSALLY-SHARED DATA

Delivering complex electromechanical products to market requires cross-discipline teams that operate at different rhythms with different requirements and introduce new methodologies and practices. But all must be in sync with one another. Many organizations encounter difficulty keeping up with the rapidly accelerating pace of demands/change in electromechanical product development, especially when their teams work in silos using outmoded systems and processes.

Silos are especially problematic if there are egos involved (and there will be), or if a project and its goals are not well-defined upfront. These among other problems can result in information being withheld from other departments which is, in turn, detrimental to the cross-disciplinary design teams and final product.



MCAD and ECAD silos of knowledge, experience and separate expectations don't work when designing electromechanical products—too little cross-disciplinary knowledge is exchanged that impact overall design decisions.

Electromechanical product development demands approaches that are fully collaborative, with live data being shared and accessed by global teams. Teams must work together throughout the entire product development lifecycle. The solutions a company employs can be a key differentiator in delivering optimum product value. Outdated document-based methods delay progress while an evolutionary leap forward comes from digitally modernizing the requirements definition, and the engineering and management processes.

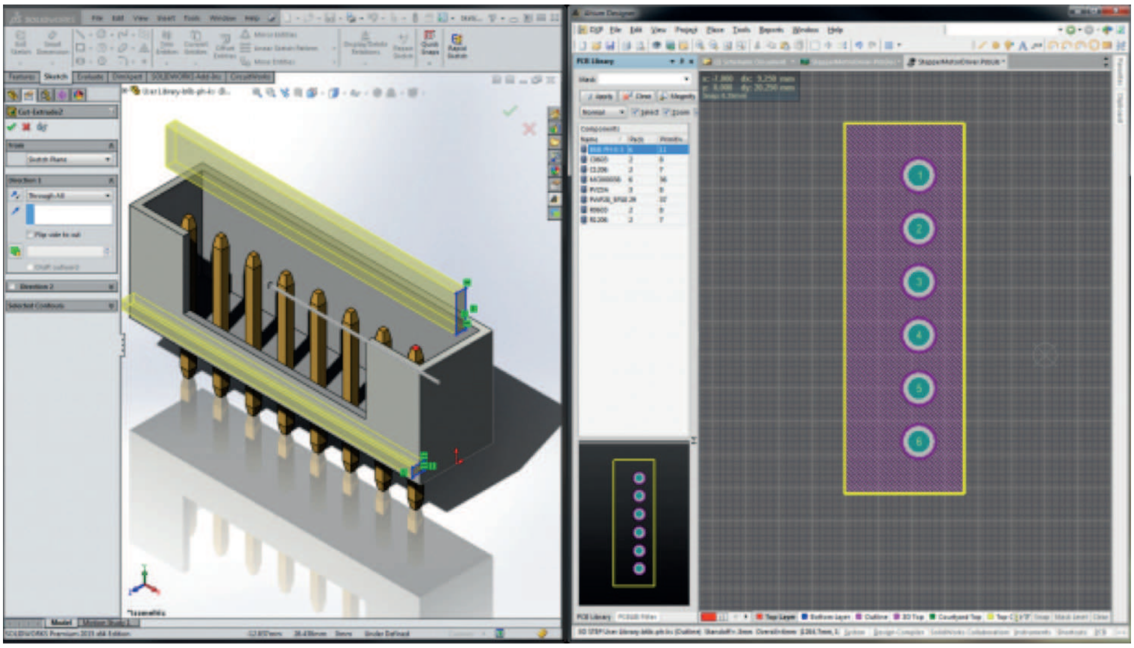
Progressive integrated teams see these disruptive technologies not as a threat but as an opportunity, embracing the change rather than challenging it.

These same teams working in complex manufacturing industries can take specific actions to help them manage complexity, coordinate effectively and develop, verify and validate more quickly.

RULE NO. 2: CLOSING THE GAP BETWEEN ECAD AND MCAD

Obviously, there are differences between ECAD and MCAD processes and the bills of material each generates, but there also some similarities. Namely, they both contain components or parts.

Essential for ECAD and MCAD to work together as one are bidirectional workflows. When something is created or changed on the mechanical side, the creation or change implications are noted on the electrical side that might influence the overall electromechanical design. It would change to accommodate accordingly. The converse would hold true for a change being made on the electrical side. It would be accounted for and reflected on the mechanical side.



SOLIDWORKS and Altium Designer working on the same component with unified component data. (Image courtesy of SOLIDWORKS.)

Bidirectional workflows also ensure real-time design collaboration, interoperability and flexibility, especially for those inevitable last-minute design changes.

For a bidirectional workflow to function effectively, a single-source parts library is essential. This is one common library for schematic symbols, 2D footprints and 3D models that provides a single, cohesive source of truth.

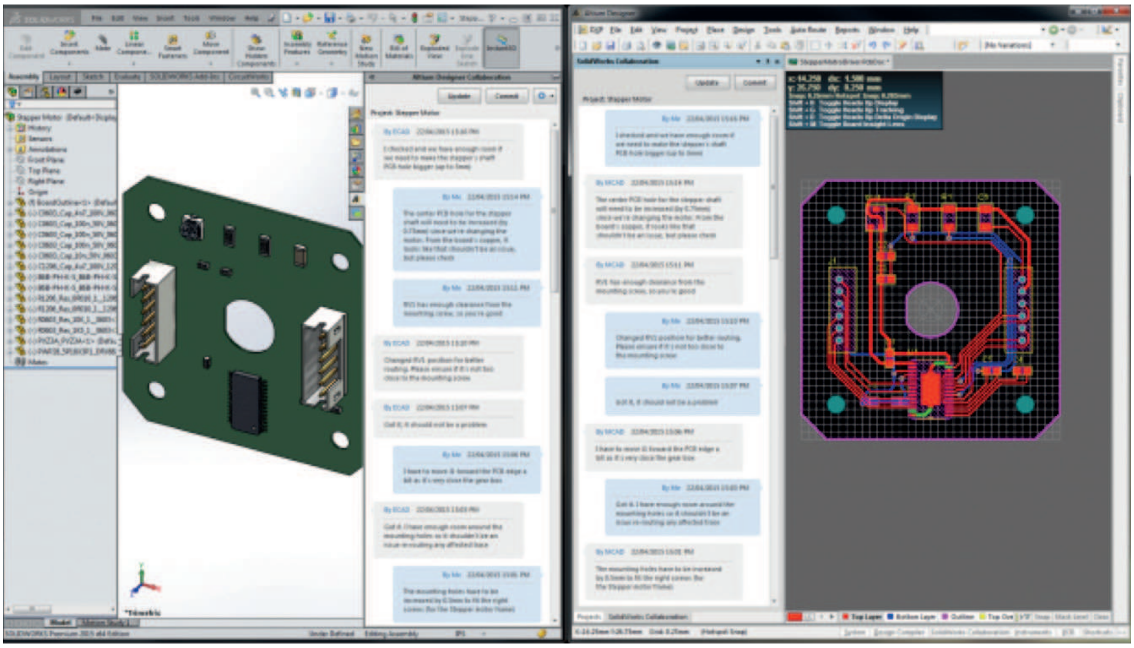
RULE NO. 3: DIGITAL TOOLS MUST BE COMPATIBLE ACROSS ENGINEERING DISCIPLINES

Tools that don't "talk" to each other, are not associative, and inhibit a bidirectional workflow are tools that lead to big problems. For example, when a mechanical change is made, it is not reflected on the electrical side and vice versa.

Some reasons for electrical and mechanical tool incompatibility include:

- Design tools address specific aspects of the design process, such as electrical or mechanical, and provide no support for comprehensive electromechanical design.
- Different tools have been designed and applied in different contexts with no regard for their interaction with other disciplines. As a result, they use incompatible representations that can require manual translation from one tool to another.
- The kinds of abstraction, reasoning and problem-solving that are natural for one discipline are usually not supported by the other discipline.

There is no guarantee that design tools coming from different vendors are compatible and will work together because user interfaces, underlying algorithms and design paradigms are different. This issue is compounded by the fact that although electrical and mechanical design do share some similarities, they also possess differences that can prompt incompatibility.



SOLIDWORKS and Altium Designer with comment and revision history tracked in the design process. (Image courtesy of SOLIDWORKS.)

On the other hand, electrical and mechanical design applications coming from a single vendor, such as SOLIDWORKS, are much more likely to be compatible with each other and the workflow for developing electromechanical products.

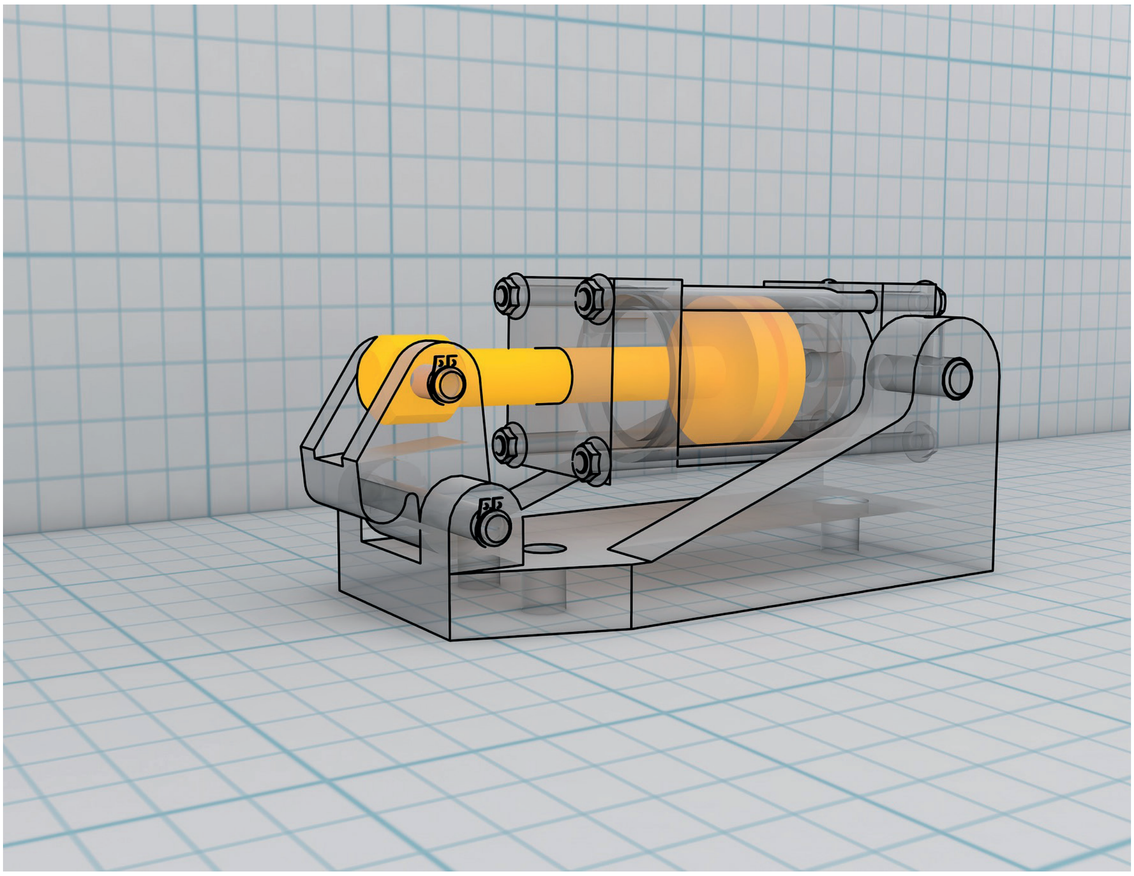
RULE NO. 4: MINIMIZING DATA TRANSLATION OVERHEAD AND MAXIMIZING RESULTS

There's an assumption that the design-to-manufacturing process is seamless, which should, as a consequence, help all parties control costs and accelerate time-to-market. However, the reality is far from perfect. Common to most processes is the bottleneck of errors and inaccuracies in 3D MCAD or ECAD data when one format is read in another CAD suite.

Accurately translating CAD files between different CAD suites is often necessary. If the data is not translated correctly, there will be difficulty in the subsequent steps of product development. For example, errors may force a team into many engineering man-hours for making a CAD file readable and, following that, additional hours for design optimization and changes.

This has major impacts. First, it adds another layer of costly engineering work, which translates into higher fiscal costs and delays. Second, it adds an unnecessarily complicated layer of work.

Fortunately, SOLIDWORKS offers a means to reduce such risks and costs by providing integrated tools that minimize problems associated with data translation coming from electrical and mechanical teams working together.



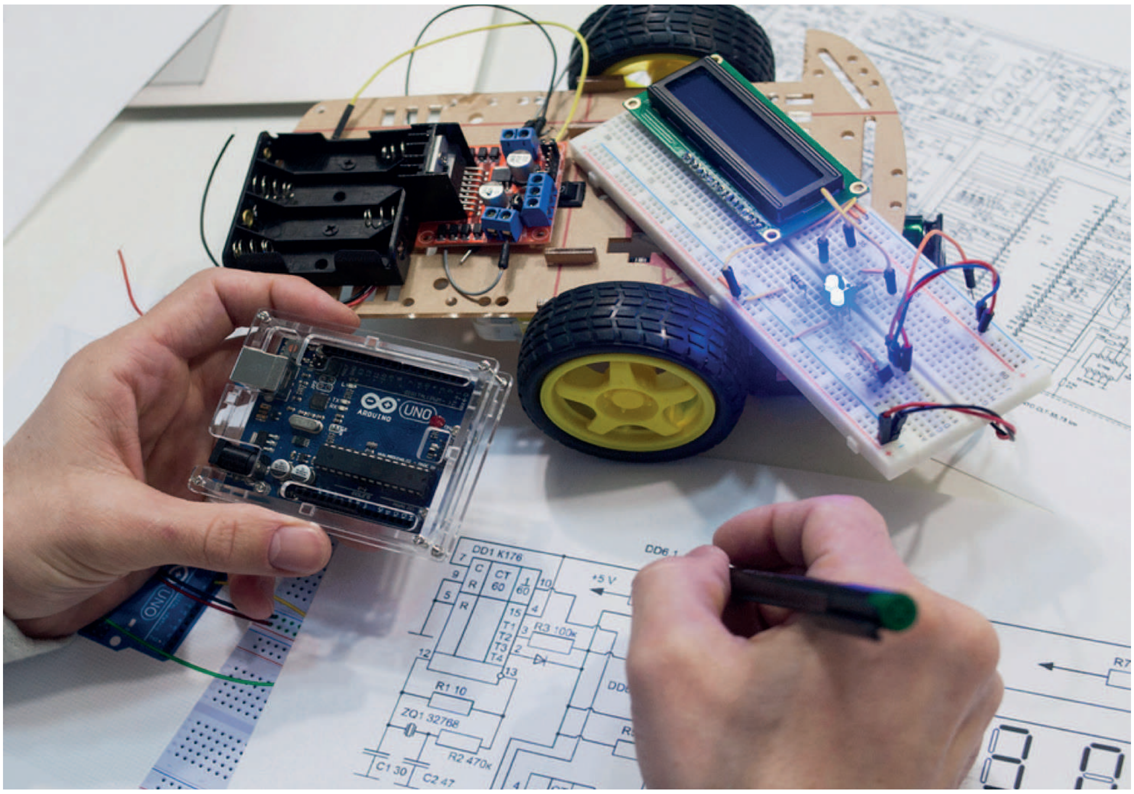
RULE NO. 5: SOLVING THE PROBLEM THAT WON'T GO AWAY—INTEROPERABILITY

Related to data translation, another major challenge that has been ever problematic in electromechanical product development is interoperability.

Simply put, engineering data interoperability is the ability to reuse data in diverse systems through data translation and transfer. The data can be 3D (solid models), 2D (drawings) or text, but the goal is to allow transfer of engineering information among diverse stakeholders in a way that adds value to the product development lifecycle. Some characteristics of effective data interoperability include:

- Data is created once and can be translated and transferred to other systems.
- Data translation is standards-based for uniformity, predictability and reduced risk.
- Data integrity is preserved with accuracy, consistency and completeness across ECAD and MCAD systems.
- Companies use their best practices and software tools from a single vendor to ensure interoperability.

The interoperability challenge is further compounded by the growing need to provide engineering information for support extending beyond the life span of individual software applications.



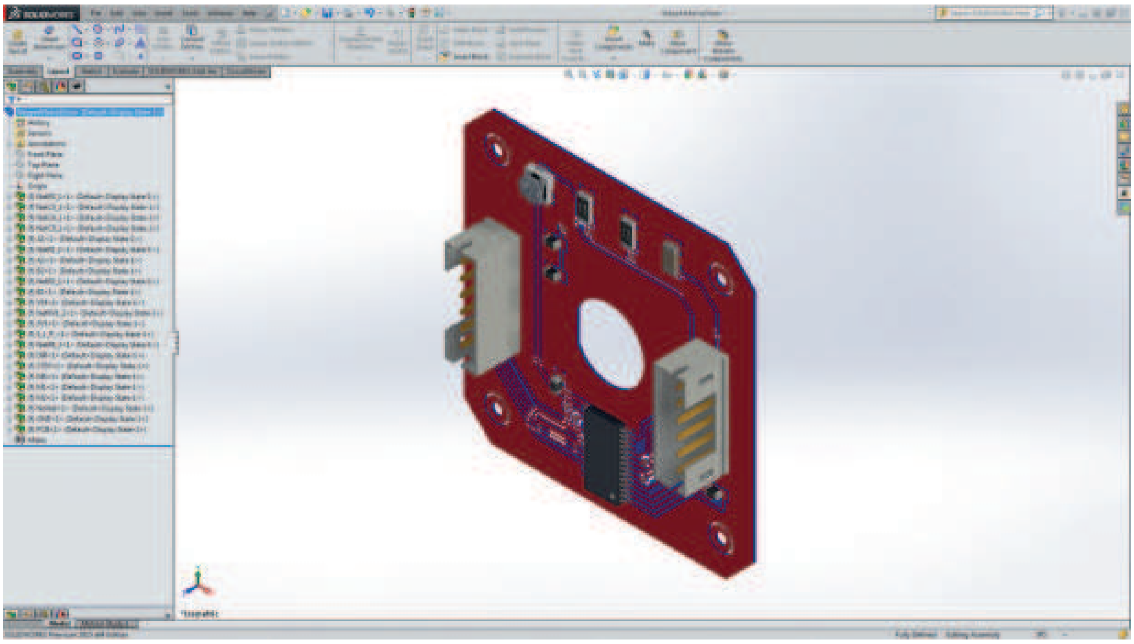
Think of it this way—ECAD or MCAD software applications may be relevant for, say, 10 years; whereas the product being designed by them may have a life span of 50 years or more.

The challenge is further compounded by the growing need to provide engineering information for support extending beyond the life span of individual applications. In fact, there is a high probability that the data will not be interpretable by another system in the distant future.

There are significant risks to any business associated with not adopting data interoperability standards in preparing for the future. However, there are ways to mitigate the risks, including:

- Implementing standards-based interoperability thinking in decision-making,
- Developing a data succession plan and an application obsolescence plan,
- Analyzing and evaluating application functionalities from competing application providers prior to acquisition,
- Choosing an application ecosystem and sticking with it,
- Avoiding any application customizations, and
- Committing to a pre-defined plan.

Luckily, SOLIDWORKS can mitigate virtually all of the risks by providing a product suite that accommodates ECAD and MCAD interoperability today and into the future.



SOLIDWORKS mitigates interoperability risks with a product suite that accommodates both ECAD and MCAD. (Image courtesy of SOLIDWORKS.)

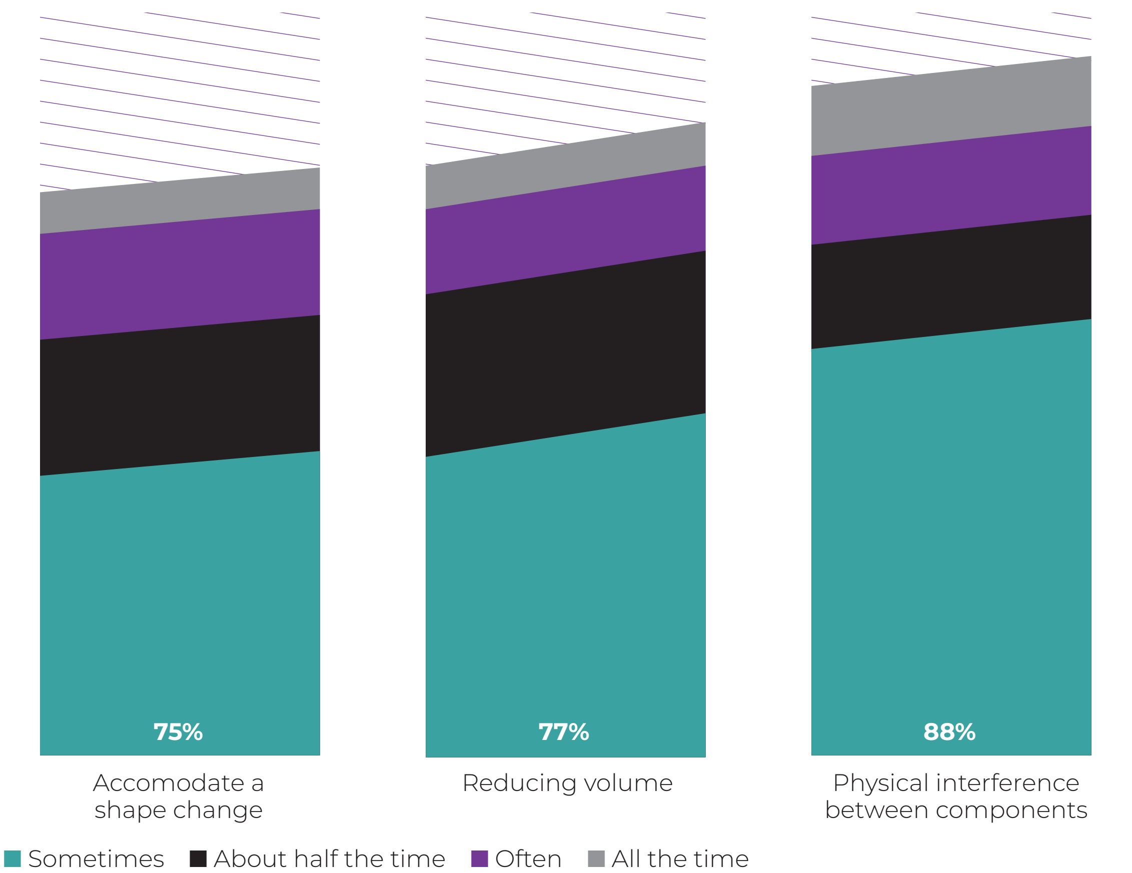
RULE NO. 6: BE AWARE OF INDUSTRY BEST PRACTICES FOR OPTIMIZING THE PRODUCT DEVELOPMENT PROCESS

As we all know, collaboration is good, but good collaboration connects data to the right people at the right time, not a disorganized jumble of files, folders and loose documents. Purposeful collaboration keeps communication connected to and focused on the work at hand.

Although by now this should go without saying, whenever possible, reuse IP. Don't limit reuse to just software code because you can (and should) repurpose entire IP blocks, such as design objects, specifications, test and validation documentation, data sheet content and process information at the outset of new development. With purposeful collaboration integrated into the product development process, teams can be confident they are using only the latest approved and validated information. With best practices that include reusing IP, organizations have a known, trusted template for future success.

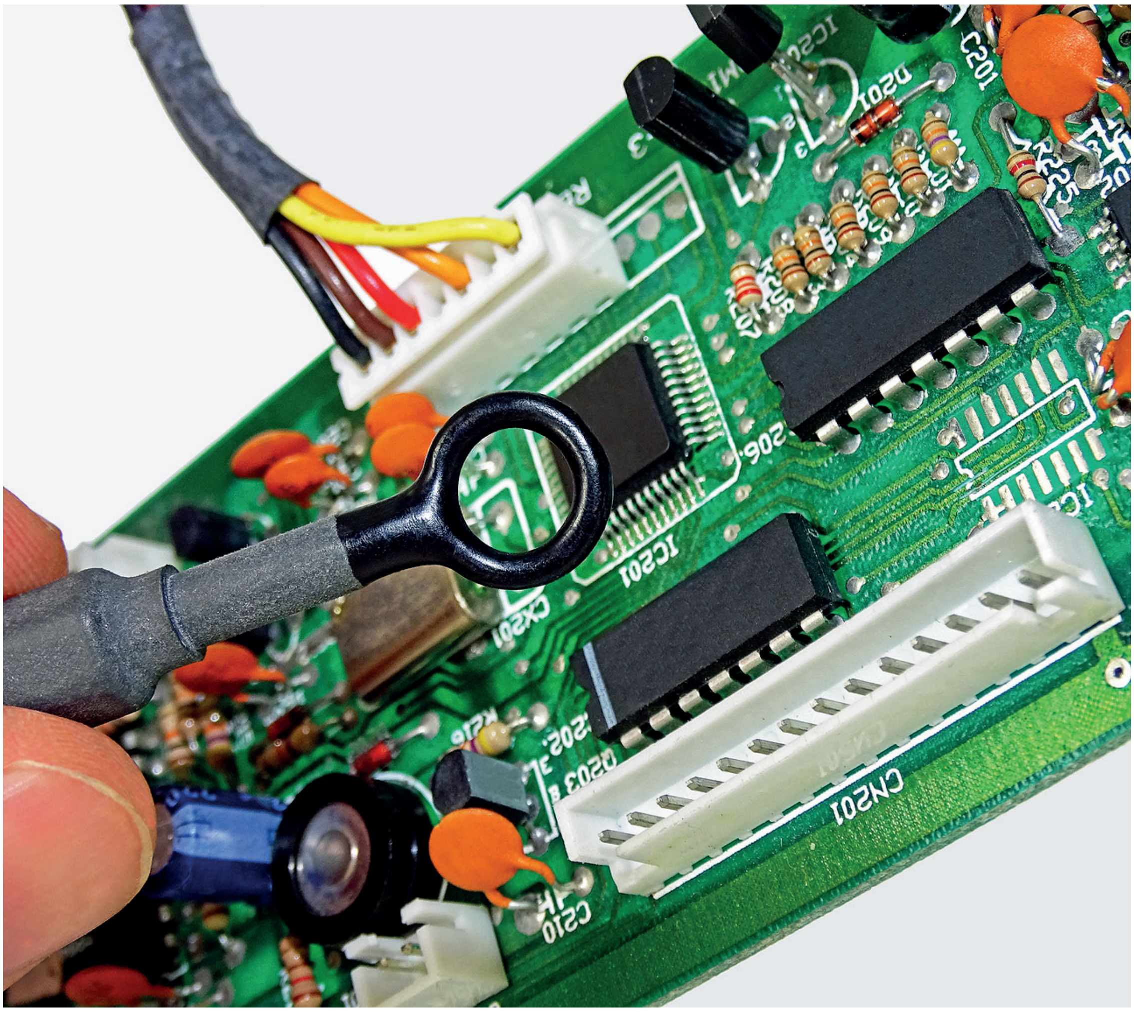
According to the survey conducted by engineering.com, the majority of the product development teams reported losing time and were challenged due to incompatibilities between electrical and mechanical design elements.

How often does your team lose time to the following electromechanical project impediments?



One of the main concerns of electromechanical design is interference between components, reported by over 80 percent of all respondents. It is a situation exacerbated by demands to make electronic assemblies smaller. This is especially true in the field of consumer goods. Reducing overall package volume was the second biggest concern.

A best design practice here revolves around the fact that microprocessors, sensors, memory, power and thermal management subsystems are being pushed into smaller packages, but they also are less expensive and consume less power. These demands have ripple effects throughout the supply chain. Subsystem suppliers not only have to anticipate the features on finished products, but they also need to honor release schedules and component costs.



80 percent of those questions reported that interference between components is a major concern.

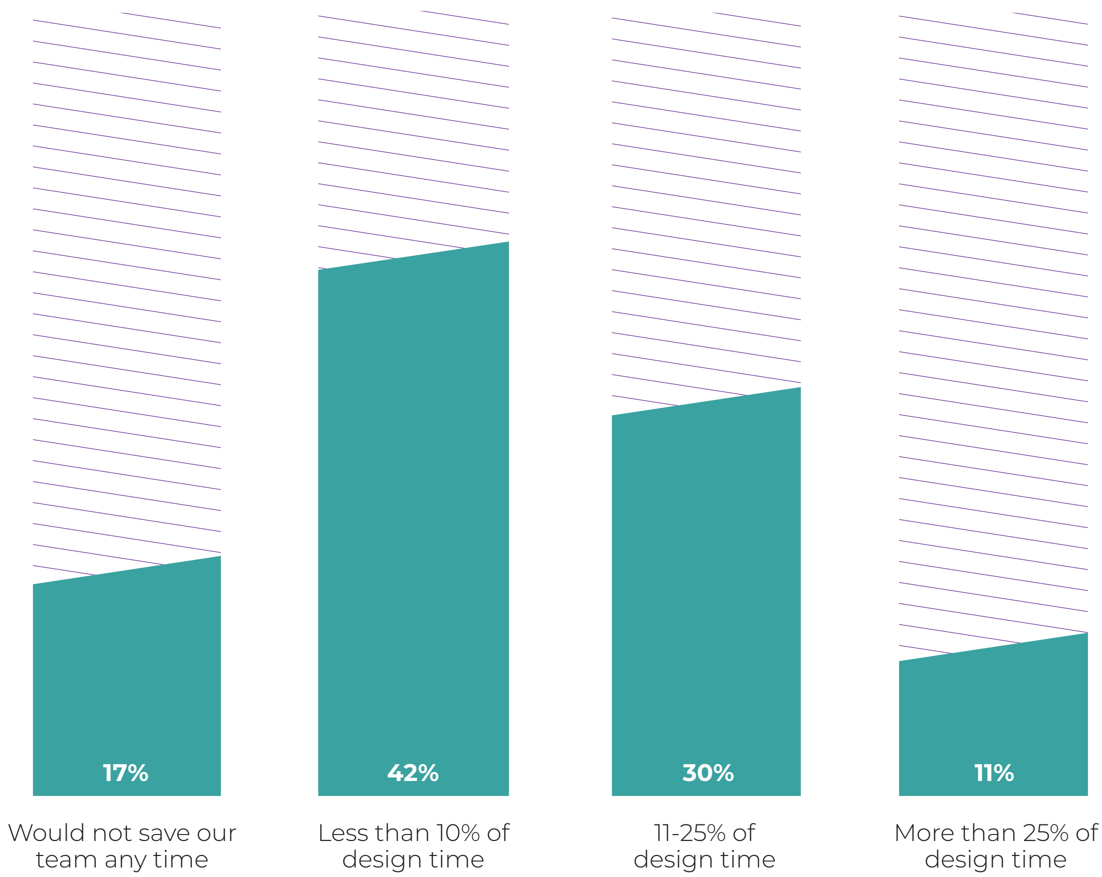
RULE NO. 7: CHOOSE THE RIGHT ECAD AND MCAD SOFTWARE TOOLS TO GET THE JOB DONE

It's pretty obvious that better integration between electrical and mechanical CAD packages could reduce the amount of time design teams spend addressing these issues. Ultimately, it could reduce the overall design cycle time and result in higher-quality products. A single source of truth for the design data that integrates both electrical and mechanical aspects of product design is essential for success.

In the survey, 83 percent of respondents said their design team could save time if they had an integrated system of electrical and mechanical design. In other words, better integrated electrical and mechanical maximizes the development effort.

Additionally, 41 percent said their teams would save more than 10 percent of their total design time. This opportunity could drive teams to investigate opportunities to better integrate these processes. Software vendors are also aware of this opportunity and several, such as SOLIDWORKS, have recently made significant advances in electrical and mechanical integration.

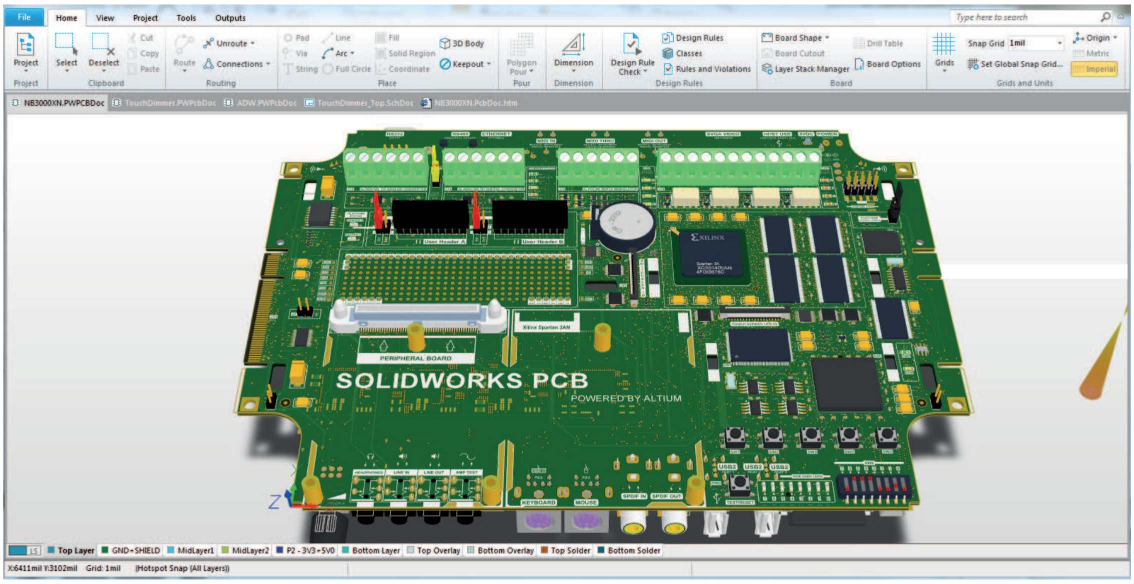
Could integrated electrical and mechanical design save you meeting and rework time?



Research has shown that integrated electrical and mechanical design reduces development cycle times. Other research has shown that product teams are under constant pressure to reduce their product development time. The survey indicates that one of the biggest ways to do that would be through deploying integrated electrical and mechanical design processes, supported with appropriate software that complements the processes.

To succeed, electromechanical design teams need software toolsets that can:

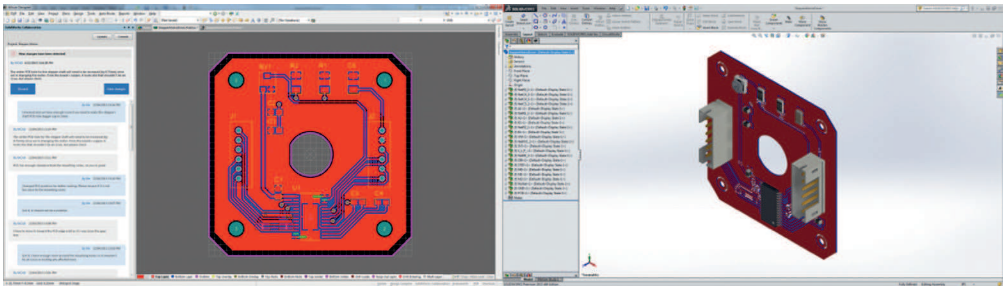
- Provide integrated electrical and mechanical design,
- Mesh MCAD well with ECAD and vice versa for data and processes,
- Exchange data with fluidity and without losses,
- Provide associativity between MCAD and ECAD.



Integrated electrical and mechanical design reduces development cycle times. (Image courtesy of SOLIDWORKS.)

RULE NO. 8: IMPLEMENTING AN INTEGRATED APPROACH WITH BEST-IN-CLASS TOOLS

There are several ECAD and MCAD tools with the capabilities needed to ensure electromechanical product development success. These tools address the needs of multi-user and cross-discipline projects with a synchronized design environment between the electrical and mechanical teams to readily implement schematically-defined electrical systems into a 3D CAD model. Multiple electrical and mechanical engineers can work on the same project simultaneously in real time using advanced database technology within a bidirectional, multi-user environment.



A PCB in Altium Designer and SOLIDWORKS. (Images courtesy of SOLIDWORKS.)

The tools, available from SOLIDWORKS to accomplish these complex tasks include:

ECAD-MCAD Collaboration: Share data between electrical CAD (ECAD) and mechanical CAD (MCAD) designers using a tool that enables teams to share, compare, update and track electrical design data so users can quickly resolve electrical-mechanical integration problems.

Link to 3D CAD from ECAD: Electrical schematics linked to a 3D assembly facilitates verification of proper fit; planning of all wire, cable and harness routes; and provides calculation of all wire lengths prior to assembly.

Common ECAD and MCAD Database: ECAD schematics should be bidirectionally linked and allow multi-user interaction in real time. ECAD and MCAD share a common database, ensuring consistency and facilitating creation of a single, unified BOM.

Electrical Cable, Wiring Harness, Pipe and Tube Routing: Tools to simplify design and documentation of routing for a range of systems and applications.

Library Management: Combine and manage schematic, PCB and mechanical component libraries together in a single location.

Managed MCAD-ECAD ECO Process: A managed ECO process between ECAD and 3D CAD that pushes changes to board shape, component placement, mounting holes and cutouts to and from ECAD and MCAD, ensuring the overall designs are in sync.

Version Control: Manage and compare all history and changes made to design files directly within the software for gaining greater control over changes made to design, as well as know exactly what changes were made and by whom.

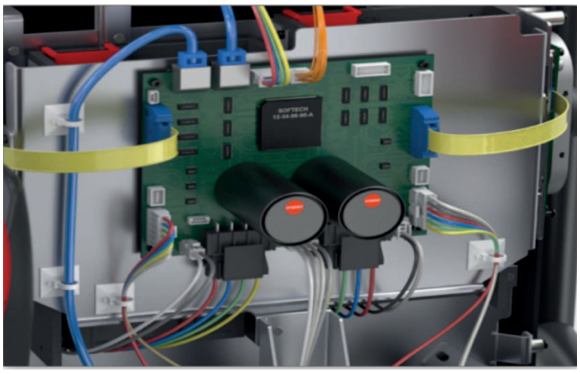
RULE NO. 9: SUCCEEDING WITH ECAD/ MCAD INTEGRATION

Companies that succeed in creating products that involve multiple disciplines need to have:

- Clear lines of communication for effective collaboration;
- Real-time/parallel processes, not sequential;
- Tools that work for each discipline and integrate with the other disciplines; and
- Integrated tools that are capable, reliable, scalable and secure.

To succeed, electromechanical development teams need a corporate commitment that may require changes in corporate culture and the way things are done, which is never an easy thing.

Although not an absolute guarantee, following the rules above provide a much higher probability of success for developing innovative products on time with higher quality and within budget. This is all made possible with great people and integrating the right tools.



An integrated ECAD/MCAD design. (Image courtesy of SOLIDWORKS.)

There is a huge opportunity to save time and develop better products that will drive teams to investigate opportunities for better integrating electrical and mechanical processes. Software vendors appear to be increasingly aware of this, as companies like SOLIDWORKS have made significant advances in electrical/mechanical integration.

With increased focus on getting to market faster, electromechanical product manufacturers can gain an edge by aligning business objectives with development by cross-disciplinary teams. Additionally, the new focus on the best software tools dramatically impacts development, an effect that will only intensify in the future. In this new paradigm, focused, cross-functional collaboration is the key enabler of innovation with integrated tools that are up for the challenge of developing increasingly complex electromechanical products.

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